Ovarian Morphology of the Threadfin Shad, Dorosoma Petenense (Günther)[1]

WILLIAM L. SHELTON, Stillwater

In the study of spawning of *Dorosoma petenense* in Lake Texoma, it is important to recognize stages in the development of ovarian eggs. Bodola (1956), was able to distinguish spent from unspawned females by ovarian examination in *Dorosoma cepedianum;* he described 6 stages and correlated them with seasons of the year.

Shad were taken in overnight sets of experimental gill nets and their ovaries removed and fixed in Smith's or Bouin's fluids within one hour of death. Both fixatives were satisfactory, although Smith's fluid proved to be better for yolky eggs. Portions of ovaries were selected, embedded in celloidin, sectioned at 14 microns, and stained with hematoxylin and phloxine.

The ovaries are large, elongate structures located dorsal to the gizzard-like stomach and compactly coiled intestines. Their dorsal surfaces are closely connected by peritoneum in which is located the ovarian artery. Posteriorly the ovaries are connected to the last few centimeters of the intestine. Internally, many connective tissues lamellae project inward from the thin ovarian wall (Fig. 1). The ovarian structure of the thread-

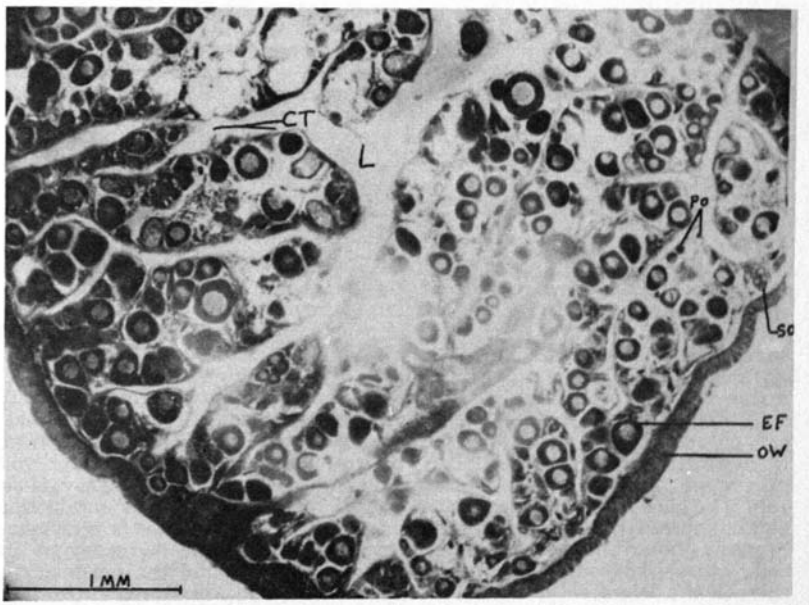

Figure 1. Cross section of middle portion of left ovary from *Dorosoma petenense* 6.1 inches in total length, taken in late June.

OW—ovarian wall
EF —egg follicle
PO —primary oocytes
SO—secondary oocyte
CT—connective tissue lamella
L —lumen

[1]Contribution from the University of Oklahoma Biological Station and No. 370, Department of Zoology, Oklahoma State University, Stillwater, Oklahoma. Supported by the Okla. Game & Fish Council. I am grateful to Dr. George A. Moore for advice and criticism.

fin shad is characterized by a large number of egg follicles in various stages of development scattered throughout the connective tissue. In all ovaries examined this size variation was noted, even in those apparently near spawning. Evidently Bodola (1956) described the 6 stages in *D. cepedianum* with reference to the predominant cell type present at a given time. All sizes of ova can be recognized in the mature ovary of *D. petenense*. In this paper, reference to a primary oocyte is restricted to those small cells with no recognizable membranes, small amounts of cytoplasm, and small nuclei with single nucleoli. Secondary oocytes are those with very dense cytoplasm, enlarged nuclei, and several nucleoli. Not until later stages do the various membranes become evident. Prior to spawning, primary oocytes exist with mature ova but after spawning there is a smaller variation in size. Subsequently during the summer, more oocytes mature and likewise more primary oocytes are produced. By late summer, ovaries which are markedly enlarged, although not ripe, contain ova in all developmental stages.

The oocytes arise from germinal epithelium and become embedded within connective tissue. Here they undergo a period of development, during which membranes are added, yolk is produced, and nuclear modifications occur. Upon maturity the eggs are shed into the ovarian lumen and thence to the outside. When the primary oocyte is produced in the germinal epithelium, it is yolkless, lacks associated epithelial cells, and is highly basophilic. The cell at this stage of development stains so intensely that it is difficult to distinguish the cytoplasm from the nucleus. In the secondary oocyte, the cytoplasm is very dense, the nucleus has increased in size and contains several nucleoli, which migrate to the periphery of the nucleus. The membranes are not as yet evident. A vitelline membrane and zona radiata are present in the larger ovule (Fig. 2). These structures are products of the ooplasm and are called primary membranes (Wilson, 1926). The vitelline membrane is an acellular, thin and lightly staining layer, located exterior to the striated, relatively thick, and lightly staining zona radiata. Epithelial cells soon become associated with and form a layer around the ovule; upon maturation the layer bursts, releasing the ovule into the lumen. The epithelial cells, the membranes, and the ovum are collectively termed the egg follicle. Associated with the epithelial cells and exterior to the vitelline membrane is a uniformly staining acellular layer, the chorion, not present in the younger ovules which have no follicular epithelium. Apparently it is produced by the follicular epithelium and can be called a chorion according to Nelson (1953). Inside the membranes are a large number of granular, highly basophilic structures, the granulosa or "yolk spheres" of Wilson. The fact that they are basophilic separates them from the Golgi bodies and mitochondria with which they are associated. The granulosa are responsible for yolk production and may function as phagocytes during resorption (Hoar, 1957). There is much disagreement as to the process of yolk production, but it appears that the granulosa bodies are converted to yolk substance, beginning near the nucleus and progressing toward the periphery of the cell. Associated with the granulosa but mainly around the periphery of the cell are large oil globules, which, like the yolk, are stored food.

In summary, the ovary of the threadfin shad was found to have a wide range in sizes of developing eggs. Throughout the summer months females having enlarged ovaries were found; although unripe, it appeared possible for such ovaries to mature within a short period of time. The variety of developmental stages within a single ovary suggests the possibility of a single female spawning over an extended period of time. In the maturing follicles the follicular epithelium, chorion, vitelline membrane, and zona radiata were observed. Internal to the membranes granulosa, oil globules, nuclei and nucleoli were present.

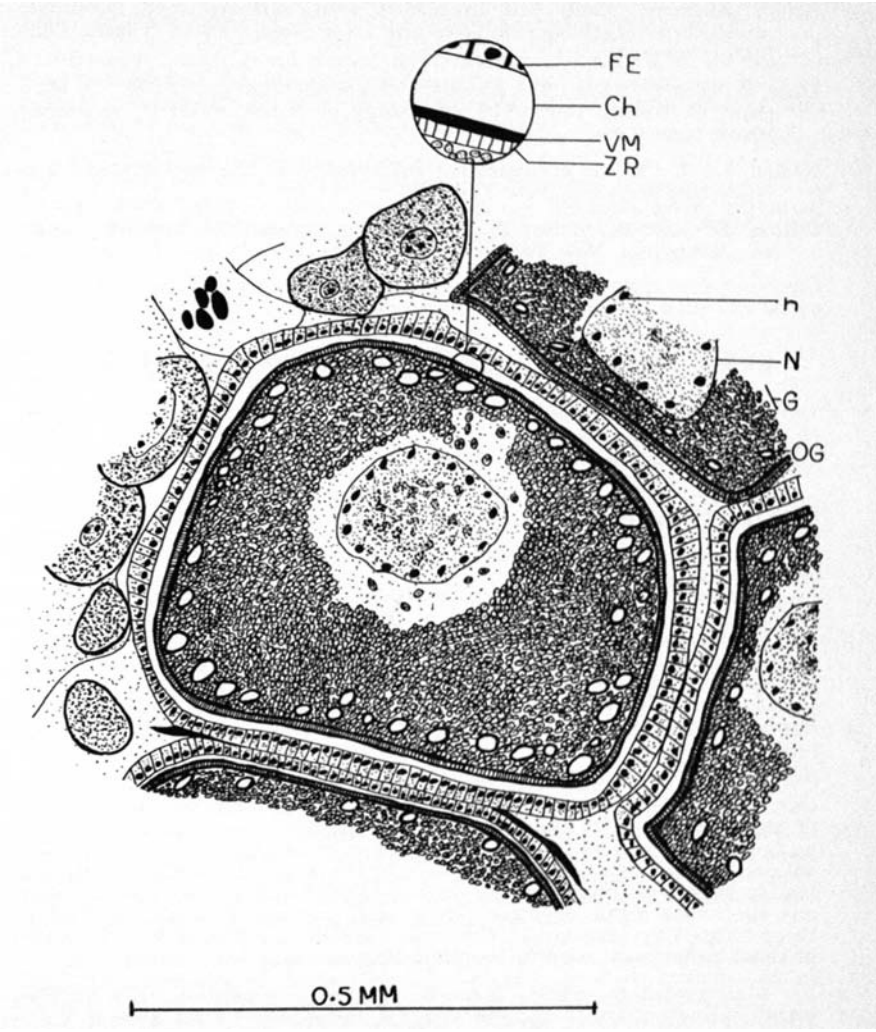

Figure 2. Maturing egg follicle from *Dorosoma petenense* 6.1 inches in total length, taken in late June.

FE—follicular epithelium
Ch —chorion
VM—vitelline membrane
ZR —zona radiata
n —nucleolus
N —nucleus
G —granulosa
OG—oil globule

LITERATURE CITED

Bodola, Anthony. 1956. The life history of the Gizzard Shad, *Dorosoma cepedianum* (LeSueur) in Western Lake Erie. Ph.D. Thesis, Ohio State University.

Hoar, William S. 1957. The gonads and reproduction, p. 287-323. In Margaret E. Brown, [ed.], The physiology of fishes. Vol. I. Academic Press, New York.

Nelson, O. E. 1953. Comparative embryology of the vertebrates. McGraw-Hill Book Co., New York.

Wilson, Edmund B. 1926. The cell in development and heredity. Third ed., Macmillan, New York.