Specimens of the order Torpediniformes (Chondrichthyes: Elasmobranchii) deposited in the Department of Zoology, The University Museum, The University of Tokyo

Ayumi Bandai[1)*], Harutaka Hata[1)], Keita Koeda[2)], Masahiro Aizawa[3)], Kazuo Sakamoto[3,4)], Rei Ueshima[3,5)]

[1)] National Museum of Natural History, Smithsonian Institution, 10th and Constitution Ave NW, Washington, DC 20560, USA
[2)] Faculty of Science, University of the Ryukyus, 1 Senbaru, Nishihara, Okinawa 901-0213, Japan
[3)] The University Museum, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan
[4)] Fish Information Center and Museum, 6-6 Toyosu, Koto-ku, Tokyo 135-0061, Japan
[5)] Department of Biological Sciences, Graduate School of Science, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan

*Corresponding author: E-mail: k3762657@gmail.com

Abstract

A list of Torpediniformes deposited in the Department of Zoology, The University Museum, The University of Tokyo includes 44 specimens (40 lots) of 5 species (including an unidentified specimen of *Torpedo*), representing three families. Type specimens were not found in this research.

Introduction

The order Torpediniformes, included within Chondrichthyes, is characterized by a soft thick body with an entirely smooth surface (no denticles, thorns or spines), and a pair of kidney-shaped electric organs in the disc, distinguishable through the skin in ventral view (Carvalho et al. 2016). Torpediniform rays are known for discharging up to 60 volts of electricity from the electric organs for both defense and predation (Bennett et al. 1961; Macesic and Kajiura 2009).

The classification of Torpediniformes has been and remains confused. Nelson et al. (2016) recognized two families, Narcinidae and Torpedinidae, whereas Carvalho et al. (2016) regarded *Hypnos* [included in Torpedinidae by Nelson et al. (2016)] and Narkinae (a subfamily of Narcinidae) as Hypnidae and Narkidae, respectively. However, although the molecular phylogenetic tree shown in Carvalho et al. (2016: fig. 2. 1) indicated that monophyly of the order was supported, those of Narcinidae and Narkidae were not. The classification of the order is likely to be revised by examinations of a greater number of species.

Species-level taxonomy of Torpediniformes is also confused, many new species and new distributional records having been confirmed in recent years (e.g., Ebert et al. 2015; Bandai et al. 2017; Bhatt et al. 2022). As an aid to future taxonomic studies, a list of specimens of Torpediniformes deposited in the Department of Zoology, The University Museum, The University of Tokyo is provided herein.

Materials and Methods

Specimens of the order Torpediniformes in the Department of Zoology, The University Museum, The University of Tokyo (abbreviated as ZUMT) were identified during the present study following Hatooka et al. (2013), Carvalho et al. (2016), and Bandai et al. (2017). Classification of the families follows Carvalho et al. (1999, 2016). Parentheses following registration numbers include total length (in mm), disc width [in mm (only indicated in *Tetronarce formosa*)], specimen numbers (if more than one included in lot), sex, collection locality, collection date, and collector. Collection data of specimens are omitted when matching that of immediately following specimens. Total length and disc width are abbreviated as TL and DW, respectively. The collection year and collector for some specimens was estimated by following Koeda et al. (2022). The ZUMT specimens listed herein were stored in Room 406 (specimen storage room) in the museum building. Most were stored in bottles on shelves, although some large specimens were stored in a glass tank, with the glass lid sealed with a silicon adhesive, in Room 406 (as of July 2022).

Results

In the ZUMT fish collection, deposition of two specimens of Narcinidae, 40 specimens of Narkidae, and two specimens of Torpedinidae were confirmed, respectively. No type specimens were found in the collection. Although Tanaka (1908) described a new species, *Tetronarce tokionis* (Torpedinidae) based on three ZUMT specimens of large-sized females [holotype (ZUMT 917: 95 mm TL) and two paratypes (uncataloged: 80 mm TL and 81 mm TL)], only a single large-sized male specimen (ZUMT 64090) with no females of Torpedinidae were discovered during our investigation. Therefore, they are now confirmed as lost (Bandai et al. 2017; Aizawa et al. 2022).

Species accounts

Order Torpediniformes　シビレエイ目
Family Narcinidae　タイワンシビレエイ科
***Narcine maculata* (Shaw, 1804)**

LOCARITY UNKNOWN

ZUMT 62644 (264.4 mm; male)
ZUMT 62645 (282.3 mm; female)

Family Narkidae　シビレエイ科
***Narke dipterygia* (Bloch & Schneider, 1801)**

LOCARITY UNKNOWN

ZUMT 62641 (103.1 mm; female), ZUMT 62642 (127.3 mm; female), ZUMT 62643 (140.6 mm; female; no data)

***Narke japonica* (Temminck & Schlegel, 1850)　シビレエイ**

JAPAN

ZUMT 23649 (118.5 mm; male; Urado, Kochi City, Kochi Pref.; 19 Apr. 1931; coll. by T. Kamohara)
ZUMT 26255 [190.2 mm; female; probably from Yamaguchi Pref.; Oct. 1933; coll. by I. Tanaka (Kashima, Hagi City)]
ZUMT 26259 [302.0 mm; male; probably from Kanagawa Pref.; coll. by K. Minoshima (Kozu, Odawara City)]
ZUMT 26641 (110.2 mm; female; Hayama Town, Kanagawa Pref.; 1 Aug. 1934; coll. by S. Inuo)
ZUMT 32007 (169.0 mm; female; off Nagasaki Pref.)
ZUMT 32478 (80.4 mm; female), ZUMT 32479 (76.0 mm; female), ZUMT 32480 (76.5 mm; male), ZUMT 32481 (78.2 mm; female), ZUMT 32482 (77.6 mm; female), ZUMT 32483 (72.0 mm; female), ZUMT 32484(75.6 mm; female), ZUMT 32485 (74.4 mm; female), ZUMT 32486 (76.0 mm; female), ZUMT 32487 (72.5 mm; male; probably collected from Misaki, Miura City, Kanagawa Pref.)
ZUMT 36413 (155.0 mm; female; Hayama Town, Kanagawa Pref.; Aug. 1936; coll. by S. Inuo)
ZUMT 48832 (124.4 mm; female; Hayama Town, Kanagawa Pref.; 13 Feb. 1956; trawl; coll. by Imperial Household Agency)
ZUMT 49641 (119.9 mm; female), ZUMT 49642 (118.6 mm; female), ZUMT 49643 (122.0 mm; female), ZUMT 49644 (142.9 mm; female), ZUMT 49645 (110.6 mm; male), ZUMT 49646 (145.8 mm; female; Hayama Town, Kanagawa Pref.; 22 Jan. 1959)
ZUMT 56934 (183.7 mm; female), ZUMT 56937 (208.7 mm; female; southeast of Tsushima Island, Nagasaki Pref.; 10 July 1987; coll. by Y. Tominaga and M. Aizawa on board F/V *No. 36 Ten'yo-maru*)

KOREA

ZUMT 51489 [192.9 mm; male; approx. 85 km west of Jeju Island (33°15’N, 125°15’E); 29 Mar. 1960; coll. by Y. Tominaga]
ZUMT 51514 [240.6 mm; male; approx. 150 km west of Jeju Island; 30 Mar. 1960]

CHINA
ZUMT 52006 [265.5 mm; male; east off Shanghai (31°45’N, 123°15’E or 31°15’N, 123°45’E)]
ZUMT 52010 [264.3 mm; female; approx. 200 km east off Shanghai (30°45’N, 124°15’E); May 1960]

EAST CHINA SEA
ZUMT 51887 (224.4 mm; female; East China Sea)
ZUMT 57632 (111.8 mm; male; East China Sea; 7 May 1988)

LOCALITY UNKNOWN
ZUMT 33000 (206.3 mm; female), ZUMT 64092 [72.6–80.7 mm; 5 specimens (3 males and 2 females); no data]

Family Torpedinidae　ヤマトシビレエイ科

Tetronarce formosa (Haas & Ebert, 2006)　ツキミシビレエイ

JAPAN
ZUMT 64090 (cloth tag labelled No. 199 “写生百九十九号”) (773.8 mm TL; 459.4 mm DW; male; probably from Japan)

Torpedo sp.

Italy
ZUMT 4774 (124.9 mm; male; probably from Italy; donated by the Zoological Station at Naples, Italy)
Remarks: This specimen was identified as genus *Torpedo* due to the presence of papillae on the spiracle margins and arched mouth (Carvalho et al. 2016). According to Carvalho et al. (2016), *T. marmorata* and *T. torpedo*, both known from the Mediterranean region, can be distinguished by the dorsal color pattern. However, the color pattern of the present specimen has been lost due to preservation, and its identity remains unresolved.

Acknowledgements

We are deeply grateful to the late Y. Tominaga for his dedication and efforts for the ZUMT collection. We thank I. Abe, S. Fujiwara, A. Iinuma, M. Saito, A. Takahashi, H. Ogata and other volunteers for the opportunity to examine the present specimens and curatorial assistance. We also greatly appreciated T. Yoshida (Marine Ecology Research Institute) and H. Wada (ZUMT) for providing information on specimen collection sites, and G. Hardy (Ngunguru, New Zealand), who read the manuscript and provided help with English. This study was supported in part by the Sasakawa Scientific Research Grant from the Japan Science Society (28-745, 2021-4064); a Grant-in-Aid from the Japan Society for the Promotion of Science for JSPS Fellows (DC2: 29-6652); JSPS KAKENHI Grant Numbers 19K23691 and 21K06313JP; JSPS Overseas Research Fellowships (202160519); the Fujiwara Natural History Foundation, Kurita Water and Environment Foundation (23B019), JST, CREST (JPMJCR23J2) and Ocean Shot from The Sasakawa Peace Foundation.

References

Aizawa, M., Koeda, K., Hata, H., Aizawa, M., Sakamoto, K. and Ueshima, R. 2022. Fish types deposited in the Department of Zoology, The University Museum, The University of Tokyo - Part 2: Myxiniformes to Acipenseriformes. The University Museum, The University of Tokyo Material Reports, 129: 189−217.

Bandai, A., Matsunuma, M. and Motomura, H. 2017. First records of the electric ray *Tetronarce formosa* (Torpediniformes: Torpedinidae) from Japan, with a revised species' diagnosis and comparisons with congeners. Japanese Journal of Ichthyology, 64 (2): 157–170. (In Japanese)

Bennett, M.V. L., Wurzel, M. and Grundfest, H. 1961. The electrophysiology of electric organs of marine electric fishes. I. Properties of electroplaques of *Torpedo nobiliana*. The Journal of General Physiology, 44: 757–804.

Bhatt, D. M., Singh, S. K. and Mankodi, P. C. 2022. New record of spot-tail sleeper ray *Narke dipterygia* (Bloch and Schneider, 1801) (Elasmobranchii, Torpediniformes, Narkidae) from the coast of Gujarat, India. Journal of Fisheries, 10 (1) (art. 101401): 1–5.

de Carvalho, M. R., Compagno, L. J. V. and Last, P. R. 1999. Order Torpediniformes. Pp. 1433–1451. In: Carpenter K. E. and Niem, V. H. (eds) FAO species identification guide for fishery purposes. The living marine resources of the western central Pacific. Vol. 3. Batoid fishes, chimaeras and bony fishes part 1 (Elopidae to Linophrynidae). FAO, Rome.

de Carvalho, M. R., Last, P. R. and Séret, B. 2016. Rays of the world. CSIRO Publishing, Melbourne. 790 pp.

Ebert, D. A., Haas, D. L. and de Carvalho, M. R. 2015. *Tetronarce cowleyi*, sp. nov., a new species of electric ray from southern Africa (Chondrichthyes: Torpediniformes: Torpedinidae). Zootaxa, 3936 (2): 237–250.

Hatooka, K., Yanagishita, N. and Yamaguchi, A. 2013. Torpediniformes. Pp. 203–204, 1770. In: Nakabo, T. (ed) Fishes of Japan with pictorial keys to the species, third edition. Tokai University Press, Hadano. (In Japanese)

Koeda, K., Hata, H., Aizawa, M., Sakamoto, K. and Ueshima, R. 2022. History of the fish collection of the Department of Zoology, The University Museum, The University of Tokyo. The University Museum, The University of Tokyo Material Reports, 129: 1−24. (In Japanese)

Macesic, L. J. and Kajiura, S. M. 2009. Electric organ morphology and function in the lesser electric ray, *Narcine brasiliensis*. Zoology, 112: 442–450.

Nelson, J. S., Grande, T. C. and Wilson, M. V. 2016. Fishes of the World, fifth edition. John Wiley & Sons, New York. 752 pp.

Tanaka, S. 1908. Notes on some Japanese fishes, with descriptions of fourteen new species. Journal of the College of Science. Imperial University, Tokyo, 23 (7): 1–54, pls. 1–4.