HERPETOLOGICAL NOTES

FURTHER ECOLOGICAL OBSERVA-
TIONS ON THE WESTERN BANDED
GECKO, *COLEONYX VARIEGATUS*.—
Field studies by Klauber (1945) and Parker
(1972) have amplified the knowledge of the
ecology of the eublepharine gekkonid
Coleonyx variegatus. The food habits and
thermal relations of the species, however,
remain little known. Knowlton (1938) and
Hardy (1944) examined some stomachs, but
their analyses were relatively qualitative.
Cowles and Bogert (1944), Brattstrom (1952a,
1965), and Mayhew (1968), reported body
temperatures of active *Coleonyx*, but sample
means are widely divergent. Vance (1973)
recently reported on body temperatures in a
thermal gradient.

Here we present some speculation on geo-
graphic distribution and predator escape
mechanisms as well as data on thermal rela-
tions in nature and stomach contents of
western banded geckos collected from 1963
through 1966 on eight Mojave and Sonoran
Desert study areas described elsewhere
(Parker, 1972; Pianka and Parker, 1972).
Most (140) of our 185 specimens were col-
lected on one area (Phoenix South Mountain,
Maricopa Co., Arizona) in pitfall traps. The
remainder were active animals captured
during normal nocturnal activities by walking
across country carrying a Coleman lantern.
The majority (92%) of the trapped animals
were obtained between 20 April and 30
August 1966. During this period, traps were
checked almost daily, in the mornings, so
stomachs of geckos should contain mostly
prey items captured during the previous
night rather than prey falling into the traps
by chance. All specimens are deposited at
the Los Angeles County Museum of Natural
History.

Table 1 shows that these geckos eat pri-
marily termites, beetles, orthopterans and
various insect larvae in order of volumetric
importance. By major category, these are
the same important prey groups as those of
sympatric diurnal lizards, particularly *Cnemi-
dophorus tigris* (Pianka, 1970) and *Uta
stansburiana* and to a lesser degree *Calli-
saurus draconoides* (Pianka and Parker,
1972). Like these diurnal species, *Coleonyx*
is at least partially opportunistic in its food
habits, as reflected by seasonal changes in
diet composition (Fig. 1). Insect larvae,

beetles and Orthoptera are important prey
items in spring, while termites are the major
summer prey, along with moderate numbers
of spiders and solpugids. In addition, more
geckos seem to be eating during the summer
since the percentage of individuals with
empty stomachs decreased steadily from April
through July, increasing again slightly in
August.

The only small nocturnal lizard over-
lapping the range of *Coleonyx* on our areas
was *Xantusia vigilis*, which apparently has
different food habits. Brattstrom (1952b)
found ants numerically most abundant, fol-
lowed by beetles and Hemiptera in 296
stomachs. Pianka (1965) recorded beetles
and ants in order of volumetric importance
in 27 *Xantusia* stomachs. Diets of these two
small nocturnal species thus overlap in only
one major category (beetles), potentially re-
ducing competition for food where they are
sympatric. Other potential food competitors
are scorpions (*Centuroides, Hadrurus, Vae-
jovis*) which eat spiders, beetles, Lepidoptera
and Orthoptera (Hadley and Williams, 1968).

Prey size was compared to gecko head
length in three ways by multiple regression
analysis: 1) 33 head length categories (based
on 33 different head lengths in 0.1 mm
increments) versus mean volume (cc) of prey
eaten by lizards with that head length; 2)
each lizard's head length versus the mean
volume of its prey; 3) prey volume versus
lizard head length for all prey items. The
latter two correlations were insignificant.
The best correlation was in the first compari-
son ($r = 0.42$, $P < .05$), showing a definite
trend for lizards with larger heads to eat
more larger prey items than those with
smaller heads.

Active *Coleonyx* were usually walking or
running in the open spaces between shrubs
when first sighted. However, some indi-
viduals were underneath or up in *Larrea*
and *Franseria* bushes, indicating that foraging
may occur underneath and within shrubs.
As a predator escape mechanism, *Coleonyx*
may actually mimic scorpions to its distinct
advantage. When frightened, the lizard
usually arches its tail up over its head and,
with its banded pattern, looks very much like
the large scorpions (*Hadrurus*) found in the
same habitat. *Coleonyx* do not stop moving
when mimicking the scorpion, and it is likely

TABLE 1. SUMMARY OF STOMACH CONTENTS OF 185 *Coleonyx* FROM EIGHT STUDY AREAS IN THE MOJAVE AND SONORAN DESERTS.

Prey category	Number	Volume (cc)	% total number	% total volume	Frequency
Spiders	56	1.50	5.07	6.75	23.8
Scorpions	4	0.35	0.36	1.58	2.2
Solpugids	16	1.08	1.45	4.87	9.7
Pseudoscorpions	3	0.02	0.27	0.10	1.6
Wasps	20	0.72	1.81	3.26	10.8
Ants	22	0.05	1.99	0.22	5.8
Orthoptera	15	3.10	1.36	13.99	7.6
Blattidae	6	0.78	0.54	3.52	3.2
Coleoptera	72	4.02	6.52	18.14	23.2
Isoptera	823	5.29	74.55	23.86	19.5
Homoptera-Hemiptera	8	0.20	0.72	0.90	4.3
Larvae	36	2.58	3.26	11.64	11.9
Pupae	1	0.02	0.09	0.07	0.5
Unidentified insects	15	0.77	1.36	3.45	14.1
Lizards, skin	4	0.41	0.36	1.83	2.2
Floral	1	0.01	0.09	0.05	0.5
Vegetative	2	0.01	0.18	0.05	1.1
Unidentified parts	—	1.27	—	5.72	23.2
TOTALS	1104	22.16			

that this results in hesitation of mammalian predators, allowing a percentage of *Coleonyx* to escape. The incidence of broken tails is high (Parker, 1972), suggesting that predation may be substantial.

All gravid female geckos contained two eggs. Mean reproductive effort (egg weight/ total wet weight of female × 100) in 14 females with oviducal eggs was 18.3 ± 1.72 (standard error). This is the second highest reproductive effort among 17 species of Gekkonidae (5 African and 12 Australian) with a range of 5.1 to 19.1.

Body temperature means for *Coleonyx* have been variously reported as 30.0 C by Cowles and Bogert (1944), and 19.4 C for 17 geckos (Brattstrom, 1965), a combined mean of 24.7 C (Brattstrom, 1965). Cunningham (1966) gave a mean of 21.3 C for 6 geckos active on roads at night, and a range of 26.8–31.3 for four found under boulder flakes. Mayhew (1968) published a frequency distribution of body temperatures of some 294 *Coleonyx* (range 17–37 C), but he provided no statistics. Vance (1973) obtained a "pre-
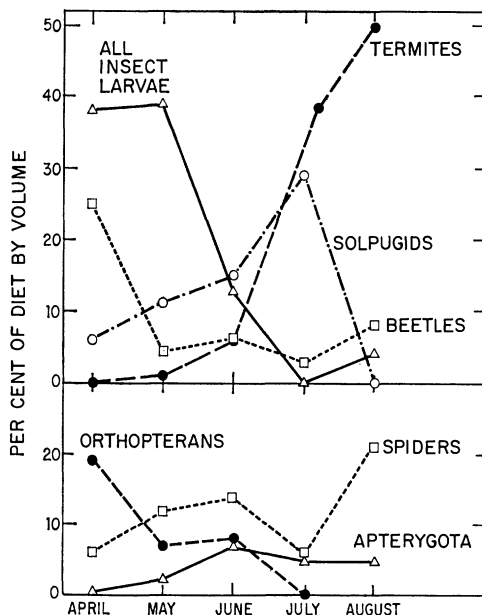

Fig. 1. Seasonal changes in the composition of the diet, by volume, of *Coleonyx* at Phoenix South Mountain, Arizona, during 1966.
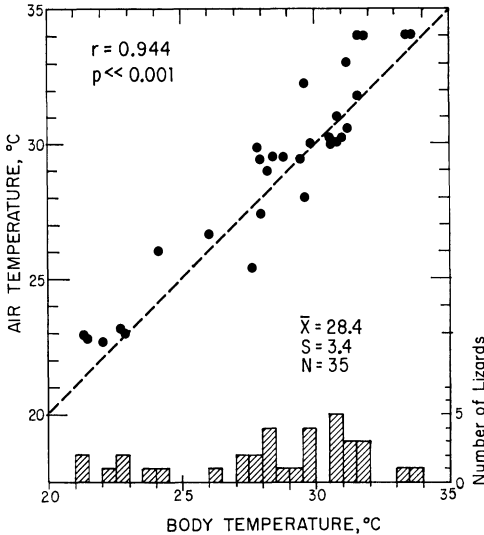
Fig. 2. Body temperatures (BT) of 31 active *Coleonyx* plotted against ambient air temperature (dashed line is BT = AT). The Pearson product-moment correlation coefficient of 0.94 is highly significant. Frequency distribution and statistics for 35 active BTs are shown at the bottom of the figure.

ferred body temperature" (PBT) of 28.6 C ± 0.24 (range 24–33 C). In 35 active animals in nature, we found a mean body temperature of 28.35 C ± 0.58, which does not differ significantly (t-test) from Vance's PBT value. Moreover, the range of BTs we observed (22.7–33.7 C) is very similar to that observed in a laboratory thermal gradient by Vance (1973). Body temperatures of active *Coleonyx* are very strongly correlated ($r = 0.94$, $P < .001$) with air temperature (Fig. 2). This correlation may be a clue in using night-time air temperatures to explain the northern limit of *Coleonyx* distribution. Klauber (1945) gave a mode of about 30 C and reported finding active geckos below about 15.2 C, although we found them active at temperatures only as low as 22.7 C. Summer night-time temperatures on the flatland desert in the Great Basin (June–August) while colder than those further south, are usually between 16–28 C, seldom dropping much below 14 C, suggesting that temperature, per se, is not likely to be the only factor limiting these lizards. Another possibility is that the seasonal period during which nocturnal temperatures are high enough for *Coleonyx* activity is too short for

successful reproduction. Klauber (1945), Mayhew (1968), and Parker (1972) found geckos active in the south from about March to October or November, with peaks in May and July. At the longest, the total season with night-time temperatures over 15 C in the Great Basin is about 3½ months (mainly June–August), or about half the length of the season known for southern *Coleonyx*. The concordance of the 160 day isopleth for the length of the frost-free period (Anon., 1941) and the range of *Coleonyx* is striking. Thus, because the season of activity of southern geckos is longer than the possible season in the Great Basin, we tentatively conclude that *Coleonyx* cannot occur in the Great Basin desert because the warm season there is too short for population replacement. The iguanid *Uta stansburiana* is limited to the west in northern California for similar reasons (Davis and Verbeek, 1972).

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BODY TEMPERATURES OF THE SEA SNAKE *PELAMIS PLATURUS.*—The black dorsal surface of the sea snake *Pelamis platurus*, together with its habit of floating at the water surface, prompted the suggestion that this species may bask in the sun to maintain body temperatures warmer than ambient sea water (Cowles, 1962; Brattstrom, 1965). It has recently been proposed (Dunson and Ehlert, 1971; Graham, Rubinoff and Hecht, 1971; Pickwell, 1972) that *P. platurus* might be capable of behaviorally regulating its body temperature by alternating basking and diving.

This paper reports the results of preliminary laboratory experiments which investigate thermoregulatory capacities and heat seeking or avoidance behavior in *P. platurus*. Snakes were collected in the Gulf of Panama, near the Pearl Islands, and held in large laboratory tanks at 27 to 28 C, in salinities from 26 to 30‰. The snakes were not fed and were used in experiments within four weeks of capture.

It is possible that over a small range of typically ambient temperatures (i.e., 25 to 30 C) snakes could maintain a constant body temperature or keep body temperature within a preferred range by basking. As a test for thermoregulation, snakes were transferred to a shallow sunlit tank (244 × 125 × 20 cm) in which ambient water temperature could be controlled through heating and cooling. Cloacal temperatures of free-swimming snakes were measured with a Schultheis thermometer. As a check for spatial differences in body temperature, deep body measurements were taken with a hypodermic thermistor probe (TRI-R Instrument Co. Model TPG).
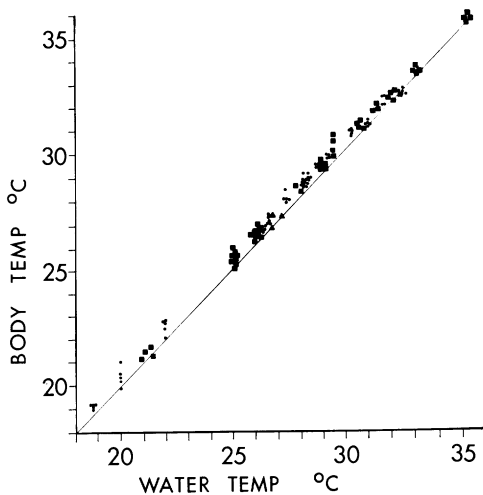

Fig. 1. Relationship between body temperature and water temperature for *P. platurus*. Symbols: cloacal temperature, dots; deep body temperatures, squares; deep body temperatures of snakes in drift lines, triangles.

These were made near the vertebral column midway between the snake's head and cloaca. One temperature measurement was made for each snake at a specific water temperature, but the same snake was often used at different temperatures. To reduce error, snakes were caught and held by a gloved hand in water while measured (within 20 seconds of constraint). Groups of four to six snakes were tested at each temperature, a total of 110 snakes were used. Deep body temperatures were measured for three snakes in drift lines near the Pearl Islands. After these were netted from a small skiff, temperatures were measured in the same manner described for laboratory snakes. These experiments were performed during the dry season (January to March) when the sky is generally cloud free. All temperature measurements were made from 0800 to 1600 on bright sunny days.

Body temperatures were measured for snakes in water ranging from 18 to 35 C (Fig. 1). Air temperatures above the experimental tank varied from 26 to 31 C. Over the entire experimental range, snake body temperatures averaged slightly warmer than water (Fig. 1). Previous experiments (Graham et al., 1971) demonstrated that snakes are not warmer than water at night, and it is assumed that elevated body temperatures are due to solar heat absorption. From 18 to 31 C the median