

***Hexanchus nakamurai*, a Senior Synonym of
H. vitulus (Elasmobranchii), with Notes
on its Occurrence in Japan**

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Hexanchus griseus (Bonnaterre) had been generally considered to be the only extant species of the genus *Hexanchus* (Elasmobranchii, Hexanchidae) until Springer and Waller (1969) described *H. vitulus* from the Bahamas as a new species. However, Teng (1962) described earlier the second form of the genus, *H. griseus nakamurai*, from Taiwan, as a subspecies, indicating that *H. griseus* described by Nakamura (1936) was a different form. Obviously Springer and Waller (1969) did not notice Teng's paper because it was originally printed in mimeograph for his doctoral dissertation. It is disputable whether Teng's paper constitutes publication as defined in the International Code of Zoological Nomenclature (Article 8). Thus Compagno (1984) retained *H. vitulus* because of the question whether Teng's (1962) work was actually published and his scientific name was available. On the contrary, Gloerfelt-Tarp and Kailola (1984), Shen (1984), and Boeseman (1984) employed *H. nakamurai* for the bigeye sixgill shark. Recently Nakaya (pers. comm.) suggested that Teng's paper should be regarded as published within the meaning of the Code. We agree to Nakaya's suggestion and use *H. nakamurai*, which is strongly suggested to be a senior synonym of *H. vitulus*.

H. nakamurai has not been reported from Japan, although it was described from Taiwan adjacent to Japan. We succeeded in collecting specimens of the shark from the Ogasawara Islands and off Kochi. Here we intend firstly to reveal relationships of *H. nakamurai* with *H. vitulus* and then to note the first record of *H. nakamurai* from Japan.

Materials and methods

The specimens of *H. nakamurai* examined here have been deposited in the Department of Fisheries, University Museum, University of Tokyo (FUMT): FUMT-P 10642, male, 1164 mm total length (TL),

March 16, 1982, near Ogasawara Islands; FUMT-P 10643, female, 958 mm TL, March 16, 1982, near Ogasawara Islands; FUMT-P 10847, female, 1021 mm TL, February, 1975, Mimase Fish Market, Kochi; and FUMT-P 10859, male, 1171 mm TL, jaw and neurocranium only, March 16, 1982, near Ogasawara Islands.

Measurements followed Bigelow and Schroeder (1948).

Results and discussion

A 1164 mm male of *H. nakamurai* collected from the Ogasawara Islands is shown in Fig. 1 and proportional dimensions of four specimens are given in Table 1. External features and body proportions are almost conformable to those described by Teng (1962), Springer and Waller (1969) (as *H. vitulus*), Bass et al. (1975) (as *H. vitulus*) and Compagno (1984) (as *H. vitulus*) except for the typographical error in the length from the snout tip to outer nostrils by Bass et al. (1975). However, no attempts have been made to compare the descriptions of *H. nakamurai* and *H. vitulus*, although recent papers treating systematics of *Hexanchus* have regarded these two species as conspecific, whether Teng's (1962) paper is considered to constitute publication or not. We believe Teng's paper was published within the meaning of the Code (Article 8) because many copies of this paper produced by mimeographing were distributed to Japanese ichthyologists when it was first issued as his doctoral dissertation. Regarding Teng's paper, Nakaya and Yang will reveal its status as publication elsewhere (Nakaya, pers. comm.).

Teng (1962) mentioned six characters as a diagnosis separating *H. nakamurai* from *H. griseus*, whereas Springer and Waller (1962) used seven characters as a diagnosis for *H. vitulus*. Among these, the concave distal margin of the pectoral fin and longer caudal peduncle are used as diagnostic characters for *H. nakamurai* in both papers. Three of the remaining four characters for *H. nakamurai* are found in the description and figures of *H. vitulus*: distance between pelvic and anal fins longer than the anal fin base; dermal denticles with a strong central ridge and two short lateral ridges; and dorsal fin origin placed a little posteriorly to the midpoint of total length. It seems that the description of the location of the anal fin origin relative to the dorsal fin base for *H. nakamurai* may be true in males but not the case in females. On the contrary, four of the

remaining five characters for *H. vitulus* are found in the description and figures of *H. nakamurai* (relative lengths of the eye and the snout are produced on the basis of proportional measurements of *H. nakamurai* and *H. griseus* from Teng (1962)): five rows of large

trapezoidal teeth on each side of the lower jaw; larger eye; longer snout (it does not seem that the latter two characters are enough to distinguish two species of *Hexanchus*); and greater distance between the dorsal fin base and upper caudal origin. How-

Table 1. Proportional dimensions in percentage of total length of *Hexanchus nakamurai* collected from the Ogasawara Islands and Kochi, Japan.

Catalogue No. (FUMT)	P10642	P10643	P10847	P10859
Total length (mm)	1164	958	1021	1171
Sex	♂	♀	♀	♂
Snout tip to:				
outer nostrils	1.3	0.8	1.1	1.2
eye	4.3	4.1	3.8	4.3
spiracle	11.8	11.5	11.5	11.4
mouth	5.3	5.3	6.4	5.0
1st gill opening	13.7	13.6	15.1	13.7
6th gill opening	16.4	17.2	18.8	17.4
pectoral insertion	16.4	17.2	18.5	17.4
pelvic insertion	40.2	39.6	41.3	41.3
dorsal fin origin	49.2	48.1	49.9	49.6
anal fin origin	53.9	53.3	53.6	54.7
upper caudal origin	66.3	65.8	66.9	66.2
Distance between bases:				
dorsal and caudal	11.6	12.4	13.3	11.1
pectoral and pelvic	18.7	18.8	17.1	17.8
pelvic and anal	7.4	7.0	6.3	7.3
anal and caudal	8.9	8.8	10.0	9.1
Distance between inner corners of nostrils	4.0	4.3	4.3	4.3
Mouth:				
width	10.9	10.2	11.1	5.4
length	5.6	5.1	5.3	
Gill-opening lengths:				
1st	5.7	5.7	5.8	5.3
6th	3.0	2.8	2.8	3.3
Orbit:				
horizontal diameter	3.3	3.6	3.3	3.2
vertical diameter	1.6	1.9	1.9	1.5
Dorsal fin:				
overall length	7.3	7.6	6.9	7.2
base length	6.2	6.3	5.8	5.7
height	3.9	4.1	3.8	4.1
Anal fin:				
overall length	5.8	5.8	5.7	5.6
base length	4.5	4.5	4.3	4.2
height	2.2	2.0	1.7	2.3
Pectoral fin:				
anterior margin length	12.5	12.3	11.6	12.8
base length	6.4	6.2	6.4	6.3
Pelvic fin:				
overall length	10.7	8.4	8.4	11.4
base length	6.5	6.8	7.4	6.5
clasper length	4.1	—	—	5.1
Caudal fin:				
dorsal lobe length	33.3	34.0	34.5	32.9
ventral lobe length	8.3	8.5	8.1	8.6

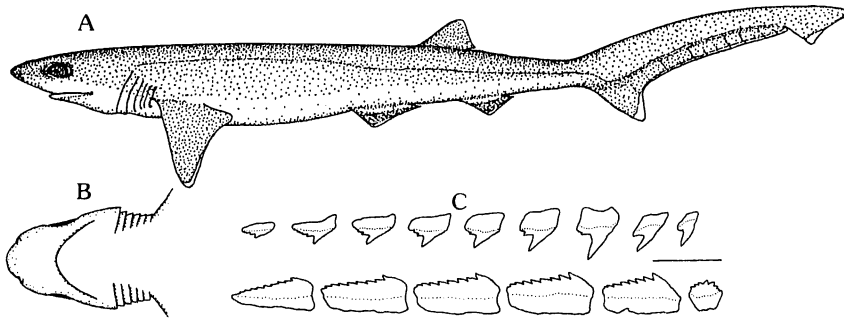


Fig. 1. *Hexanchus nakamurai* from Japan. A, lateral view of a male specimen, FUMT-P 10642, 1164 mm TL; B, ventral view of the same; C, large teeth on right jaw of a male specimen, FUMT-P 10859, 1171 mm TL.

ever, since the type specimen of *H. nakamurai* is immature with a total length of 750 mm, we do not know if adults of *H. nakamurai* have imbricated denticles of nearly uniform size on the lateral surface of the upper distal portion of the caudal fin as described for the adults of *H. vitulus*. We could not compare proportional dimensions of *H. nakamurai* and *H. vitulus* because they were not given in the description of *H. vitulus*. However, we cannot find any other apparent differences in external morphology between *H. nakamurai* and *H. vitulus*. For these reasons, we came to the conclusion that *H. nakamurai* is a senior synonym of *H. vitulus*.

The general appearance of *H. nakamurai* is similar to that of *Heptranchias perlo* rather than its congener, *H. griseus*, as pointed out by Teng (1962) and Bass et al. (1975). Bass et al. (1975) stated that the general aspect of *H. griseus* is similar to that of *Notorynchus cepedianus*, while that of *H. vitulus* (= *H. nakamurai*) is reminiscent of *Heptranchias perlo*. For this reason, Bass et al. (1975) demonstrated that the family Hexanchidae might be divided along these differences rather than according to the numbers of gill openings. On the other hand, Maisey and Wolfram (1984) and Maisey (1986) pointed out that *H. griseus* and *H. vitulus* (= *H. nakamurai*) are united by having six gill openings and lateral teeth of similar shape, while *Heptranchias perlo* is separable from other hexanchoids in the presence of a median cusp in the lower symphyseal and particularly in cranial morphology. However, in constructing a cladogram of hexanchoids, Maisey and Wolfram (1984) and Maisey (1986) produced an unresolved trichotomy between the two species of *Hexanchus* and *Heptranchias perlo*. Thies (1987) opposed Maisey and Wolfram's (1984) cladogram for the reason that dental characters defined by them are not

suited to evaluate the relationship existing between these living species. Thies (1987) proposed an alternative view of hexanchiform interrelationships based on additional characters and including other fossil hexanchiforms. His cladogram shows that *Heptranchias* is most primitive among the three extant genera and *Notorynchus* forms a sister group of *Hexanchus*. If we accept the views of Bass et al. (1975) and Maisey and Wolfram (1984), we suspect that the difference and similarity among the four living species may lead to establishment of a new taxon for *H. nakamurai*, under the assumption that external features are not subject to allometric changes which invalidate the difference and similarity. If we agree to the view of Thies (1987), it is quite unnecessary to split the genus *Hexanchus* into two taxa. More detailed studies are needed to elucidate interrelationships of the family Hexanchidae, taking into consideration external characters such as body proportions as well as neurocrania.

The occurrence of *H. nakamurai* in the Ogasawara Islands and off Kochi may be expected from its distributional pattern, i.e. it was described from Taiwan which is located very close to southern Japan. *H. nakamurai* is supposedly world-wide in distribution, although it was spottily distributed (Compagno, 1984). Relatively rare records of the occurrence of *H. nakamurai* compared to *H. griseus* may be due to its recent distinction from the latter species. It is probable that *H. nakamurai* shows a continuous distribution, as indicated by a report of its occurrence in the Mediterranean (Tortonesi, 1985).

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シロカグラ *Hexanchus nakamurai* は, *H. vitulus* の上位同物異名であることおよびその日本初記録

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原記載の比較に基づいて、台湾産のシロカグラ *Hexanchus nakamurai* はバハマ諸島産の *H. vitulus* の上位同物異名であることを検証した。本種は近縁種のカグラザメ *H. griseus* とは下顎に櫛状の大きな歯が1列に5個並ぶこと(カグラザメでは6個)、胸鰭後縁が凹むこと、尾柄が長く臀鰭基底の少なくとも1.5倍はあること、背鰭は尾鰭から少なくともその基底長の2倍離れていることで区別される。本種が小笠原諸島周辺、高知沖に分布することを明らかにした。本報が本種の日本初記録である。

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