



Rathke's Gland Secretion by Loggerhead (*Caretta caretta*) and Kemp's Ridley (*Lepidochelys kemp*) Sea Turtles

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RATHKE'S GLAND SECRETION BY LOGGERHEAD (*CARETTA CARETTA*) AND KEMP'S RIDLEY (*LEPIDOCHELYS KEMPI*) SEA TURTLES.—Many aquatic turtles possess paired exocrine organs called Rathke's glands that open through pores in the axillary, inframarginal, and/or inguinal regions (Waagen,

1972; Ehrenfeld and Ehrenfeld, 1973). Predator repulsion, intraspecific communication, and shell maintenance are among the functions discussed for Rathke's gland secretions (Ehrenfeld and Ehrenfeld, 1973; and others). Weldon and Tanner (1990) suggested that these glands excrete metabolites such as lactic acid, which was found in high concentrations in the exudates of hatchling loggerhead sea turtles (*Caretta caretta*). Other compounds, including lipids (Eisner et al., 1978; Weldon and Tanner, 1990; Weldon et al., 1990) and glycoproteins (Radhakrishna et al., 1989), have been characterized from the secretions of various species.

Rathke's gland fluids are reported to be released when turtles are injured or disturbed (Neill, 1948a; Goode, 1967), but little else is known of secretion discharge. We report here on two aspects of Rathke's gland secretion in marine turtles: (1) the volume of secretions released by hatchling *C. caretta* and Kemp's ridley (*Lepidochelys kempi*) sea turtles, along with estimates of the amounts of some secretion components discharged; and (2) possible evidence of glandular discharge by adult turtles in the form of clearings on the shell around the gland duct openings.

Methods.—*Caretta caretta* and *L. kempi* hatched in July 1987 from eggs collected at Clearwater, Florida, and Rancho Nuevo, Mexico, respectively. Turtles were maintained as described in Radhakrishna et al. (1989).

Hatchling *C. caretta* generally possess two Rathke's gland pores in the axillary/anterior inframarginal region and one in the inguinal region (Stromsten, 1917; cf. Waagen, 1972; Rainey, 1981; Fig. 1A). The two anterior pores receive secretions from one bilobed gland; the inguinal pore receives secretions from a separate gland (Stromsten, 1917). Hatchling *L. kempi* possess six Rathke's gland pores, five on the posterior margins of inframarginal scutes, and one in the inguinal region (cf. Waagen, 1972; Fig. 1B). Each pore in *L. kempi* receives secretions from a separate gland.

The volume of Rathke's gland fluids discharged in response to electrical stimulation was measured individually in 10 *C. caretta* and 10 *L. kempi*, 39- and 36-weeks old, respectively. Turtles were removed from their containers, and their shells were lightly wiped with a paper towel. Individuals discharging secretions after wiping were not used as subjects. An electrical probe (described in Radhakrishna et al., 1989) was

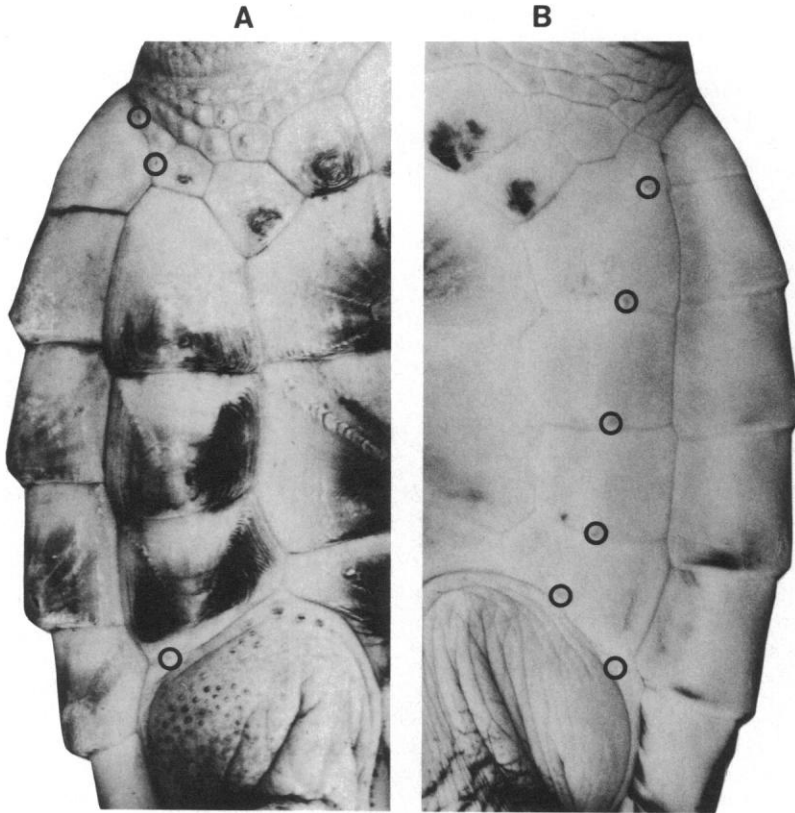


Fig. 1. (A) Unilateral ventral views of *C. caretta*; and (B) *L. kempfi* (both approx. 20 cm in carapace length). Circles mark the location of Rathke's gland orifices.

applied at repeated 2 sec intervals to skin in the axillary and inguinal regions. Stimulation was continued until fluid discharge ceased, whereupon the other region on the same side of the body was stimulated. The side of the body from which secretions were obtained and the region first stimulated were alternated with successive subjects. The pores from which secretions issued were noted.

Secretions from *C. caretta* were collected in a calibrated 0.8 ml glass vial with spout. The top of the vial was plugged by a cork pierced by a hollow needle, the outside end of which was attached to plastic tubing. Fluids were drawn into the vial by suction. Secretions from 10 *L. kempfi* were collected in a 1.3 ml vial with spout and were then drawn into a calibrated syringe for volume measurement.

Results and discussion.—The mean (\pm SE) volume of secretions collected from 10 *C. caretta* and 10 *L. kempfi* following unilateral axillary and

inguinal stimulation was $193.5 (\pm 24.0) \mu\text{l}$ and $283 (\pm 40.8) \mu\text{l}$, respectively. In *C. caretta*, fluids were released solely from the pore(s) in the region stimulated. Similarly, *L. kempfi* typically released fluids (sometimes tainted with blood) through three anterior pores in response to axillary stimulation and through three to four posterior pores with inguinal stimulation. These observations suggest that Rathke's glands may discharge selectively in response to proximal nociceptive cues.

Volume measurements of the Rathke's gland fluids allow estimates to be made of some secretion components discharged. Proteins occur in concentrations of 20 and 10 mg/ml in the secretions of *C. caretta* and *L. kempfi*, respectively (Radhakrishna et al., 1989). Our data indicate that the wholesale discharge of these paired organs could result in the release of approx. 6–8 mg of water-soluble macromolecules. Lactic acid was reported in a concentration of nearly 2.5 mg/ml in *L. kempfi* secretions (Weldon et al., 1990), and values nearly twice this amount have

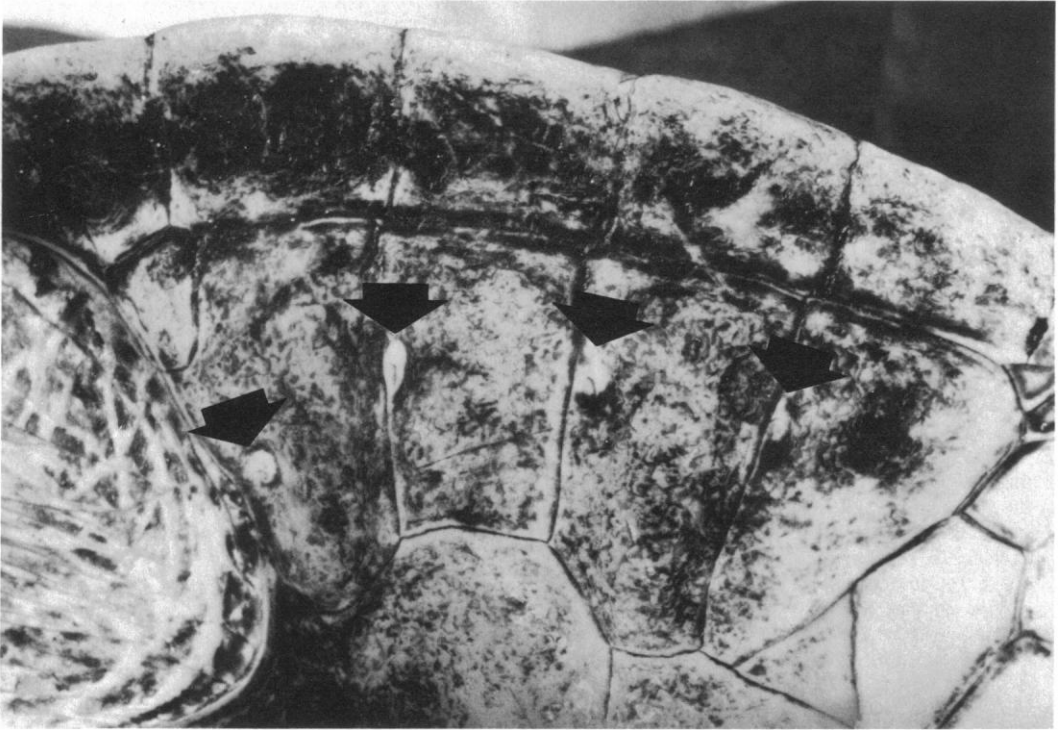


Fig. 2. Ventral view of farm-reared adult female *L. kempi* (carapace length = 57 cm). Arrows indicate clearings around Rathke's gland orifices.

been detected in *C. caretta* (Weldon, unpubl. obs.). Evacuation of Rathke's glands, therefore, could result in the removal of approx. 1–2 mg of this compound. Studies of the rates at which glandular fluids are replenished are needed to appreciate the significance of these values, particularly if Rathke's glands perform a homeostatic function, e.g., excretion.

Observations on adult Lepidochelys kempi.—Several authors have commented on possible ontogenetic changes in Rathke's gland activity, where younger individuals appear to have more active glands or discharge them with less provocation (Neill, 1948b; Waagen, 1972 and references therein). Carr (cited in Ehrenfeld and Ehrenfeld, 1973) noted that the Rathke's gland orifices of the green turtle (*Chelonia mydas*) may disappear with age. In *L. kempi*, we have observed that the inguinal pore, which is uniformly present in hatchlings, is occluded in many individuals one-year old or older.

Our attempts to elicit Rathke's gland discharge in captive adult sea turtles were inconclusive. However, evidence of secretion dis-

charge was observed in adult *L. kempi* maintained in a seminatural enclosure at the Cayman Turtle Farm, Grand Cayman, Cayman Islands, British West Indies. Twenty male and 16 female eight-year-old turtles were kept year-round in a 9 × 23 m fenced enclosure (maximum depth = 2.8 m) with an adjacent 9 × 11 m beach (see Wood and Wood, 1988). Turtles were sexually dimorphic (e.g., tail length), had mated, and had produced offspring.

Ten male and 10 female turtles were weighed and examined at two- to four-month intervals from June 1987 to July 1988. A layer of algae was present on the inframarginal and plastral regions of the shell except for ellipsoidal clearings around the Rathke's gland orifices (Fig. 2). We suggest that these clearings, which were present on all individuals throughout the year, were created by the discharge of Rathke's gland secretions. Rathke's gland pores are obscured by fouling organisms in some turtles, as Rainey (NOAA, unpubl.) reports for *C. caretta*, but tell-tale marks such as those observed by us in captive *L. kempi* may permit glandular activity to be inferred in free-living turtles. This, in turn,

could provide additional clues on the function of these ancient skin glands.

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NOMENCLATRURAL STATUS OF *EMOIA CYANURA* (LACERTILIA, SCINCIDAE) POPULATIONS IN THE CENTRAL PACIFIC.—*Emoia cyanura* as currently recognized is the most abundant and widespread skink of the Pacific. Its distribution encompasses much of Oceania from the Hawaiian archipelago, Clipperton Island, and Easter Island westward through Polynesia and Melanesia to the Admiralty and Bismarck islands (Fig. 1). This concept of a widespread, monotypic *E. cyanura* has been the dominant view for much of the twentieth century. Recently, Ineich, (1987) discovered that two morphotypes of *cyanura* occurred in French Polynesia and that these two morphotypes were also ecologically distinct. Being different morphologically and ecologically, one of the populations was described as a new species, *Emoia pheonura* (Ineich, 1987). Further study has revealed that the two species are sympatric throughout most of their distributions and that the new name is a synonym. The pattern of differentiation and speciation within the *cyanura* species complex remains unresolved and will be analyzed later by Ineich. Herein, we wish to outline the nomenclatural problems associated with this complex and clearly define which populations and which morphotypes are correctly assigned to *cyanura sensu stricto*.

Nomenclatural history of cyanura species complex.—Lesson (1826, 1830) described a series of striped skinks from Tahiti as *Scincus cyanurus*; the exact number of specimens in the type series was not specified in the original description. In 1839, Duméril and Bibron proposed *Eumeces Lessonii* as a replacement name for Lesson's *cyanurus*, because a blue tail is common to many skinks and they considered that it would be confusing to retain *cyanurus* for these Pacific island skinks. Duméril and Bibron did not see Lesson's specimens, rather they examined Leyden museum specimens, which had been described earlier as *Tiliqua Kienerii* by Cocteau (1836); neither the number of specimens nor their precise geographic origin was stated. Cocteau (1836) had also proposed the name *Tiliqua Lessonii*, and Duméril and Bibron listed both of Cocteau's names as synonyms of their *Eumeces Lessonii*. Most subsequent researchers have ignored this replacement name.

In 1898, Werner described *Lygosoma impar*, a *cyanura*-like species from the Bismarck Archi-