Sprinting performance in the field by the western whiptail lizard, *Aspidoscelis tigris*

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Aspidoscelis tigris:

- Lives in desert scrub
- Is a wide, intensive forager
- Almost always on the move
- Has large home range
- Crosses open ground often
- Seeks hidden prey under shrubs
- Captures prey often
- Can have short activity period

Gambelia wislizenii, the long-nose leopard lizard is the predominant predator of *A. tigris*. In this photo, an adult female *G. wislizenii* is eating an adult female *A. tigris*.

INTRODUCTION

Locomotory behavior is assumed to be an integral component for meeting the ecological challenges of food acquisition, mate seeking, predator evasion, refugium seeking and dispersal in vertebrates. There have been neither comprehensive studies of locomotory capablilities for any taxon of terrestrial vertebrate, nor adequate observation and testing of locomotory capabilities in the field. Terrestrial lizards in desert scrub are useful model systems for studying locomotory adaptedness because they perform well in the lab and they can be observed easily in the field as they forage, seek mates and evade predators.

Aspidoscelis tigris (family Teiidae) is a wide foraging lizard that inhabits open desert scrub. The primary predators of *A. tigris* are ambush predators, such as the leopard lizard *Gambelia wislizenii*, which wait at the shrubs that *A. tigris* visits to forage for prey. Hence, *A. tigris* is expected to exhibit rapid acceleration and high sprint speeds. Acceleration, maximum sprinting velocities, and stride lengths of *Aspidoscelis tigris* running in a straight raceway on natural sand substratum were documented for adults of both sexes from a single northern population in the Great Basin desert scrub.

The research site is in the Great Basin desert scrub, in the Alvord Basin, to the east and south of Steens Mt, in Harney Co, Oregon

Among ten available 20x20m quadrants on a 1 ha plot, in the largest open patch beginning in each quadrant, the mean maximum straight-line distance without encountering any plants, was 16.8 ± 13.3 m, with a range of 5–56 m and a median of 10.4 m (note raceway lengths).

The raceway

Methods

Ten meter raceways were constructed in 2002 and 2003. A 20m raceway was constructed in 2004.

Raceway floors were natural sand substratum Raceway walls were made of aluminum flashing.

Lizards were held in a portable incubator and maintained at field active body temperatures (39-40ºC), so that body temperature was obviated as a source of variation in sprinting performance.

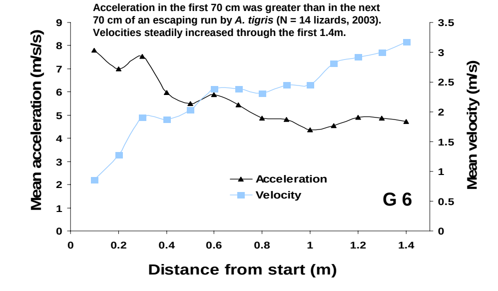
Lizards were released at one end and chased by a human in the raceway toward a refugium at the far end.

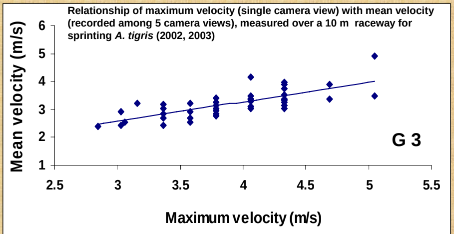
Five to six video cameras were used to document acceleration, velocity, gait type and stride length over separate 1- 1.4 m sections along the raceway.

Stopwatches were used to measure average velocity over the entire raceway and over large subsections of the raceway.

T2 Comparisons of trends for locomotory features of *A. tigris* at the beginning of an escaping run on a straight, field raceway on natural sand substratum, in 2003 (N = 14). Values are means & (SD).

	0 – 0.5 m	0.5 -1.0 m	1.0 - 1.4 m
Stride length (meters /stride)	0.12 (0.03)	0.18 (0.04)	0.23 (0.18)
Strides per meter	8.64 (1.91)	5.86 (1.03)	4.42 (1.66)
Stride frequency (strides per second)	11.42 (2.34)	13.28 (2.84)	12.49 (5.67)
Mean velocity ($m\ s^{-1}$)	1.35 (0.29)	2.33 (0.61)	2.88 (0.71)
End-section velocity ($m\ s^{-1}$ in last 10 cm)	1.92 (0.69)	2.31 (0.67)	2.99 (0.82)
Acceleration at maximum distance ($m\ s^{-2}$)	5.71 (2.89)	4.33 (1.93)	4.44 (1.78)





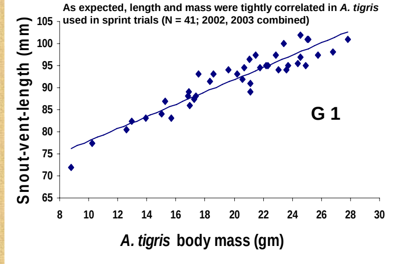
Results and Discussion

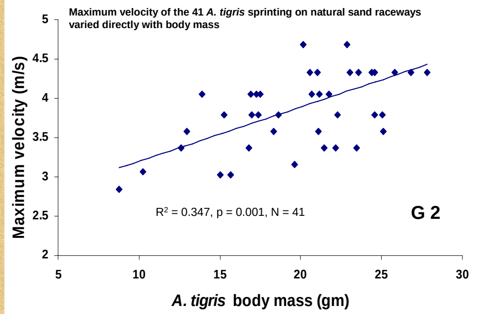
The 2002 and 2003 data comprise graphs G1-G6 and tables T1 & T2. Examine the first 4 graphs (G1-G4) in sequence, then examine T1 before G5; then look at T2 along with G6.
The 2004 data comprise T3 and the adjacent text.

In general, these field data on velocity (both for 10 m and 20 m sprints) corroborated lab studies on high speed treadmills, although artificial conditions of substrata (not sand) and sprinting logistics (treadmill) appear to enable higher sprint speeds (about 6m/sec) than actually seen on natural substrata.

Males and females were remarkably similar in sprint speeds. Larger lizards ran faster, but based on preliminary, insufficient data, acceleration may be lower in the very largest lizards than in average sized adults. Lizards were able to run faster bipedally than quadrupedally.

Maximum velocities and acceleration were high and similar to those of another lizard species (*Callisaurus draconoides*, family Phrynosomatidae) commonly seen in the open areas of the desert scrub of North America. Stride lengths of sprinting *A. tigris* rose with velocity; these data are similar to data on *C. draconoides*.





In 2004, 28 females and 19 males were chased on a 20.5 m raceway 6 times: 4 times on sand only and 2 times on half sand and half on the carpet backing. Velocities were measured for two distances:

T 3	Velocity over all 20.5 m (mean, SD, range) (N = 28 F, 19 M)	Velocity over last 7.5 m (mean, SD, range) (N = 19 F, 12 M)
Females	3.58 ± 0.44 m/sec 2.88-4.37	4.12 ± 0.87 m/sec 2.88-5.90
Males	3.56 ± 0.42 m/sec 2.53-4.74	4.08 ± 0.60 m/sec 3.40-5.47

In 2004, 32 of 47 individuals had steady runs for at least one of the half-sand-and-carpet runs.

An overall sample of 177 sand runs to 94 sand-and-carpet runs yields a proportionately expected random ratio of faster runs for the 32 individuals.

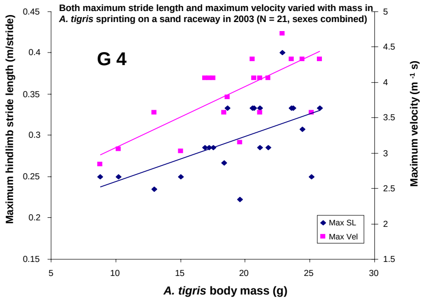
Expected:

21 faster on sand v. 11 faster on sand-and-carpet.

Observed:

13 faster on sand v. 19 faster on sand-and-carpet.

With the one-tailed binomial test, $p = 0.017$; thus sand-and-carpet lizards were faster more often than lizards sprinting on sand only.



Future Research

Other features of locomotory capabilities in *A. tigris* yet need to be studied, such as 1) the cost of locomotion, 2) how far the lizards can run fast, and 3) how often they can repeat fast runs, and 4) agility during fast runs.

These locomotory data are part of what should become the first integrated study of locomotory adaptedness for any terrestrial vertebrate.

Similarly intensive efforts to study locomotory adaptedness are needed for lizards from other taxa, with other food acquisition modes, and in different habitats. Once these data are obtained, we then may begin to venture satisfactory answers to the basic and profound questions about the relative ecological challenges faced by animals and how those challenges are met by the complex of morphotype, physiotype, and behavior that comprises locomotory adaptedness.

T1 Stride lengths (m/stride) of *A. tigris* among five locations on a 10 m field raceway with natural substratum in 2003 (sexes combined, N = 21). The mean stride length varied among locations (ANOVA, $F = 30.863$, $p < 0.05$, $N = 21$).

Distance from start of sprint	Stride length mean ± SD (m)	Range of stride lengths
0-1 m	0.14 ± 0.02	0.11 – 0.18
2.6-3.6 m	0.23 ± 0.05	0.13 – 0.33
5-6 m	0.28 ± 0.05	0.20 – 0.40
7-8 m	0.26 ± 0.04	0.18 – 0.33
9-10 m	0.26 ± 0.05	0.17 – 0.33