

Variation in food acquisition behavior of an ambush predator: patterns and correlates

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Introduction

Documenting intra-specific variation in food acquisition behavior and investigating the consequences of that variation among individuals should strengthen macro-evolutionary comparisons among species.

It is expected that such comprehensive comparisons will deepen our understanding of the primary features of adaptedness that exemplify each species and each genus.

Lizards that live in open, desert scrub habitats are excellent model systems for studying the evolutionary ecology of food acquisition:

- Lizards in northern deserts have few predators of which to be wary.
- Prey of lizards can be counted.
- Lizards can be observed closely outside of the reproductive season.
- Lizards can be studied when thermal constraints are minimal.

Thus, focal observations can be performed when food acquisition is assumed to be the primary activity of these lizards.

Animals have four basic tasks:

- Acquire and utilize food
- Acquire mates and reproduce
- Evade, avoid, and defend against predators
- Cope with abiotic stresses & avoid abiotic extremes

How does each basic task relate to, or cause the behavioral, physiological and morphological features of the animal?

What is the intensity of challenges imposed by each task and how do these tasks compare in how they affect the animal's features?

Food Acquisition Mode (FAM):

A coordinated set of physiological, behavioral, and morphological characteristics that are integrally involved in the search, detection, capture, and eating of food.

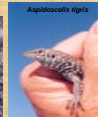
It is likely that many of the aforementioned characteristics are those that essentially characterize the principal features of adaptedness in a species.

Primary behavioral features of FAM:

- The movement patterns while searching for food
- The methods and modalities used for food detection
- The means of capturing prey



Ambush predation and wide foraging predation are two common and contrasting modes of food acquisition in lizards.



| Characteristic | Ambushers | Wide Foragers |
|------------------------------------|-----------------------------------|---|
| Prey types | Mobile prey | Hidden, sedentary prey |
| Number, amounts of prey/min caught | Lower (passive searcher) | Higher (active searcher) |
| Daily energy needs | Lower | Higher (more movement) |
| Sensory mode | Mainly vision | Chemoreception & vision |
| Morphotypes | Stocky body, wide mouth | Gracile body, forceps jaws |
| Exercise correlates | Fast, short, agile chases of prey | Long, fast evasive runs, and rapid recovery |

Behavioral variables that can be used to characterize food acquisition mode:

Number of movement bouts per minute (to find patch or prey)
v.
Number of sedentary bouts per minute

Time spent per movement bout (consider velocity & distance)
v.
Time spent per sedentary bout

Proportion of time spent moving
v.
Proportion of time spent being sedentary

Proportion of prey detected & pursued during movement
v.
Proportion of prey detected & pursued from sedentary position

Study Animal and Study Site

The subject species:
Long-nosed Leopard Lizard, *Gambelia wislizenii*.

The study habitat:
Great Basin desert scrub, in the Alvord Basin, Harney County, Oregon.

Lizard Features:
Gambelia wislizenii are abundant top-predatory lizards. These ambush predators are easy to find, easy to capture, and remarkably easy to observe without affecting their behavior.

Principal prey of *G. wislizenii*:
Large insects, particularly grasshoppers, and other lizards, particularly *Aspidoscelis tigris*, the western whiptail lizard.

Focal observations: 25-30 minute audio & video-recordings

Primary dates: June 29-July 15

Primary years: 2006 (8M, 8F), 2003 (13M, 3 F), 2005 (3 F)

Primary times: 0900-1100 (these observations are subsets of larger samples, because this study restricts analyses to time of peak activity, little overt thermoregulation)

Lizard subjects: Adult *Gambelia wislizenii*, primarily in prey-search (no early morning basking and no early season mate-searching).

Standardized plot searches
200m x 200m plot,
with flags at each 10m.

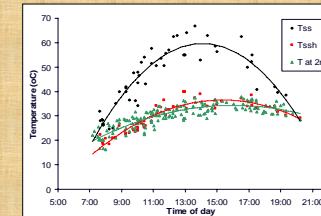
Periodic searches through day.
6-12 searchers / period.

Sighting details recorded
for each lizard.

Unpainted lizards caught,
measured and painted.

Colors of painted lizards noted.

All resident lizards censused
(*G. wislizenii* & its prey, *A. tigris*)



Representative temperatures of air and sunlit & shaded soil surfaces, collected over several days in early July (2003). Because lizard movement is restricted during the heat of the day, the focal observations that were the source data for this poster were limited to the more salubrious periods of mid morning, and to years when mate seeking was not a preoccupation. Thus the data presented herein permit a focused study of food acquisition behavior in *Gambelia wislizenii*.

Grasshopper Surveys

Three mesohabitats:
dune, hardpan, sandy flats.
Each mesohabitat:
three 10m x 40m plots,
each sampled 9 times.
Each plot:
sixteen 5m x 5m quadrats.
Eight quadrats sampled:
diagonal quadrats only.
Search Method:
close visual search of all shrubs, with slow combing hand movements to reveal nymphs & adults.



Mid-morning is conducive to prey-search and minimal overt thermoregulation:

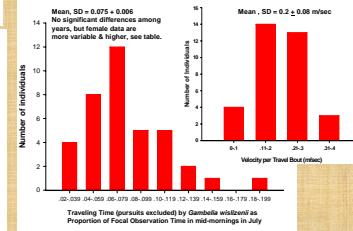
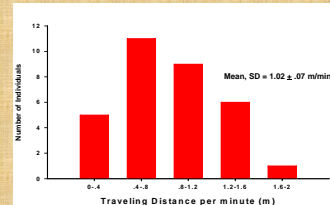
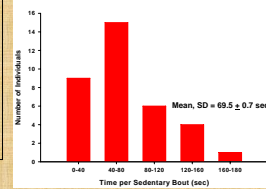
Despite proximity to perennials, wherein lizards could be expected to move frequently in-and-out of the shade inadvertently, the *G. wislizenii* changed thermal microhabitats (between shade, sunlit, and dappled lighting) in only 48% of their moves.

Among all sedentary bouts, 76% were in the FLEPOS position (front legs extended, pelvis on substratum), an archetypal prey search stance (see photo).

In 34 focal observations, averaging 27 minutes per observation, 74% of the lizards were observed attempting prey capture, and about half of those were successful.

Comparisons of movements of *Gambelia wislizenii* with other lizards that also use open habitats

| Lizard, predator type | Moves per minute | % time moving |
|--|---|--|
| <i>Gambelia wislizenii</i> , short-wait ambusher | 0.9 (range: 0.4-3.0) (1.03 with pursuits) | 7.5 (range: 3-18) (11.4 with pursuits) |
| <i>Crotaphytus reticulatus</i> , long-wait ambusher | 0.24 | 1.20 |
| <i>Cophosaurus texanus</i> , long-wait ambusher | 0.46 | 2.30 |
| <i>Aspidoscelis tigris</i> , wide, intensive forager | 0.50 | 87 |
| <i>A. sexlineatus</i> , wide, intensive forager | 1.44 | 72 |



Gambelia wislizenii displaying cat-like stalking behavior (a grasshopper is on the ground, just out of camera view). These lizards leap-capture flying prey in mid-air (see table).

Significant differences between years in
1) the number of grasshoppers seen per plot survey on 3 Sandy Flats plots in early July (27 surveys)
2) the number of *A. tigris* on 4 ha plot (lizard census)

| | |
|------|---------------------------------|
| 2003 | 7.7 ± 0.5 grasshoppers |
| 2006 | 3.0 ± 2.0 grasshoppers |
| 2003 | 29.3/ha <i>A. tigris</i> census |
| 2006 | 15.2/ha <i>A. tigris</i> census |



Some of the Basic Results

| | | |
|-------------------------|--|---|
| Sex affects | Body Size male = 97 mm ± 4 female = 101.5 mm ± 6 | SVL means, sd N = 21 M, 14 F t = 2.5, p = 0.023 |
| SVL affects | + Distance/move + Time/ move | F = 6.6, p = 0.016 F = 8.2, p = 0.012 |
| Sex affects | + Moves/minute | t = 2.0, p = 0.05 F = 0.72, M = 1.1 |
| Env Temps affect | Amount of time being sedentary | warmer = longer F = 7.2, p = 0.015 |
| Sex affects | Time spent moving (excludes pursuit time) | t = 2.3, p = 0.04 F = 0.08, M = 0.06 |

Distribution of Predatory Behaviors
(21 captures in 60 attempts by 31 individuals in mid-mornings)

| Behavior used | Captures/Attempts | Directly ending in Capture |
|------------------|--|----------------------------|
| Detection method | All prey were seen by sedentary lizard | |
| Stalk | 16 of 35 | 0 |
| Leaping! | 11 of 32 | 11 |
| Lunge | 9 of 14 | 9 |
| Run | 11 of 27 | 1 |
| Climb | 2 of 6 | 0 |

Conclusions

Observational-descriptive research via detailed focal observations can reveal much about the animal, especially when other biotic and abiotic variables also are documented.

The food acquisition mode of the *Gambelia wislizenii* can be characterized as a short-wait ambusher. Its predatory behavior varies with prey being pursued, and probably also varies according to which prey it is seeking. More analyses among years wherein grasshopper prey and lizard prey vary in availability should enhance understanding of the effect of prey availability on prey-seeking by the predator.

The predatory behavior of this leopard lizard is remarkably cat-like, thus one can infer that there may be numerous organismal features common to ambush predators. More detailed studies of other lizards are needed before comprehensive comparisons with food acquisition of *G. wislizenii* can be made.