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REPLY TO DEKEL ET AL.:

# Preagricultural commensal niches for the house mouse and origins of human sedentism

Lior Weissbrod<sup>a,1</sup>, Fiona B. Marshall<sup>b</sup>, François R. Valla<sup>c</sup>, Hamoudi Khalaily<sup>d</sup>, Guy Bar-Oz<sup>a</sup>, Jean-Christophe Auffray<sup>e</sup>, Jean-Denis Vigne<sup>f</sup>, and Thomas Cucchi<sup>f,9,1</sup>

In their letter, Dekel et al. (1) comment on our recent findings on the origin of house mice (*Mus musculus domesticus*) 15,000 y ago, ecological impacts of the first settled hunter-gatherers, and insights that this study provides on early domestication processes (2). They maintain that mice were parasitic with humans rather than commensal, and attracted by refuse and feeding opportunities in nomadic and sedentary hunter-gatherer settlements. Dekel et al. (1) contrast “negative” interactions with mice with the benefit that hunter-gatherers obtained from early interactions with wolves and wild boar. These arguments do not conform to empirical results from our study on mice (2), recent research on wild boar domestication (3), or theoretical expectations regarding commensal and preagricultural human/animal interactions (4–6).

We do not argue for mutualism and domestication. The question of whether house mice were commensal with humans or parasitic is an interesting issue. However, Schwarz (7) argued that parasitism is not an appropriate description of human/mouse relations because mice do not depend on human hosts for their existence. Neither do the negative effects of mice (food consumption and disease transmission) involve direct impacts, *sensu stricto*. Our record on Levantine mice (2) offers rare empirical archaeological evidence demonstrating both positive and negative ecological effects on wild populations, which complies with formal definitions of commensalism in ecological theory (6, 8). We demonstrate absolute population shifts in mice with oscillations in mobility among Levantine

hunter-gatherers preceding intensive Neolithic cultivation (ca. 15,000–11,500 B.P.).

Still, current thinking on questions of animal domestication goes considerably farther than matching of species with categories of human/animal interaction. Niche construction paradigms examine intentional and unintentional cultural influences and the evolutionary trajectories of species that share human environments (4, 5, 9), providing a framework for understanding the mutable nature of commensal and mutualistic relationships characteristic of domestication (10). Our results demonstrate that early forager sedentism and its increasing ecological impact on ancient landscapes triggered new forms of interaction with species such as mice. It is likely that changing settlement habitats influenced wolves and wild boar, but in different ways. It was not merely the availability of “human waste” that provided a triggering mechanism for incipient domestication (1). It was rather the changing settlement ecology due to longer term and more intensive human occupation, as compellingly proposed by Edgar Anderson’s dump-heap hypothesis (4). The influence of the built environment on intraspecies and interspecies social interactions and predation and the variable role of human intentionality was culturally significant. Our study of mice binds these strands of theory together, establishing that early sedentism marked a significant turning point in human ecological interactions, ushering in an era of steadily increasing anthropogenic ecosystem transformation and changing human/animal relations.

- 1 Dekel Y, et al. (2017) Mammal domestication and the symbiotic spectrum. *Proc Natl Acad Sci USA*, 10.1073/pnas.1705784114.
- 2 Weissbrod L, et al. (2017) Origins of house mice in ecological niches created by settled hunter-gatherers in the Levant 15,000 y ago. *Proc Natl Acad Sci USA* 114:4099–4104.
- 3 Vigne J-D, et al. (2009) Pre-Neolithic wild boar management and introduction to Cyprus more than 11,400 years ago. *Proc Natl Acad Sci USA* 106:16135–16138.

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The authors declare no conflict of interest.

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- 7 Schwarz E (1939) Commensalism and domestication. *Am Nat* 73:270–278.
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