

Identification of thirteen pelagic shark species of the Indian ocean occurring around Sri Lanka; using morphological characters of their fins

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Abstract

Sharks are of great commercial importance in the marine fisheries sector in Sri Lanka. They are taken in large quantities for human consumption, especially to obtain shark fins, which is an export oriented product and to a lesser extent for the extraction of liver oil. Past research has reported 60 species of sharks. Among the shark landings in Sri Lanka Silky shark (*Carchahinus falciformis*) is the dominant species followed by Blue sharks (*Prionace glauca*) Oceanic whitetip shark (*Carcharhinus longimanus*) and Scalloped hammerhead (*Sphyrna lewini*) respectively. Contribution of other sharks including Shortfin mako (*Isurus oxyrinchus*), Smooth hammerhead shark (*Sphyrna zygaena*), Longfin mako (*Isurus paucus*) Great hammerhead shark (*Sphyrna mokarran*) and Blacktip reef shark (*Carcharhinus melanopterus*) sharks to the total shark landings is relatively very small. Under the Shark Fisheries Management regulations in 2015; prohibition of catching Common thresher shark (*Alopias vulpinus*), Big-eye thresher shark (*Alopias superciliosus*), Pelagic thresher shark (*Alopias pelagicus*), Oceanic whitetip shark (*Carcharhinus longimanus*) and Whale shark (*Rhincodon typus*) in high seas were declared.

Fins from these species crossing international boundaries are required to be accompanied by an export permit issued by the national CITES authority. One of the most important issues in identify by species by using shark fins. Accordingly, it is important to investigate the morphological characteristics of shark fins in establishing a key to discriminate species. In this study, shark fins from 9 species landed mainly in large pelagic fishery and 5 species prohibited catching in high seas were used for examination.

To assist in identification of fins, we have designed an easy-to-use identification key based on morphological characteristics of the fin such as fin colour, distinct markings, fin shape to be used by fisheries field officers, custom officers, wildlife inspectors, and fishers to

provisionally identify detached, dried, unprocessed dorsal, pectoral and caudal fins from pelagic sharks that are commonly occurring around Sri Lanka,

Results of our examination revealed that the species were identifiable by the morphological characteristics of any fin among the first dorsal, pectoral and caudal fins.

Introduction

The fisheries industry of Sri Lanka contributes significantly to the nutrition, employment, food security, foreign exchange earnings and government revenue, and thus its sustainability is a primary concern in economic development of the country (SL-NPOA-shark). Marine fishery industry consists of two main sectors: coastal and offshore. Coastal fisheries target the resources that lie within the continental shelf and it is traditionally a small scale fishing industry. The offshore fishery is carried out within the EEZ and also in high seas, basically targeting tuna and bill fishes which are highly migratory species and shared by other coastal countries and distant water fishing countries fishing in the Indian Ocean.

Sri Lanka has a tropical climate with an annual weather cycle of two main periods: the South-West monsoon from May to August and the North-East monsoon from October to January. Shark resource in Sri Lanka is not a target fishery; its availability is incidental as by-catch. The only fishery that directly targets shark is the bottom long line fishery for gulper shark. However, due to the lack of economical market for their liver oil, only a few coastal boats are engaged in this fishery, off North-West (Kalpitiya), West (Negombo), South-West (Beruwala), South (Mirissa) and East (Valachchannai and Mutur). Shark flesh is a high priced commodity and their fins are a high priced export commodity. Shark production comes mainly from large pelagic fishery employing long line and gill net and comes as an incidental by catch. The first dorsal, paired pectoral fins and the lower lobe of the caudal fin are highly prized in trade. Second dorsal fin, paired pelvic fins and anal fin, though less valuable, also occur in trade.

The objective for developing this set of tools came in response to the need of coast guard, custom officers, wild life officers, fisheries inspectors and any other enforcement agent facing the technical difficulty of assigning detached fins to the correct shark species. This identification key covers 13 shark species belonging to 3 orders and 5 families that are

commonly occurring around Sri Lanka and are of major importance owing to either their conservation status or because they are a main target for the international trade in the fins.

Methodology

Shark fin samples were observed and identified to species of origin from whole dead animals in field visits. Several fin exporters from various institutions also provided fin sets. Some literatures were collected from published reference documents field guides and on the internet.

This guide contains simple, easy-to-use keys that highlight certain morphological characteristics and measurements for identification purposes. (annexure 1 and 2). Conspicuous fin markings were also assessed for pattern and consistency within species using photographs published in the literature and on the internet

The keys are further supported by detailed species information and illustrations so that identification can be made with confidence.(Annexure 3,4 and 5)

Data for this study was mainly obtained through the *PELAGOS* database of Sri Lanka and Fisheries and aquatic resources act, no 2 of 1996.

Results

Present status of shark resources in Sri Lanka

The annual shark production has been estimated at 1230Mt in 2015. When considering the percentage contribution of sharks to the total large pelagic fish production by weight, currently it remains around 1% while tuna has accounted for more than 61% by weight of the total large pelagic production. Billfish ranked next at 10% by weight.

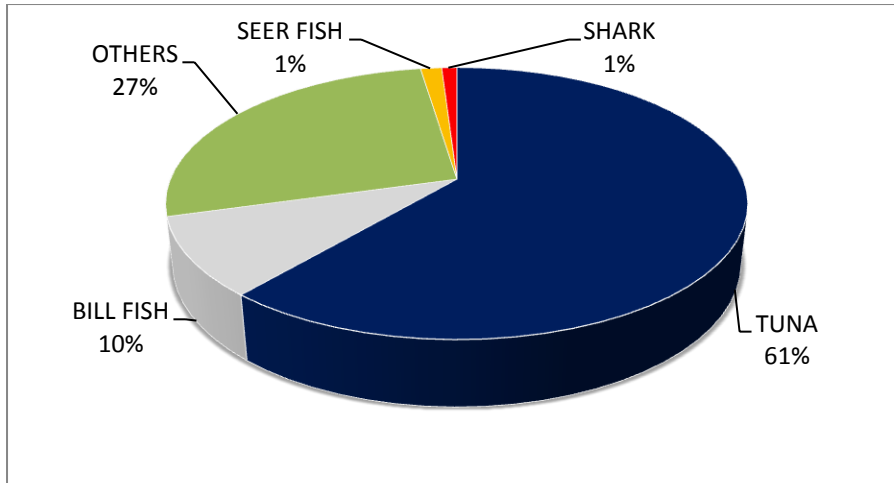


Fig 1: Contribution of sharks to the total large pelagic fish production 2015

Source: PELAGOS data base – Sri Lanka

Among the shark landings in Sri Lanka Silky shark (*Carchahinus falciformis*) is the dominant species followed by Blue shark (*Prionace glauca*) and Scalloped hammerhead (*Sphyrna lewini*) respectively. Contribution of other sharks including Shortfin mako (*Isurus oxyrinchus*), Smooth hammerhead shark (*Sphyrna zygaena*), Longfin mako (*Isurus paucus*), Great hammerheadshark (*Sphyrna mokarran*) and Blacktip reef shark (*Carcharhinus melanopterus*) sharks to the total shark landings is relatively very small. Under the Shark Fisheries Management regulations in 2015; prohibition of catching Common thresher shark (*Alopias vulpinus*), Big-eye thresher shark (*Alopias superciliosus*), Pelagic thresher shark (*Alopias pelagicus*), Oceanic whitetip shark (*Carcharhinus longimanus*) and Whale shark (*Rhincodon typus*) in high seas were declared.

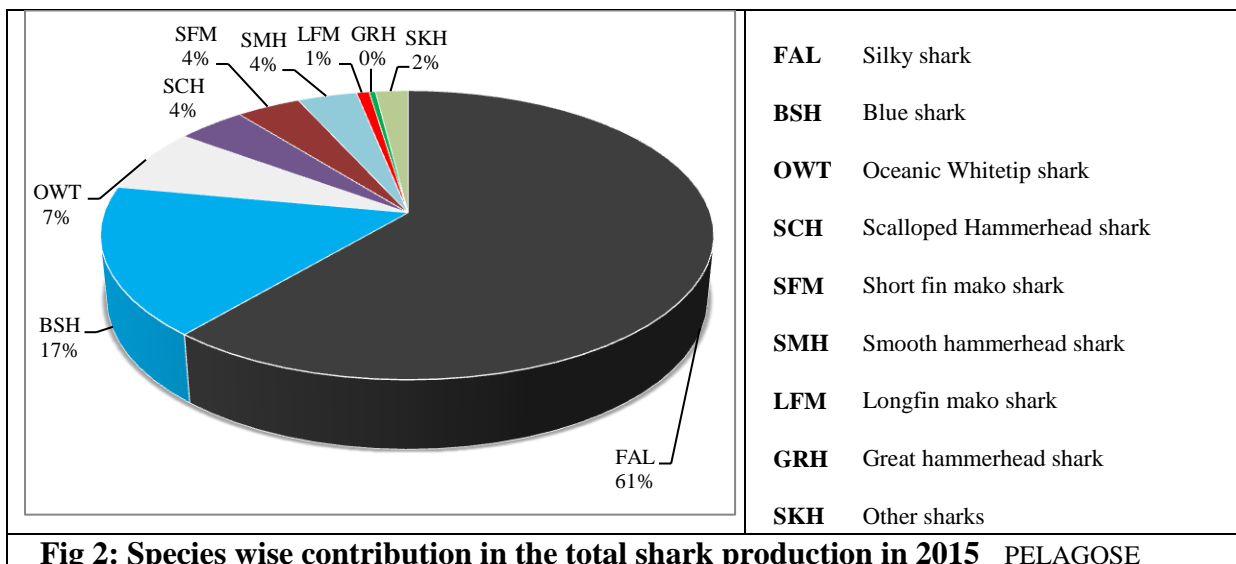


Fig 2: Species wise contribution in the total shark production in 2015 PELAGOSE

Identification of shark species using morphological characteristics of their fins

Specific colour pattern of each fin was found for some shark species. Especially *Rhincodon typus* was easily identified from their white spots on their fins. (Figure 10,22 and 33) *Carcharhinus melanopterus* could be easily identified from their brilliant black blotch on the tip of the first dorsal fin. In addition to that several morphological characters such as shape of the fin, colour of the fin , were useful for identification of the sharks.

These morphological characters used for identification were also confirmed through photographs (Annexure 3 to 5) suggesting the possibility of making a shark fins identification manual.

Box No.	Description	Species
1A	White spots evident on the dorsal fins with skin	<i>Rhincodon typus</i> Fig 10
1B	No white spots on the dorsal fin	2
2A	Brilliant black blotch on the tip of the first dorsal fin	<i>Carcharhinus melanopterus</i> Fig 11
2B	No Brilliant black blotch on the tip of the first dorsal fin	3
3A	Absolute height of fin longer than length of fin base	4
3B	Absolute height of fin is same as length of fin base	11
4A	White and black mottling present on tip of fin	<i>Carcharhinus longimanus</i> Fig 12
4B	White and black mottling absent on tip of fin	5
5A	Posterior margin with a denticulated pattern	6
5B	Posterior margin without a denticulated pattern	8
6A	Uniformly black in colour	<i>Alopias supercilliosus</i> Fig 13
6B	Black to bluish colour partly other colours	7
7A	Posterior margin black without a whitetip	<i>Isurus paucus</i> Fig 14
7B	Posterior margin not black with a whitetip	<i>Alopias vulpnus</i> Fig 15
8A	length of free rear tip shorter than one-third of length of fin base, height same as length of base	<i>Isurus oxyrinchus</i> Fig 16
8B	length of free rear tip longer than one-third of length of fin base, height distinctly longer than length of base	<i>Sphyrna sp.</i> 9
9A	Ratio of Absolute height to total fin with more than 1.14	<i>Sphyrna mokarran</i> Fig 17
9B	Ratio of Absolute height to total fin with less than 1.14	10
10A	Fin thin coloured with brown	<i>Sphyrna lewini</i> Fig 18
10B	Fin thick coloured with grey	<i>Sphyrna zygaena</i> Fig 19
11A	Colour black to blue with posterior margin sharply curved and V-shaped, length of free rear tip shorter than half of length of fin base	<i>Prionace glauca</i> Fig 20
11B	Colour black to brown with posterior margin slightly curved, length of free rear tip longer than half of length of fin base	<i>Carcharhinus falciformis</i> Fig 21

Table 1: Identification of shark species using morphological characteristics of their first dorsal fin

Box No.	Description	Species
1A	White spots evident on the dorsal surface of pectoral fins with skin	<i>Rhincodon typus</i> Fig 22
1B	No white spots on the dorsal surface of pectoral fins	2
2A	Shape slender, length of fin longer than three times the length of fin base	3
2B	Shape broad, length of fin shorter than three times the length of fin base	6
3A	Colour brownish on upper side tipped with white and black mottling	<i>Carcharhinus longimanus</i> Fig 23
3B	Colour grey to brown upper side tipped with plain colour	4
4A	Colour grey to brown on surface and white on back side	5
4B	Colour grey to brown each side	8
5A	Fin thick coloured with grey around back side, posterior margin with black denticulated pattern	<i>Isurus paucus</i> Fig 24
5B	Fin thin coloured with black tip on back side, posterior margin is not denticulated	<i>Prionace glauca</i> Fig 25
6A	Colour slightly white on central part of surface side without whitetip	<i>Alopias supercilliosus</i> Fig 26
6B	Colour grayish on front side with white tip and white mottling present on base of fin	<i>Alopias vulpinus</i> Fig 27
7A	Tip anterior margin and posterior margin of back side coloured with black	<i>Carcharhinus falciformis</i> Fig 28
7B	Tip anterior margin and posterior margin of back side with plain colour	9
8A	Front side brownish with a black tip	<i>Sphyrna sp</i> 9
8B	Front side bluish without black tip and its posterior margin curved	<i>Isurus oxyrinchus</i> Fig 29
9A	Falcate shape, tip shape sharply pointed	<i>Sphyrna mokarran</i> Fig 30
9B	No falcate shape, tip shape broadly pointed	10
10A	Slightly dusky dorsal tip markings	<i>Sphyrna lewini</i> Fig 31
10B	Dusky grey ventral tip markings, tapering distally from the tip along 1/3 of the posterior margin	<i>Sphyrna zygaena</i> Fig 32

Table 2: Identification of shark species using morphological characteristics of their pectoral fins

Box No.	Description	Species
1A	White spots evident on the caudal fin with skin	<i>Rhincodon typus</i> Fig 33
1B	No white spots on the caudal fin	2
2A	Conspicuous black band on the posterior margin	<i>Carcharhinus melanopterus</i> Fig 34
2B	No conspicuous black band on the posterior margin	3
3A	Upper lobe longer than the lower lobe and caudal keels absent	4
3B	Upper lobe crescent in shape as long as lower lobe and caudal keels present	10
4A	Upper lobe longer than six times of lower lobe	<i>Alopias</i> sp. 5
4B	Upper lobe shorter than six times of lower lobe	7
5A	Sub terminal notch moderately large	6
5B	Sub terminal notch very small	<i>Alopias supercilliosus</i> Fig 35
6A	With a white tip on the lower lobe	<i>Alopias vulpinus</i> Fig 36
6B	Without a white tip on the lower lobe	<i>Alopias pelagicus</i> Fig 37
7A	White and black mottling present on tip of each lobe	<i>Carcharinus longimanus</i> Fig 38
7B	White and black mottling absent on tip of each lobe	9
8A	Length of lower lobe nearly as long as half of upper lobe	10
8B	Length of lower lobe distinctly shorter than half of upper lobe	<i>Sphyrna</i> sp
9A	Upper and lower lobe coloured with black to blue and terminal lobe longer than one-fourth of upper lobe	<i>Prionace glauca</i> Fig 39
9B	Upper and lower lobe coloured with black to brown and terminal lobe shorter than one-fourth of upper lobe	<i>Carcharhinus falciformis</i> Fig 40
10A	Posterior margin of each lobe with black denticulated pattern	<i>Isurus paucus</i> Fig 41
10B	Posterior margin of each lobe without black denticulated pattern	<i>Isurus oxyrinchus</i> Fig 42

Table 3: Identification of shark species using morphological characteristics of their caudal fin

Discussion

Thirteen species of sharks were regarded as sharks mainly occurring around Sri Lanka. . We could identify almost all species of shark fin trade and prohibited shark species in Sri Lanka.

The first dorsal, pectoral and caudal fins were used for identification of sharks by species level. We studied the shape, ratios of technical measurements and colour patterns of each shark fin for each shark species in this study. In addition to that, variation in morphology of shark fins , due to growth and preservation , should also be considered. Twelve species of sharks were identified using from their first dorsal fin, eleven species of sharks were identified using from their pectoral fins and ten species of sharks were identified using from their caudal fin. In near future, we intend to investigate the variation of morphology by collecting more specimens and more species in order to establish an identification guide for shark fin

Acknowledgement

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The Fisheries and Aquatic resources Act, No.2 of 1996

Annexure 1 : Technical terms of shark fins

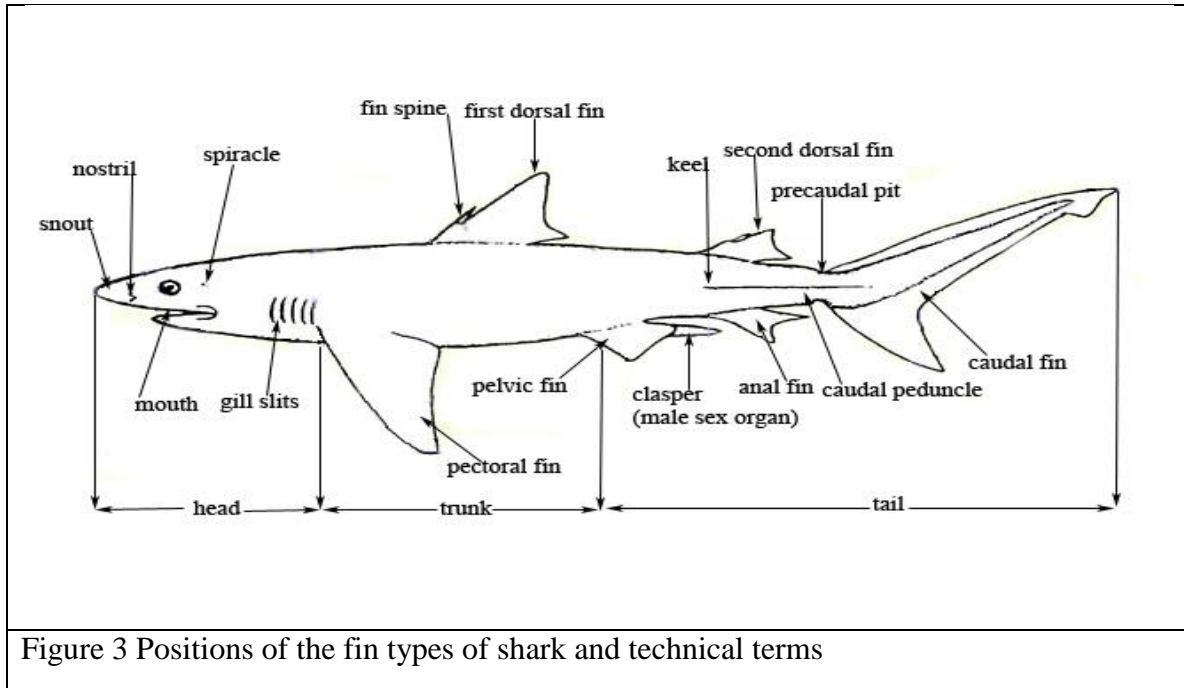


Figure 3 Positions of the fin types of shark and technical terms

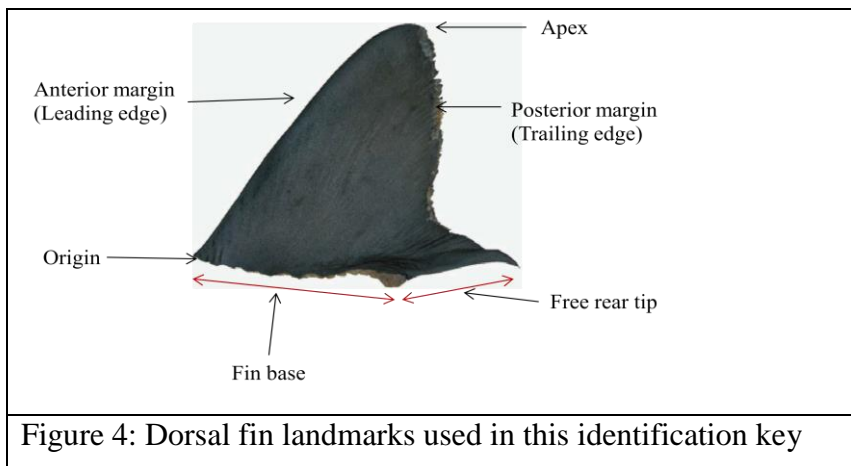


Figure 4: Dorsal fin landmarks used in this identification key

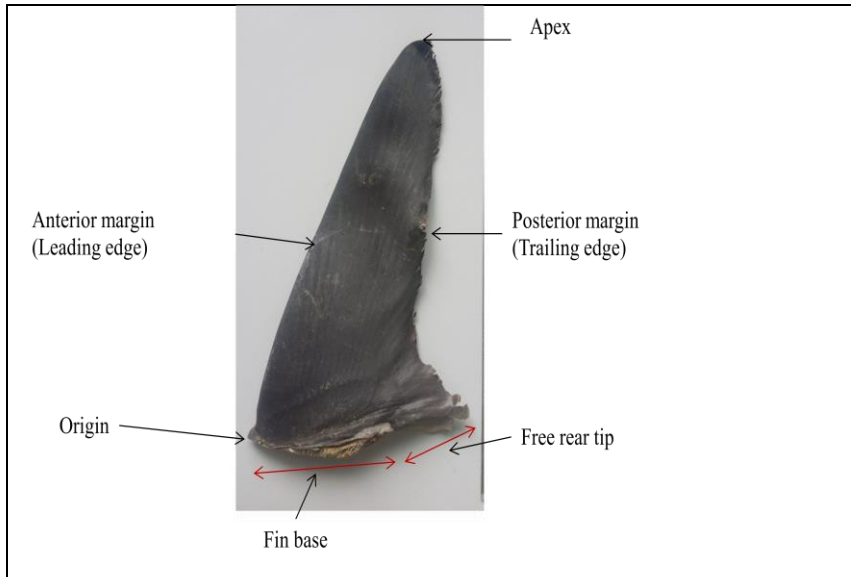
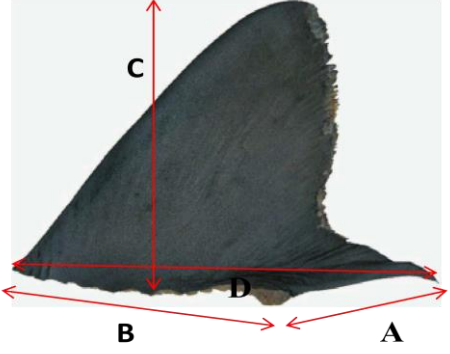


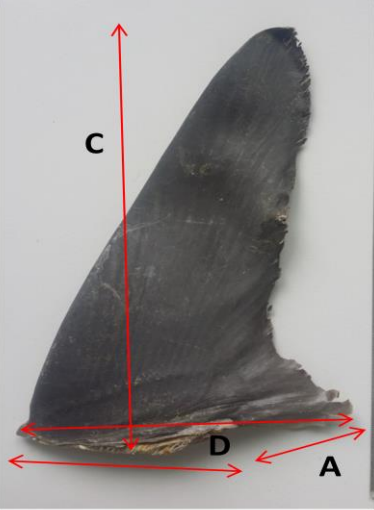
Figure 5: Pectoral fin landmarks used in this identification key

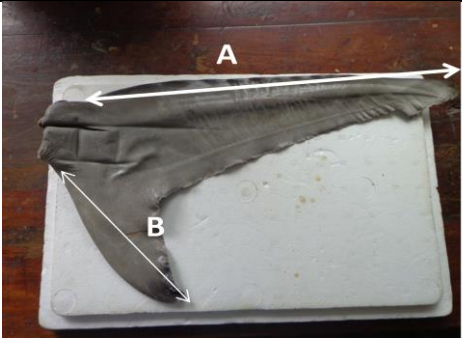


Figure 6: Caudal fin landmarks used in this identification key

Annexure 2 : Measurements of shark fins

	<p>A = Length of free rear tip</p> <p>B = Length of fin base</p> <p>C = Absolute fin height</p> <p>D = Total fin width</p>
<p>Figure 7: Measurements of dorsal fin used in this identification key</p>	

	<p>A = Length of free rear tip</p> <p>B = Length of fin base</p> <p>C = Absolute fin height</p> <p>D = Total fin width</p>
<p>Figure 8: Measurements of pectoral fin used in this identification key</p>	

	<p>A = Length of upper lobe</p> <p>B = Length of lower lobe</p>
<p>Figure 9: Measurements of Caudal fin used in this identification key</p>	

Annexure 3 : Descriptive characteristics of first dorsal fins


<p>FAO Field guide</p> 	<ul style="list-style-type: none"> ➤ Tip shape broadly rounded ➤ $\frac{\text{Length of free rear tip}}{\text{Length of fin base}} = 0.4$
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Figure 10 : First dorsal fin of *Rhincodon typus*


<p>IOTC ID</p> 	<ul style="list-style-type: none"> ➤ Brilliant black blotch on the dorsal apex ➤ Posterior margin curving ventrally from fin apex
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Figure 11 : First dorsal fin of *Carcharhinus melanopterus*


<p>FAO Field guide</p> 	<ul style="list-style-type: none"> ➤ Tip shape broadly rounded ➤ Free rear tip medium length ➤ $\frac{\text{Length of free rear tip}}{\text{Length of fin base}} = 0.28 - 0.41$ ➤ Posterior margin slightly concave. ➤ Fin apex has a white patch that is often mottled; remaining fin is light brown or bronze in colour.
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Figure 12: First dorsal fin of *Carcharhinus longimanus*


<p>FAO Field guide</p> 	<ul style="list-style-type: none"> ➤ Free rear tip very small. ➤ $\frac{\text{Length of free rear tip}}{\text{Length of fin base}} = 0.13 - 0.28$ ➤ Posterior margin fairly straight to slightly concave ➤ Upper posterior margin straight to convex.
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Figure 13: First dorsal fin of *Alopias superciliosus*


<p>FAO Field guide</p> 	<ul style="list-style-type: none"> ➤ Tip shape broadly pointed ➤ Free rear tip short ➤ $\frac{\text{Length of free rear tip}}{\text{Length of fin base}} = 0.24 - 0.35$ ➤ Posterior margin slightly concave ➤ Upper posterior margin straight to slightly convex.
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Figure 14: First dorsal fin of *Isurus paucus*


	<ul style="list-style-type: none"> ➤ Fin is tall, erect and narrow ➤ The anterior margin has a very steep angle. ➤ Short free rear tip ➤ Fin colour is dark grayish brown ➤ Basal cartilage is elongated laterally.
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Figure 15: First dorsal fin of *Alopias vulpinus*


<p>FAO Field guide</p> 	<ul style="list-style-type: none"> ➤ Fin size fairly large ➤ Tip shape bluntly pointed ➤ Free rear tip very short ➤ $\frac{\text{Length of free rear tip}}{\text{Length of fin base}} = 0.13 - 0.24$ ➤ Anterior margin has a steep angle. ➤ Moderately straight posterior margin. ➤ Fin thick coloured with brown,
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Figure 16: First dorsal fin of *Isurus oxyrinchus*


<p>FAO Field guide</p> 	<ul style="list-style-type: none"> ➤ Tip shape sharply pointed ➤ Extremely tall ➤ $\frac{\text{Absolute fin height}}{\text{Total fin width}} = 1.14 - 1.31$ ➤ Free rear tip short ➤ $\frac{\text{Length of free rear tip}}{\text{Length of fin base}} = 0.18 - 0.39$ ➤ Posterior margin concave
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Figure 17: First dorsal fin of *Sphyrna mokarran*


<p>FAO Field guide</p> 	<ul style="list-style-type: none"> ➤ Tip shape broadly pointed ➤ Free rear tip fairly short ➤ $\frac{\text{Length of free rear tip}}{\text{Length of fin base}} = 0.25 - 0.40$ ➤ Posterior margin concave ➤ $\frac{\text{Absolute fin height}}{\text{Total fin width}} = 0.88 - 1.08$
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Figure 18: First dorsal fin of *Sphyrna lewini*


<p>FAO Field guide</p> 	<ul style="list-style-type: none"> ➤ Tip shape broadly pointed ➤ Free rear tip very short ➤ $\frac{\text{Length of free rear tip}}{\text{Length of fin base}} = 0.15 - 0.34$ ➤ Posterior margin concave. ➤ $\frac{\text{Absolute fin height}}{\text{Total fin width}} = 0.94 - 1.13$
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Figure 19: First dorsal fin of *Sphyrna zygaena*


<p>FAO Field guide</p> 	<ul style="list-style-type: none"> ➤ Anterior margin has a very shallow angle ➤ Posterior margin of the fin convex (Curved outwards) ➤ Tip shape broadly pointed ➤ Free rear tip moderately long ➤ $\frac{\text{Length of free rear tip}}{\text{Length of fin base}} = 0.34 - 0.65$
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Figure 20: First dorsal fin of *Prionace glauca*


<p>FAO Field guide</p> 	<ul style="list-style-type: none"> ➤ Tip shape broadly rounded. ➤ Long free rear tip ➤ $\frac{\text{Length of free rear tip}}{\text{Length of fin base}} = 0.24 - 0.59$ ➤ Upper posterior margin typically convex.
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Figure 21: First dorsal fin of *Carcharhinus falciformis*

Annexure 4 : Descriptive characteristics of pectoral fins


<p>FAO Field guide</p> 	<ul style="list-style-type: none"> ➤ Fin size very large. ➤ Falcate shape ➤ Tip shape narrowly rounded, ➤ Free rear tip medium ➤ $\frac{\text{Length of free rear tip}}{\text{Length of fin base}} = 0.5$ ➤ Posterior margin deeply concave ➤ Ventral fin colour stark white ➤ White spot present on the dorsal surface
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Figure 22: Pectoral fins of *Rhincodon typus*


<p>FAO Field guide</p> 	<ul style="list-style-type: none"> ➤ Tip shape broadly rounded. ➤ Free rear tip medium size ➤ $\frac{\text{Length of free rear tip}}{\text{Length of fin base}} = 0.66 - 0.86$ ➤ Posterior margin slightly concave. ➤ Dorsal tip colour mottled white ➤ Ventral side of the fin is yellow colour, dusky mottled markings toward the proximal half of the fin.
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Figure 23: Pectoral fins of *Carcharhinus longimanus*


<p>FAO Field guide</p> 	<ul style="list-style-type: none"> ➤ Fin size medium – large. ➤ Straight to falcate ➤ Tip shape pointed but broad. ➤ Free rear tip medium ➤ $\frac{\text{Length of free rear tip}}{\text{Length of fin base}} = 0.67 - 0.87$ ➤ <i>Posterior margin convex</i> ➤ Ventral colour stark white
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Figure24: Pectoral fins of *Isurus paucus*


<p>FAO Field guide</p> 	<ul style="list-style-type: none"> ➤ Long, straight ➤ Free rear tip moderately large ➤ $\frac{\text{Length of free rear tip}}{\text{Length of fin base}} = 0.62 - 0.94$ ➤ Posterior margin generally concave ➤ Ventral colour pure white
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Figure25: Pectoral fins of *Prionace glauca*


 <p>FAO Field guide</p>	<ul style="list-style-type: none"> ➤ Fin size large ➤ Straight, very tall ➤ Tip shape broadly pointed ➤ Free rear tip very short ➤ $\frac{\text{Length of free rear tip}}{\text{Length of fin base}} = 0.39 - 0.60$ ➤ Posterior margin slightly convex ➤ Ventral surface has large, dusky, black marking on both the anterior and posterior edge of the fin.
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Figure 26: Pectoral fins of *Alopias superciliosus*


	<ul style="list-style-type: none"> ➤ Dorsal surface is slate grey or dark grey-brown colour ➤ The ventral surface is just as dark with mottled white marking at the base of the fin. ➤ Long slender from anterior margin to posterior margin , curving sharply at the apex ➤ Very small white spot present at the tip of the apex, visible on dorsal and ventral sides.
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Figure 27: Pectoral fins of *Alopias vulpinus*


 <p>FAO Field guide</p>	<ul style="list-style-type: none"> ➤ Fairly long medium size fin ➤ Tip shape broadly pointed ➤ Free rear tip medium ➤ $\frac{\text{Length of free rear tip}}{\text{Length of fin base}} = 0.55 - 0.93$ ➤ Posterior margin fairly concave ➤ Ventral fin colour stark white ➤ Ventral tip colour is dusky
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Figure 28: Pectoral fins of *Carcharhinus falciformis*


 <p>FAO Field guide</p>	<ul style="list-style-type: none"> ➤ Straight, medium size fins ➤ Tip shape bluntly pointed to narrowly rounded. ➤ Posterior margin moderately concave ➤ Free rear tip fairly short ➤ $\frac{\text{Length of free rear tip}}{\text{Length of fin base}} = 0.41 - 0.69$
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Figure 29: Pectoral fins of *Isurus oxyrinchus*


<p>FAO Field guide</p> 	<ul style="list-style-type: none"> ➤ Falcate shape ➤ Moderately short ➤ $\frac{\text{Absolute fin height}}{\text{Total fin width}} = 1.38 - 1.53$ ➤ Tip shape sharply pointed and narrow ➤ Posterior margin concave ➤ Ventral colour creamy white ➤ Free rear tip short ➤ $\frac{\text{Length of free rear tip}}{\text{Length of fin base}} = 0.49 - 0.84$
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Figure 30: Pectoral fins of *Sphyrna mokarran*


<p>FAO Field guide</p> 	<ul style="list-style-type: none"> ➤ Tip shape broadly pointed ➤ Free rear tip short medium ➤ $\frac{\text{Length of free rear tip}}{\text{Length of fin base}} = 0.54 - 0.83$ ➤ Posterior margin concave ➤ Slightly dusky dorsal tip markings ➤ Ventral fin colour white.
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Figure 31: Pectoral fins of *Sphyrna lewini*

<p>FAO Field guide</p> 	<ul style="list-style-type: none"> ➤ Moderately short fins ➤ Slightly falcate ➤ Tip shape broadly pointed ➤ Posterior margin concave ➤ Ventral fin colour creamy white ➤ Dusky grey ventral tip markings, tapering distally from the tip along 1/3 of the posterior margin. ➤ Free rear tip short ➤ $\frac{\text{Length of free rear tip}}{\text{Length of fin base}} = 0.34 - 0.61$
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Figure 32: Pectoral fins of *Sphyrna zygaena*

Annexure 5: Descriptive characteristics of caudal fins


 <p>IOTC ID</p>	<ul style="list-style-type: none"> ➤ White spots evident on the caudal fin with skin ➤ Semi lunate caudal fin without a prominent sub terminal notch
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Figure 33: Caudal fin of *Rhincodon typus*


 <p>IOTC ID</p>	<ul style="list-style-type: none"> ➤ Conspicuous black band on the posterior margin ➤ Distinct black marking at the tip of the lower lobe
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Figure 34: Caudal fin of *Carcharhinus melonopterus*


<p>FAO Field guide</p> 	<ul style="list-style-type: none"> ➤ Terminal lobe of upper lobe moderately large ➤ Colour blackish without white tip on lower lobe.
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Figure 35: Caudal fin of *Alopias superciliosus*


<p>IOTC ID</p> 	<ul style="list-style-type: none"> ➤ Long curving upper caudal lobe about as long as rest of shark ➤ Colour grayish with a white tip on lower lobe
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Figure 36: Caudal fin of *Alopias vulpinus*


<p>IOTC ID</p> 	<ul style="list-style-type: none"> ➤ Terminal lobe of upper lobe very small ➤ without white tip on lower lobe.
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Figure 37: Caudal fin of *Alopias pelagicus*


<p>IOTC ID</p> 	<ul style="list-style-type: none"> ➤ Demarcated, mottled, white tips on lower and upper caudal lobes and along post ventral margin ➤ $\frac{\text{Length of lower caudal lobe}}{\text{length of upper caudal lobe}} = 0.39 - 0.53$ ➤ Sub terminal notch present ➤ Lower caudal lobe tip shape broadly rounded ➤ No caudal keels
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Figure 38: Caudal fin of *Carcharhinus longimanus*


<p>FAO Field guide</p> 	<ul style="list-style-type: none"> ➤ Sub terminal notch fairly small ➤ $\frac{\text{Length of lower caudal lobe}}{\text{length of upper caudal lobe}} = 0.30 - 0.50$ ➤ Caudal lobe tip narrow and pointed ➤ No caudal keel
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Figure 39: Caudal fin of *Prionace glauca*


<p>FAO Field guide FAO Field guide</p> 	<ul style="list-style-type: none"> ➤ Sub terminal notch fairly small ➤ $\frac{\text{Length of lower caudal lobe}}{\text{length of upper caudal lobe}} = 0.36 - 0.54$ ➤ Caudal lobe tip shape broadly pointed ➤ Coloration uniformly dark grey and diffuse lighter patch near the lower origin ➤ No caudal keels
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Figure 40: Caudal fin of *Carcharhinus falciformis*


<p>FAO Field guide</p> 	<ul style="list-style-type: none"> ➤ Homocercal ➤ $\frac{\text{Length of lower caudal lobe}}{\text{length of upper caudal lobe}} = 0.69 - 0.77$ ➤ Sub terminal notch fairly small ➤ Lower caudal tip shape broadly pointed ➤ Sharply, demarcated white blotch at lower origin, often mottled with black spots ➤ Distinct caudal keels present
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Figure 41: Caudal fin of *Isurus paucus*


<p>FAO Field guide</p> 	<ul style="list-style-type: none"> ➤ Homocercal ➤ $\frac{\text{Length of lower caudal lobe}}{\text{length of upper caudal lobe}} = 0.67 - 0.83$ ➤ Sub terminal notch very small ➤ Lower caudal tip pointed ➤ Sharply, demarcated white blotch at lower origin ➤ Distinct caudal keels present
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Figure 42: Caudal fin of *Isurus oxyrinchus*


<p>FAO Field guide</p> 	<ul style="list-style-type: none"> ➤ Lower caudal lobe tip sharply pointed and slightly dusky ➤ Slightly light colouring near the lower origin and pre ventral margin ➤ $\frac{\text{Length of lower caudal lobe}}{\text{length of upper caudal lobe}} = 0.39 - 0.50$ ➤ Sub terminal notch present ➤ No caudal keels
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Figure 43: Caudal fin of *Sphyrna zygaena*

