

**First Record of the Bigeye Sand Tiger
Shark *Odontaspis noronhai* from
the Pacific Ocean**

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The family Odontaspidae consists of the genera *Eugomphodus* Gill, 1862 and *Odontaspis* Agassiz, 1838 (Compagno, 1984a). Two species of *Odontaspis* are currently recognized: *O. ferox* and *O. noronhai* (Compagno, 1984a). Compagno (1981) originally suggested that *O. noronhai* may be an extreme variant of *O. ferox*. Further evidence convinced Compagno (1984a, b) that *O. noronhai* is morphologically distinct from *O. ferox* and is a valid species.

Odontaspis noronhai was previously reported with certainty from only the Atlantic Ocean: 2 specimens from the type locality Madeira (Maul, 1955), 10 specimens from off southern Brazil (Sadowsky et al., 1984), and a specimen from the western Gulf of Mexico (Branstetter and McEachran, 1986). The single record outside of the Atlantic is either from the Indian Ocean or possibly South China Sea and based on a set of jaws nearly identical to the holotype in dentition (pers. comm. cited in Sadowsky et al., 1984). Furthermore, several *Odontaspis* teeth collected from bottom deposits in the central North Pacific, although not clearly identifiable to *O. noronhai*, suggest a possible Pacific occurrence (Belyaev and Glikman, 1970 as cited in Sadowsky et al., 1984). Herein, we report the first definitive record of *O. noronhai* from the Pacific Ocean and compare its morphometrics and dentition with those reported elsewhere.

Materials and methods

A 216.8 cm total length (TL) male *O. noronhai* was captured on tuna longline gear set by a commercial vessel fishing 550 km southwest of the Island of Hawaii (16°N, 160°W) in July 1985. Depth of capture is uncertain; the vessel captain estimated a 450 m depth. Stored frozen for 1 year, the specimen was partially dehydrated when measured. This specimen was deposited in the

Laboratory of Marine Zoology, Hokkaido University (HUMZ 110959) in Hakodate, Hokkaido, Japan. Measurements were taken to the nearest millimeter following Compagno (1984a) and converted to percent total length (%TL) to compare with Atlantic specimens (Maul, 1955; Sadowsky et al., 1984; Branstetter and McEachran, 1986). The repositories of the Atlantic specimens are the Museu Municipal do Funchal (MMF), Museu de Pesca (MP), and the Texas Cooperative Wildlife Collections (TCWC).

Tooth count of the Hawaii specimen follows the methods and terminology of Applegate (1965), except for the necessity of combining counts of lateral and posterior teeth. This modification still allowed for a comparison of dental counts between our Hawaii specimen and those from the Atlantic reported in Sadowsky et al. (1984) and Branstetter and McEachran (1986).

***Odontaspis noronhai* (Maul, 1955)**
(Fig. 1)

Carcharias noronhai Maul, 1955: 3, figs. 1–4 (type locality, off Camara de Lobos, Madeira).

Odontaspis noronhai: Sadowsky et al., 1984: 69, figs. 1–4 (southern Brazil and Indian Ocean or possibly South China Sea); Branstetter and McEachran, 1986: 153, fig. 1 (Gulf of Mexico).

Description. Proportional dimensions and dental counts of the Hawaii and Atlantic specimens of *O. noronhai* are presented in Tables 1 and 2, respectively. The following description is of the 216.8 cm TL male Hawaii specimen.

Snout conical and bulbous, tip rounded. Preoral length (snout tip to mouth) 21.7% of head length (snout tip to last gill-slit). Eyes large and ovoid, nictating membrane absent. Spiracle small, located behind and slightly below level of lower eye border. Mouth extends just beyond posterior border of eye. Snout tip to pectoral origin 82.1% of distance between first and second dorsal origins. Origin of first dorsal aligned behind inner margin of pectorals. Origin of second dorsal over pelvic inner margin, second dorsal insertion aligned somewhat closer to anal origin than pelvic insertion. Anal fin low and rounded, outer portion of posterior free margin under precaudal pit. First dorsal slightly larger than pelvics, second dorsal smaller than pelvics, and anal smaller than second

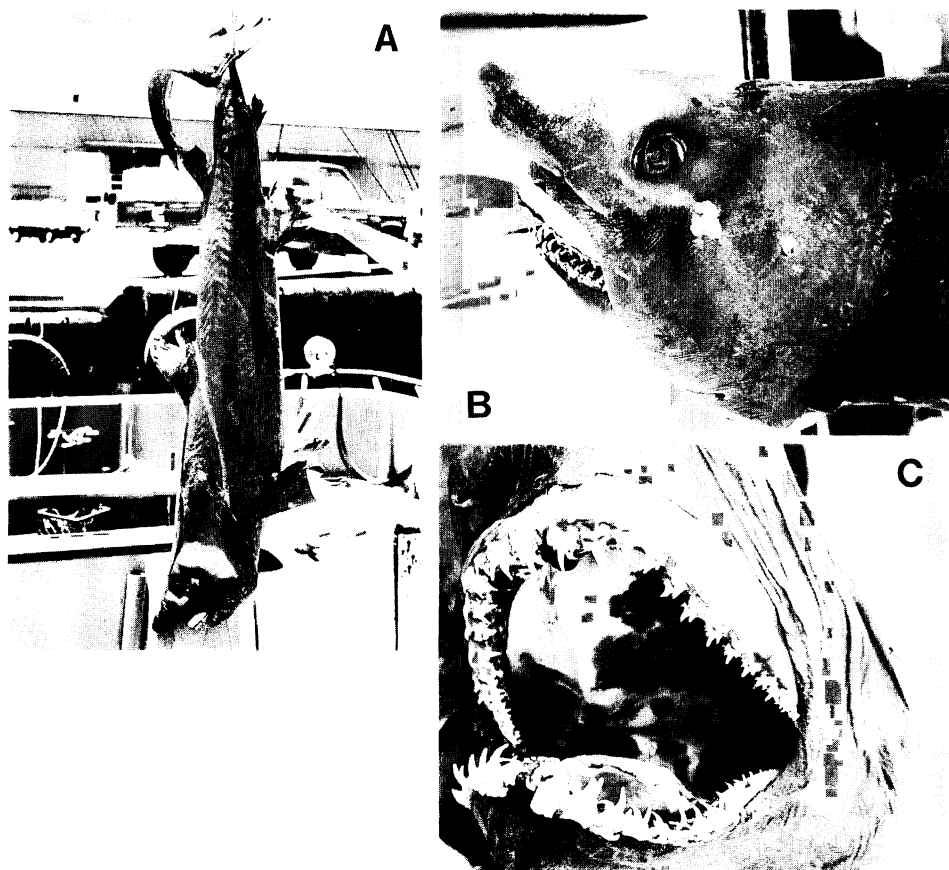


Fig. 1. *Odontaspis noronhai*, HUMZ 110959, 216.8 cm total length male, from off the Island of Hawaii.
A: Lateral view. B: Lateral view of head. C: Upper and lower jaw; note dark coloration on palate and along inner lining of upper jaw.

dorsal. Lateral keels absent. Tip of ventral caudal lobe somewhat pointed. Edge along posterior margin of all fins appears thin and frayed.

Single symphyseal tooth in upper jaw and first two symphyseal teeth on either side of lower jaw without cusplets. Third and fourth symphyseal teeth of lower jaw with minute cusplet on lateral side only. Anterior, intermediate, and lateral teeth in both jaws similar with a distinct, pointed cusplet on each side of cusp; slender, curved and awl-shaped; teeth appear to protrude outward from jaws. Anterior teeth longest, those of lower jaw somewhat longer than those of upper. In both upper and lower jaws, teeth following 1st lateral gradually decrease in size.

Body color a uniform chocolate brown, all fins except pectorals with a thin dark edging along

posterior margin. Inside mouth, inner lining of both jaws black; an irregular-shaped, dark patch present on middle of palate and tongue; internal gill arches with dark patches.

Discussion

Proportional dimensions of our Hawaii specimen closely correspond with those of the intact Brazil (MP 547) and Gulf of Mexico specimens with only a few differences. The Hawaii specimen has a somewhat greater upper caudal fin and anterior pectoral margin length than the Brazil specimen and a greater prepectoral but smaller pre-second dorsal length than the Gulf of Mexico specimen. The smaller outer clasper length of the Hawaii specimen is attributed to sexual immaturity. Greatest differences exist between the

Table 1. Proportional dimensions (in percent of total length (TL)) of Hawaiian *Odontaspis noronhai*, two Madeira specimens including holotype (MMF 2691) (Maul, 1955), two Brazil specimens (Sadowsky et al., 1984), and Gulf of Mexico (Branstetter and McEachran, 1986) specimen. The Brazil (uncat.) specimen consists of only a head; TL was estimated, so %TL values for this specimen are approximations.

Measurement	Hawaii, male HUMZ 110959 216.8 cm TL		Madeira, female MMF 2691 171 cm TL	Madeira (sex?) MMF 3376 118 cm TL	Brazil, male MP 547 342 cm TL	Brazil (sex?) (uncat.) ca. 360 cm TL	Gulf of Mexico, female TCWC 3922.1 321 cm TL
	cm	%TL	%TL	%TL	%TL	%TL	%TL
Snout tip to:							
outer nostrils	10.8	5.0	—	—	—	—	—
eye	15.6	7.2	5.9	6.3	5.7	ca. 5.9	7.0
mouth	10.9	5.0	5.0	7.0	4.4	ca. 4.7	5.3
spiracle	24.7	11.4	12.6	—	9.8	ca. 10.9	—
1st gill-slit	36.4	16.8	19.0	—	16.0	—	—
5th gill-slit	50.3	23.2	24.0	—	23.5	—	—
pectoral origin	51.2	23.6	22.6	24.1	22.8	—	20.9
pelvic origin	115.4	53.2	51.7	50.2	52.6	—	53.9
1st dorsal origin	68.8	31.7	30.4	31.6	31.3	—	33.1
2nd dorsal origin	130.5	60.2	55.0	57.9	59.6	—	62.6
anal fin origin	145.2	67.0	62.0	63.8	68.1	—	67.6
upper caudal origin	159.1	73.4	68.4	71.8	73.7	—	72.9
Distance between origins of:							
1st and 2nd dorsal fins	62.4	28.8	—	—	—	—	—
pectoral and pelvic fins	70.2	32.4	28.6	26.0	—	—	33.0
pelvic and anal fins	30.2	13.9	11.7	14.3	—	—	13.7
Space between:							
dorsal fin bases	39.9	18.4	16.5	15.5	—	—	19.9
2nd dorsal and caudal fins	16.1	7.4	—	—	—	—	—
pectoral and pelvic fins	59.4	27.4	—	—	—	—	—
pelvic and anal fins	16.7	7.7	—	—	—	—	—
anal and caudal fins	7.5	3.5	—	—	—	—	—
Eye:							
Horizontal diameter	4.9	2.3	2.8	2.3	1.8	ca. 1.7	1.6
Eye-spiracle distance	6.8	3.1	—	—	3.4	ca. 3.1	—
Interorbital space	10.8	5.0	5.0	—	4.5	ca. 4.7	—
Distance between inner corners of nostrils	9.0	4.2	4.9	4.3	3.7	ca. 4.1	4.7
Mouth length	10.4	4.8	—	—	3.7	ca. 5.3	—
Gill height:							
1st gill-slit	14.6	6.7	5.5	5.0	5.1	—	5.6
3rd gill-slit	12.8	5.9	5.1	4.6	—	—	5.9
5th gill-slit	12.8	5.9	4.9	3.9	4.8	—	4.7

Table 1. Continued.

Measurement	Hawaii, male HUMZ 110959 216.8 cm TL		Madeira, female MMF 2691 171 cm TL	Maderia (sex?) MMF 3376 118 cm TL	Brazil, male MP 547 342 cm TL	Brazil (sex?) (uncat.) ca. 360 cm TL	Gulf of Mexico, female TCWC 3922.1 321 cm TL
	cm	%TL	%TL	%TL	%TL	%TL	%TL
1st dorsal fin:							
length	24.4	11.3	—	—	—	—	—
length of base	19.7	9.1	8.1	10.6	9.6	—	10.9
length of posterior margin	11.2	5.2	—	—	—	—	—
height	14.5	6.7	5.1	6.2	6.0	—	6.2
2nd dorsal fin:							
length	16.3	7.5	—	—	—	—	—
length of base	11.6	5.4	5.3	6.4	6.4	—	5.8
length of posterior margin	9.5	4.4	—	—	—	—	—
height	14.5	4.1	4.4	4.7	4.3	—	4.4
Anal fin:							
length	11.9	5.5	—	—	—	—	—
length of base	7.9	3.6	3.3	5.2	3.5	—	3.9
length of posterior margin	7.2	3.3	—	—	—	—	—
height	5.3	2.4	2.8	4.5	3.1	—	4.1
Pectoral fin:							
length of base	11.1	5.1	—	4.9	4.6	—	5.1
length of anterior margin	30.4	14.0	12.5	12.7	11.6	—	15.3
length of inner margin	11.0	5.1	4.0	4.9	4.2	—	6.9
length of posterior margin	19.3	8.9	—	—	—	—	—
height	23.9	11.0	9.8	8.0	—	—	12.8
Pelvic fin:							
length	23.4	10.8	—	—	11.4	—	—
length of base	13.6	6.3	—	—	7.9	—	—
length of anterior margin	18.6	8.6	9.4	7.9	7.5	—	9.5
length of posterior margin	19.9	9.2	5.4	7.0	—	—	8.4
height	14.3	6.6	—	—	—	—	5.6
length of inner margin	11.8	5.4	—	—	—	—	—
Clasper:							
outer length	3.6	1.7	—	—	8.9	—	—
inner length	15.4	7.1	—	—	—	—	—
base width	1.3	0.6	—	—	—	—	—
Caudal fin:							
length of upper lobe	64.5	29.8	29.2	28.1	26.3	—	29.3
length of lower lobe	21.0	9.7	—	—	8.5	—	11.1
depth of notch	5.0	2.3	—	—	—	—	—
subterminal caudal margin	6.3	2.9	—	—	—	—	—

Madeira holotype (MMF 2691) and the Brazil (MP 547), Gulf of Mexico, and Hawaii specimens. Three of the holotype's proportional dimensions (preanal, pre-second dorsal, and precaudal length) were 4.5–7.6%TL smaller than those of the Hawaii, Brazil (MP 547), and Gulf of Mexico specimens. Allometric growth and/or possible taxidermic alteration of the holotype may be factors responsible for these discrepancies. Other variation from the holotype morphology involves the alignment of the second dorsal origin just anterior to the pelvic midbase. This was originally described by Maul (1955) and is one of the three key characters proposed by Compagno (1984a) to distinguish *O. noronhai* from *O. ferox*. The second dorsal origin appears to be aligned over the posterior third of the pelvic fin base in the Brazil (MP547) and Gulf of Mexico specimens and is aligned over the pelvic inner margin of the Hawaii specimen. The apparent variability of this morphological feature diminishes its utility as an identifying characteristic.

We also found an apparent error on page 3 in Maul (1955) regarding head length: "Eye moderate, almost 2.7 in snout, which is nearly 4 in head (measured from snout tip to last gill-slit)." On page 4 of Maul (1955), nine body measurements (in millimeters) of the holotype are presented.

Assuming that the measurement snout tip to upper lip in Maul (1955) refers to snout length, this length divided into snout tip to last gill-slit length yields a value of 4.8, whereas snout length divided into snout tip to first gill-slit length yields 3.8. We believe Maul (1955) mistakenly used the latter measurement for head length in the above cited text.

Another character proposed by Compagno (1984a) to distinguish *O. noronhai* from *O. ferox* is the presence of only a single row of intermediate teeth on each side of the upper jaw. The holotype and all other *O. noronhai* examined by Sadowsky et al. (1984) and Branstetter and McEachran (1986) concur with Compagno (1984a). The Hawaii specimen, however, possesses two rows of upper intermediate teeth on each side. Other dentitional differences in the Hawaii specimen include the presence of four rows of lower symphyseal teeth and three rows of lower anterior teeth on each side compared with two to three rows of lower symphyseals and two rows of lower anteriors in all other *O. noronhai* examined (Sadowsky et al., 1984; Branstetter and McEachran, 1986). Recognizing that the third lower anterior tooth of the Hawaii specimen might also be classified as a 1st lateral tooth by other investigators, we attribute the other dentitional differences to natural variation

Table 2. Tooth count and dental formula of Hawaiian *Odontaspis noronhai* with the revised count of the Madeira holotype and data from three Brazil specimens (Sadowsky et al., 1984) and one Gulf of Mexico specimen (Branstetter and McEachran, 1986). Dental formula follows Applegate (1965) where P=posterior, L=lateral, I=intermediate, A=anterior, and S=symphyseal teeth. Posterior and lateral tooth counts were combined for the Hawaii specimen.

Specimen	Tooth count (upper/lower)	Dental formula (upper/lower)									
Hawaii,	36	P+	L-14	I-2	A-2	S-1	S-0	A-2	I-2	L+	P-13
(HUMZ 110959)	46	P+	L-16	I-0	A-3	S-4	S-4	A-3	I-0	L+	P-16
Madeira,	38										
(MMF 2691)	44										
Brazil,	38	P-3	L-13	I-1	A-3	S-0	S-0	A-2	I-1	L-13	P-3
(MP 547)	42	P-3	L-13	I-0	A-2	S-3	S-3	A-2	I-0	L-13	P-3
Brazil,	40	P-4	L-13	I-1	A-2	S-0	S-0	A-2	I-1	L-13	P-4
(uncat.)	43	P-4	L-13	I-0	A-2	S-3	S-3	A-2	I-0	L-13	P-3
Brazil,	43	P-4	L-13	I-1	A-2	S-1	S-0	A-2	I-1	L-13	P-6
(MM 250)	40	P-4	L-12	I-0	A-2	S-2	S-2	A-2	I-0	L-12	P-4
Gulf of Mexico,	34	P-4	L-10	I-1	A-2	S-0	S-0	A-2	I-1	L-10	P-4
(TCWC 3922.1)	37	P+	L+	I+	A-16	S-2	S-2	17-A	+I	+L	+P

between ocean populations and believe they do not warrant separate taxonomic status for the Hawaii specimen.

Despite variation in two diagnostic features, *O. noronhai* is distinguishable from *O. ferox* by several characters. *Odontaspis noronhai* has only one cusplet on each side of a cusp, one to two rows of upper intermediate teeth between anterior and lateral rows, two to four rows of lower symphyseal teeth on each side, and uniform chocolate brown to dark reddish brown body coloration, without spots.

Few aspects of the habits and ecology of *O. noronhai* are known. Sadowsky et al. (1984) suggested that the capture of the large Brazil specimens, all from the same area and only during the spring season, may reflect a migrational movement. Observations of the Hawaii specimen at time of capture indicate highly aggressive behavior; the shark vigorously thrashed and snapped while at the surface and on deck (D. Knottingham, pers. comm.). Vertical distribution is extensive, ranging from 60–120 m off Brazil (Sadowsky et al., 1984) to 800–1,000 m off Madeira (Maul, 1955). Atlantic captures of *O. noronhai* suggest this species is a coastal inhabitant, although the Hawaii specimen was caught over deep oceanic waters far offshore. Interestingly, *O. noronhai* was not reported among some 6,000 sharks captured during an extensive longline fishing program conducted throughout the central Pacific in 1952–1955 (Strasberg, 1958). Fishing depths surveyed ranged from the surface to 150 m, which suggests that *O. noronhai* probably inhabits deeper waters in the central Pacific. The previously unknown occurrence of *O. noronhai* in the Pacific, coupled with the capture of all known *O. noronhai* by commercial fishing gear, underscores the important contribution that fishermen can offer in furthering our knowledge of rare and new species.

Acknowledgments

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Literature cited

Applegate, S. H. 1965. Tooth terminology and vari-

ation in sharks with special reference to the sand shark, *Carcharias taurus* Rafinesque. Contr. Sci. Los Angeles County Mus., 86: 1–18.

Belyaev, G. M. and L. S. Glikman. 1970. The teeth of sharks on the floor of the Pacific Ocean. Trans. P. Shirshov Inst. Oceanol., Acad. Sci. USSR, Moscow, 88: 252–276. (In Russian with English summary.)

Branstetter, S. and J. D. McEachran. 1986. A first record of *Odontaspis noronhai* (Lamniformes: Odontaspidae) for the western North Atlantic, with notes on two uncommon sharks from the Gulf of Mexico. Northeast Gulf Sci., 8 (2): 153–160.

Compagno, L. J. V. 1981. Sharks. In W. Fischer, G. Bianchi and W. B. Scott, eds. FAO species identification sheets for fishery purposes. Eastern Central Atlantic. Fishing Areas 34, 47 (in part), Vol. 5. By arrangement with FAO, Rome. Department of Fisheries and Oceans, Ottawa.

Compagno, L. J. V. 1984a. FAO species catalogue. Vol. 4. Sharks of the world. An annotated and illustrated catalogue of shark species known to date. Part 1. Hexanchiformes to Lamniformes. FAO Fish. Synop., No. 125, vol. 4, pt. 1: 1–249.

Compagno, L. J. V. 1984b. Sharks. In W. Fischer and G. Bianchi, eds. FAO species identification sheets for fishery purposes. Western Indian Ocean. Fishing Area 51, Vol. 5. Prepared and printed with the support of the Danish International Development Agency (DANIDA). FAO, Rome.

Maul, G. E. 1955. Five species of rare sharks new for Madeira including two new to science. Notul. Nat. Acad. Nat. Sci. Philad., (279), 13 pp.

Sadowsky, V., A. F. Amorim and E. A. Arfelli. 1984. Second occurrence of *Odontaspis noronhai* (Maul, 1955). B. Inst. Pesca, Sao Paulo, 11(1): 69–74.

Strasberg, D. W. 1958. Distribution, abundance, and habits of pelagic sharks in the central Pacific Ocean. Fish. Bull., U. S. Fish. Wildl. Serv., 58: 335–361.

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ミスワニ科 *Odontaspis noronhai* の太平洋初記録

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ミスワニ科シロワニ属の *Odontaspis noronhai* はこれまで大西洋からのみ報告されていた (holotype のものとほとんど同じ歯列をもつインド洋あるいは南シナ海でとれたと思われる一組の顎の報告はある)。今回ハワイ島の南西 550 km の地点でマグロ延縄にかかった個体が採集されたので、その測定値と歯列について他海域のものと比較し報告する。標本は北海道大学水産学部保管されている。