LITERATURE CITED

CEI, J. M. 1962. Batracios de Chile. Ediciones Universidad Chile. Santiago, Chile.

DARWIN, C. 1839. Journal of researches into the geology and natural history of the various countries visited by H.M.S. BEAGLE. (Facsimile ed., 1952.) Hafner Publ. Co., New York, N. Y.

HAMMEL, H. T. 1960. Thermal and metabolic responses of the Alacaluf Indians to moderate cold exposure. U.S.A.F., Wright Air Develop. Div., Tech. Rep. 60–633, 44 pp.

RAYMOND J. HOCK, *Northrop Space Laboratories, Hawthorne, California.*

RUNNING SPEED OF THE LIZARD *BASILISCUS BASILISCUS* ON WATER.—The ability of basilisks to run across the surface of the water has long been known but never studied in detail. Basilisks presumably are able to run on the surface without sinking because of the large area presented by the long fringed toes, speed of limb movement, and the short contact time between feet and water surface. This paper provides data on the speed at which they run over the surface of the water.

Though Snyder (1949) described the bipedal locomotion of basilisks on sandpaper, he did not study either speed or running on water. Snyder (1962:193–194) stated that *Basiliscus* terrestrial speed was 5.6–6.8 mph under his laboratory conditions.

Basiliscus basiliscus Linnaeus is common in Panama, along the edges of streams and lakes. Basilisks can swim well and sometimes dive and hide in the water. When disturbed a basilisk usually runs away on its hind legs, crossing water as readily as it crosses dry land. A basilisk running on land may continue across a body of water. A basilisk may also launch itself directly from its perch onto the surface of the water and run. Rand once saw a basilisk that had fallen into the water submerge, surface, raise itself, and run across the surface. Similar behavior was observed by E. R. Dunn (Barden, 1943).

To determine the speed at which basilisks run on water we caught a total of 39 animals during four evenings in March 1966. These lizards were found asleep on overhanging branches along the shore of Barro Colorado Island, Canal Zone.

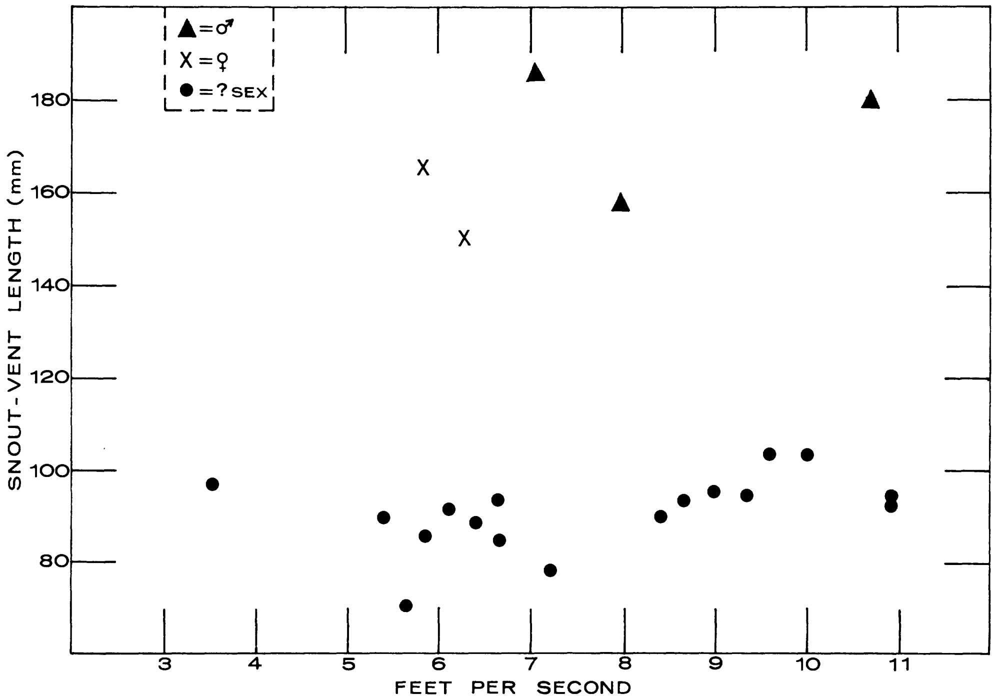

Fig. 1. Relation of snout-vent length to average speed over surface of water in *Basiliscus basiliscus.*

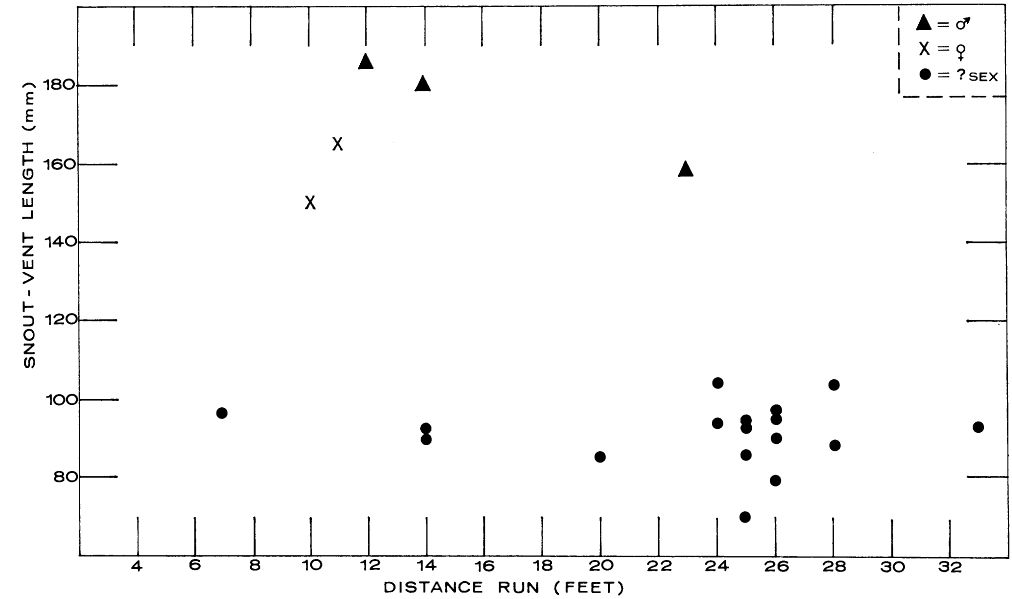

Fig. 2. Relation of snout–vent length to distance run over water in *Basiliscus basciliscus.*

The morning after capture the basilisks were released singly onto a small wooden platform 4–6 inches above the surface of the water and about 20–30 ft from the irregular shoreline. Their temperatures approximated that of the air, about 34° C. After a brief rest period on the platform each lizard was stimulated to move by being approached closely and, if necessary, lightly touched. Some lizards dove from the platform and swam away under water. The others ran across the surface. Each lizard was timed from leaving the platform until it dove or reached shore. The time taken to run the course was timed by two stopwatches (average taken) and the course was measured with a steel tape.

The tested basilisks included 25 juveniles, probably less than one year old (snout–vent length 70–110 mm), and 14 adults (7 females, 136–165 mm; 7 males, 158–203 mm). Snout–vent length was directly proportional to the cube root of the weight. Snout–vent length is used as our measure of size.

In the test situation, as in our impression in the wild, juveniles ran across water more readily (17 of 25 tested, 68%) than adults (5 of 14, 38%). However, even large adult males did run and those basilisks whose speeds were measured span nearly the total size range tested (Table 1).

The basilisks' speeds averaged 7.63 ft/sec (extremes, 3.5 and 10.87 fps). This mean is equivalent to 5.2 mph and is much slower

Table 1. Size and Speed Data for *Basiliscus basiliscus* Timed Running on Surface of Water.

Sex	No.	Snout–vent Length (mm)	Wt (g)	Distance (ft)	Time (sec)	Speed (ft/sec)
Runners: ??	17	70–104 (91.06)[1]	10– 31 (21.12)	7–33 (23.29)	2.0–4.4 (3.10)	3.50–10.87 (7.65)
♀♀	2	150–165 (157.50)	99–116 (107.50)	10–11 (10.50)	1.6–1.9 (1.75)	5.79– 6.25 (6.02)
♂♂	3	158–186 (174.67)	130–212 (182.00)	12–23 (16.33)	1.3–2.9 (1.97)	7.06–10.73 (8.58)
Adults	5	150–186 (167.80)	99–212 (152.20)	10–23 (14.00)	1.3–2.9 (1.88)	5.79–10.73 (7.55)
Divers:[2] ??	8	70–110 (93.88)	9– 45 (25.63)			
♀♀	5	136–156 (143.20)	72– 96 (82.20)			
♂♂	4	174–203 (187.00)	143–299 (211.25)			
Adults	9	136–203 (162.67)	72–299 (139.56)			
Totals	39	70–203 (118.00)	9–299 (66.18)	7–13 (21.18)[3]	1.3–4.4 (2.82)	3.50–10.87 (7.63)

[1] Range ($\bar{X}$). [2] Did not run, dove beneath surface of water. [3] 22 specimens.

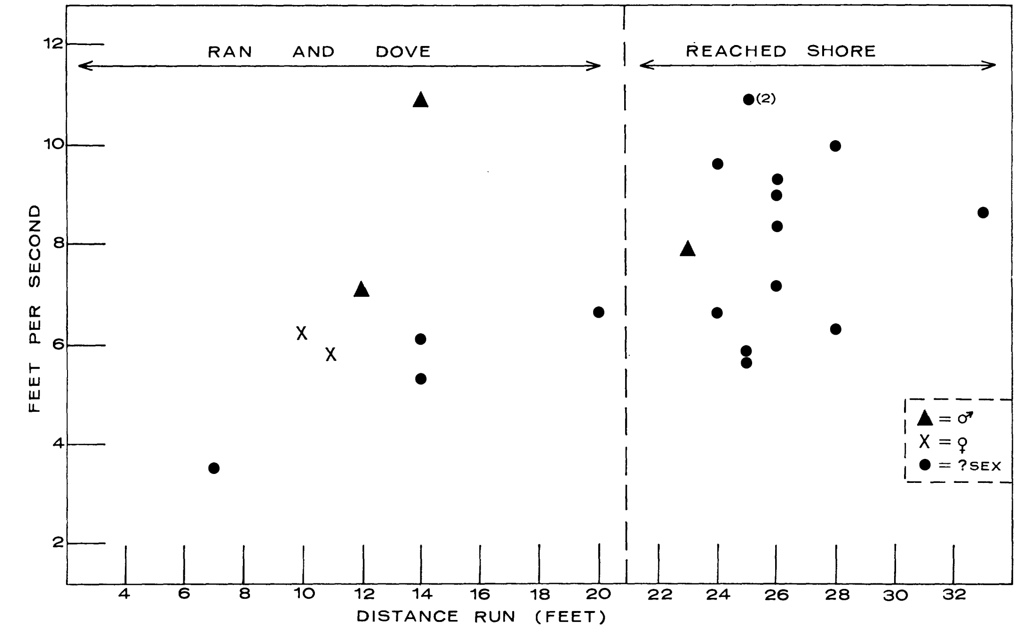

Fig. 3. Relation of average speed over surface of water to distance run in *Basiliscus basiliscus*.

than the maximum speeds of 3 iguanids on land—15 mph, *Uma* and *Callisaurus* (Oliver, 1955); 18.0–18.1 mph for *Dipsosaurus dorsalis* and *Callisaurus draconoides* (Belkin, 1961). However, this average speed on water is slightly less than the land speed of *Basiliscus* under laboratory conditions (Snyder, 1962).

There is no correlation between size and speed (Fig. 1). The speed of juveniles (mean 7.65 fps; range 3.50–10.87) does not differ significantly from that of the adults (7.55; 5.79–10.73).

Five of the 14 tested adults ran over the surface of the water; the remaining 9 adults dove under the surface and swam away. Of the 5 running adults, the 3 males ran faster than did the 2 females. This sample is too small to determine if this sexual difference in speed is real or a sampling error.

Only 1 adult basilisk ran as far as most of the juveniles (Fig. 2). Four of 5 running adults dove before reaching shore though only 4 of the 17 juveniles did so (Fig. 3).

Running on the surface may require proportionately more effort for the larger animals than for the smaller animals even though both are running at the same speed. The large lizards seem to sink deeper into the water and splash water higher than the small ones.

The juveniles that dove before reaching shore ran more slowly on the average (mean speed 5.4 fps; 3.5–6.7) than those that reached shore (8.3, 5.7–10.9) (Fig. 3). Figure 3 suggests that there is acceleration by juveniles. But the regression of speed on distance in these juveniles is not significantly different from zero ($b = 0.22 \pm 0.2$). Therefore there is no relationship between distance run and speed.

We suggest that these lizards run across the surface of the water in preference to swimming to avoid potential aquatic predators. They do swim well and hide under the surface of water and this in itself would certainly avoid most non-aquatic predators. Basilisks will avoid most terrestrial arboreal predators by just leaving the land. However, they can get from a log or shore to another log or shore (for safety, basking, or feeding) more quickly by running on the surface of the water than by swimming. This minimizes the time they are exposed to aquatic predators such as crocodiles, caymans, and large fish that are common in tropical waters and were evident at this site.

In summary, (1) juvenile and adult *Basiliscus basiliscus* ran on the surface of water at approximately the same speed, averaging 5.6 mph, (2) juveniles tended to reach shore whereas adults tended to submerge after a short run, (3) juveniles that ran to shore were not significantly faster than juveniles that dove under the surface of the water after a shorter run, and (4) probably these lizards run across the water instead of swimming so as to minimize exposure to aquatic predators.

LITERATURE CITED

BARDEN, A. 1943. Notes on the basilisk at Barro Colorado Island, Canal Zone. Ecology 24:407–408.

BELKIN, D. A. 1961. The running speeds of the lizards *Dipsosaurus dorsalis* and *Callisaurus draconoides*. Copeia 1961(2):223–224.

OLIVER, J. A. 1955. The natural history of North American amphibians and reptiles. Van Nostrand and Co., New York, N. Y.

SNYDER, R. C. 1949. Bipedal locomotion of the lizard *Basiliscus basiliscus*. Copeia 1949(2): 129–137.

———. 1962. Adaptations for bipedal locomotion of lizards. Am. Zool. 2:191–203.

A. STANLEY RAND, *Smithsonian Tropical Research Institute, Balboa, Canal Zone* AND HYMEN MARX, *Field Museum of Natural History, Chicago, Illinois 60605.*

THE NUCLEAR DNA OF A CAECILIAN. —The available data indicate that there is a remarkable difference between salamanders and frogs in the amount of nuclear DNA. We record here the quantity of nuclear DNA of a caecilian.

Liver tissue from a specimen of *Gymnopis multiplicata proxima* was fixed in a 3 : 1 mixture of absolute alcohol and glacial acetic acid. Nuclei were isolated from the fixed tissue by homogenization and centrifugation in a 0.1% solution of Tween 80, smeared on a slide, and stained by the Feulgen reaction. Absorption units per nucleus were read on a Barr and Stroud scanning-integrating microdensitometer. (For a fuller description of this method of determining nuclear DNA content, see Bachmann and Cowden, 1965.)

Fifty nuclei showed an average of 15.38 absorption units (SD = 2.34, SE = 0.334). A comparison of published values for the nuclear DNA of various species of fishes obtained by an extraction technique (Mirsky and Ris, 1951) with absorption unit values obtained by Feulgen densitometry indicates that 2.09 absorption units correspond to one pgram of DNA (Bachmann and Cowden, unpubl. data). Thus, *Gymnopis* has approximately 7.4 pgrams of DNA/nucleus.

We have measured nuclear DNA for 36 species of frogs representing the families Pelobatidae, Ranidae, Microhylidae, Bufonidae, Hylidae, and Leptodactylidae. Values obtained range from approximately 2.15 pgrams of DNA/nucleus in *Scaphiopus holbrooki* to 13.0 in *Rana catesbeiana*. Salamanders show a different range of values. Published values obtained by extraction techniques (Mirsky and Ris, 1951; Vendrely, 1955; Swift, 1958; Commoner, 1964) range from 48.8 pgrams/nucleus in *Necturus* to 168.0 in *Amphiuma*. The large amounts of DNA present in salamander nuclei introduce a density-dependent error in readings made on the scanning-integrating microdensitometer. Until the extent of this error can be determined, we are not prepared to publish figures for salamanders. However, preliminary readings on nine species were all higher than the readings for *R. catesbeiana*. The quantity of nuclear DNA of *Gymnopis*, an apode, is thus within the range of DNA/nucleus values of the anurans and well below the known range of values for salamanders.

The specimen of *Gymnopis* was collected in Costa Rica by Mr. Larry Ogren during the summer of 1965. We wish to thank Dr. A. F. Carr for making this specimen available to us.

Our studies have been supported by grants GB 3644, National Science Foundation and 5 T1 GM 1142-03 and GM-10003-03, U. S. Public Health Service.

LITERATURE CITED

BACHMANN, K. AND R. R. COWDEN. 1965. Quantitative cytophotometric studies on isolated liver cell nuclei of the bullfrog, *Rana catesbeiana*. Chromosoma (Berl.) 17:22–34.

COMMONER, B. 1964. Roles of deoxyribonucleic acid in inheritance. Nature 202(4936):960–968.

MIRSKY, A. E. AND H. RIS. 1951. The deoxyribonucleic acid content of animal cells and its evolutionary significance. J. Gen. Physiol. 34 (4):451–462.

SWIFT, H. 1958. Cytoplasmic particulates and basophilia. *In:* Symposium on the chemical basis of development. W. D. McElroy and B. Glass, eds., pp. 174–210. Johns Hopkins Press, Baltimore, Maryland.

VENDRELY, R. 1955. The deoxyribonucleic acid content of the nucleus. *In:* The nucleic acids. E. Chargaff and J. N. Davidson, eds., 2:155–180. Academic Press, New York, N. Y.

OLIVE B. GOIN AND COLEMAN J. GOIN, *Department of Zoology,* AND KONRAD BACHMANN, *School of Biology, Georgia Institute of Technology, Atlanta, Georgia.*

Literature Cited

Notes on the Basilisk at Barro Colorado Island, Canal Zone
Albert Barden
Ecology, Vol. 24, No. 3. (Jul., 1943), pp. 407-408.
Stable URL:
http://links.jstor.org/sici?sici=0012-9658%28194307%2924%3A3%3C407%3ANOTBAB%3E2.0.CO%3B2-D

The Running Speeds of the Lizards Dipsosaurus dorsalis and Callisaurus draconoides
Daniel A. Belkin
Copeia, Vol. 1961, No. 2. (Jun. 19, 1961), pp. 223-224.
Stable URL:
http://links.jstor.org/sici?sici=0045-8511%2819610619%293%3A1961%3A2%3C223%3ATRSOTL%3E2.0.CO%3B2-L

Bipedal Locomotion of the Lizard Basiliscus basiliscus
Richard C. Snyder
Copeia, Vol. 1949, No. 2. (Jun. 30, 1949), pp. 129-137.
Stable URL:
http://links.jstor.org/sici?sici=0045-8511%2819490630%293%3A1949%3A2%3C129%3ABLOTLB%3E2.0.CO%3B2-6