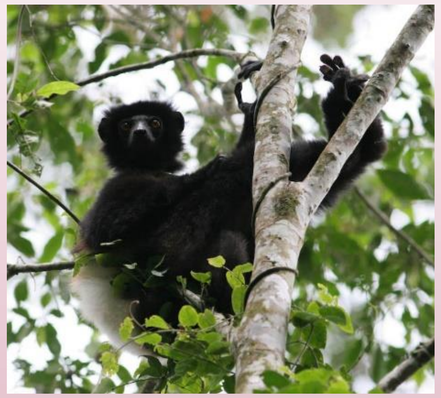


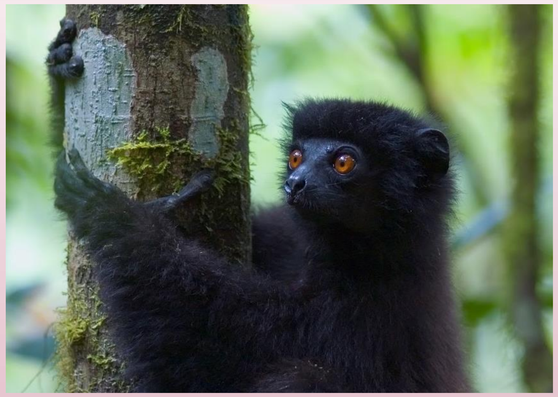
Do grooming bouts diminish ectoparasite load in wild *Propithecus edwardsi* in the rainforests of Madagascar?

KATHERINE J. KLING[1] M. ELISE LAUTERBUR[2], PATRICIA C. WRIGHT[1]

[1]Stony Brook University, Department of Anthropology, Stony Brook, NY;

Interdepartmental Doctoral Program in Anthropological Sciences (IDPAS)

[2]Stony Brook University, Department of Ecology and Evolution, Stony Brook, NY



Introduction

- Grooming is a well-documented behavioral archetype among primates and one which has long been suggested to serve both social and hygienic functions.
- While the primary function of grooming has not been agreed upon among primatologists, a number of studies have claimed hygiene as the predominant role (Perez and Vea, 2000; for endoparasites: Tanaka and Takefushi, 1993)
- Strepsirrhines, such as *Propithecus edwardsi*, possess toothcombs, unique lower anterior dentition specially-adapted for grooming that can aid in ectoparasite removal.
  - Differences between strepsirrhine and anthropoid grooming techniques (oral v. hands) and patterns (e.g. the predominance of mutual over unilateral grooming in strepsirrhines) have prompted debate as to whether strepsirrhine grooming has less of a social component (Lewis, 2010; Barton, 1987).
- While grooming has been shown to assist in ectoparasite removal (Akinyi et al. 2013; Duboscq et al. 2016), the extent to which it directly impacts ectoparasite load in lemurs warrants further exploration.

Study Objective and Predictions

Test association between grooming and ectoparasite load in a social strepsirrhine, *Propithecus edwardsi*

I. Variation in ectoparasite loads will be associated with variation in proportion of total grooming bouts received.

II. Variation in ectoparasite loads will be associated with variation in proportion of autogrooming bouts.

Methods

- **Behavioral data**: Grooming bouts (mutual, unilateral, autogrooming) of Milne-Edward's sifaka (*Propithecus edwardsi*) in Ranomafana National Park (RNP), southeastern Madagascar were recorded during focal animal observations between 1995-1998 and 2000-2005
- **Ectoparasite data**: Relative ectoparasite load (on a scale 0-5) and presence of ectoparasites by type (leech, tick, mite, louse and hippoboscid (biting) fly) were recorded during *P. edwardsi* captures (n = 70) in RNP during the same time period
  - Relative ectoparasite load was determined via methodologies of Wright et al. 2009.
- The confluence of behavioral and ectoparasite data produced 18 data points across 13 individuals. Loads 3-5 were removed from analyses due to limited sample size.
- **Analysis**: ANOVAs were run using R (R Core Team, 2015) to test the association between ectoparasite load (predictor) and grooming (response) (both total grooming bouts and autogrooming bouts)
  - Linear regressions and ANOVAs were run to test the association between year, age of individual, and group identity and grooming.

Results

Grooming

- Received grooming bouts (mutual, unilateral, auto) accounted for **25.21%** of all observations.
  - Majority of grooming bouts were auto-grooming: **16.28%** of all non-mutual grooming observations.

Ectoparasite Load

- The lowest ectoparasite load (1) characterized individuals in **44.3%** of all captures (Figure 1)
  - Hippoboscid flies were the most commonly-found ectoparasite (Figure 2)
  - **65.7%** of all capture-instances found individuals with single ectoparasite types

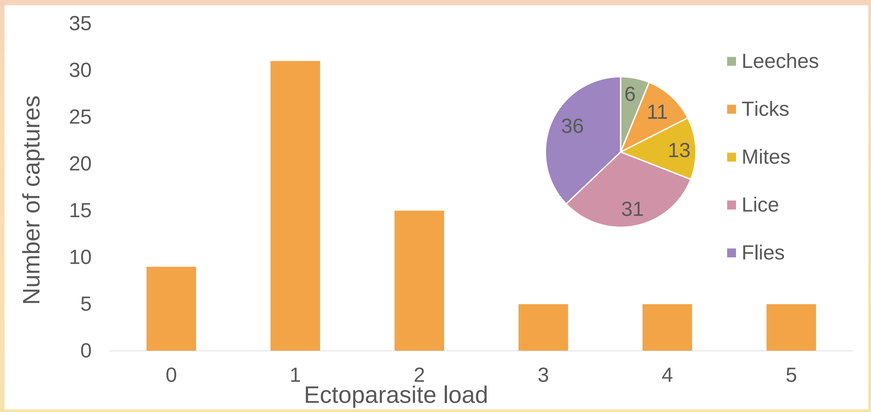
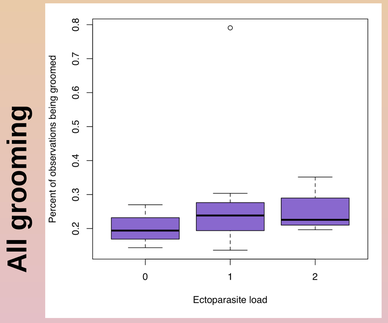


Figure 1. Ectoparasite load (0-5) and number of captures (n = 70) for *Propithecus edwardsi* in Ranomafana National Park, Madagascar from 1995-1998 and 2000-2005.
Figure 2 (inset). Ectoparasite type and number of associated captures (n = 70). Note that categories do not sum to 70 due to overlap of types found in some capture-instances (n = 24).

Tested Relationship between Grooming and Ectoparasite Load

- No associations found between all grooming year, age, or group identity.
- No association found between grooming and ectoparasite load (all: p = 0.738, Figure 3; auto: p = 0.395, Figure 4)
  - With the removal of an outlier in Category 1 (2 yo male in 2003), the association between parasite load and autogrooming is significant (p = 0.0489, without correction for multiple comparisons)



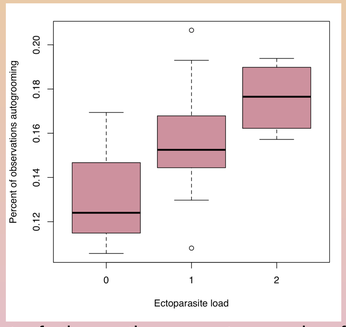


Figure 3 (left). Ectoparasite load (0-2) and Percent of observations spent grooming for *Propithecus edwardsi* in Ranomafana National Park, Madagascar from 1995 to 1998, 2000-2005.
Figure 4 (right). Ectoparasite load and Percent of observations being groomed.

Conclusions

- Differences in ectoparasite loads were not associated with differences in proportion of bouts spent being groomed. However, the data suggest an association between autogrooming and ectoparasite load and thus that auto-, and not allo-, grooming may serve a more hygienic function.
  - The trend between autogrooming and ectoparasite load was not significant due to multiple comparison corrections and limited sample size. As the data were not collected for this question, further research may elucidate the function of mutual and autogrooming.
- This study suggests that grooming in *P. edwardsi* likely serves a function beyond purely maintaining hygiene and could indicate an important social aspect of the behavior in strepsirrhines (for primates: Dunbar, 1991).
- As studying social interactions, via methods such as social network analysis (Duboscq et al. 2016), may be used to predict ectoparasite load among primates, ectoparasite tracking may be utilized to infer social dynamics among hosts as well (e.g. lice and *Microcebus rufus:* Zohdy et al. 2012).
- Ectoparasites are known to spread disease among primates and other mammals (Zohdy et al. 2012; Kurvers et al. 2014): further understanding of parasite transmission through host social activity is therefore paramount for its potential contribution to conservation and global health (Bicca-Marques and Calegaro-Marques, 2014).
  - Habitat disturbance may additionally play a role in ectoparasite transmission: at this site in particular (RNP), ectoparasite load intensity was highest in its most disturbed area (Wright et al. 2009).

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