string is used to maintain the position of the unit in the body (Fitch and Shirer, 1971). It is essential that any implanted transmitter not interfere with feeding and digestion. Our placement of the transmitter immediately anterior to the gonads seems to fulfill these requirements. We observed our snakes feeding and defecating normally and increasing in length while carrying transmitters. In addition, six gravid snakes carrying transmitters produced broods of young without apparent complication.

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DETECTION OF GLANDULAR SECRETIONS BY YEARLING ALLIGATORS.—Intraspecific chemical communication is an important aspect of the biology of many animals including fish (Solomon, 1977), amphibians, reptiles (Madison, 1977) and mammals (Müller-Schwarze and Silverstein, 1980). However, the chemical communication system of crocodilians has not been systematically studied in spite of the existence of four prominant scent glands (traditionally referred to as "musk" glands) in all recent members of the order (Gadow, 1901). Members of both sexes have a pair of mandibular and a pair of cloacal glands which have been described by Reese (1921). The mandibular glands located adjacent to the lower jaw, are found beneath longitudinal slits. Part of the gland duct can be everted forming a rosette on the surface. The duct leads to a lumen which contains what appears to be sebaceous material according to Reese's description of it. Apparently, eversion of the mandibular glands is common during the mating season (Gadow, 1901; Burrage, 1965). Crocodilians also possess a pair of glands on each side of and emptying into the cloaca.

In this initial study we presented odors to yearling alligators. Odors were presented in an air stream. In some other reptiles, most notably snakes, direct contact with chemical stimuli has been found to be essential for a behavioral response (Kubie and Halpern, 1978; Sheffield et al., 1968). Recent evidence has indicated that the vomeronasal organ is involved in many of these responses (Burghardt, 1980). Since the crocodilians are not known to possess a vomeronasal organ we presented the odors in an airstream which did not allow the animals to directly contact the secretions.

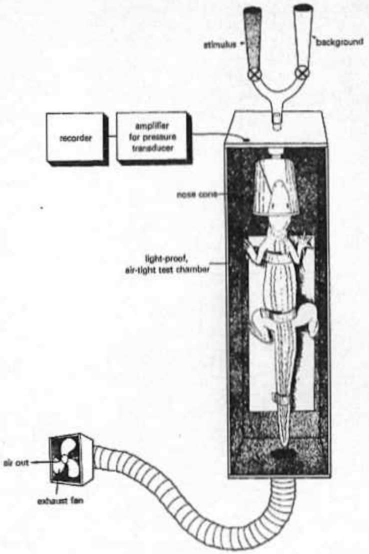

Fig. 1. Olfactometer used to measure response of yearling alligators to odors.

Huggins and co-workers (Huggins et al., 1968; Naifek et al., 1970) have shown concurrent muscular activity of the nares and gular pouch which have a clear relationship with the electroencephalographs recorded from the olfactory bulbs of caimans. Recorded impedance pneumograms of a caiman show gular pumping primarily during the nonventilatory phase of respiration. In this study we have recorded gular pumping as a measure of the sniffing response to odors.

We investigated the response of yearling alligators to seven stimuli: 1) cloacal gland secretion from alligator "B"; 2) cloacal gland secretion from alligator "C"; 3) mandibular gland secretion from alligator "C"; 4) citronellol; 5) androstenol; 6) amyl acetate and 7) a blank control. Citronellol was chosen as an odorant because it was isolated and identified from the gland secretion of the caiman (*A. sclerops* = *C. sclerops*) in the only published chemical studies of scent gland secretions of crocodilians (Fester and Bertuzzi, 1934; Fester et al., 1937). Androstenol was chosen because it has a musk-like odor. Organoleptic analyses of the secretion indicated that some components had odors similar to androstenol. Amyl acetate was chosen as a control odorant. In addition to the 6 odors, a blank, no-odor control was presented to each alligator. We hypothesized that alligators would respond more strongly to odors of alligator origin than to the blank or control odors.

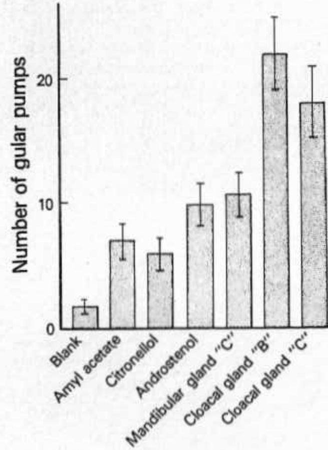

Fig. 2. Responses of yearling alligators to seven stimuli as measured by gular pumping. Bars represent mean response of 17 animals (±SEM).

Alligator scent glands were obtained from the Florida Fish and Game Commission. They had been dissected from freshly killed animals, immediately frozen and shipped packed in dry ice to Philadelphia where they were stored at −65 C. Alligator "B" was a 2.4 m male and alligator "C" was a 2.9 m male. Glands from females were not available. The glands were thawed, rinsed with deionized water and dissected. A yellow oil was removed from the surface of the gland pockets. This oil was stored at −60 C.

The experimental animals were 17 yearling alligators, 50 to 60 cm in length, captured by hand at night from the southwest corner of Orange Lake in Alachua county Florida (approximately 29.44°N 82.19°W). Animals were transported 26.5 km (straight line distance) to

the laboratory for testing the next day. The experimental animals were from three pods. Animals from a nearby pod showed gular pumping of such a low amplitude that we were unable to record from them.

Alligators were fixed to a board by velcro straps and were placed into an olfactometer with their snouts in a nose cone (Fig. 1). An exhaust fan at the posterior end of the olfactometer drew an airstream across the animals' snout in which stimulus samples could be introduced.

Gular pumping was recorded by a Narco sound/pressure transducer taped to the lower portion of the animal's chin. Signals were amplified by a Narco Electro-sphygmomanometer (PE-300) and displayed on a Narco two channel recorder.

Stimulus samples were introduced into the test chamber by an air-stream passing through a 10 mm × 15 cm glass tube which had been packed with glass wool. Chemicals or gland secretions were placed on this wool. No attempt was made to control the concentration of the stimuli. All odors were detectable by humans in the exhaust.

Stimuli were presented for 20 sec intervals separated by at least 100 sec. Small gular pumps were observed for a 20 sec prestimulus interval before the stimulus was turned on. Recordings were made continuously. The number of gular pumps greater in amplitude than those recorded during the prestimulus period were counted for the stimulus interval. All samples were presented twice, each set in a random sequence. The results for two presentations of a stimulus were averaged for an animal.

The results indicated that alligators responded most strongly to the cloacal gland secretions (Fig. 2). One-way analysis of variance with repeated measures indicated significant differences among the samples [$F(6,96) = 16.5$, $P < .01$]. The means were compared by the Newman-Keuls procedure which revealed that the cloacal and mandibular gland secretions elicited responses which were significantly different from the blank, citronellol and amyl acetate ($P < .01$). Of the pure compounds, only the response to androstenol was significantly different from the blank. Responses to the two cloacal gland secretions were not different from each other but were different from the mandibular gland secretion and androstenol ($P < .05$).

The data demonstrate that yearling alligators respond differentially to adult male glandular secretions compared with other odors. These findings complement the observation of Huggins et al. (1968) that the responses, measured by EEG recordings in the olfactory bulb, of caiman to glandular secretions were greater than to oil of cloves and ethanol.

The role that these odors play in the biology of the alligators is not known. The mandibular glands have been observed to be frequently everted during reproductive activities (Burrage, 1965), and during handling. These substances may play a role in reproduction, warning or other social activities; more work is required to evaluate this.

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MARINE TURTLE NESTING IN INDONESIA.—Three species of marine turtles have figured significantly in Indonesian economy since ancient times. The green (*Chelonia mydas*) and hawksbill turtles (*Eretmochelys imbricata*) are commercially exploited for both meat and eggs; the leatherback turtle (*Dermochelys coriacea*) is rarely eaten and only the eggs are commercially harvested. One of us (INSN) studied marine turtles in Indonesia from 1975 through 1979; the other (JDL) is involved in marine turtle conservation in general and in the Indian Ocean in particular (Lazell, 1980a). Four principal nesting areas have been identified, two of which are further subdivided into four and seven named beaches: Fig. 1. Dominant vegetation was identified at each site.

Leatherback.—Leatherbacks are presently known to nest only on the Bengkulu beaches. Eggs appear in local markets (Bengkulu and Padang) in late June and July. Ten days field work (INSN), 28 June through 7 July, 1978, on these beaches resulted in the discovery of only one nesting female, 5 July, who laid 94 eggs. The weather during this period was inclement, with nightly gales and downpours. The site is a barrier site dominated at its highest point above the berm by the exotic tree *Casaurina equisetifolia* ("Australian pine" or "cemara laut"). This gives way on the back (north) side to a graminoid zone above tideline and emergent *Sonneratia* sp. ("pidada") in Kadang Cove. The sand here is largely fine as a result of yellowish clay and mud brought down the Tanjung River. There are no reefs directly offshore. There are no adjacent marine algal beds.

The leatherback is locally known as "penyu belimbing" for a fruit, "buah belimbing," which its carapace shape resembles, or "penyu raksasa," simply "giant turtle." This species is now rare and endangered in Indonesia. There has been legal protection for it in Indonesia since 29 May 1978, but depredation continues.

Hawksbill.—It has proven difficult to ascertain a definite nesting season for this species (Carr et al., 1966). The only relatively precise date available is "May, 1975." The site was 3–4 m above high tide at Sawangkatung. Other nesting data are based on eggs for sale and reconstructions of the sites. Hawksbills are believed to live mostly in subtidal rocky areas and reefs off Ai-Ketapang (esp. Genale, Tanin and Liang Bolo) and Bengkulu (esp. Sawangkatung). At Ai-Ketapang the berms are very narrow; the strand vegetation is a strip dominated by *Pandanus tectorius*; this gives way to a forest of mixed *Pandanus, Hibiscus tiliacus* and *Terminalia catapa*. The sands are coarse with a heavy admixture of broken shell and dead coral. These observations resemble those of Carr et al. (1966) and Lazell (1980b) for Caribbean sites and habitats.

Green turtle.—As elsewhere in the Indian Ocean (Lazell, 1980a) the green turtles apparently have very different nesting seasons at different sites. At Sukomade 48 nests were laid from May to July, 1979. Three hatchlings (from a nest of 80 eggs, the remainder of which decayed) emerged in September. This site is within the Meru Betiri Nature Reserve, administered and protected by the Ministry of Agriculture. The berm at Sukomade is ca 10 times as wide as that at Ai-Ketapang; the forest is similar, but the zone largely dominated by *Pandanus* is relatively narrow. The sands at three *Chelonia* sites sampled were of mostly intermediate particle size.

At Pengumbahan the Government of the Sukabumi District regulates harvest of green turtle eggs and reports nesting from November to February. This commercial harvest may depress the population seriously. The berm at Pangumbahan is broad; the strand vegetation is a strip of *Pandanus tectorius* which gives way to groves of *Cocos nucifera* (coconut palm). Bustard (1972) and Rebel (1974) agree with our observations that a dense background of vegetation seems ideal for nesting *C. mydas.* Off the western part of Pangumbahan are extensive inshore marine algal beds dominated by *Sargassum, Graciliaria* and *Gelidium.* While these no doubt are of seasonal importance to green turtles, present evidence supports the view of

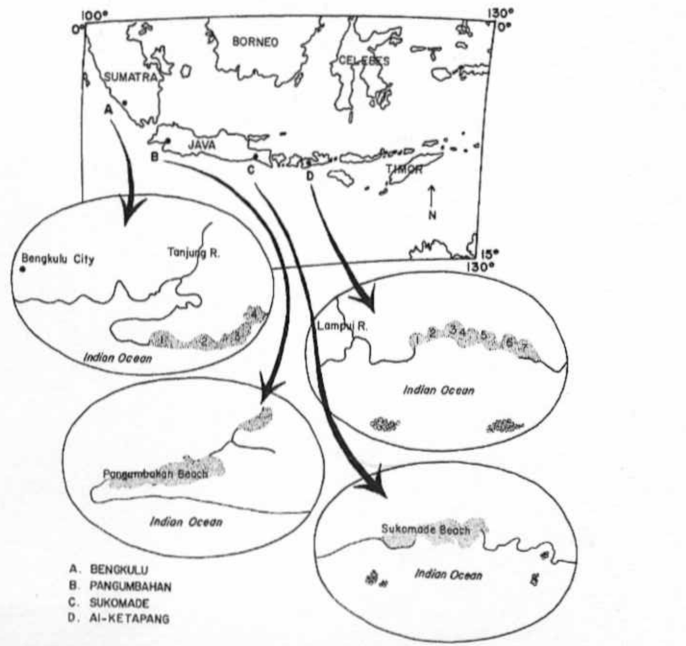

Fig. 1. Four marine turtle nesting areas in Indonesia noted in text. Sand is stippled. Offshore coral reefs are indicated. The subdivisions at Bengkulu (upper left enlargement) are: 1, Kadang; 2, Bai; 3, Pendek; and 4, Sawangkatung. The subdivisions at Ai-Ketapang (upper right enlargement) are: 1, Sadudu; 2, Kemu; 3, Songa; 4, Lampit; 5, Genale; 6, Tanin; and 7, Liang Bolo.

Schulz (1975) that green turtles are highly migratory and do not live year round close to the nesting beaches.

At Ai-Ketapang the green turtles nest from April to July. Their eggs are also a seasonal staple in the Bengkulu market.

A tagging program at these beaches is clearly needed. Marine turtles have traditionally been important to fishermen from Bali, Bajau, Bugis and elsewhere in the archipelago. If this fishery and these populations are to survive, new approaches to conservation and regulation of harvest will be needed.

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