SWIMMING ABILITY OF POCKET GOPHERS (GEOMYIDAE)

by TROY L. BEST[1]

Department of Zoology and Stovall Museum of Science and History, The University of Oklahoma, Norman 73069

and E. BLAKE HART

Museum of Natural History, The University of Kansas, Lawrence 66044

Reprinted from THE TEXAS JOURNAL OF SCIENCE
Volume XXVII, No. 3, September, 1976

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ABSTRACT

Swimming behavior was investigated for *Geomys bursarius, G. pinetis,* and *Pappogeomys castanops*. No statistical differences were observed between age groups, sexes, or species. Average swimming duration in *Geomys* was 362 seconds and the average rate was 17 cm/second. When water depth was increased to prevent the gophers from occasionally touching the bottom, average swimming duration decreased significantly (t-test, $P < 0.05$) to 106 seconds. Behavior during swimming is described and illustrated.

INTRODUCTION

Kennerly (1963) pointed out the importance of considering swimming ability in relation to distributional barriers, dispersal, and gene flow in pocket gopher populations. While Hamilton (1943) and Jackson (1961) stated that pocket gophers were not able to swim, Kennerly's (1963) findings indicated that Texas *Geomys bursarius* were rather vigorous swimmers in placid water, and presumably could cross narrow waterways. We were prompted to undertake the present study because of the paucity of detailed knowledge concerning the swimming ability of pocket gophers. We investigated: (1) swimming behavior; (2) duration of swimming; (3) swimming speed; and (4) differences in swimming ability between age groups, sexes, and the 3 species—*G. bursarius, G. pinetis,* and *Pappogeomys castanops.*

MATERIALS AND METHODS

We captured one *P. castanops* and 28 *G. bursarius* using modified live traps (for a description of the traps see Hart, 1973). Of the 28 *G. bursarius,* 24 were captured in Norman, Cleveland Co., Oklahoma, 3 near Eudora, Douglas Co.,

[1]Present address: Department of Biology, Eastern New Mexico University, Portales 88130.

Kansas, and one 9 mi S, 1 mi W Tolar, Roosevelt Co., New Mexico. The *P. castanops* was also collected at the latter locality. Larry N. Brown sent us 2 *G. pinetis* from Tampa Co., Florida.

Some of the animals had been injected within the previous 2 hours with a colchicine solution, but it appeared to have no effect on body functions. None of the females were gravid, and all swimmming tests were conducted immediately after animals were captured.

The gophers were placed into the center of a water filled wooden trough (30 cm x 30 cm x 3 m) lined with polyethylene film. The trough was marked in 30 cm increments to allow accurate measurement of distance traveled. Swimming speeds were recorded only when the test animal was moving in the water. Water depth was approximately 15 cm for all except 4 tests (see text and Table 1), and water temperature was approximately 25°C. Animals were allowed to swim until they tired and began to sink to the bottom, but not allowed to drown.

Table 1

Summary of pocket gopher swimming performance.

	Swimming Duration (sec.)	Swimming Speed (cm/sec.)
Geomys bursarius		
Adult ♂	5(361.0; 194.83)[a]	5(18.0; 0.08)
Juvenile ♂	3(613.3; 238.24)	3(12.4; 0.15)
Adult ♀	9(235.6; 142.28)	5(18.0; 0.09)
Subadult ♀	3(591.7; 280.73)	3(16.4; 0.06)
Juvenile ♀	4(288.5; 39.27)	3(20.7; 0.08)
[b]Adult ♂	1(105.0; ----)	1(26.4; ---)
[b]Subadult ♀	3(106.7; 54.85)	3(13.7; 0.17)
Geomys pinetis		
Subadult ♂	1(735.0; ----)	1(12.2; ---)
Adult ♀	1(530.0; ----)	1(13.8; ---)
Pappogeomys castanops		
Adult ♀	1(130.0; ----)	1(18.3; ---)

[a]sample size (mean; standard deviation)

[b]water depth was 23 cm; all others 15 cm

RESULTS AND DISCUSSION

A summary of swimming duration and speed is presented in Table 1. All *Geomys* tested appeared to be excellent swimmers. Five gophers, 2 male and 2 female *G. bursarius* and one female *G. pinetis,* swam for more than 10 minutes. The maximum time recorded was for a juvenile male *G. bursarius* that was in the water for 885 seconds (14.75 min). A *t*-test revealed no significant difference between the average swimming times of males vs. females. In addition, a Student-Newman-Keuls *a posteriori* test for multiple comparisons among means (Sokal and Rohlf, 1969) indicated no significant differences in swimming times between any of the sex and age classes for *G. bursarius* listed in Table 1.

Behavior of individual pocket gophers was variable, but most assumed a horizontal swimming posture (Fig. 1A) with the forepaws stroking directly forward, transcribing circular vertical strokes. The limbs on one side of the body moved synchronously in the same direction: opposite the limbs on the other side of the body. After 3-5 minutes of swimming back and forth in the trough, gophers would generally begin to "dog-paddle" in a position approaching vertical (Fig. 1B). In this position the forelimbs appeared to perform most of the stroking with the hind legs moving very weakly. The tail moved laterally back and forth in all swimming positions, and possibly performed a sculling function as suggested by Kennerly (1963).

Swimming time appeared directly proportional to an individual's success in touching the bottom of the trough. As a gopher began to tire, it appeared to hold its breath and allowed the head to sink (up to 10 cm) below the water surface while maintaining the vertical position. As the tail contacted the bottom of the trough the experimental animal would immediately swim back to the surface and begin stroking once again. In the vertical dog-paddling posture (Fig. 1B), the tail appeared to function as a "water-depth probe." To test this observation further 4 *G. bursarius* (3 subadult females and 1 adult male) were placed into 23 cm deep water. They were not observed to touch the bottom of the trough, and their swimming times were the briefest recorded (170 sec., 105 sec., and 2 swam 75 sec. each). A *t*-test indicated a significant difference ($P < 0.05$) betweeen swimming duration of the 24 *G. bursarius* tested in 15 cm deep water (mean 362.3 sec.; st. dev. 211.50) and the 4 in 23 cm deep water (106.3; 44.79). Times recorded for our deep water tests are close to those reported by Kennerly (1963) for the adult female and subadult male *G. bursarius* he observed. His animals swam in a tank with 7 in (17.5 cm) of water, thus not allowing the animals to touch bottom, for 160 seconds each.

There are reasons to expect that real differences actually exist between swimming duration times of juvenile and adult pocket gophers, but sample sizes probably need to be increased to detect such differences. If this ability to survive longer actually exists it could be based for the most part, on the

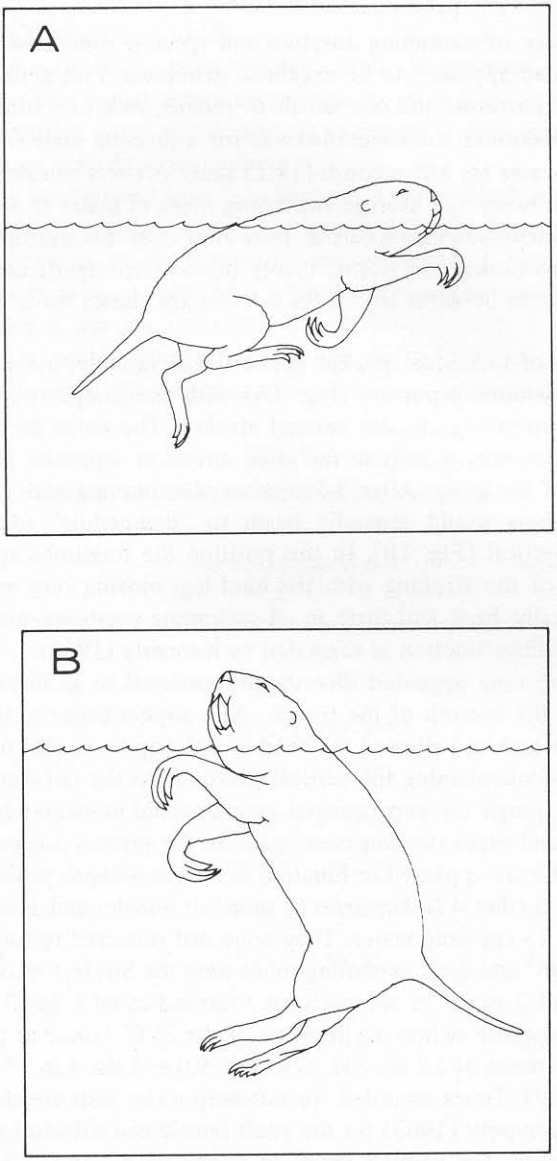

Figure 1. Swimming positions of *Geomys bursarius*. (A) Duration of this initial horizontal position was 3-5 minutes. All swimming speeds were recorded when test animals were in this position. (B) An increase in stroking by the front legs and decrease by the hind legs characterized the behavior while in this vertical position.

animal's ability to float. As discussed by Dagg and Windsor (1972), the position of an animal in the water is reflected in part by its hair. Instances of hair increasing floatation have been reported for caribou, porcupine, red fox (Cahalane, 1947), water shrews, white-tailed deer (Hamilton, 1943), and brown lemmings (Myllymaki *et al.*, 1962). After rubbing detergent, which acted as a wetting agent, on mice, rats, and gerbils, Dagg and Windsor (1972) observed all of these animals to swim in almost a vertical position. This indicated to them that the amount of air in the fur is extremely important in floatation. Previous work on muskrats (Johansen, 1962, Wragge, 1954), which have 21.5% of the animal's total dry volume as air in the fur, support their conclusion. Several times we observed juvenile pocket gophers that ceased paddling and remained floating in a horizontal position on the surface of the water. The tendency for younger animals to have a greater amount of body fat and relatively light weight (see Dagg and Windsor, 1972) may enable them to stay high in the water; thus greatly increasing the time for water to soak into the fur. Probably the change in angle of swimming in older individuals (Figs. 1A and 1B) was due principally to the fur becoming water soaked and only secondarily to fatigue.

Kennerly's (1963) 2 pocket gophers swam at a speed of 9 in per second (ca. 22.86 cm/sec.), which is similar to our group averages (Table 1). Statistical examination revealed no differences between groups. Most *Geomys* consistently swam at about 17 cm/sec. The small standard deviations we observed lead us to believe this is a relatively accurate measurement of swimming speeds for short periods of time. When compared to those species tested by Dagg and Windsor (1972), pocket gophers are relatively slow swimmers.

Due to the small sample sizes for *G. pinetis* and *P. castanops* we did not make statistical comparisons with *G. bursarius*. We noted no subjective differences between the 2 species of *Geomys*, but the *P. castanops* had to be removed from the water after only 130 seconds. Perhaps this more xeric species (Reichman and Baker, 1972; Best, 1973) is not as capable a swimmer as the 2 species of *Geomys*.

CONCLUSIONS

We have shown that pocket gophers are good swimmers, at least in calm water, and are able to sustain themselves for relatively long periods without drowning. If an "average" *Geomys* (in water shallow enough for it to occasionally touch the bottom) swam for 362 seconds at a speed of 17 cm/sec., it could cross a placid body of water more than 50 m across. Even allowing for drift due to current, this is quite significant.

ACKNOWLEDGEMENTS

We are grateful to Larry N. Brown, Univ. of South Florida, for providing

the specimens of *Geomys pinetis;* and to Gary D. Schnell, Univ. of Oklahoma, and Robert S. Hoffman, Univ. of Kansas, for critically reviewing the manuscript. Ginna Davidson, Department of Zoology, Univ. of Oklahoma, prepared the figure.

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