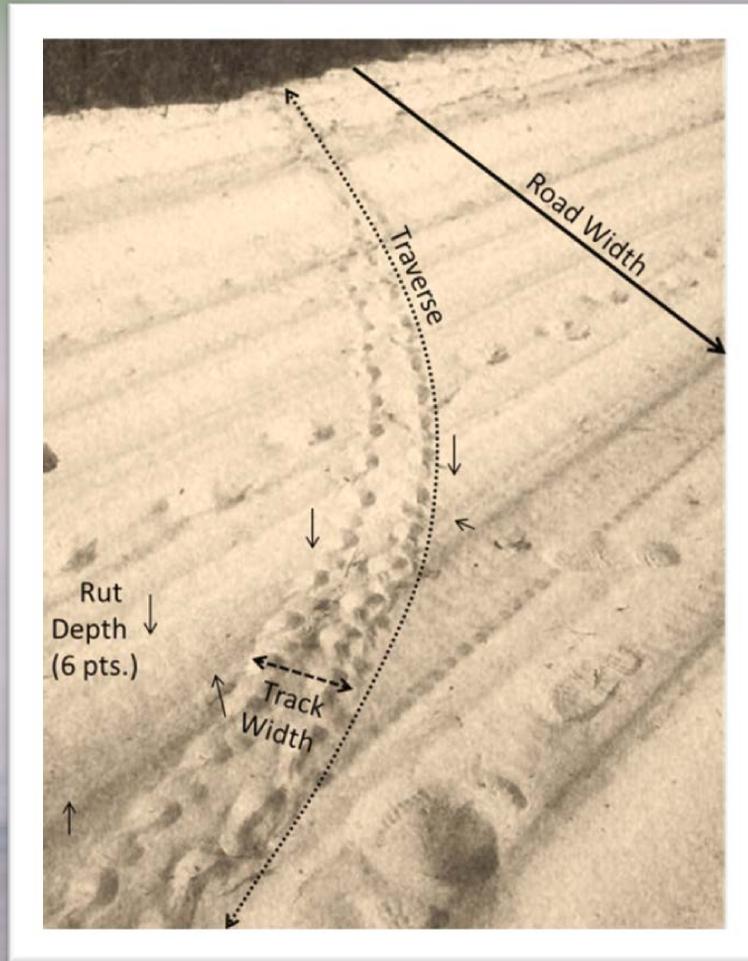




- potential costs of ruts in sand roads...

We observed small gopher tortoises (*Gopherus polyphemus*) dead in the ruts of a low-traffic sand road in Florida scrub, and posed three questions in response:

1. Do tortoises use sand roads for travel through scrub, or do they merely traverse them when they encounter such roads?
2. Do sand roads challenge tortoises (influence their travelling behaviour)?
3. Are the effects influenced by tortoise size?



Methods

We measured the lengths of traverse for tracks of 44 tortoises on sand roads. We used track width as a proxy for tortoise size. We measured rut depth as six location where a traverse crossed a rut.

We defined:

- a track as a single set of gopher tortoise footprints,
- a traverse as the route of a set of tortoise tracks over a sand road, and
- travel as tortoise movement on and off a sand road, as inferred from the traverse

... are mediated by tortoise size:

1. Traverse lengths overshoot road widths by an average of 4.9 meters. But does that mean that tortoises were choosing to use roads? We think not, because traverse to road width ratios varied with size (see figure below), and larger tortoises did not make longer traverses on sand roads.

2. Sand roads influenced travelling behaviour for smaller tortoises, whose traverse lengths increased when they became stuck in ruts; larger tortoises complete crossings.

3. Small gopher tortoises showed greater variation in traverse lengths than did medium and large tortoises.

Ruts in sand roads were deeper than the average track width of small tortoises, posing greater physiological challenges (Zani and Kram, 2008) to smaller than to larger tortoises.

| Tortoise Size Class | Turn Back | Rut Follow & Turn Back | Rut Follow & Cross Completion | Direct Cross | (n) |
|---------------------|-----------|------------------------|-------------------------------|--------------|-----|
| Small (<11 cm) | 0 | 4 | 4 | 1 | 9 |
| Medium (12-20 cm) | 2 | 0 | 13 | 13 | 28 |
| Large (>20 cm) | 0 | 0 | 4 | 3 | 7 |
| Total | 2 | 4 | 21 | 17 | 44 |

Tortoise track width (proxy for animal size) significantly influenced the likelihood of completing a traverse (Mann-Whitney $U_{6,36} = 39.5$; $p = 0.0081$; $\alpha(\text{Holm}) = 0.0056$; however, tortoise size did not influence whether the complete traverse was a direct cross or followed a rut first (M-W $U_{21,17} = 143.5$; $p = 0.308$; $\alpha(\text{Holm}) = 0.0125$).

