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Brian K. Walker and Robin L. Sherman. 2001. Gross Brain Morphology in the Yellow Stingray, Urobatis jamaicensis .Florida Scientist , (4) : 246 -249. https://nsuworks.nova.edu/occ_facarticles/138.

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GROSS BRAIN MORPHOLOGY IN THE YELLOW STINGRAY, *UROBATIS JAMAICENSIS*-*BRIAN K. WALKER AND ROBIN L. SHERMAN*, Nova Southeastern University Oceanographic Center, 8000 N. Ocean Drive, Dania Beach, FL 33004

Published in Florida Scientist, Autumn, 2001, Volume 64, Number 4, pp. 246-249.
Accepted February 27, 2001.

ABSTRACT: The yellow stingray, *Urobatis jamaicensis* (family Urolophidae), a short-lived, relatively small elasmobranch species (35--40 cm total length), is a common inhabitant of hard bottom and coral reef communities in southeastern Florida and many parts of the Caribbean. A paucity of published studies deal with the yellow stingray, none however on the gross morphology of its nervous system. The gross brain structure of the yellow stingray is compared with previously published studies on other batoid elasmobranchs. The external brain structure of *Urobatis jamaicensis* was similar to that reported for other Dasyatids, including presence of an asymmetric cerebellum. The bilaterally symmetric brain is well developed and quite large in proportion to body size (≈1--2% bw). Stingrays generally possess a brain three to 10 times the size of their sister groups, the electric rays, guitarfish, and skates (Northcutt, 1989), the yellow stingray is no exception.

THE YELLOW stingray, *Urobatis jamaicensis*, is a short-lived, small elasmobranch species (35--45 cm TL), commonly inhabiting hard bottom and coral reef communities of southeastern Florida. Its small size, ease of capture, and large abundance makes it an ideal candidate for many ecological and physiological studies. We used this species to examine the elasmobranch histaminergic system since there is a paucity of published studies dealing with the yellow stingray, and, to our knowledge, none on its nervous system. We compared gross brain structure of the yellow stingray with previously published studies on other batoid elasmobranchs to better understand its nervous system.

MATERIALS AND METHODS- Three male and two female sexually mature yellow rays captured on the inshore hard bottom community off Dania Beach, FL were killed with a lethal dose of MS-222 (Finquel, tricaine methanesulfonate). The dorsal side of the brain case was dissected in two males and two females, allowing an untouched look at the brain placement in the skull. Eye muscles of the third male were dissected and a longitudinal section of the brain was made to find cranial nerves IV and VI. Dorsal and ventral aspects were illustrated (Figure 1).

RESULTS AND DISCUSSION- Most previous work on *Urobatis sp.* focused on aspects of behavior or ecology. A few studies investigated aspects of the nervous system in the genus, for example, the innervation of the gills (Donald, 1988) and clasper control (Liu and Demski, 1993); however, the gross morphology of the yellow stingray's brain has been overlooked. Conversely, the gross brain morphology of several other elasmobranch species has been well documented (Hofmann, 1999; Northcutt, 1978). Extensive studies have been conducted with the closely related *Dasyatis sabina* such as the documentation of age- related increase in neuronal and axonal numbers in the ventral horn (Leonard et al., 1978), the identification of the midbrain locomotor region and its relation to descending locomotor pathways (Bernau et al., 1991), and most recently, mapping the morphology of the mechanosensory lateral line system (Maruska and Tricas, 1998).

The external brain structure of *U. jamaicensis* is similar to that reported for other Dasyatids, including presence of an asymmetric anterior caudal cerebellum (Fig. 1).

Comparatively, stingrays possess a brain three to 10 times the size of its sister groups, the electric rays, guitarfish, and skates (Northcutt, 1989). The yellow stingray is no exception. Its mostly bilaterally symmetric brain is well developed and quite large in proportion to body size (≈1--2% bw).

The telencephalon (Fig. 1), the largest and most anterior portion, extends two thick short olfactory tracts (cranial nerve I) to the olfactory bulbs in the anterior portion of the head. The diencephalon (Fig. 1) extends ventrally caudal to the telencephalon. This area contains the large optic nerves (II), the inferior lobe of the infundibulum, and the hypophysis.

The mesencephalon (Fig. 1), a pronounced bulbous feature in the middle of the brain caudal and dorsal to the diencephalon, is comprised of the optic lobe (dorsal) and the tegmentum (ventral). Two distinctive oculomotor nerves (III) extend out from the ventral side of the mesencephalon. The trochlear nerve (IV) extends rostrally from the dorsal caudal section of the optic lobe.

The rhombencephalon (Fig. 1), the most posterior portion of the brain, comprises the cerebellum, the trigeminal (V), abducens (VI), facial (VII), auditory (VIII), glossopharyngeal (IX), the vagus nerves (X), and the medulla oblongata. The rhombencephalon extends caudally out of the brain case, into the spinal cord, which extends to the tail of the animal.

The cerebellum is heavily reticulated and covers the entire dorsal surface of the mesencephalon and most of the rhombencephalon. It is split into three distinct parts, the anterior rostral, the anterior caudal, and the posterior cerebellum. The anterior caudal portion of the cerebellum is the only part that exhibits asymmetry in the yellow stingray brain (Fig. 1, dorsal view). The yellow stingray did not exhibit variations in anterior rostral cerebellar morphology as seen in the Atlantic stingray, *Dasyatis sabina* (Puzdrowski and Leonard, 1992).

The yellow stingray possesses a brain two times the size of the clearnose skate, *Raja eglanteria*, and the thornback skate, *Platyrhinoidis triseriata*, and a proportionately larger telencephalon. This feature in *U. jamaicensis* is similar to the bat ray, *Myliobatis californica*, the southern stingray *D. americana,* and the Atlantic stingray, *D. sabina* (Northcutt, 1978). Contrary to the telencephalon, the cerebellum in the yellow stingray is much less complex than the bat ray or southern stingray, and more closely resembles the Atlantic stingray (Puzdrowski and Leonard, 1992).

The nerves in the yellow stingray vary from other elasmobranchs as well. In the spiny dogfish, *Squalus acanthias*, the trigeminal (V), facial (VII), and auditory (VIII) nerves exit the brain in a single trunk (Gilbert, 1989), however, in the yellow stingray and other closely related elasmobranch species, including *D. sabina*, the trigeminal (V) is a distinct, separate trunk. Another interesting feature is the vagus (X). This nerve appears as a bundle of seven to eight nerves exiting the brain in a single place (Fig. 1, dorsal view). Similar to other skates and rays, these nerves are separate, but are bundled together into seemingly one large nerve that exits the brain case before splitting to innervate the heart, gills, stomach, intestine, pharynx, esophagus, and body wall.

Compared to the morphology and function of other stingray species nervous systems, we found the yellow stingray brain morphology to be most similar to *Dasyatis sabina* in form. Further investigations into other Urolophids will likely provide similar results.

ACKNOWLEDGMENTS-We wish to thank Dr. Richard Spieler for the use of his facilities and professional advice. Thanks to Tiffany Vaughn, Elizabeth Glynn, Pat Quinn, Dan Fahy, and Paul Arena for assisting with field work, to Dr. Andrew Rogerson for editing assistance, and to Dana Rankin for illustration assistance.

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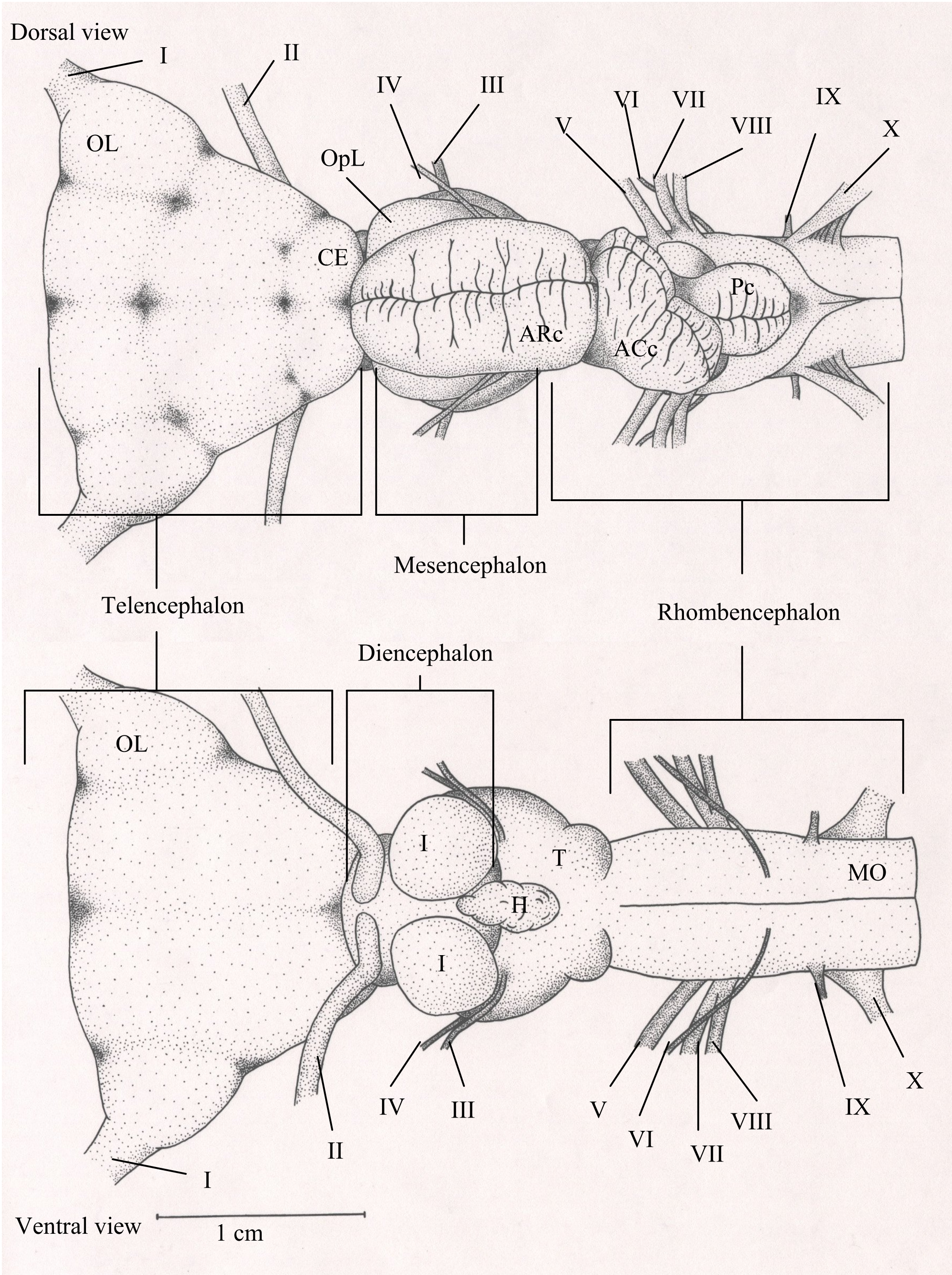

Fig. 1. Dorsal and ventral view with cranial nerves and major topography. Cranial Nerves: I- Olfactory, II- Optic, III- Oculomotor, IV- Trochlear, V- Trigeminal, VI- Abducens, VII- Facial, VII- Auditory, IX- Glossopharyngeal, X- Vagus. Major Topography: ACc- Anterior caudal cerebellum, ARc- Anterior rostral cerebellum, CE- Cerebrum, H- Hypophysis, I- Inferior lobes of infundibulum, MO- Medulla oblongata, OL- Olfactory lobe, OpL- Optic Lobe, Pc- Posterior cerebellum, T- Tegmentum.