Seasonal variation in sexual segregation in spider monkeys (*Ateles geoffroyi yucatanensis*) at Runaway Creek Nature Reserve, Belize

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Sexual segregation defined….

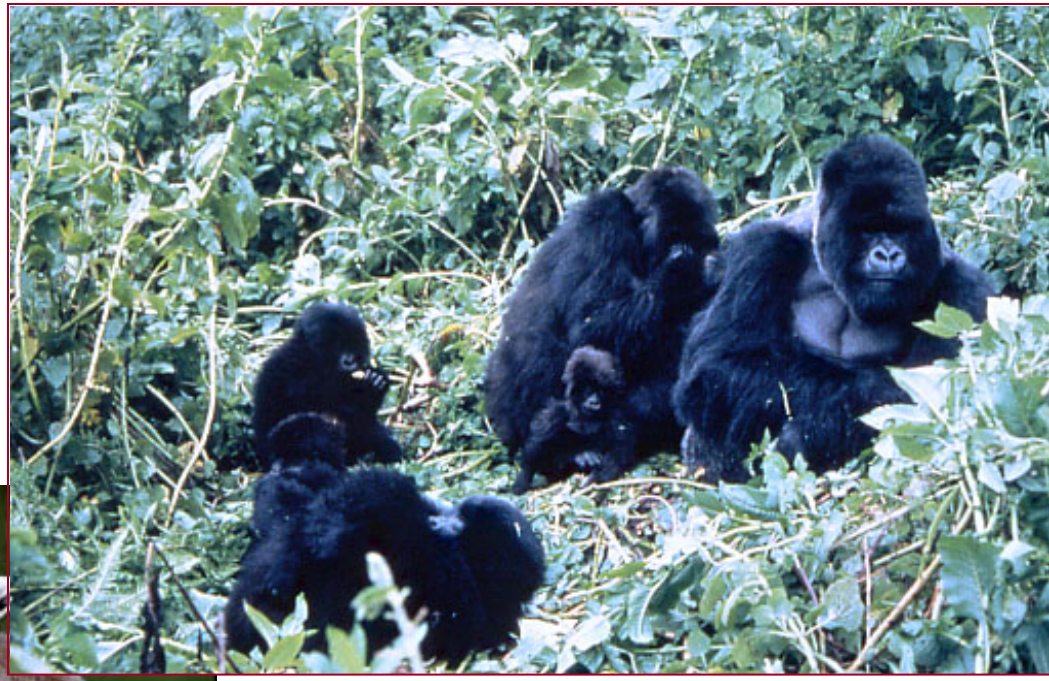
The separation of males and females outside of seasonal or opportunistic mating periods, either socially (i.e., living in the same area but not associating) or by habitat (i.e., occupying different habitats within a range or geographically distinct ranges).

Sexually segregated species tend to be:

Sexually dimorphic
AND
Seasonal breeders

Primates:

- Many species are sexually dimorphic and/or seasonal breeders…




But MOST primate males and females maintain year-round associations with one another.

Exceptions include:

- So-called “solitary” species

- Classically defined “fission-fusion” species

Outstanding issues:

- Are FF species truly “sex-segregated”?
- Does sexual segregation vary over time as a function social and/or ecological factors, such as:
  - Food availability
  - Different energetic demands
  - Feeding competition
  - Preferential association and/or avoidance patterns

Outline of presentation:

- Analyses

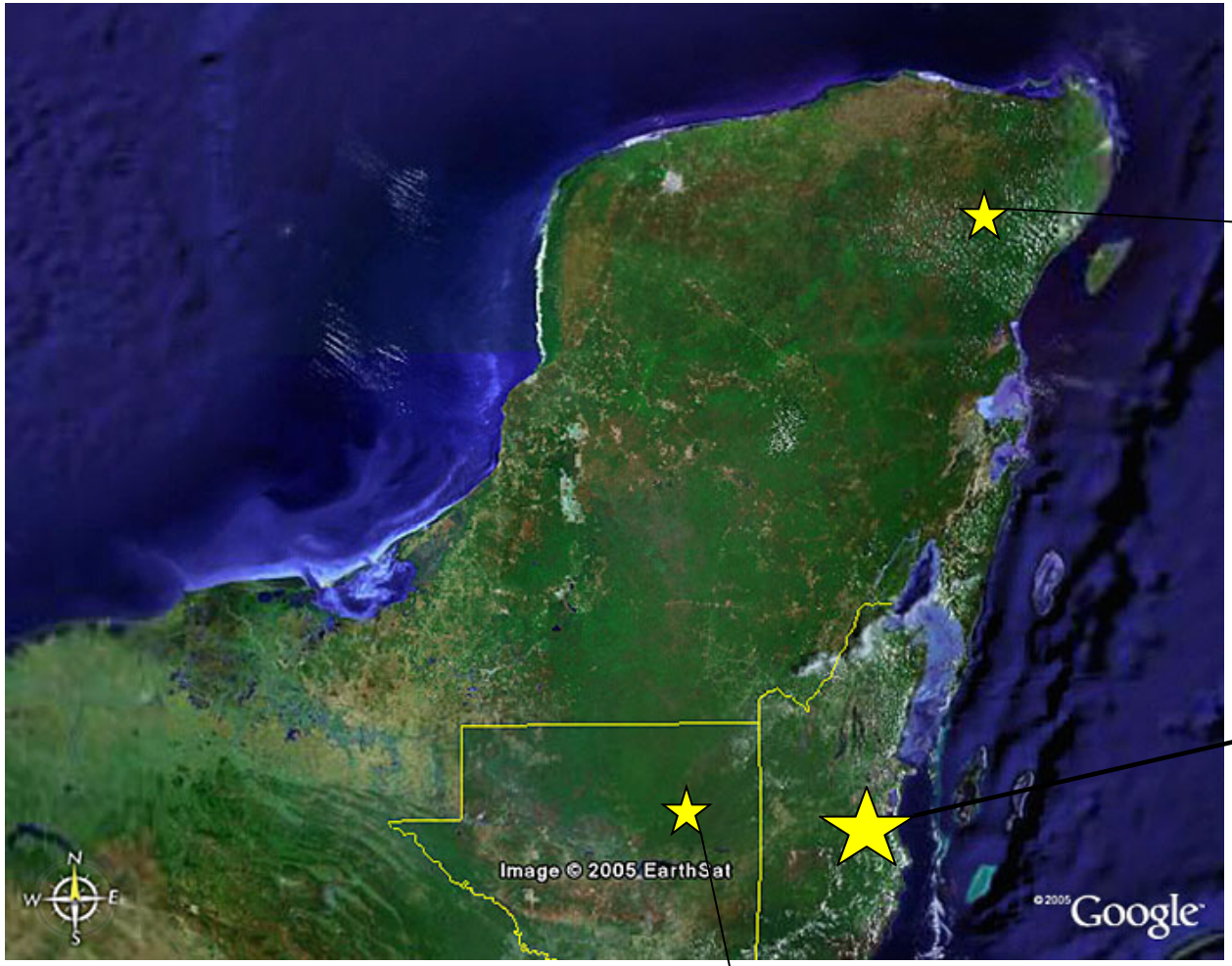
  Are spider monkeys sexually segregated?

  Do ecological factors (ie., food availability) affect patterns of sexual segregation?

- Discussion

  Possible functions of sexual segregation in spider monkeys

Study site and subjects



Punta Laguna
Mexico

Runaway Creek Nature Reserve, Belize

Tikal National Park, Guatemala

image: Google Earth

- **Runaway Creek**
  - Limestone karst hill topography
  - Tropical broadleaf forest and pine savanna
  - Selective logging until 1970s
  - 2 primate spp. (*A. pigra* & *A. g. yucatanensis*)
  - 3 known communities of spider monkeys

Study Subjects

GROUP F composition: number of individuals in each age and sex class (A= adult; SAM/F= subadult; JM/F= juvenile; I= infant) and sex (M= male; F= female).

Year	Age/sex class								Total
	AM	AF	SAM	SAF	JM	JF	IM	IF	
2008	3	11	2	3	3	2	2	5	31
2009	3	12	2	1	5	4	3	5	35

Sex ratio m:f = 1:4

Data Collection

- Jan 2008 – December 2009 for a total of 23 months (774 contact hours).
- Full or part day subgroup (50m group spread) follows
- 5-minute, instantaneous scans at 30 minute intervals. (Ids, activity, food sp., GPS location).
- Food availability: phenology trails (Jan. – Dec. 2009)

Photo: Paul Durkie

Testing sex segregation

- Sexual Segregation and Aggregation Statistic (SSAS) (Bonenfant et al. 2007) to test for random association between males and females against two alternative conditions: (1) the sexes segregate or (2) the sexes aggregate.

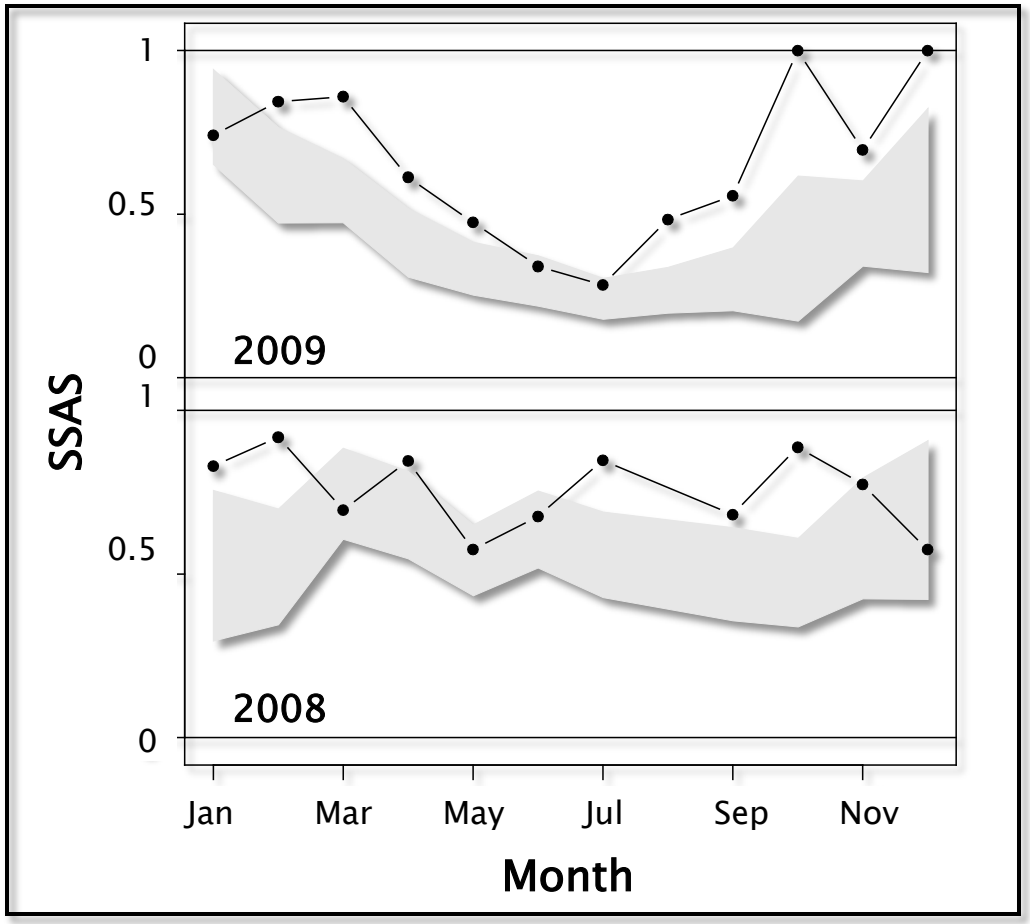
- SSAS uses the number of males and females at each subgroup scan *that included adults* (N=1492) to generate an expected distribution of males and females if they associated at random (given the sex ratio of 1:4).

Data analyses

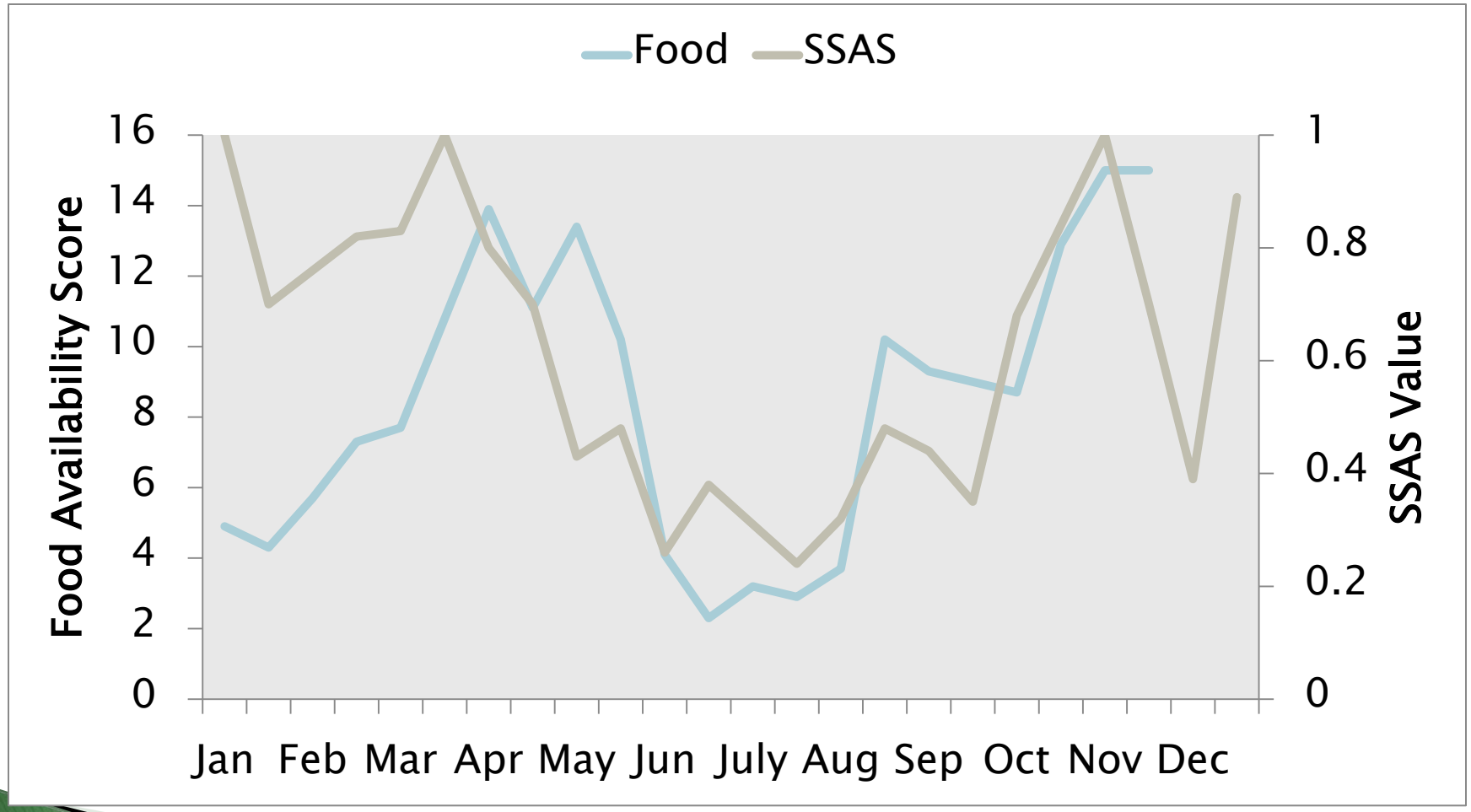
Temporal variation in sexual segregation and food availability (sampled at *monthly* & *bi-weekly* intervals)

Results

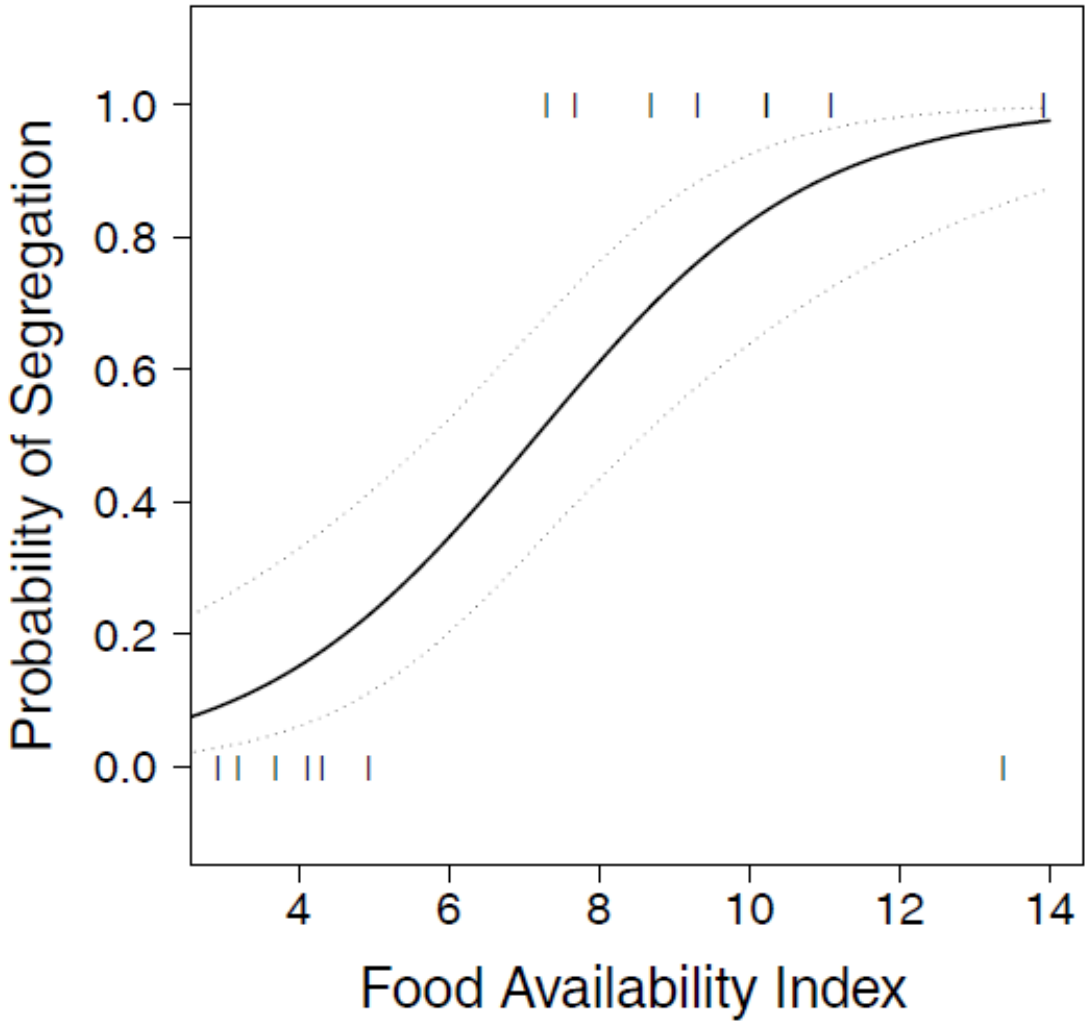
- Monthly variation in sexual segregation



Biweekly variation in food availability and SSAS scores (2009)



Probability of sexual segregation based on biweekly food availability scores (P=0.0017)



Discussion

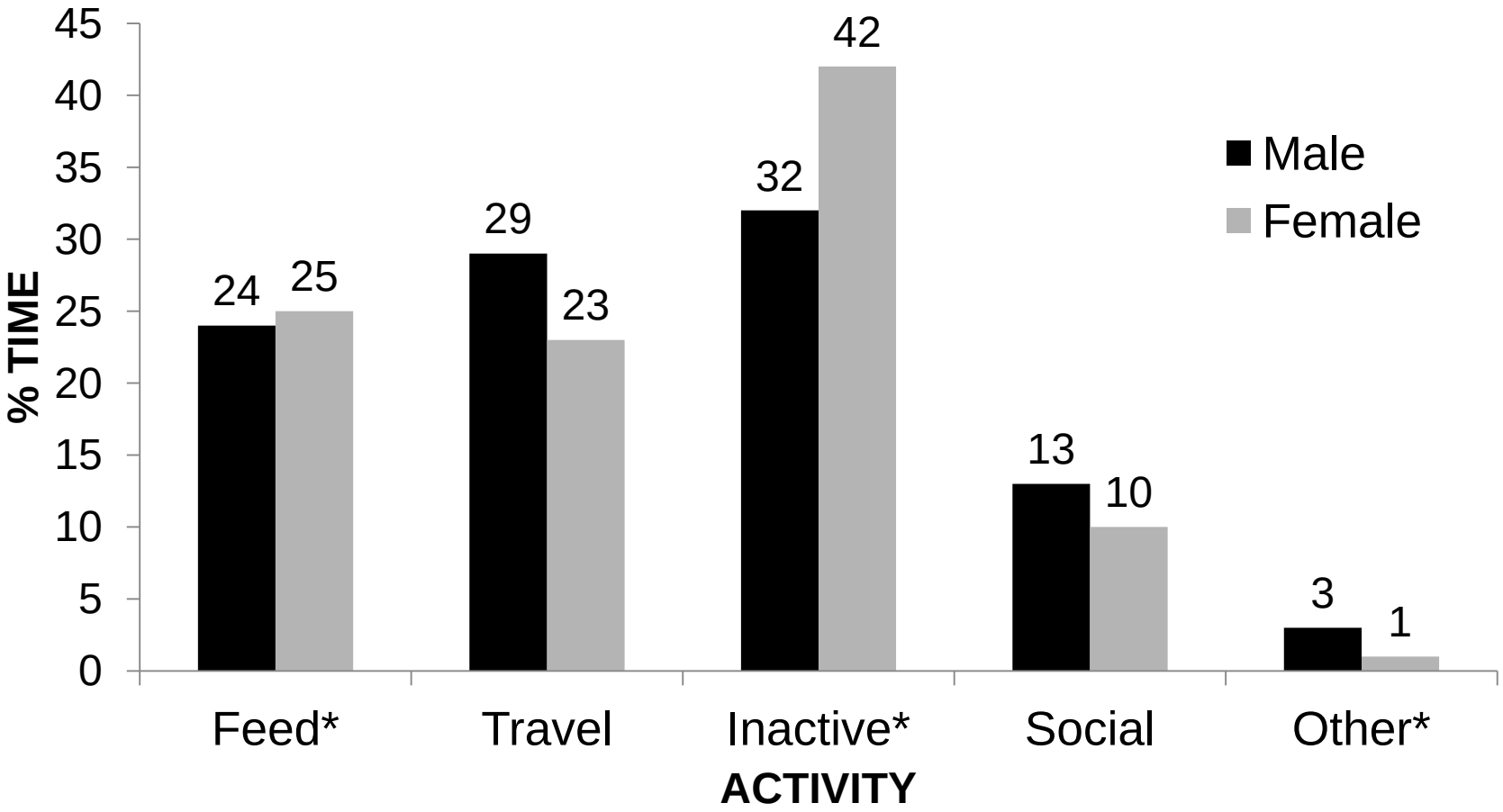
- 1. Spider monkeys can accurately be described as a sexually segregated species as they spend the majority of their time in same-sex groups

- 2. Food availability predicts whether the sexes segregate and might be the proximate mechanism behind segregation
  - More feeding sites available, sexes segregate, and *vice versa*…

On-going research directions and early findings

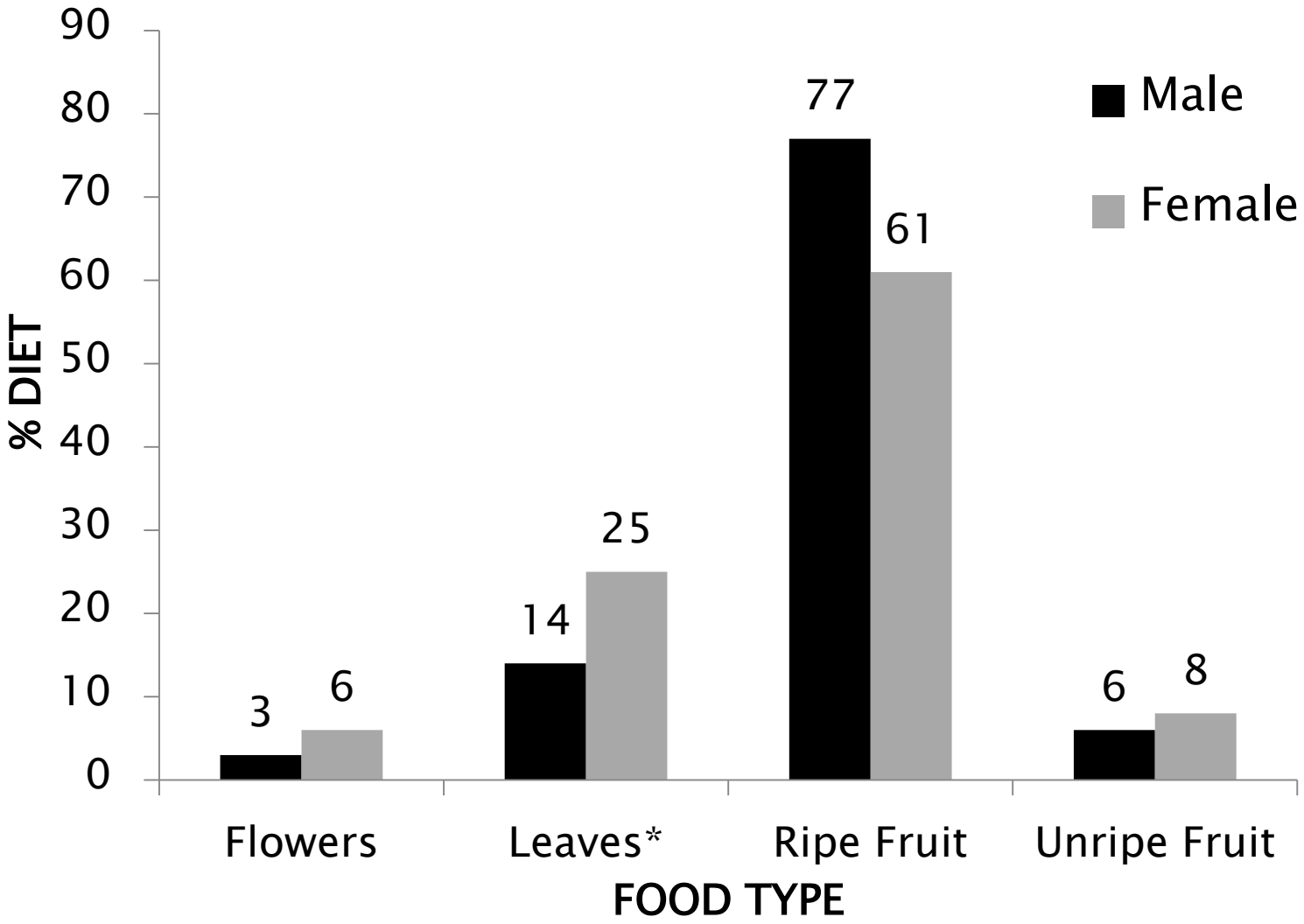
- Proposed functional mechanisms behind sexual segregation:
  - Sex differences in activity budgets
  - Sex differences in diet
  - Sex differences in the likelihood of directing/receiving aggression and the contexts of that aggression

Sex differences in activity budgets



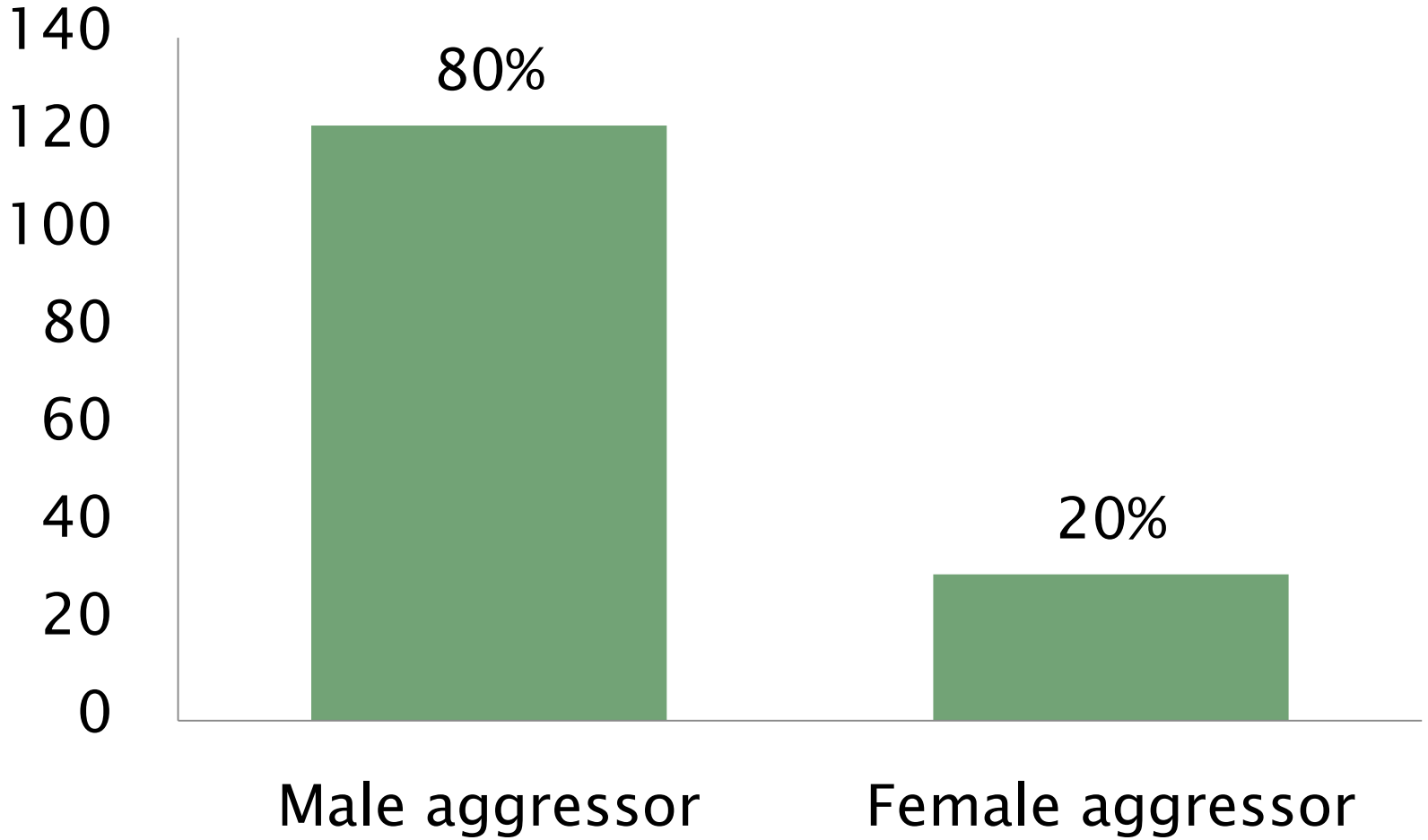
X^2=69.26, df= 4, p=<0.0001

Sex differences in diet



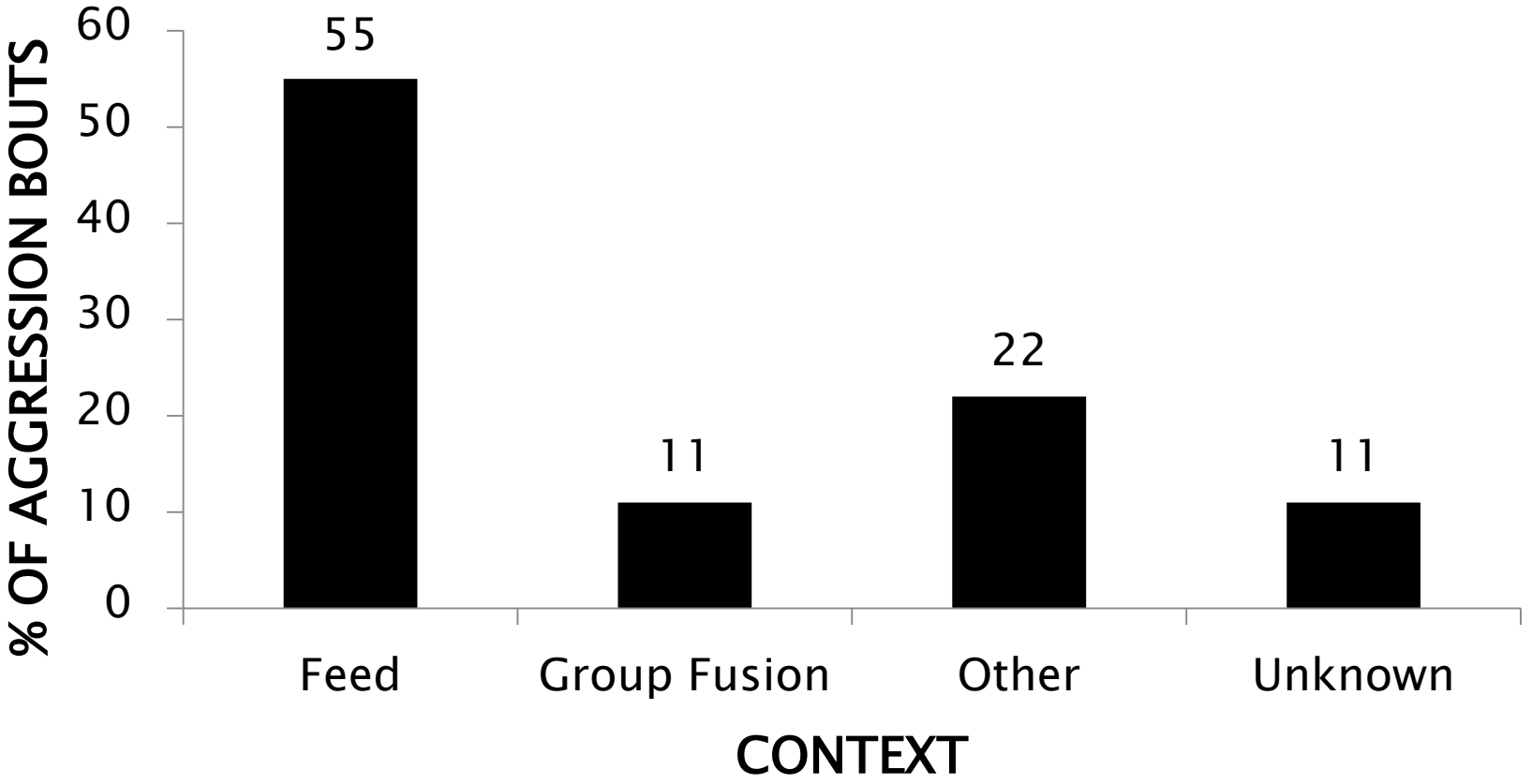
$X^2 = 21.74$, df= 3, p=<0.0001

Incidents of female-directed aggression (FDA) directed by males & females (N = 152)



X^2=54.48, df= 1, p=<0.0001

Contexts of female-directed aggression (FDA) by males (N=122)



X^2=61.93, df= 3, p=<0.0001

Conclusions:

- Sexual segregation in spider monkeys might primarily be a form of “social segregation”
- Females may avoid males at feeding sites in order to avoid FDA. The cost of this avoidance may be a lower quality diet (unripe fruits/leaves).

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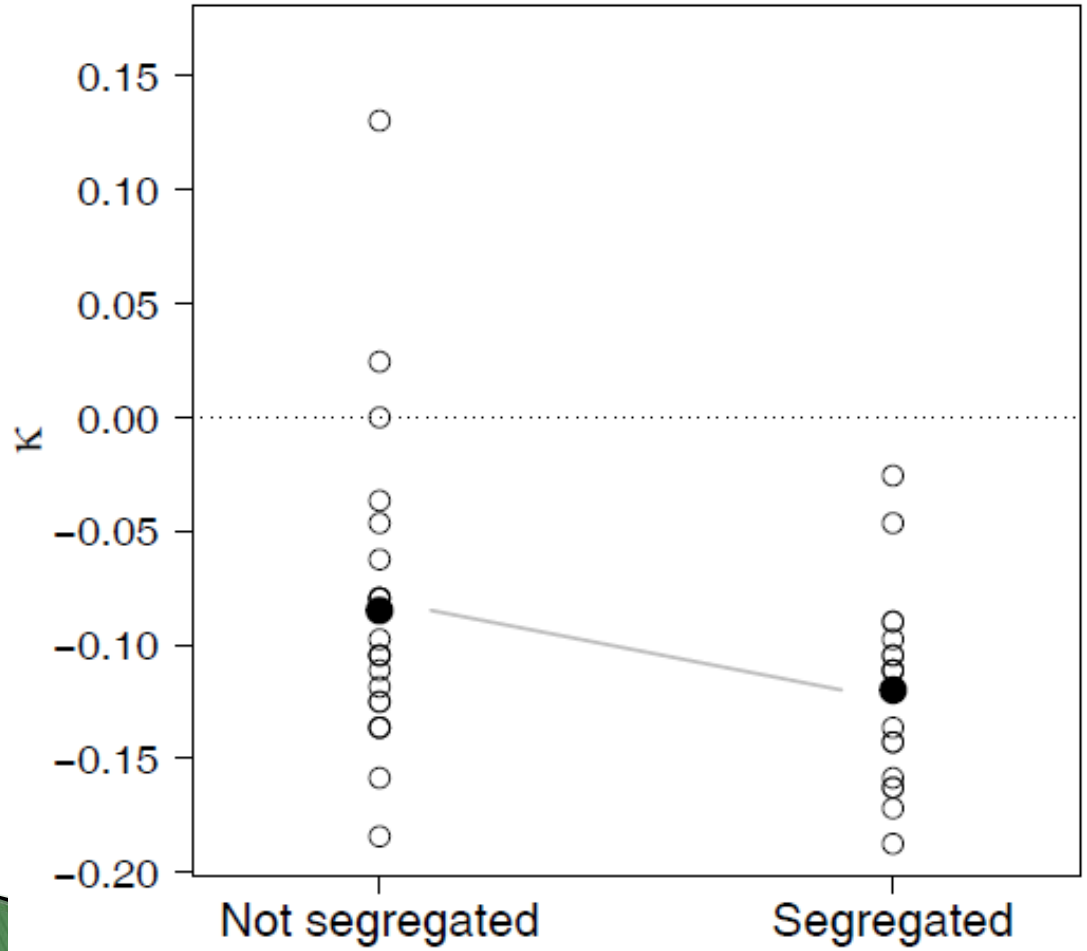
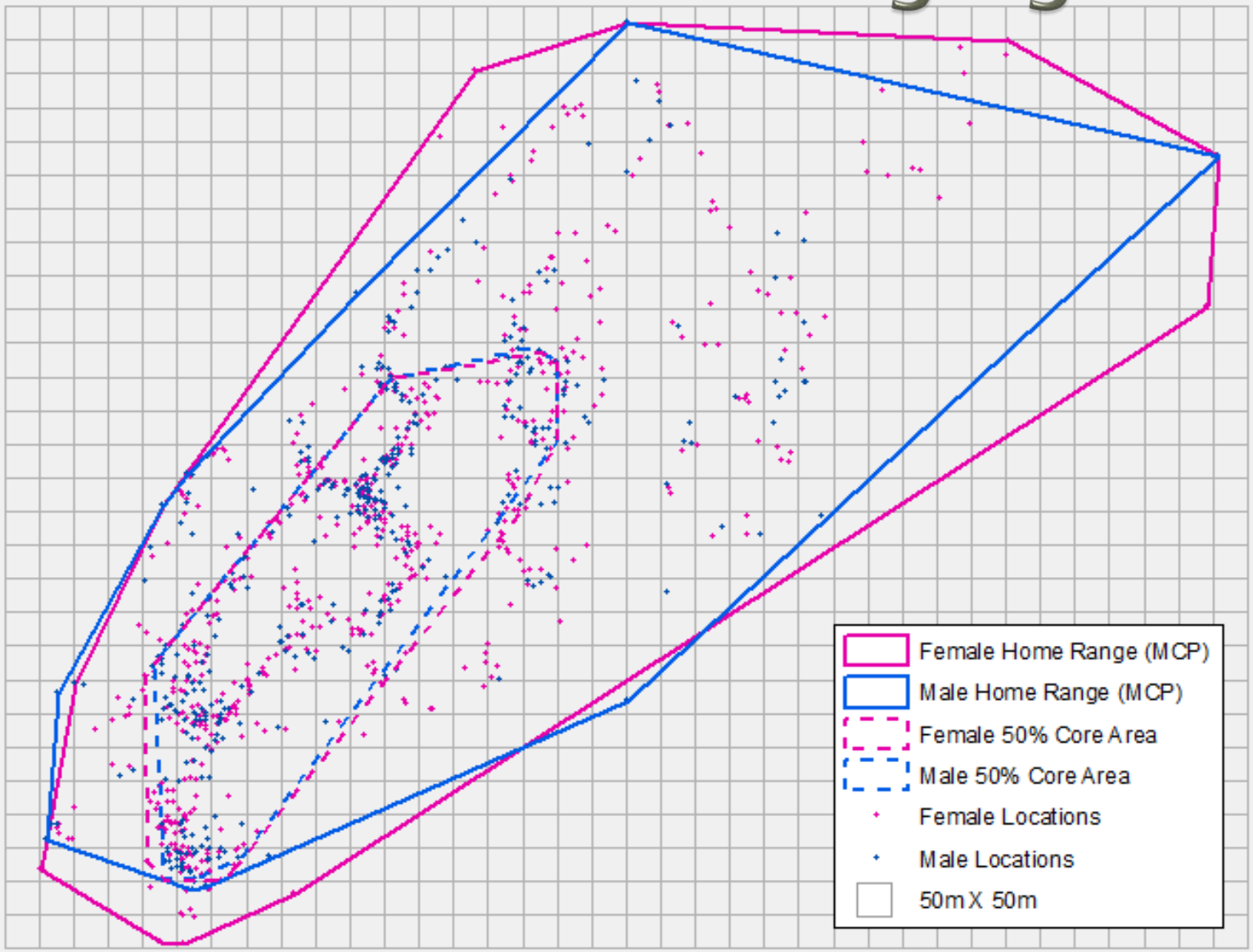
Differences in behavioural synchrony between same- and mixed-sex groups



Segregated groups: Cohen's kappa coefficient: $P = 0.012$

Non-segregated groups: Cohen's kappa coefficient: $P = 0.22$

Sex differences in ranging



$$SSAS = 1 - \frac{N}{XY} \sum_{i=1}^{k} \frac{X_i Y_i}{N_i}$$

- Where:

  XY = total number of males and females sampled

  k = total number of subgroups sampled

  i = selected subgroup

  N_i = subgroup size

  $X_i Y_i$ _ number of males and females is a subgroup