DESCRIPTIVE NOTES ON A PORBEAGLE, *LAMNA NASUS*, FROM ARGENTINE WATERS, COMPARED WITH THE NORTH PACIFIC SALMON SHARK, *LAMNA DITROPIS*

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I. Introduction

Four species of the genus *Lamna* have been known to live in the world oceans, i.e. *Lamna nasus* (Bonnaterre) from the North Atlantic (e.g. Bigelow & Schroeder, 1948), the South Western Atlantic (Springer & Garrick, 1964) and the South African waters (Smith, 1953); *L. philippi* Perez Canto from the waters off Chile (*in* Garrick & Schultz, 1963; Fowler, 1967); *L. whitleyi* Phillipps from the waters around New Zealand and Australia (Graham, 1956; Munro, 1956); *L. ditropis* Hubbs & Follett from the North Pacific (Hubbs & Follett, 1947; Lindberg & Legeza, 1967; Okada & Kobayashi, 1968).

However, the systematic relationships of these four species are still in question and especially the southern hemisphere species are doubtful (Garrick & Schultz, 1963; Hubbs, personal communication). Garrick & Schultz (1963) suggested that *L. whitleyi* from Australasia was synonymous to *L. nasus* and that the relationships of *L. philippi* of Chile to other *Lamna* species were not clear. Kato et al. (1967) reported only *L. nasus* from Chile, not *L. philippi*.

In Argentine waters, it is generally thought that *L. nasus* hardly occurs. Although Lahille (1928, *in* Bigelow & Schroeder, 1948) had reported a shark under the name of *Lamia nasus* from the waters of Argentina, Bigelow & Schroeder (1948) recognized this specimen as a synonym of *Isurus oxyrinchus* Rafinesque. Ringuelet & Aramburu (1960) suggested that *L. nasus* had never been found in this area, referring to previous literatures. Springer & Garrick (1964) studied on the vertebral numbers of various kinds of sharks from various seas. In thier report, they gave the scientific name *L. nasus* for the Argentine porbeagle captured at Puerto Quequén. But they didn't discuss the systematic relationships among *Lamna* species, giving only the data on the vertebral numbers.

Last year, the present author took part in the research cruise of the *R.V. Kaiyo Maru* of the Japan Fisheries Agency. In the cruise, the exploratory trawl fishings were made in the waters around the Falkland Islands and off Patagonia, Argentina, during the period from December 1969 to January 1970. Out of about seventy hauls of trawling, a single male porbeagle was caught at the station (47°01'S, 62°02'W) far off Comodoro Rivadavia.

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The present paper deals with the systematic notes on this Argentine porbeagle compared with the closely allied North Pacific salmon shark, *L. ditropis*. Since the southern hemisphere species of *Lamna* are not systematically clear, it seems to be useful to give detailed descriptions on this Argentine porbeagle.

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II. Materials

The materials offered for the present paper are one Argentine porbeagle, three North Pacific salmon sharks and four jaws of salmon sharks from the Bering Sea. The data on the measurements and photographs of the Argentine porbeagle were taken on board the *R. V. Kaiyo Maru*, and its jaw and caudal fin were brought back to the laboratory of the university to be examined closely. The actual measurements were taken on a horizontal line between perpendiculars at given points and proportional dimensions in percent of the total length were calculated (Table 1). The figures of the whole fish were drawn carefully referring to the photographs and results of measurements (Fig. 1). Data on capture of materials are as below.

No. 1. Male, T.L. 2190 mm
Date; Jan. 19, 1970
Locality; Lat. 47°01′S, Long. 62°02′W (Argentine waters)
Gear; Otter trawl
Water temperature; 14.0°C at surface, 6.2°C at bottom
Depth; 134 m

No. 2. Male, T.L. 2260 mm*
Date; July 15, 1970
Locality; Lat. 52°30′N, Long. 155°16′E (the Okhotsk Sea)
Gear; Gill net

No. 3. Female, T.L. 1830 mm

* Measurements of this specimen owe to Assoc. Prof. S. Mishima.

Date; Aug. 27, 1970
Locality; Usujiri, Minami Kayabe on the southern coast of the Volcano Bay, Hokkaido, Japan
Gear; Set net

No. 4. Female, T.L. 2000 mm
Date, Locality and Gear; same as those of No. 3 material

No. 5. Jaw of a male, T.L. 1950 mm*
Date; June 14, 1963
Locality; Lat. 54°07'N, Long. 177°17'W (the Bering Sea)
Gear; Gill net

No. 6. Jaw of a female, T.L. 2150 mm*
Date; June 20, 1963
Locality; Lat. 55°51'N, Long. 172°07'W (the Bering Sea)
Gear; Gill net

No. 7. Jaw of a male, T.L. 2300 mm*
Date, Locality and Gear; same as those of No. 6 material

No. 8. Jaw of a female, T.L. 2400 mm*
Date; June 30, 1963
Locality; Lat. 56°01'N, Long.167°50'W (the Bering Sea)
Gear; Gill net

III. Description

The proportional dimensions of each specimen (Material No. 1 to No. 4) are summarized in Table 1.

I. *Lamna nasus* (Bonnaterre) from Argentine waters (Fig. 1A)

Isurus nasus Garman, Mem. Mus. Comp. Zool. Harv., Vol. 36, p. 34, 1913
Lamna nasus Fowler, U.S. Nat. Mus., Bull. 100, Vol. 13, p. 106, 1941; — Bigelow & Schroeder, Mem. Sears Found. Mar. Res., Pt. 1, p. 112, 1948; — Perlmutter, Guide Mar. Fish., p. 232, 1961; — Leim & Scott, Fish. Res. Bd. Canada, Bull. 155, p. 32, 1966; — Wheeler, Fish. British Isles N.W. Europe, p. 13, 1969
Lamna cornubica Andriyashev, Israel Prog. Sci. Trans., p. 30, 1964

Material used; No. 1 material

Trunk robust, its height at origin of 1st dorsal fin about 1/5 of total length. Head and snout conical and sharp pointed; head 28.3% of total length; snout 19.4% of head. Distance from posterior edge of eye to 1st gill opening about two times as great as from tip of snout to anterior edge of eye**. Eye circular, no

* These materials were collected and kept by Prof. S. Okada.

** Distance from posterior edge of eye to 1st gill opening was not measured actually. The numeral was calculated from fine photographs.

Table 1. Proportional dimensions in percent of total length

Measured part	Argentine porbeagle	North Pacific salmon shark		
	Material No. 1	Material No. 2	Material No. 3	Material No 4
Distance from tip of snout to:				
eye	5.5%	4.9%	4.6%	5.0%
nostrils	4.8	4.2	3.6	3.6
1st gill opening	—	20.0	19.1	19.0
Length of head	28.3	27.0	27.3	26.5
Distance from tip of snout to origin of:				
pectoral fin	25.8	28.8	25.1	25.5
pelvic fin	53.9	54.0	53.6	50.3
1st dorsal fin	32.9	31.2	33.3	30.5
2nd dorsal fin	69.9	70.0	70.5	68.5
anal fin	69.9	70.8	68.9	68.5
caudal fin	80.8	78.8	77.6	74.0
Pectoral fin:				
outer margin	18.0	18.1	18.6	18.5
distal margin	14.8	16.4	15.3	16.5
inner margin	5.3	4.9	5.2	5.0
First dorsal fin:				
length of base	10.0	11.1	10.4	10.0
vertical height	12.3	12.2	13.1	12.0
Second dorsal fin:				
length of base	1.4	2.2	1.6	1.8
vertical height	1.6	1.5	1.9	1.5
Anal fin:				
length of base	1.5	3.1*	1.9	1.8
vertical height	2.2	2.0	1.9	1.8
Caudal fin:				
length of upper lobe	22.8	23.5	25.7	25.5
length of lower lobe	17.1	19.0	18.0	18.5
Interspace between:				
eye and 1st gill opening	—	13.2	13.1	13.0
1st and 2nd dorsal fin	26.9	27.0	26.2	28.5
2nd dorsal and caudal fin	7.8	6.9	6.6	7.3
anal and caudal fin	7.5	5.8	6.0	6.5
Distance from origin to origin of:				
pectoral and pelvic fin	27.9	27.7	27.9	26.5
pelvic and anal fin	17.1	17.7	15.8	16.8
Mouth:				
width	7.1	10.1*	8.2	8.0
height	4.2	3.4*	4.4	5.0
Diameter of eye	—	1.8	1.6	1.5
Gill opening length:				
1st	6.8	8.3*	6.6	7.0
2nd	7.3	8.3*	6.6	7.5
3rd	7.3	8.3*	6.6	7.3
4th	7.1	8.5*	6.8	8.3
5th	6.9	8.1*	6.8	7.8

* Numeral with asterisk seems to be erroneous.

nictitating membrane or fold on lower eye lid. Nostrils approximately transverse; snout in front of nostrils 1.5 times as great as width between nostrils.

Gill openings five, all before origin of pectoral fin; first gill opening shortest; first, 2nd and 3rd gill openings almost straight; fourth and 5th gill openings oblique and curving rearward and ventrad for a short distance around origin of pectoral fin.

Origin of pectoral fin at about 1/4 of total length from tip of snout; its distal margin moderately concave; its outer corner rounded.

Mouth broadly rounded; distinct labial furrows on each jaw, upper longer than lower.

Origin of 1st dorsal fin at slightly less than 1/3 of total length from tip of snout, and over inner margin of pectoral fin; its anterior margin slightly convex, its apex broadly rounded, its rear margin straight toward its apex; its height about 123% of its base.

Origin of 2nd dorsal fin at about 70% of total length from tip of snout. Origin of anal fin just below origin of 2nd dorsal fin. Anal and 2nd dorsal fin not slender as a whole. Anal fin a little larger in area than 2nd dorsal fin.

Caudal peduncle strongly flattened dorsoventrally and sharp edged; both upper and lower precaudal pit strongly developed as transverse furrows, the former stronger and more rearward than the latter; a secondary keel on each side of caudal fin below primary keel. Upper precaudal pit at 80% of total length from tip of snout.

Teeth alike and smooth edged in both jaws, $\frac{15\text{–}14}{13\text{–}14}$ counted (Fig. 2A); no median tooth in either jaw; teeth in both jaws slender, but lower teeth more slender and erect; all teeth except those next to the corners of jaw with a basal denticle on either side of each tooth; basal denticles of 1st tooth in both jaws not so sharp as those of other teeth; first and 2nd teeth in each jaw largest; third upper tooth remarkably smaller and oblique than 2nd and 4th, and almost equal in size to 10th upper tooth; fourth upper tooth almost erect or only slightly oblique inward (Fig. 2A); eighth and subsequent upper teeth smaller to the corners of mouth; right 5th tooth in lower jaw deformed and conspicuously smaller than 4th and 6th; in lower jaw 3rd and subsequent teeth smaller to the corners of mouth.

Body color dark bluish gray above and white without dark blotches below. Pectoral fin black-tipped below.

II. *Lamna ditropis* Hubbs & Follett from the North Pacific (Fig. 1B)

Lamna cornubica Jordan & Fowler, Proc. U.S. Nat. Mus., Vol. 26, p. 623, 1903; — Okada, Uchida & Matsubara, Nihon Gyorui Zusetsu, p. 54, 1935; — Matsubara, Fauna Nipponica, Vol. 15, No. 1, p. 94, 1936

Isurus nasus Oshima, Sakana, p. 184, 1940; — Tanaka & Abe, Yuyo Gyorui Senshu, p. 17, 1955

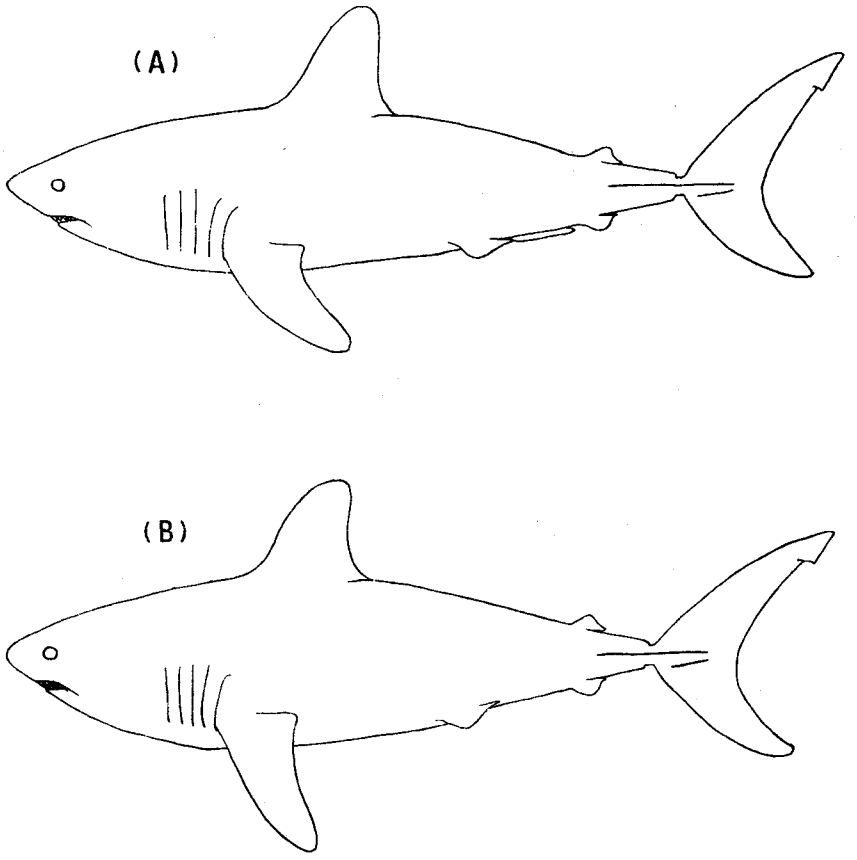

Fig. 1. A, *Lamna nasus* (Bonnaterre), adult male, 2190 mm in total length, from Argentine waters (Material No. 1); B, *Lamna ditropis* Hubbs & Follett, adult female, 2000 mm in total length, from North Pacific (Material No. 4)

Lamna ditropis Roedel & Ripley, Fish. Bull. 75, Div. Fish Game, p. 43, 1950; — Matsubara, Fish Morph. Hierar., Pt. 1, p. 115 and Pt. 3, fig. 12, 1955; — Ueno, Hokusuishi Geppo, Vol. 22, No. 8, p. 7, 1965; — Kato, Springer & Wagner, Fish Wildl. Serv., Circ. 271, p. 20, 1967; — Lindberg & Legeza, Israel Prog. Sci. Trans., Pt. 1, p. 50, 1967; — Okada & Kobayashi, Colored illus. pelag. bott. fish. Bering Sea, p. 6 and fig. 1, 1968

Material used; Material Nos. 2 to 8

Trunk robust and not slender. Head and snout conical and somewhat round-tipped; head 26.5–27.3% (mean 26.9%) of total length, snout 17.0–18.9% (mean 18.0%) of head length. Distance from posterior edge of eye to 1st gill opening

2.6–2.8 times (mean 2.7 times)* as great as that from tip of snout to anterior edge of eye. Eye circular, no nictitating membrane or fold on lower eye lid. Nostrils approximately transverse, snout length in front of nostrils 1.1–1.3 times (mean 1.2 times) as great as width between nostrils.

Gill openings five, all before origin of pectoral fin; first or 1st and 2nd gill openings shortest; first, 2nd and 3rd gill openings almost straight; 4th and 5th oblique and curving rearward and ventrad for a short distance around origin of pectoral fin.

Origin of pectoral fin at about 1/4 of total length from tip of snout; its distal margin moderately concave; its outer corner somewhat pointed.

Mouth broadly rounded; distinct labial furrows on each jaw, upper longer than lower.

Origin of 1st dorsal fin at 30.5–33.3% (mean 31.7%) of total length from tip of snout and above inner margin of pectoral fin; its anterior margin slightly convex, its apex broadly rounded, its rear margin straight toward its apex, its height 109.9–126.3% (mean 118.7%) of its base.

Origin of 2nd dorsal fin at 68.5–70.5% (mean 69.7%) of total length from tip of snout. Origin of anal fin at 68.5–70.8% (mean 69.4%) of total length from tip of snout. Origin of anal fin below origin of 2nd dorsal fin; anal fin a little larger in area than 2nd dorsal fin. Second dorsal and anal fin not slender as a whole.

Caudal peduncle strongly flattened dorsoventrally and sharp edged; both upper and lower precaudal pits strongly developed as transverse furrows, the former stronger and more rearward than the latter; a secondary keel on each side of caudal fin below primary keel. Upper precaudal pit at 74.0–78.8% (mean 76.8%) of total length from tip of snout. Subterminal notch of caudal fin strongly marked.

Teeth alike and smooth-edged in both jaws, No. 5 material $\frac{16–15}{13–13}$, No. 6 material $\frac{16–15}{14–15}$, No. 7 material $\frac{15–15}{13–14}$, No. 8 material $\frac{15–15}{13–13}$ (Fig. 2B) counted in each specimen; no median tooth in either jaw in all specimens; teeth in both jaws slender and almost erect, but upper 4th and 5th teeth strongly oblique inward, especially 4th tooth more strongly oblique inward (Fig. 2C right); all teeth except those next to the corners of jaw with a basal denticle on either side of each tooth; first and 2nd teeth in each jaw largest, 3rd upper tooth remarkably smaller than 2nd and 4th, almost erect and equal in size to 11th or 12th tooth. Fifth, 6th or 7th and subsequent teeth in upper jaw smaller to the corners of mouth in each specimen; left 8th tooth on upper jaw of No. 6 material deformed and conspicuously

* Although Bigelow & Schroeder (1948) writes, "Distance from tip of snout to anterior edge of eye less than 1/3 as great as from posterior edge of eye to 1st gill opening;...." in their key, the present data are never 3 times or more.

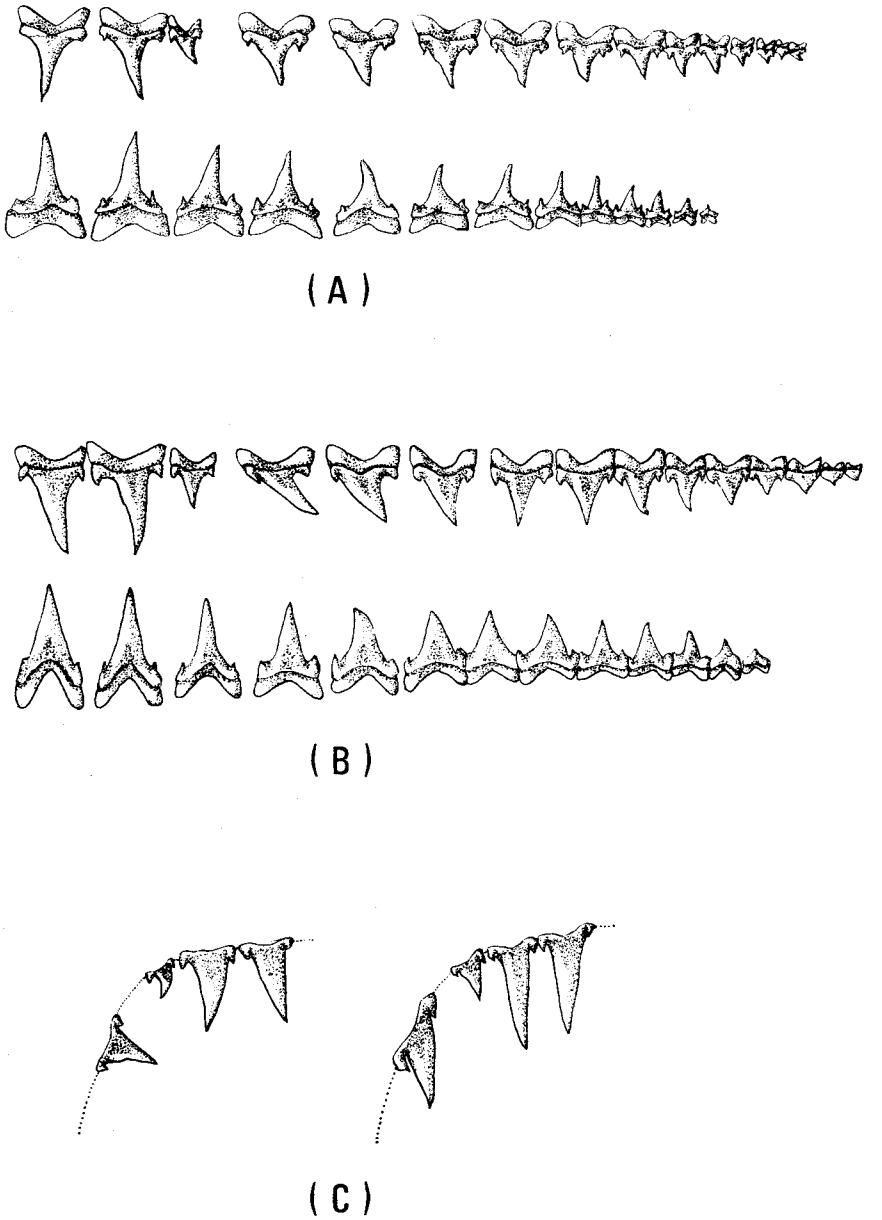

Fig. 2. A, Left upper and lower teeth of Argentine porbeagle (Material No. 1), about two thirds of natural size; B, Left upper and lower teeth of North Pacific salmon shark (Material No. 8), about two thirds of natural size; C, First to 4th tooth on right upper jaw, looked at from below. Left; teeth of Argentine porbeagle (Material No. 1). Right; teeth of North Pacific salmon shark (Material No. 8)

smaller than 7th and 9th, 7th tooth strongly oblique inward; in lower jaw 3rd and subsequent teeth smaller to the corners of mouth.

Body color dark bluish gray to bluish black above, white with dark blotches below, number, shape and position of which greatly changeable in each specimen. Pectoral fin black-tipped below.

IV. Discussion

The descriptions on the North Western Atlantic porbeagle, *L. nasus*, reported by Bigelow & Schroeder (1948) did not seem entirely adequate for a morphometrically detailed comparison with the present Argentine porbeagle, as their materials were too young and all less than 1000 mm in total length.

Therefore, the present Argentine male porbeagle measuring 2190 mm in total length was compared with the specimens of the closely allied North Pacific salmon shark, *L. ditropis* which were seven in number ranging from 1830 mm to 2400 mm in total length, referring also to the descriptions of Bigelow & Schroeder (1948).

The major differences between Argentine porbeagle and North Pacific salmon shark are summarized in Table 2.

Table 2. Remarkable differences in external morphology between Argentine porbeagle and North Pacific salmon shark

Major differences	Argentine porbeagle	North Pacific salmon shark*
Distance from tip of snout to:		
eye	5.5%	4.8%
nostrils	4.8%	3.8%
origin of caudal fin	80.8%	76.8%
Length of head	28.3%	26.9%
Caudal fin:		
length of upper margin	22.8%	24.9%
length of lower margin	17.1%	18.5%
Interspace between:		
2nd dorsal and caudal fin	7.8%	6.9%
anal and caudal fin	7.5%	6.1%
Posterior edge of eye to 1st gill opening / Length of snout	ca. 2	2.7
4th upper tooth	Almost erect. When looked from below, at right angle to 2nd upper tooth.	Considerably oblique inward. When looked from below, parallel to 2nd upper tooth.
Color pattern of ventral surface	Snow white	Snow white with dark blotches.

* Numerals of North Pacific salmon shark are the mean values of three materials referred to in Table 1.

As shown in Table 2, the Argentine porbeagle has longer snout, head and prenarial snout, but smaller and shorter caudal fin than the North Pacific salmon shark. In the Argentine porbeagle, just like in the North Western Atlantic porbeagle, the distance from the posterior edge of eye to the first gill opening compared with the snout length is much smaller than that in the North Pacific salmon shark.

The interspaces between the 2nd dorsal fin and the caudal one and between the anal fin and the caudal one are both greater in the Argentine porbeagle than in the North Pacific salmon shark.

The North Pacific salmon shark has always dark blotches on the ventral surface, though individual differences are observed in the shape, position and number of the blotches, while the Argentine and the North Western Atlantic porbeagles have no dark blotches below.

The teeth of the Argentine porbeagle are thicker and stronger than those of the North Pacific salmon shark. The fourth upper tooth of the former is almost erect or only slightly oblique inward, but that of the latter is strongly inward. Accordingly, the fourth upper tooth of the North Pacific salmon shark projects parallel to the 2nd upper tooth, but that of the Argentine porbeagle projects at almost right angle to the 2nd upper tooth (Fig. 2C). Judging from the figure by Bigelow & Schroeder (1948, p. 114), the 4th and 2nd upper teeth in the North Western Atlantic porbeagle are the same as in the Argentine porbeagle.

Therefore, mentioned facts indicate that there are sharp differences between the present Argentine porbeagle and the North Pacific salmon shark (*L. ditropis*), while there is no important specific difference between the former and the North Western Atlantic porbeagle (*L. nasus*) and that the Argentine porbeagle is referable to *Lamna nasus* (Bonnaterre).

V. Summary

A single male porbeagle was captured by the *R.V. Kaiyo Maru* on January 19, 1970 in Argentine waters (47°01'S, 62°02'W) where the porbeagle seems to be very rare. After careful examination of this specimen, its characteristics were minutely compared with the North Western Atlantic *L. nasus* and with the original data of the closely allied North Pacific salmon shark, *L. ditropis*. The results clearly indicate that the present male porbeagle from Argentina is referable to *Lamna nasus* (Bonnaterre).

A detailed description of *Lamna nasus* from Argentine waters has not been made hitherto. It will be useful for a future discussion on the systematic interrelationships among *Lamna* species to describe this porbeagle with precision.

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