



The Urban Heat Island Promotes Cannibalism in Desert and Urban Black Widow Spiders

Christopher de Tranaltes, Destiny Ryan, Natasha Snider, Jessie Dunn, Zarpana Olumi & J. Chadwick Johnson

School of Mathematical & Natural Sciences, Arizona St. Univ., West



INTRODUCTION

- We are interested in the effect of urbanization on the behavior, ecology and evolution of organisms.
- Urban, built structures (e.g. concrete) retain heat and result in the Urban Heat Island (UHI) effect [1].
- Nevertheless, urban pests thrive in the face of this environmental change despite temperature increases involving metabolic costs [2].
- Black widow spiders (*Latrodectus hesperus*) from urban Phoenix experience a 6°C UHI (33 v 27 °C) relative to desert counterparts, drastically slowing spiderling development (In prep.).
- Sibling cohorts routinely exhibit a great deal of variation in their cannibalistic behavior, a behavior that likely has population growth implications [3].
- Here we ask whether UHI temperatures influence cannibalism, and whether urban and desert lineages respond to the UHI differently.

METHODS

- Urban areas were classified as within city limits and in proximity to urban development (e.g roads, industry, ..).
- Desert areas were classified as relatively undisturbed desert habitats at least 15 km outside of city limits.
- Egg sacs were collected from 6 urban and 7 desert females and isolated for 31 days at 23° C.
- Juvenile spiders were divided into groups of 5 siblings and placed into a clear acrylic box (4.1 x 4.1 x 5.7 cm)
- Boxed groups were split into 27° and 33° C incubators for an average of 12 replicates per treatment group.
- These treatments mimic the average daily temperature in July of desert (27°C) and urban (33°C) black widow microhabitats (In prep.).
- Survivorship was scored daily and cannibalism was confirmed by the presence of silk wrapping.

RESULTS

- Family of origin had a significant effect on time to 40% cannibalism ($F_{12,298}=50.63, p<0.001$) (Fig 1) and time to 80% cannibalism ($F_{12,298}=15.92, p<0.001$). Family wide averages were used for subsequent statistical analysis.
- Desert lineages were quicker to reach 40% cannibalism than urban lineages ($F_{1,22}=6.40, p=0.019$), while temperature showed no significant effect on this measure ($F_{1,22}=1.61, p=0.217$) (Fig 3).
- 33°C treatments were quicker to reach 80% cannibalism than 27°C treatments ($F_{1,22}=8.133, p=0.009$), while habitat of origin showed a marginally non significant quickening of cannibalism in the desert group ($F_{1,22}=3.826, p=0.063$) (Fig 4).

DISCUSSION

- Desert spiders cannibalized faster than urban spiders suggesting urban spiders are more tolerant of siblings.
 - The increased social tolerance of urban spiders may explain the severity of urban widow infestations (e.g. web sharing).
 - Perhaps the prey abundance typical of urban widow habitats [4] has selected for less cannibalistic spiderlings.
- Increased cannibalism after exposure to UHI temperatures suggests urbanization may actually **limit** black widow population growth.
 - Mechanistically, increased metabolic demands associated with higher temperatures may explain increased cannibalism at UHI temperatures [4].
 - Again, higher prey density in urban environments [5] may compensate for the UHI metabolic demands and allow urban infestations to occur.
- Future studies should compare UHI survivorship between desert and urban lineages across a realistic continuum of food limitation.

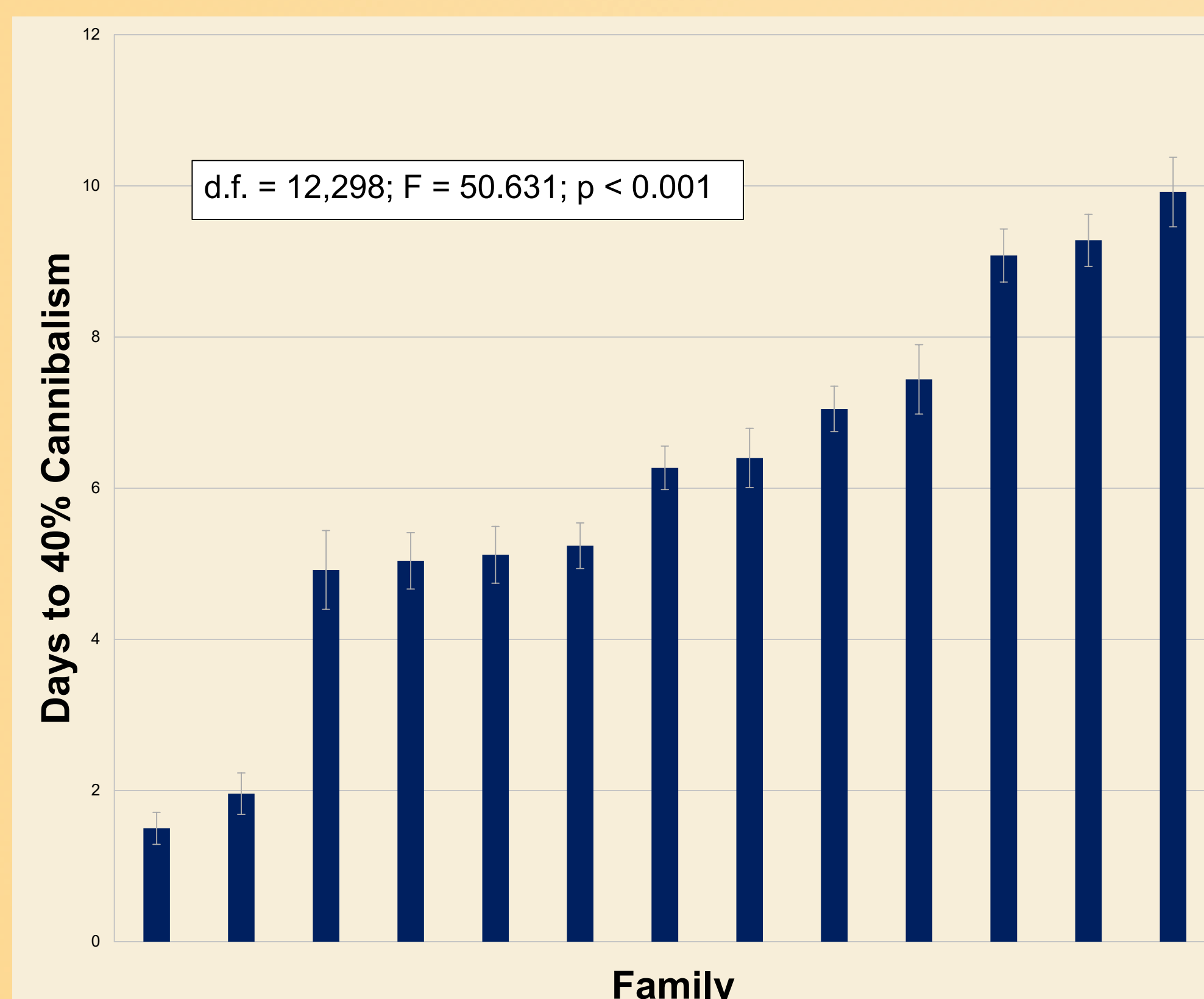


Figure 1. Family Affects Time to 40% Cannibalism

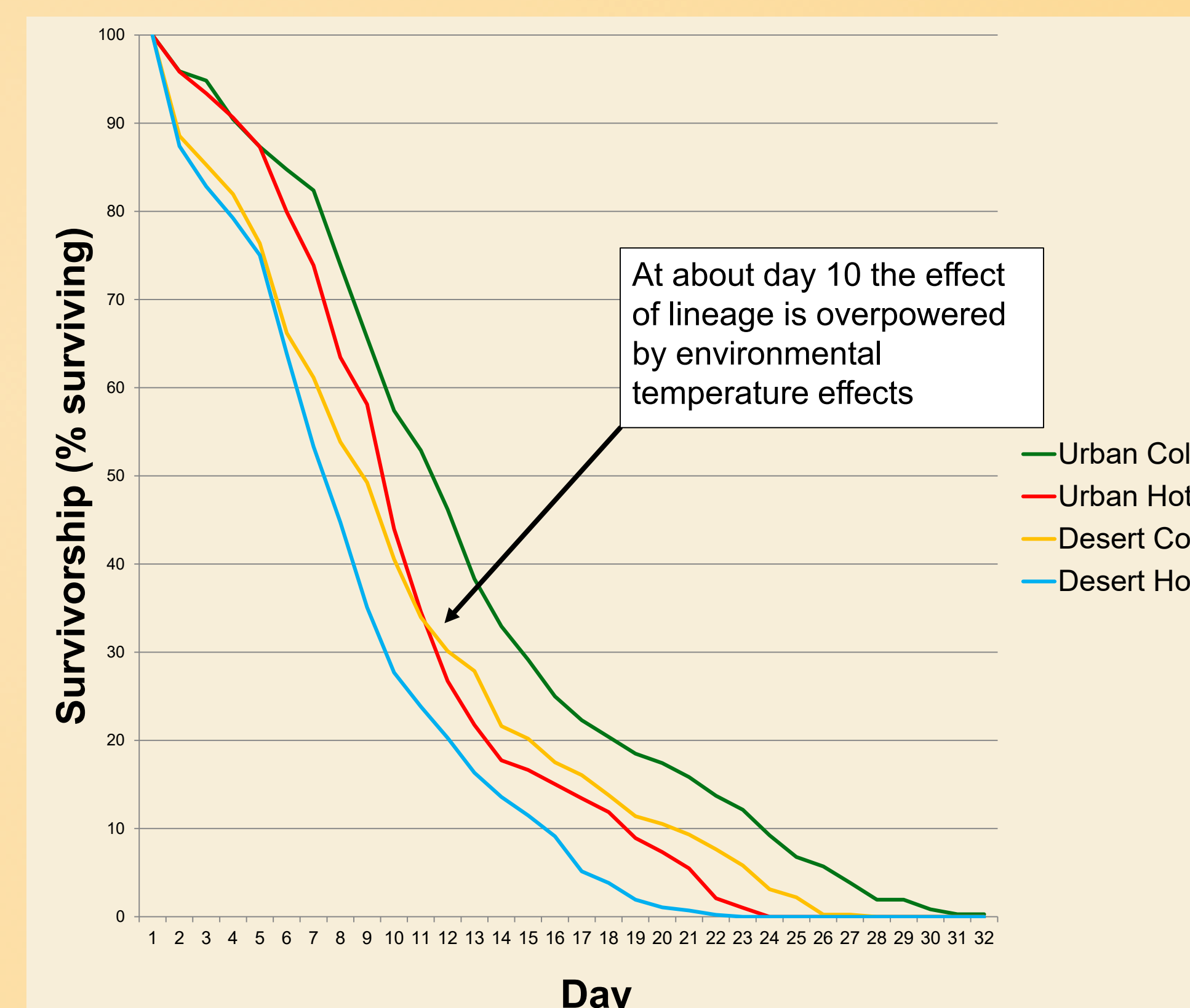


Figure 2. Average Treatment Group Survivorship

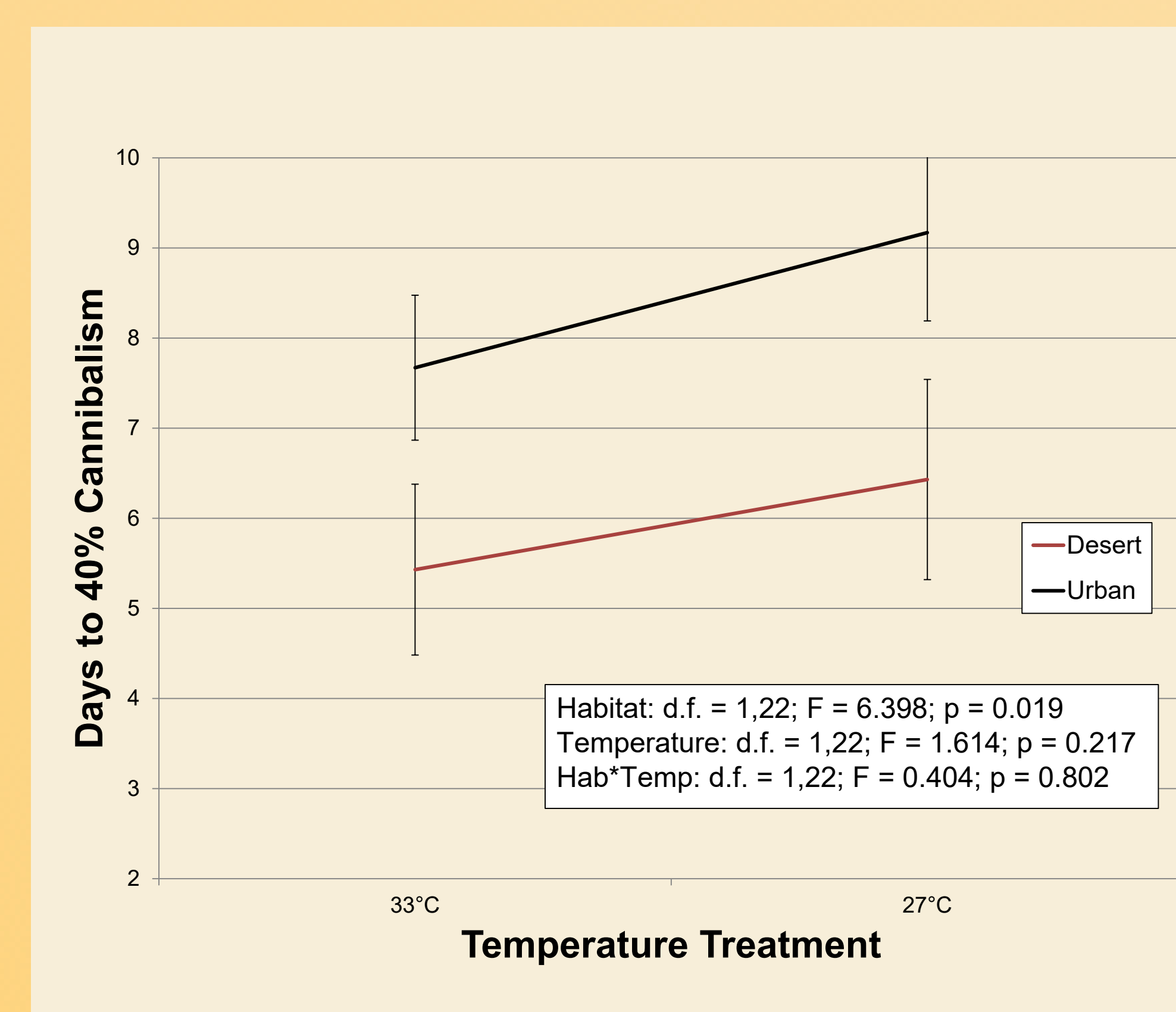


Figure 3. Habitat Affects Time to 40% Cannibalism, Temperature Does Not

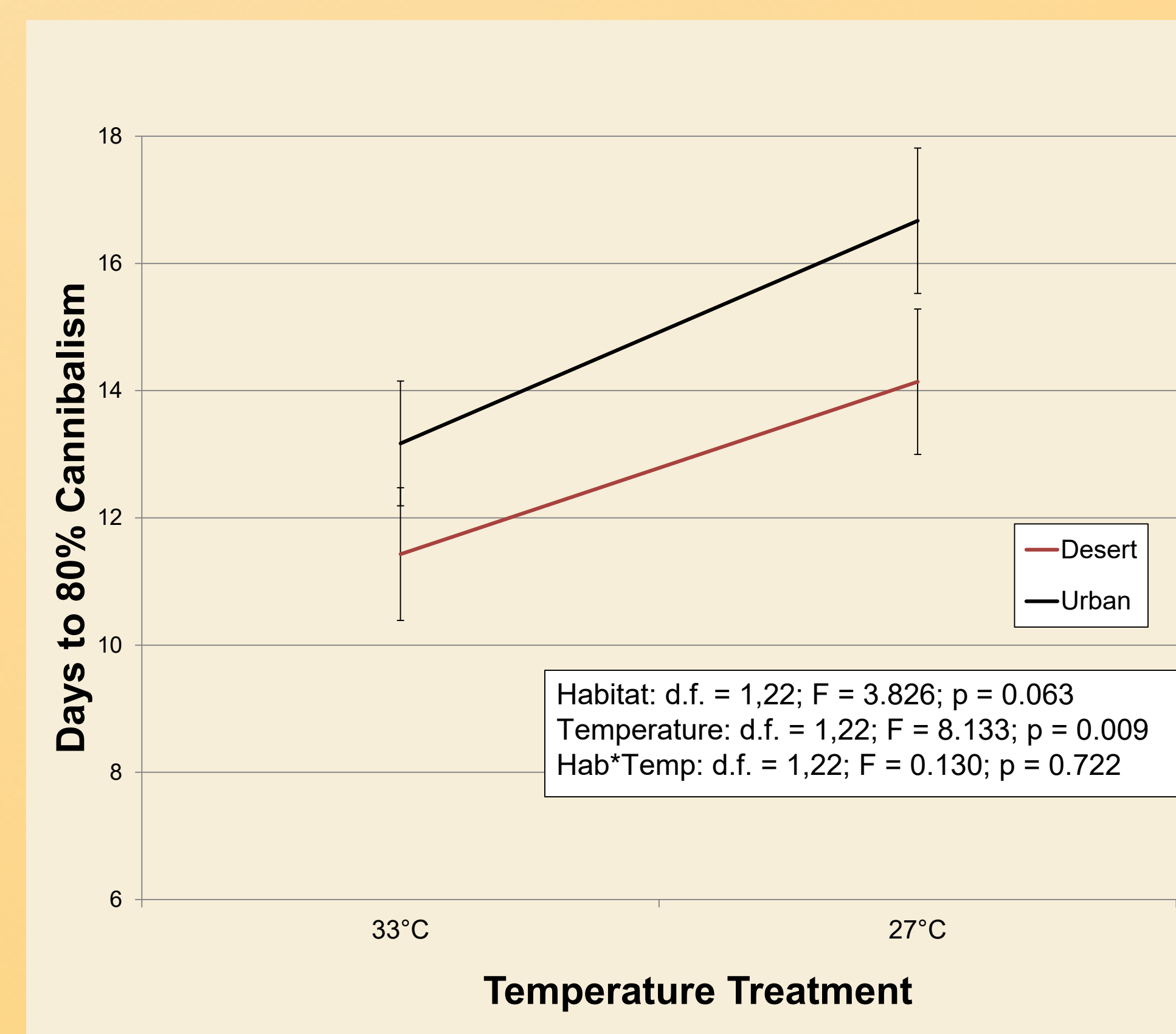


Figure 4. Temperature Affects Time to 80% Cannibalism, Habitat Marginally So

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