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SEA TURTLE REPRODUCTIVE CHRONOLOGY: THE MODEL AND THE QUESTIONS

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Because sea turtles deposit multiple clutches in a nesting season and because they often skip one to several years between nesting migrations, the chronological relationship between mating, fertilization of ova and nesting has been an interesting question. Carr and Hirth (1962) saw female Chelonia mydas being mounted as they returned to the water after nesting. On the other hand, in the same species Booth and Peters (1972), Bustard (1972) and Ulrich and Owens (1974) observed functional mating only prior to nesting. In separate reviews Frazier (1971), Ehrhart (1982) and Owens (1980) each concluded that the bulk of the observational data available supported the idea that mating occurred during a distinct receptive period prior to nesting. At Cayman Turtle Farm, female C. mydas are now well documented to enter a receptive period of a few days about 30 days prior to the first nest (Wood and Wood 1980, Comuzzie 1987). Rostal (unpublished data) has made similar observations in a captive colony of Lepidochelys kempi.

The work of Licht and our group has also provided an increasingly more refined understanding of the endocrine and reproductive events in the production of the several clutches of eggs. The following "Model" is presented as an approximation of the chronological events as we now interpret them.

- A. After suitable gametogenesis on the feeding ground, a distinctive testosterone peak is correlated with migration away from the feeding ground in both sexes.
- B. Either during the migration or near the nesting grounds a female enters her receptive period in which one or more males mates her for up to several hours each.
- C. During the following week or more the sperm move up the very long oviducts (4.5 m or longer) and lodge in albumin glands where they are stored to fertilize each subsequent ovulation of the season (see Solomon and Baird 1979, Gist and Jones 1987).
- D. Luteinizing Hormone and progesterone surge dramatically, resulting in a very rapid ovulation from both ovaries. In only 24-36 hours the follicles are expelled from the ovaries, fertilized (presumably in the infundibulum of the oviduct), the albumin coat is secreted in the mid oviduct, the protein membranes are deposited on top of the albumin and the eggs are transported to the base of the oviduct where calcium secretion occurs.
- E. Calcium secretion appears to be the rate limiting step, requiring about 10 days for completion of the eggs (note exceptions below).
- F. During the calcification phase, final growth of the next largest set of follicles has occurred in the ovaries.
- G. Within a few hours after oviposition of the clutch, the next ovulation surge occurs to refill the oviducts. Stored sperm fertilize the follicles as they enter the oviducts and the egg cycle is repeated until the ovaries are exhausted of large sets of follicles. With each ovulation there are a few mature follicles which do not ovulate. These become the characteristic dark colored atretic follicles which are slowly reabsorbed.

Two obvious exceptions to this pattern occur. First, in Dermochelys the egg cycle is faster, with calcification apparently taking only 5-7 days. Second, in the Lepidochelys species, the eggs are prepared at the same speed as the other genera, however the females may retain the eggs in the base of the oviduct to wait for the behavioral cues involved in the arribada. Even though the eggs may be in the oviducts much longer than in other species, they do not appear to experience extra calcification. The Lepidochelys females appear to move quickly through the egg cycle so that their next clutch will be ready whether the arribada is sooner (14 days) or later (30-40 days).

Questions: Harry and Briscoe (1988) used isozyme electrophoresis to describe multiple genotypic ratios within clutches from Caretta females. This seems to be strong evidence for multiple paternity within a season for an individual female. On the other hand, they also suggest that mating may have taken place after nesting in Caretta since the ratios changed in subsequent clutches from the same female. We believe a more reasonable explanation may be that all mating occurred prior to the first clutch, but sperm from different males may not be equally available during each sequential ovulation. Thus the different males would have variable percentages of fertilizations in each clutch depending on where their sperm were stored in the oviduct.

Alvarado and Figueroa (1988) have recently published a very interesting study of the black turtles (Chelonia agassizi) in Michoacan, Mexico. They report several lines of evidence that mating in this species may occur either before or after nesting. Several individuals which were tagged while nesting were later captured while mating, nesting females have fresh claw scars on their carapaces throughout the nesting season and males are generally much more obvious late in the nesting season than at C. mydas nesting areas. Since these observations do not appear to fit the above "Model", two suggested explanations come to mind. First, it is possible that the reproductive chronology of C. agassizi is strikingly different from other sea turtles. Second, an unusually skewed sex ratio dominated by males may give the impression of altered mating patterns when actual effective mating is still as suggested in the model. Regardless of what is happening, this population represents an unusually interesting situation which should be carefully evaluated.

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