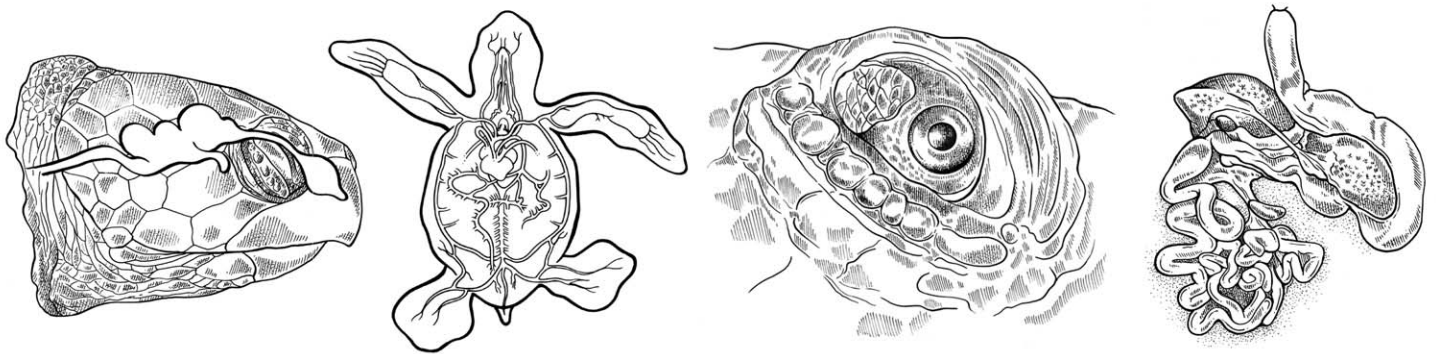
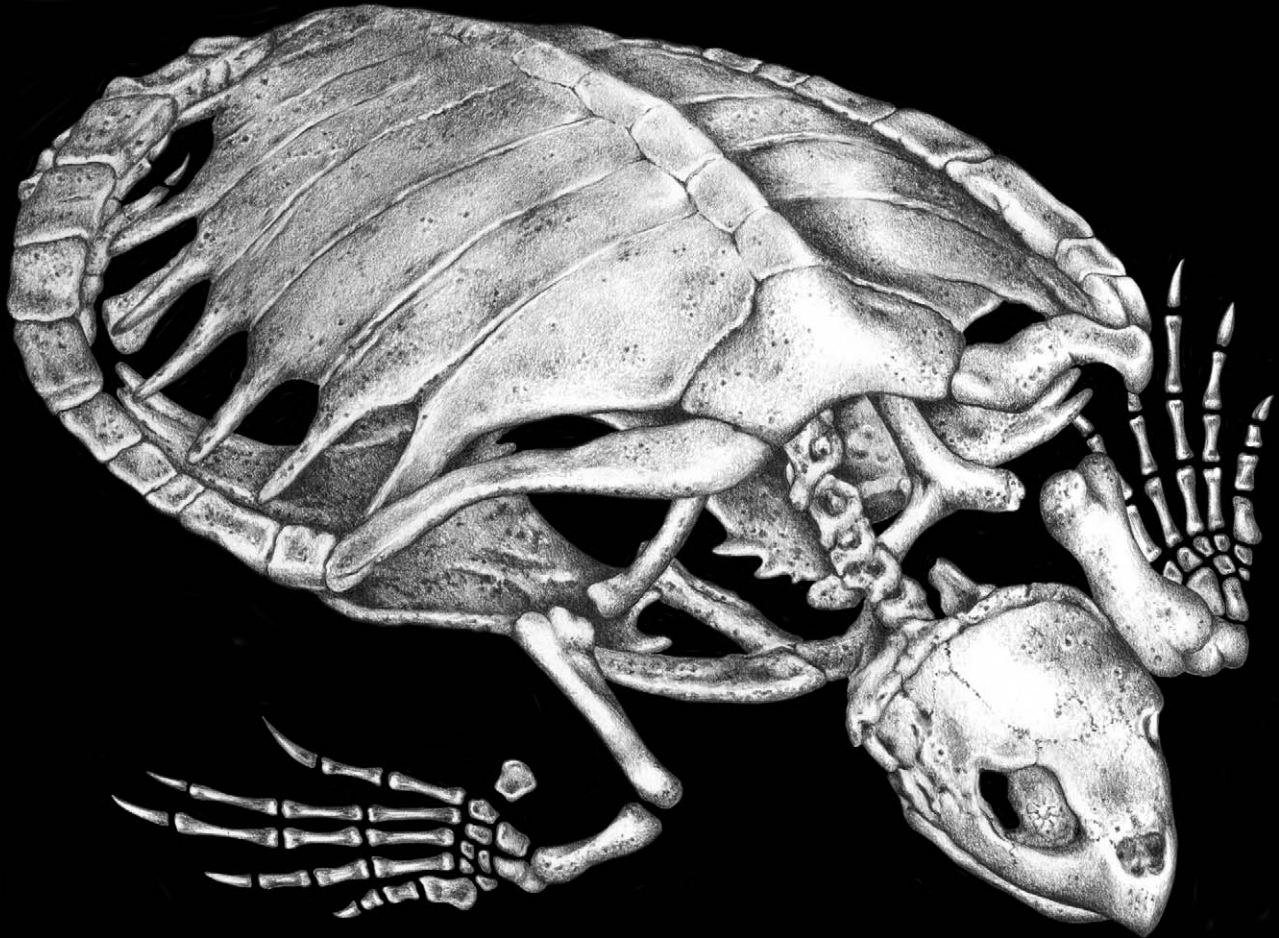


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# The Anatomy of Sea Turtles



**Jeanette Wyneken, Ph.D.**

Illustrated by Dawn Witherington

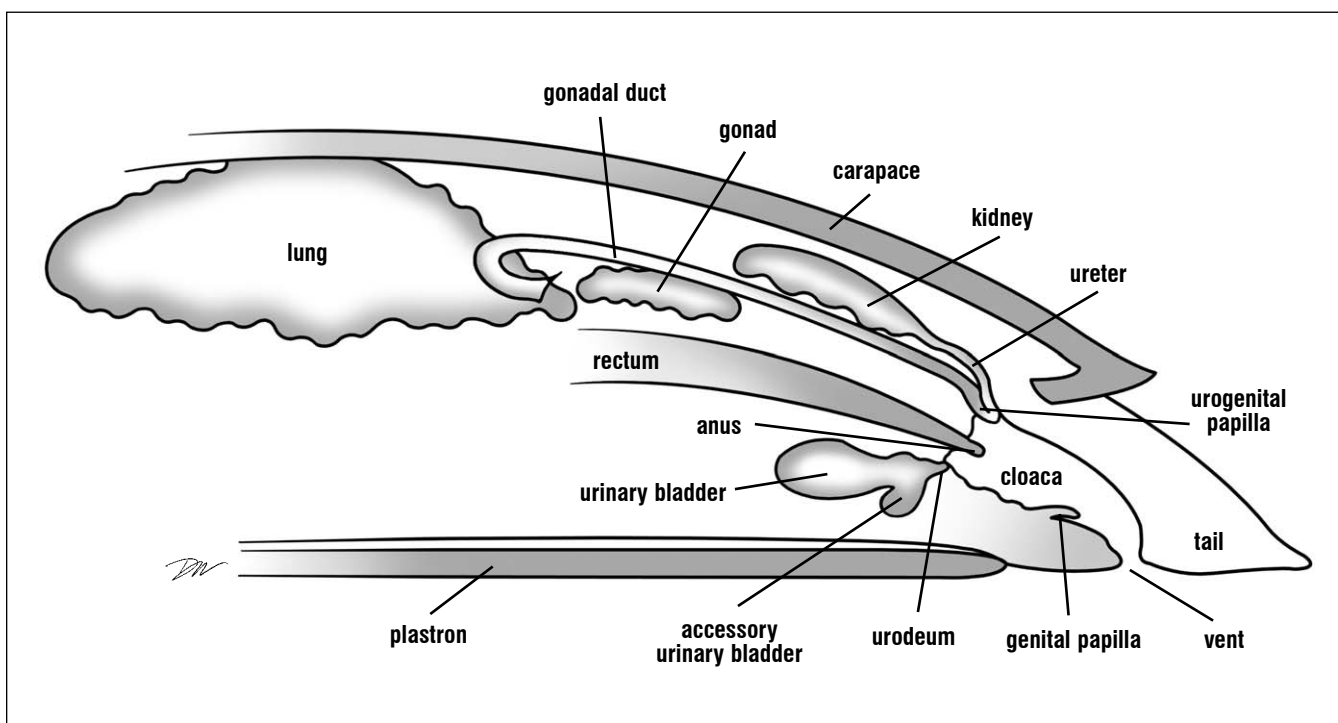
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## UROGENITAL SYSTEM

### Urogenital Anatomy

The **urogenital system** (UG) is made up of the **kidneys**, **ureters**, **gonads** and their ducts, the **urinary bladder**, and derivatives of the **genital papilla** (penis or clitoris) in the floor of the cloaca. The kidneys function in removal of nitrogenous wastes (excretion) and maintaining water and electrolyte balance (osmoregulation). The ureters transport nitrogenous wastes to the cloaca where it either drains into the urinary bladder or is eliminated. The gonads (**ovaries** or **testes**) produce gametes and their ducts

**Excretory System.** The kidneys are paired, lobular, elliptical red structures that are located retroperitoneally (between the peritoneum and the shell). Sea turtle kidneys are **metanephric**, meaning (1) they arise from the posterior part of the nephric ridge in the embryo and (2) the kidney tubules are drained by ureters (metanephric ducts). The ureters extend from the kidney, through the peritoneum and empty into the dorsal cloaca on each side. Ureters are located on the ventral



**Fig. 219.** Diagram of the Urogenital System. The relative positions of the kidneys, gonads (undifferentiated for diagrammatic purposes),

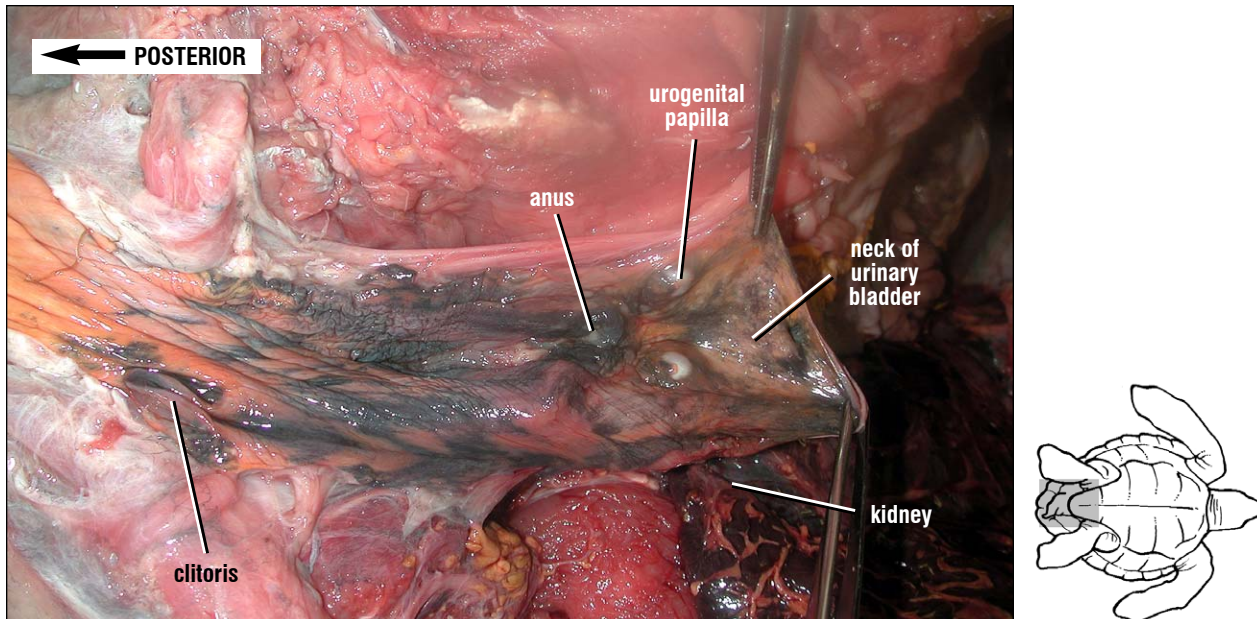
accessory ducts, urinary bladder, rectum and cloaca are shown. Anterior is to the left.

transmit eggs or sperm to the cloaca. They are reproductive structures. The urinary bladder functions in water and urine storage. The cloaca is the common chamber into which the ureters, gonadal ducts, rectum, and bladder empty. The cloaca leads to the outside of the body via the vent.

surface of each kidney. They drain uric acid, ammonia, and water to the cloaca. Each ureter enters the cloaca with a gonadal duct via a **urogenital papilla** in the **urodeum** portion of the cloaca (Figs. 219 - 220).



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**Fig. 220.** Lateral view of the cloaca of an immature hawksbill. The lateral wall of the cloaca has been cut away to show the urogenital papillae from the oviducts and ureters, the opening to the urinary bladder, and the dorsally positioned anus from the rectum. The urinary and genital ducts enter the cloaca adjacent to one another in females. They are small and located as the lateral walls of the urogenital papillae.

The kidneys of sea turtles lack a distinct **cortex** and **medulla**. Sea turtle nephrons are composed of a **renal capsule**, **proximal tubule** (which is linked to water transport and protein synthesis), an **intermediate segment** (function unknown), **distal convoluted tubule** (responsible for fluid reabsorption) and **collecting tubule** (draining to the ureters). There is no loop of Henle as is found in mammalian nephrons. Unlike higher vertebrates, marine turtles retain the ability to form new functional nephrons as they mature (and perhaps throughout life).

Blood flows through the kidneys from afferent vessels entering (renal arteries and iliac veins), and efferent vessels leaving (renal portal and renal veins) the kidneys. Water and mineral waste (a filtrate) is removed from the blood at the renal corpuscle (glomerulus plus renal capsule).

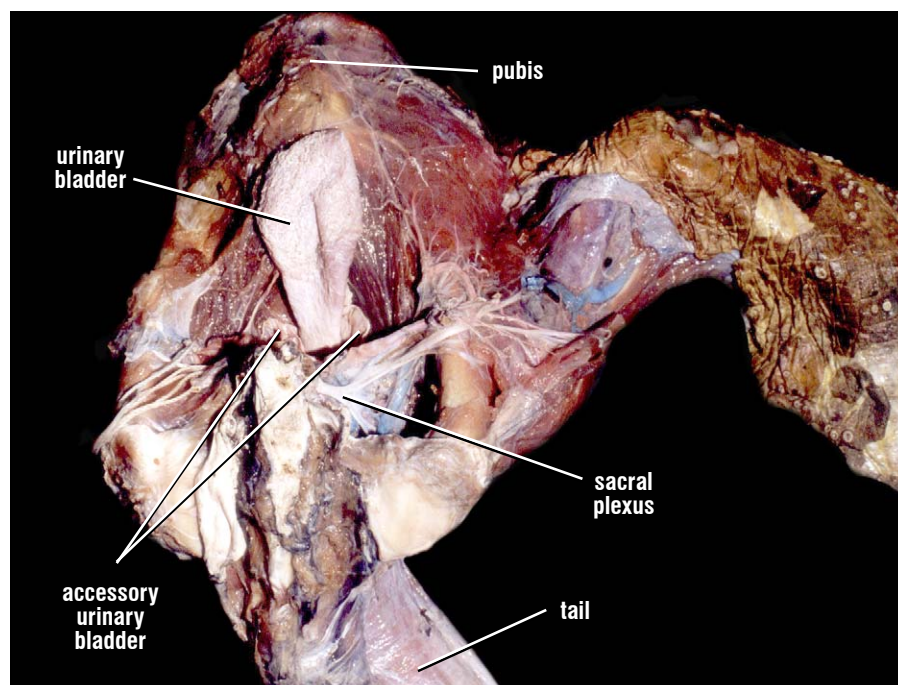
The urinary bladder is a highly elastic, single,

sack-like structure located along the midline of the pelvis. It opens via a single opening to the ventral floor of the cloaca (Figs. 219-221). The bladder is located ventrally and urine, water, and sometimes other waste products may enter it via the cloaca. This anatomical position and the connection of the cloaca to the outside sometimes allows materials other than urine (e.g., fecal material, parasites, or, in females, eggs) to enter opportunistically.

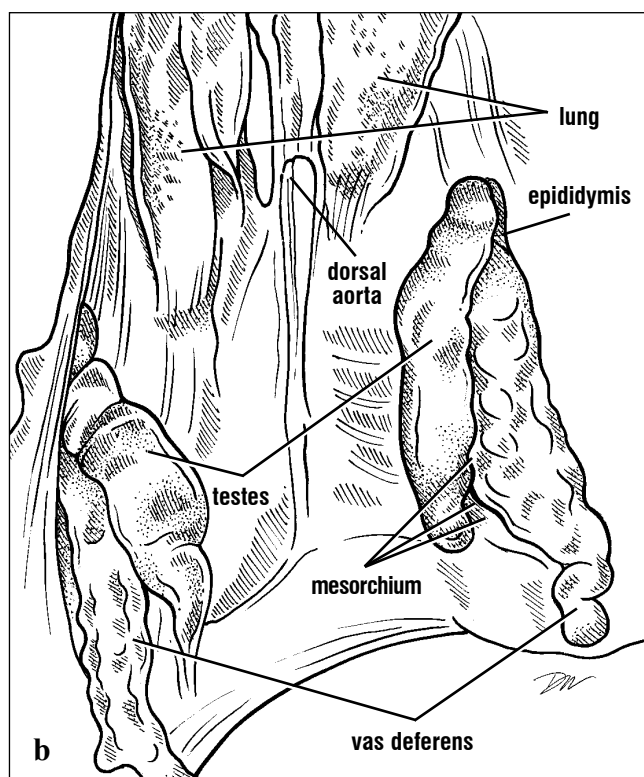
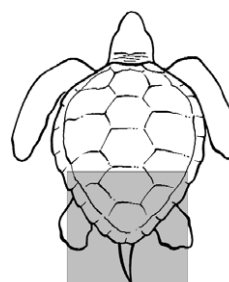
Sea turtles have two small **accessory urinary bladders** connected to the urinary bladder; each located lateral to the neck of the urinary bladder and dorsal to the pubis (Fig. 221). They are seldom filled and often are missed in dissections.

**Gonads.** The gonads of both species are located dorsally in the body cavity, posterior to the lungs, and ventral to the kidneys and peritoneal wall (Figs. 222 and 223).

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**Fig. 221.** Dorsal view of the urinary bladder and dorsal pelvis of a male loggerhead. The empty urinary bladder and accessory bladders are shown free of connective tissues. The ilia are found laterally; the sacral and proximal caudal vertebrae are present dorsally. The sacral plexus is exposed in part.

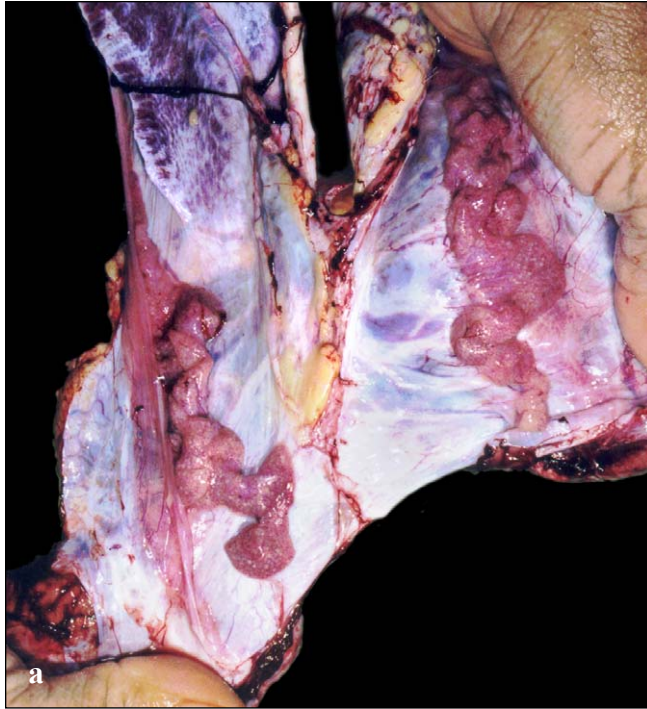


**Figs. 222a and 222b.** Testes of an immature green turtle. The testes are attached to the peritoneal wall by their flat dorsal surface. Lateral and slightly

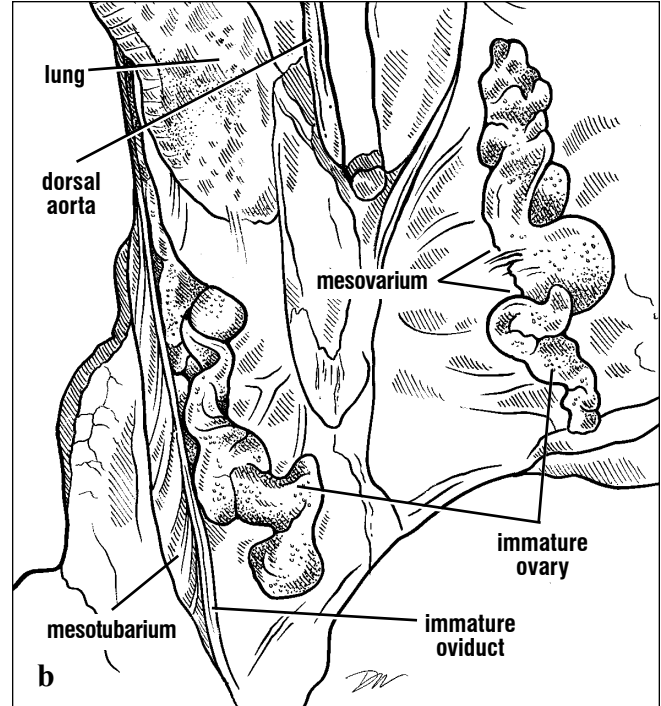
dorsal to each testes is an epididymis, which leads to a vas deferens. The surface of the testis is smooth in immature turtles.



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**Figs. 223a and 223b.** Ovaries of an immature green turtle. The ovaries are attached to the peritoneal wall by their lateral edges. The surface



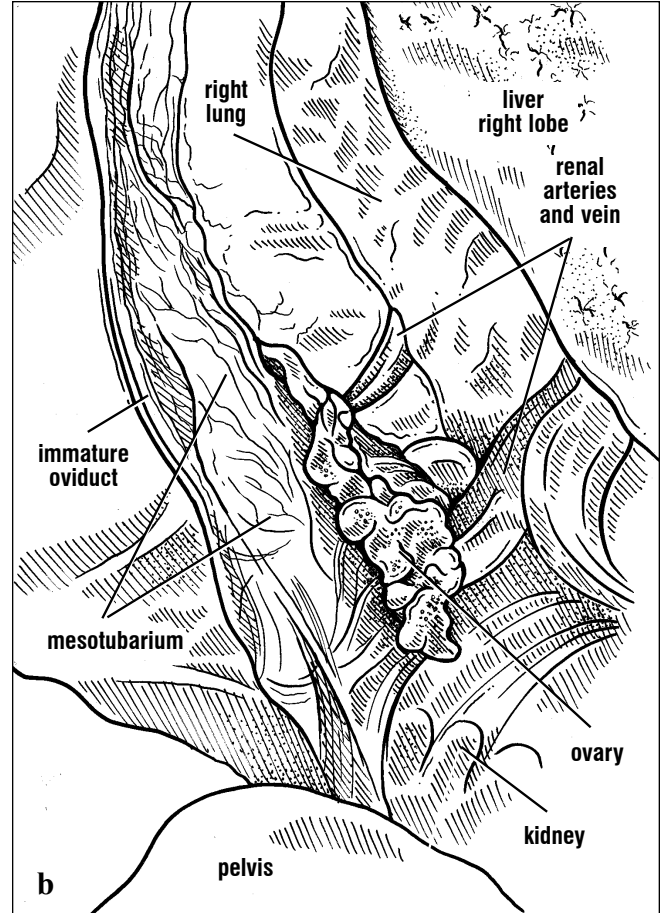
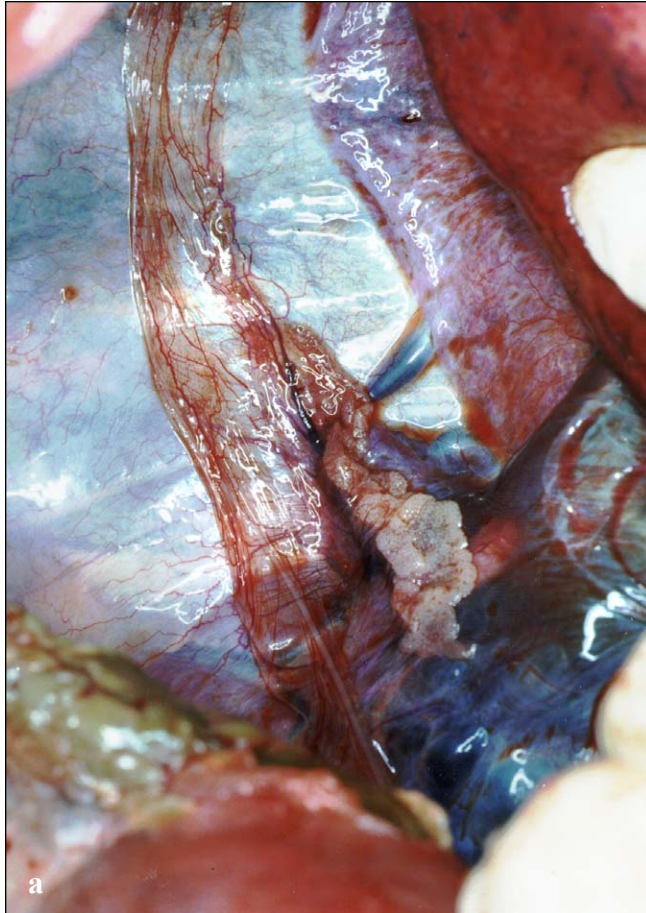
of the ovary is granular. Lateral to the ovary is the immature oviduct, which is suspended by the mesotubarium.

**Female:** The female reproductive tract consists of paired ovaries, oviducts (also called **Müllerian ducts**), and the suspensory ligaments or mesenteries (**mesovarium**, **mesosalpinx**, and **mesotubarium**). The ovary and oviduct change in size and composition with age and between breeding and nonbreeding seasons.

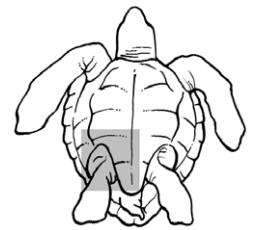
The cranial pole of the ovary is located just posterior to the lung and extends posteromedially toward the cloaca. Along its medial and dorsal

surface, it is attached by the mesovarium to the peritoneum that overlies the kidney (Fig. 224). Another ligament, the mesotubarium, extends from the ovary to the oviduct. The oviduct lies lateral to the ovary and extends anteriorly, before curving medially and ending in a funnel shaped opening, the ostium. The ostium, which receives ovulated follicles, is supported by the mesosalpinx. There are no tubules connecting the ovary directly to the oviduct. The posterior end of each oviduct joins the urodeum of the cloaca (Fig. 225).

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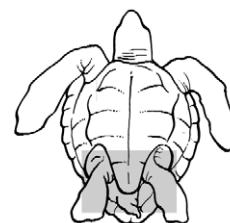
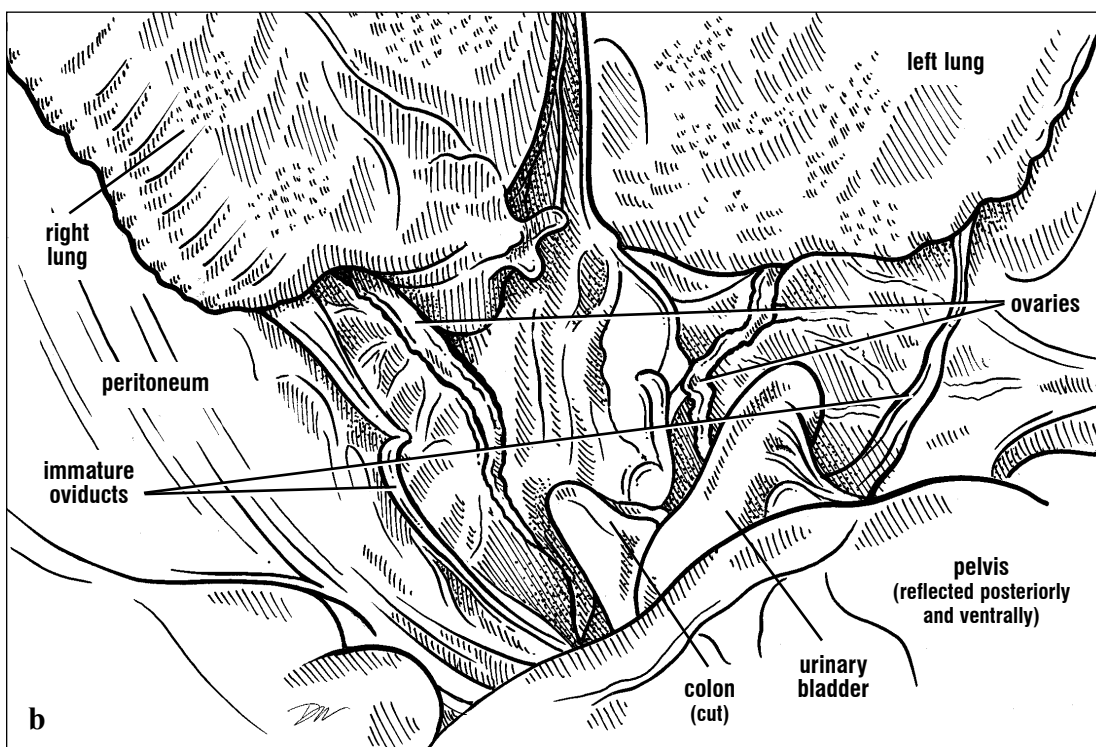


**Figs. 224a and 224b.** Ovary and accessory ducts of a juvenile green turtle, (ventral view). This immature ovary has a granular surface. Its follicles have not yet added significant amounts of yolk. The immature oviduct is a thin, flat tube supported in the mesentery (mesotubarium). Engorged renal arteries and veins can be seen extending from the kidney, anatomically dorsal to the ovary, and toward the midline.





## UROGENITAL SYSTEM

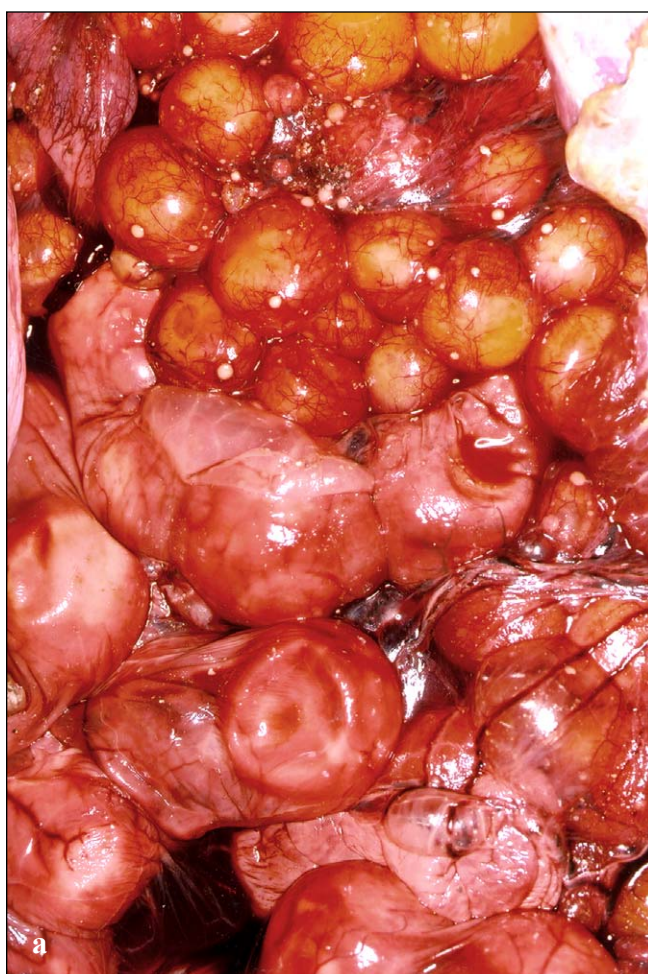


**Figs. 225a and 225b.** Immature ovary and oviduct (ventral view). The immature ovary is thin and located more medially than the oviduct. The immature oviduct extends anteriorly then turns posteriorly. The ostium is formed at the expanded end. The oviduct, mesotubarium, and mesosalpinx are reflected laterally.

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In hatchlings, the ovaries are difficult to distinguish from testes. If histology is unavailable, the attachment of the mesovarium to the ovary edge and the lack of a coiled vas deferens suggest that the gonad is an ovary. In older turtles, the gonad will be pink and will have a grainy texture as small follicles become more distinct. As turtles approach maturity, some follicles increase in size and start to accumulate bright yellow yolk. In sexually mature turtles, mature follicles tend to cluster along the cranial aspect of the ovaries. Immature follicles are most concentrated in the

posterior third of the ovary. Mature turtles that have nested previously will have large follicles that are ~2-3cm in diameter and scars from previously ovulated follicles, **corpora albicans** (Fig. 226). Recently ovulated follicles leave active scars, each is called a **corpus luteum**. The corpus luteum becomes a corpus albicans after it ceases to produce the hormone progesterone. The ages of corpora albicans are difficult to judge, however larger ones are generally more recent than smaller ones. It is safest to use this information simply to determine if the turtle had nested previously or not.



**Figs. 226a and 226b.** Eggs, follicles, and corpora albicans in a reproductively active loggerhead. This oviduct holds shelled eggs. Above the oviduct

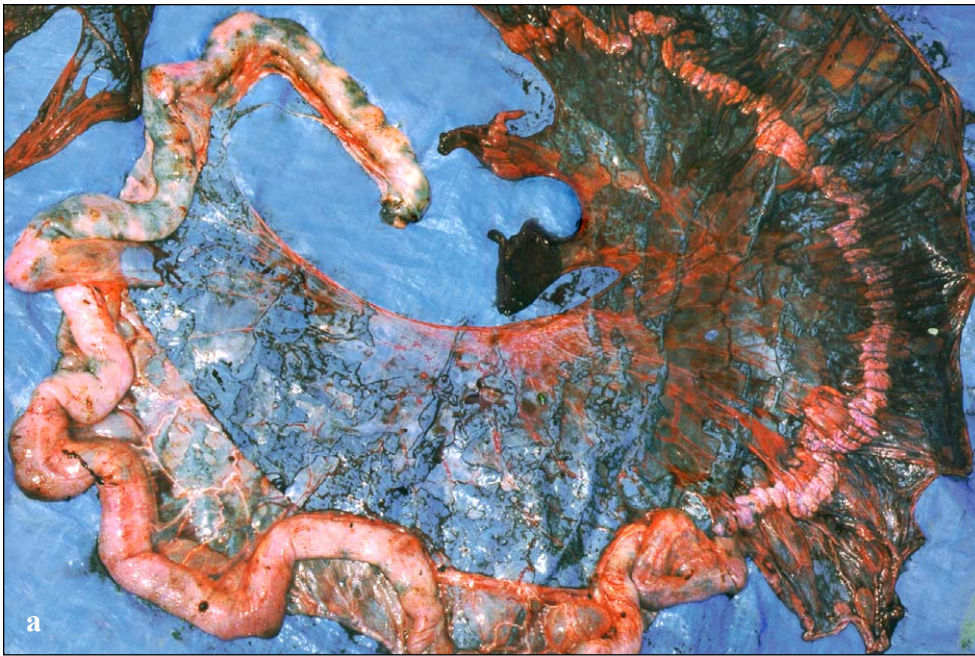
are several sizes of maturing follicles and the scars (corpora albicans) remaining from the sites of ovulated follicles.



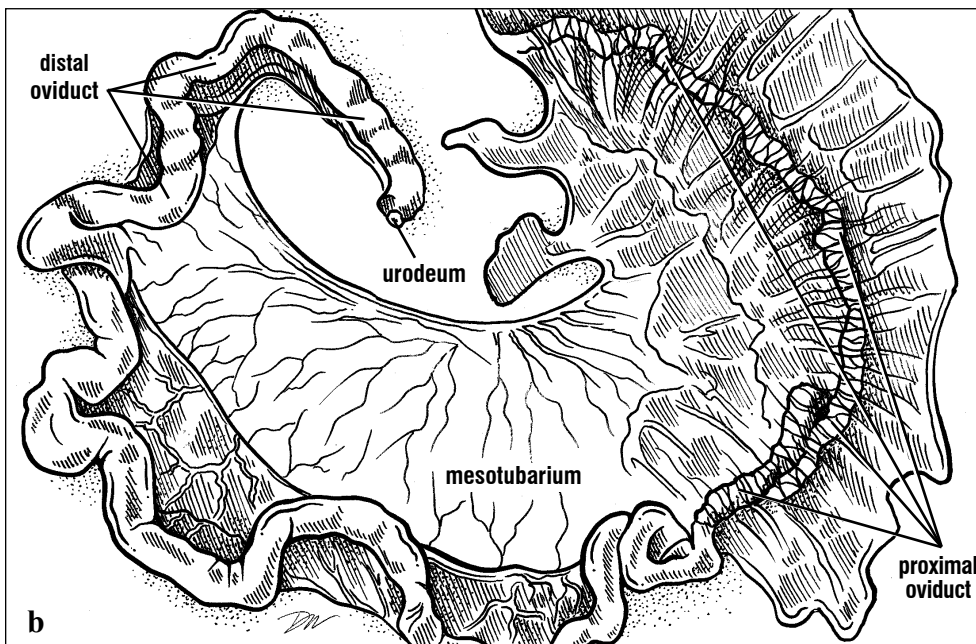
## UROGENITAL SYSTEM

The oviduct of immature turtles is a thin walled tube (Figs. 224-225). As females mature, the walls of the oviduct thicken and the lumen increases in diameter. It appears folded along its length when not active (Fig. 227). The oviduct can be described functionally (but not in gross structure) as having 5 regions: the ostium (or infundibulum), aglandular

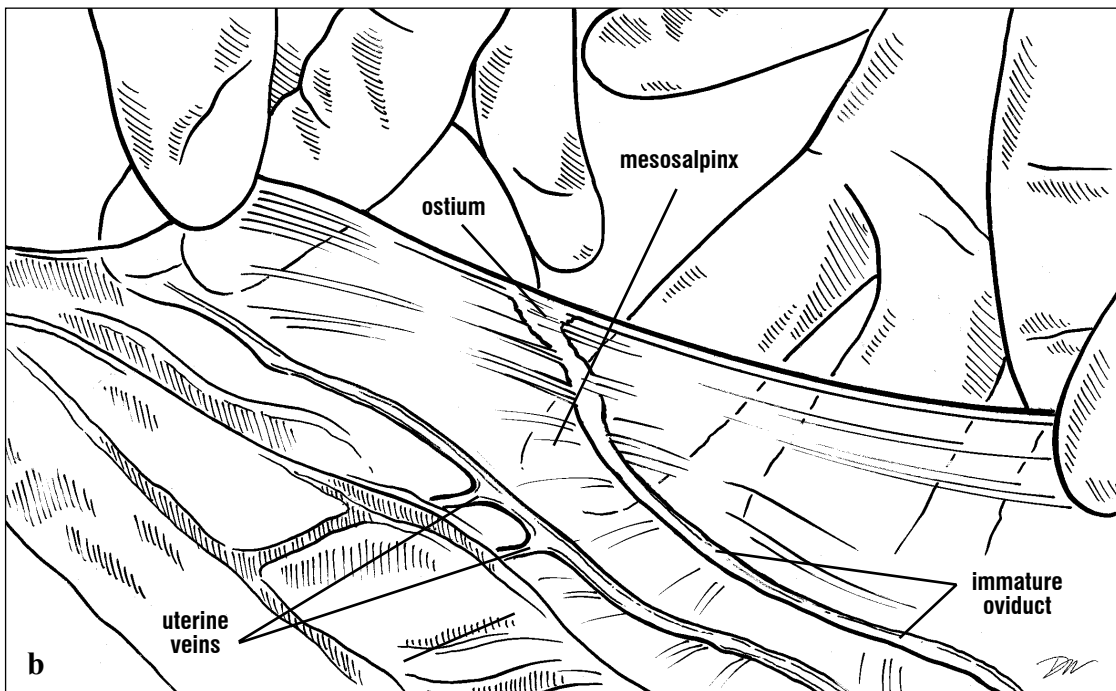
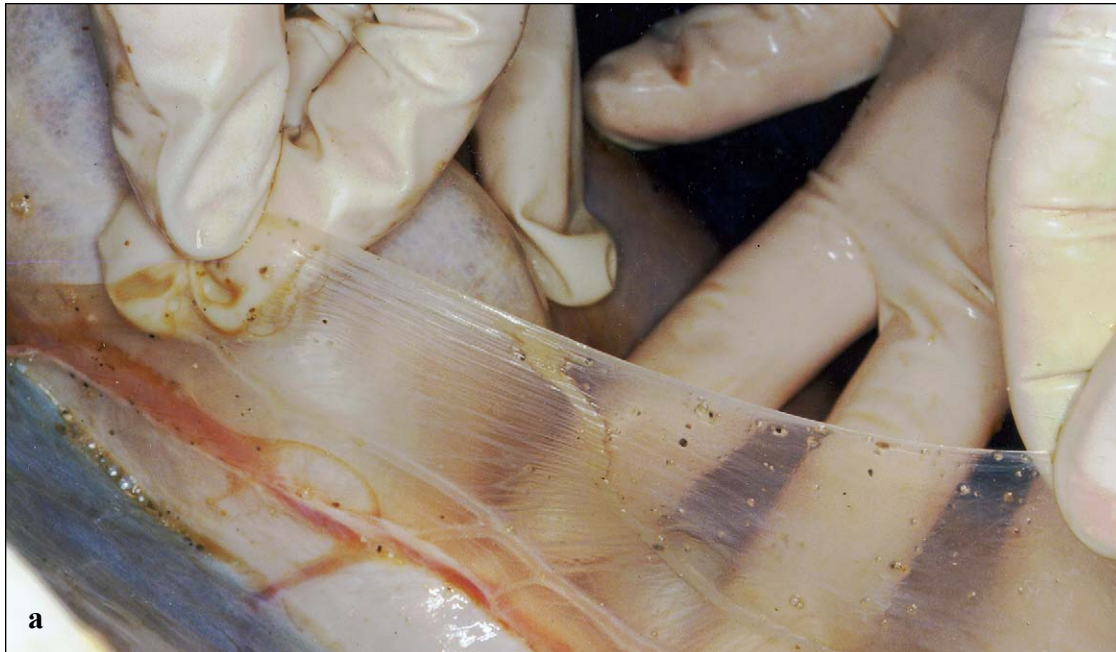
segment, magnum, shell gland, and vagina. The ostium remains thin-walled but increases in size (Figs. 228-229). The oviduct of mature females is muscular and mobile. It is assumed that the ostium migrates across the ovary surface collecting the ovulated follicles.



**Figs. 227a and 227b.** Mature oviduct of a leatherback. The mature oviduct has a large lumen and the walls have undulatory folds. The mesosalpinx and mesotubarium enlarge to accommodate the mature structures. The distal ends would normally enter the cloaca. The proximal end is the site of the ostium.



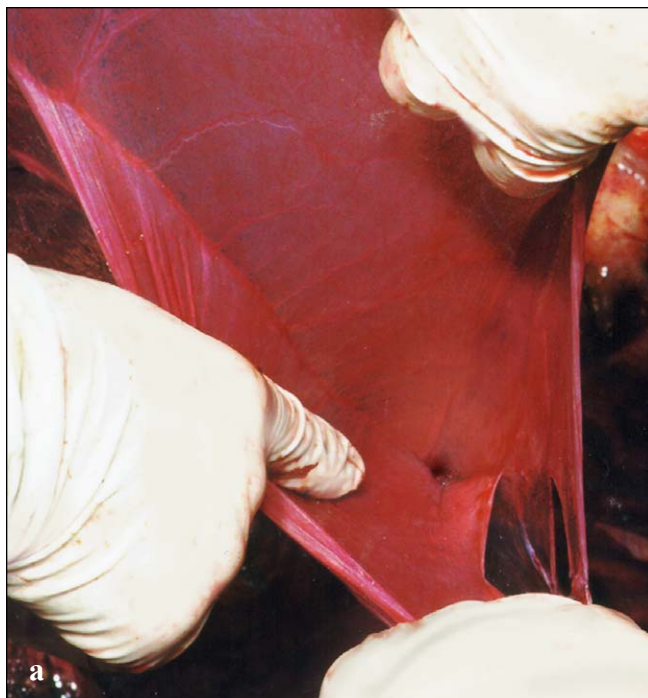
## UROGENITAL SYSTEM



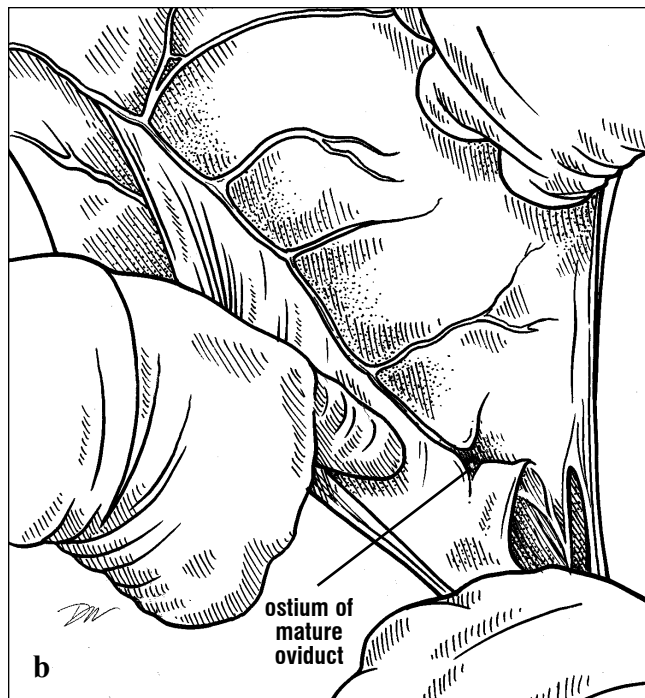
**Figs. 228a and 228b.** The ostium of an immature oviduct. The ostium is flattened when not active; the funnel-shaped opening is small in young turtles.



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**Figs. 229a and 229b.** The ostium of a mature oviduct. The ostium of this leatherback's oviduct is large, funnel-shaped and thin walled. The base



of the ostium opens into the aglandular part of the proximal oviduct.

In preparation for nesting, an entire clutch of follicles matures and ovulates together. Once in the ostium, each follicle travels past the aglandular segment and into the magnum (anterior glandular region) where it is coated with layers of albumen. After about 3 days, the follicles pass to the shell gland where the protein and carbohydrate shell membrane (chorion) and the aragonite shell matrix are secreted. The shell calcification takes about 6 to 7 days. Eggs pass to the vagina where they remain until deposition, several days later. During deposition, the posterior oviduct allows eggs to pass to the cloaca, then out the vent into the nest. The cloaca forms a tubular orifice in nesting turtles. The structures that form this "egg tube" are unknown.

**Males:** The male reproductive tract consists of paired **testes**, **epididymi**, **deferent ducts** (vas deferens = ductus deferens), suspensory ligaments (**mesorchium** from the body wall to the testis), and a single **penis**. Müllerian ducts may persist as

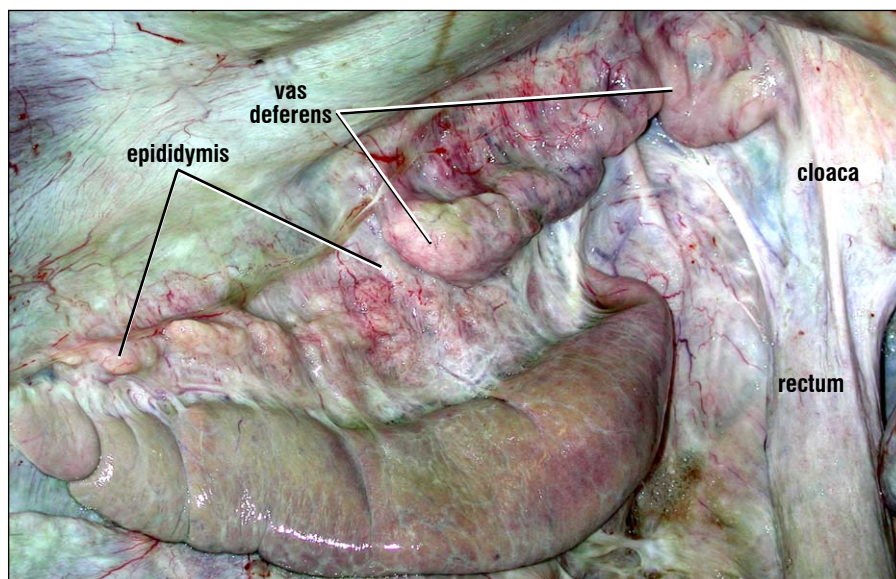
a pair of small, flat, thin-walled tubes in some males. When present, they are located along the lateral body wall (suspended by a mesotubarium) from the duct to the testis or peritoneum overlying the kidney. They will often extend toward the anterior third of the body, lateral to the lung.

The testis is fusiform shaped (Fig. 222). The cranial pole is located just posterior to the lung; it extends posteromedially toward the cloaca. Along its dorsal surface, it is attached by the mesorchium to the peritoneum overlying the kidney. The testis is light tan or yellow in some species and gray to pink in others. Sperm are produced in the testis and are conveyed via very small efferent ductules to the epididymis, which lies lateral or posterolateral to the testis. The vas deferens leads from the epididymis to the cloaca at the base of the penis, demarked by the **corpra cavernosum** (Fig. 222). The testis, epididymis, and vas deferens change in size and form with age and between

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breeding and nonbreeding seasons (Fig. 230). Testes in mature breeding males are often twice as long as their diameter and filled with white fluid (sperm and accessory gland fluid).

spermaticus; Fig. 231). During mating, the corpora cavernosa are supplied with blood via the hypogastric and internal iliac veins. When erect, the walls of the urethral groove meet dorsally to

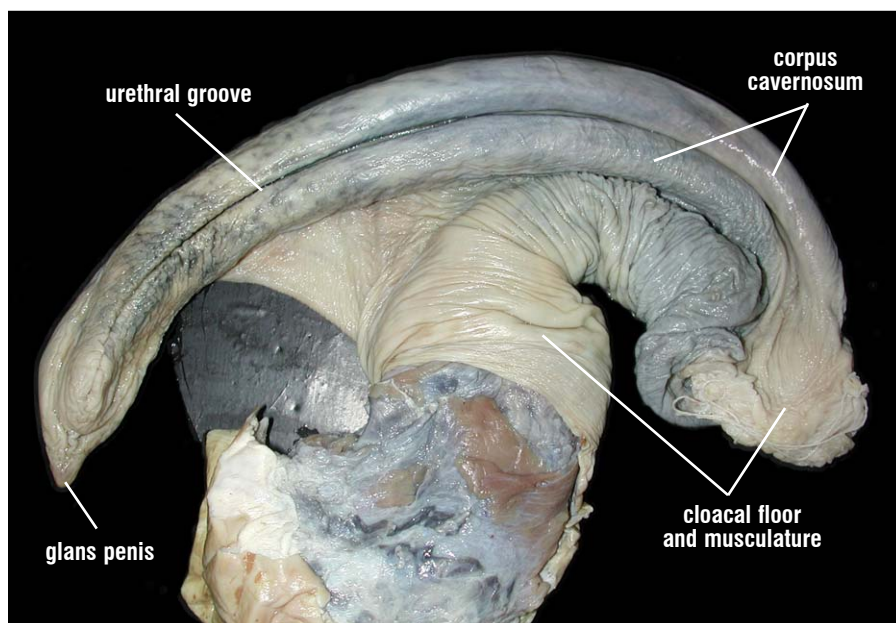


**Fig. 230.** Mature loggerhead testis and accessory ducts (posteroventral view). The testes, epididymis, and vas deferens in a mature male during breeding season. The vas deferens lead to the base of the penis in the ventral floor of the cloaca.



The genital papilla elongates into the penis during maturation. The penis is retracted except during mating, trauma, or death; it lies in the ventral floor of the cloaca. It is composed of a pair of **corpora cavernosa** and a "urethral groove" (= sulcus

form a functional tube through which sperm and fluids pass. Some species have ornamented structures (e.g., spines or flaps that have a triradiate form) on or near the glans penis at the distal tip (Fig. 232).



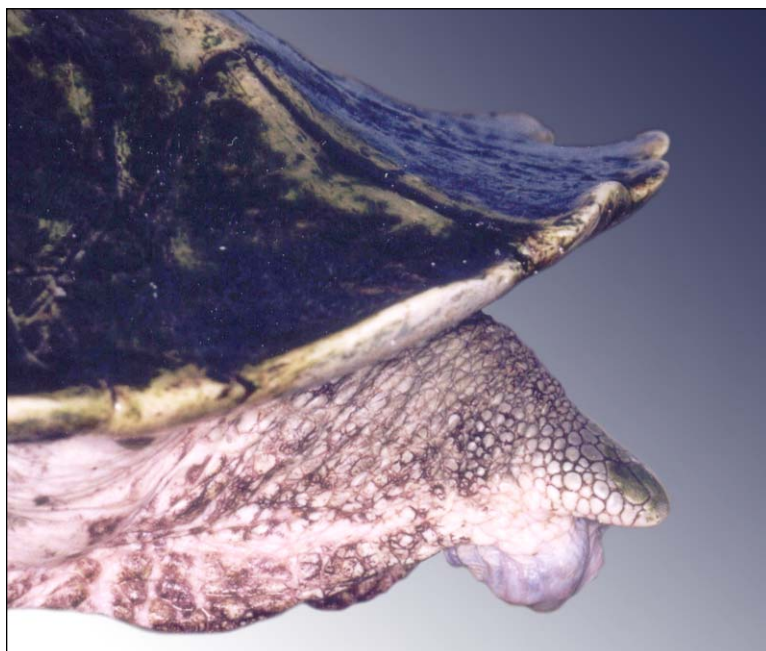
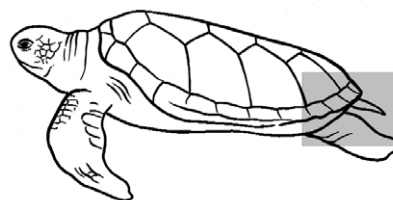
**Fig. 231.** Adult loggerhead penis (dorsal view). The marine turtle penis is part of the ventral floor of the cloaca. The two corpora cavernosa function in penile erection and elongation. The urethral groove, between the two cavernous bodies conveys sperm during mating. The penis is completely housed within the cloaca when not erect.



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**Fig. 232.** Tail and penis of a Kemp's ridley. The long tail and distally positioned vent are distinctive of adult male turtles. This animal has a semi-erect penis with a subterminal horn on the ventral lobe of the glans penis. Not all species have ornaments on the penis. Generally, maturing males have a more distally positioned vent than a female of the same body size. However, not all males start maturation at the same size, so the combination of tail length and cloacal position should be used with caution when identifying the sex of the turtle.



**Fig. 233.** Tail of an adult female Kemp's ridley. The short tail and cloaca located proximally are characteristic of females and immature males. This female protruded the cloacal opening as is seen in nesting turtles.

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**Sexual dimorphism.** Adult females differ little in external morphology from large, immature males. Typically, females have a short tail and the cloacal opening (**vent**) is located roughly half way between the tip of the tail and the plastron's anal scute (Fig. 232). Within the cloaca, the genital papilla remains small as the clitoris on the floor of the cloaca. (Fig. 219).

In the Western North Atlantic, female loggerheads mature at an average SCL of 92 cm (range: 75-104 cm). Green turtle females mature and nest at an average SCL of 97 cm (range: 83-113 cm) and leatherback females are about 155 cm CCL (very

few nesting females have been measured on U.S. beaches). The minimum size of a nesting female leatherback in the USVI was 133 cm CCL.

Adult males are characterized by a long tail with the cloacal opening near the tip, and strongly curved claws on the second digit. During breeding season, a decornification of the plastron occurs along and to each side of the midline (Fig. 233). The plastron becomes increasingly vascular and edematous. Male leatherbacks, have slightly concave plastrons. There is no evidence of decornification or increased plastral vascularization during leatherback breeding season.



**Fig. 234.** Sexually mature male ridley. Male sexually dimorphic characteristics include an elongated tail, long curved claws, and, during breeding season, the midventral plastron becomes soft.