Socio-ecology Part 1: Spatial Groups

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Biol 417: Evolutionary Ecology

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Review

Last lecture we covered how mating systems are driven by male mate guarding strategies adapted to the spatiotemporal distribution of females and the importance of paternal care.

Mate guarding and the spatiotemporal distribution of females sow the seeds of group living, but group living generates competition between mating partners, as well as parents and their offspring.

Over the course of the next several lectures we will cover the ecological conditions that favour the evolution of stable social groups, and the subsequent evolution of social behaviour.

Socio-spatial Organisation

Socio-spatial organisation

Broadly, there are three forms of animal socio-spatial organisation:

i) Simple social systems with minimal cohesion that are often the result of temporary feeding aggregations.

Source: Kids Discover

Socio-spatial organisation

Broadly, there are three forms of animal socio-spatial organisation:

ii) Soc. sys. arising from reproductive behaviour, ranging from brief copulatory associations, to prolonged periods of mate guarding.

Frey *et al.* (2020)

Socio-spatial organisation

Broadly, there are three forms of animal socio-spatial organisation:

iii) long-term associations of multiple adults from both sexes, maintained throughout reproductive, and non-reproductive periods.

Source: Wikipedia

Socio-spatial organisation cont.

These three forms of social organisation are not mutually exclusive, but the latter form is both the most derived, and least prevalent.

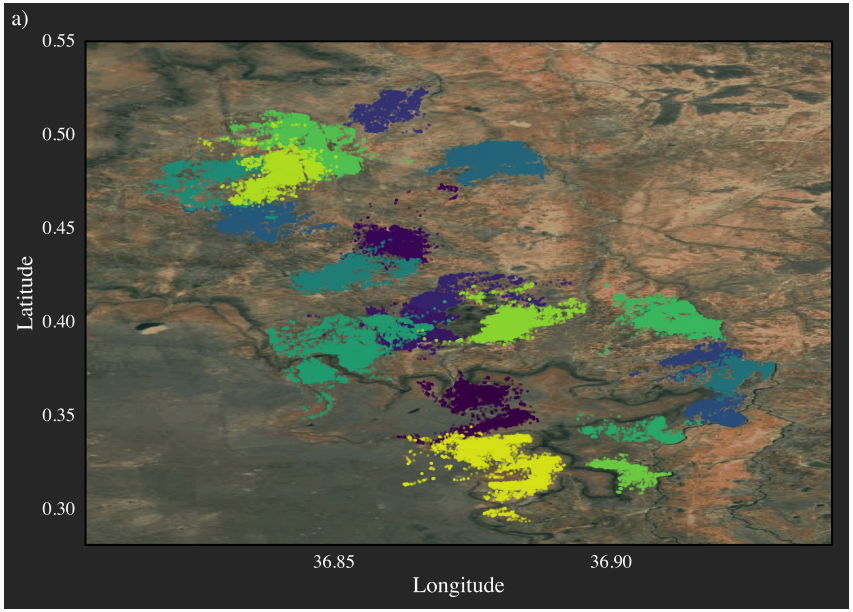
For these long-term associations to develop and persist, temporary aggregations resulting from either feeding ecology or reproductive behaviour must be maintained over time.

This means, the individual level benefits of living with conspecifics must outweigh the costs.

Caveats

Solitary is not synonymous with **asocial**.

The spatial organisation of solitary species is often the result of interactions with conspecifics.



Source: Prof. Adam Ford

Impala (Aepyceros melampus)

Source: Betty Eich, Fine Art America

Caveats cont.

Long-term associations are not synonymous with **cooperative societies**.

Numerous group-living species do not interact cooperatively, and forage alone.

Caveats cont.

Co-operation is not a pre-requisite for the formation of social groups.

Co-operation not a necessity of group-living.

There is a distinction between **spatial groups**, which are stable but exhibit little evidence of cooperative behaviour and **social groups**, which exhibit at least some extent of social behaviour.

Evolution of spatial groups

Given the variation in life-histories, diets, body sizes, morphologies, niches, etc. across the animal kingdom, it is clear that no single mechanism is, or indeed can be, universal.

Over the next couple of lectures we will explore several non-mutually exclusive hypotheses for addressing the formation of spatial groups.

Predator Avoidance Hypothesis

Predator Avoidance Hypothesis

The predator avoidance hypothesis was first mentioned by Francis Galton in 1871, but formalised a century later by Hamilton (1971).

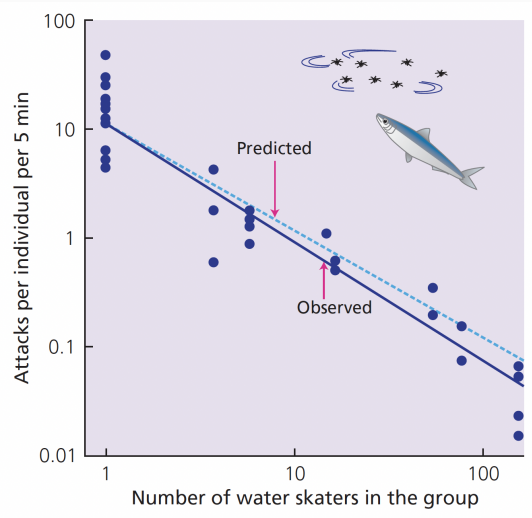
Mechanism: Aggregations serve to dilute the individual level predation threat.

If a solitary animal encounters a predator the probability of being preyed upon is 1.

If a group of animals encounter a predator the probability of being preyed upon is $\frac{1}{N}$.

Predator Avoidance Hypothesis cont.

Water skaters (*Halobates robustus*)



Davies *et al.* (2012)

There is substantial support for the predation dilution mechanism.

... but the maintenance/size of these groups poses a significant challenge.

These groups can only be supported if local resources can support the energetic requirements of multiple adults.

Meerkat Societies

Source: Wikipedia

Meerkat (*Suricata suricatta*) societies benefit from:

- Predator dilution.
- Mobbing of predators.
- Collective vigilance.
- Collective protection of neonates.
- Collective burrow maintenance.

Diet is primarily insectivorous with opportunistic omnivory.

Predator Avoidance Hypothesis

Although the mechanisms have support, the predator avoidance hypothesis alone often falls short for describing patterns in group living.

Many species with few to no predators still form groups

Source: Earth Magazine, David S. Green

... and those with many predators and abundant resources don't form groups.

Source: Wikipedia

Information Center Hypothesis

Information Center Hypothesis

The Information Center Hypothesis was formalised by Ward & Zahavi (1973).

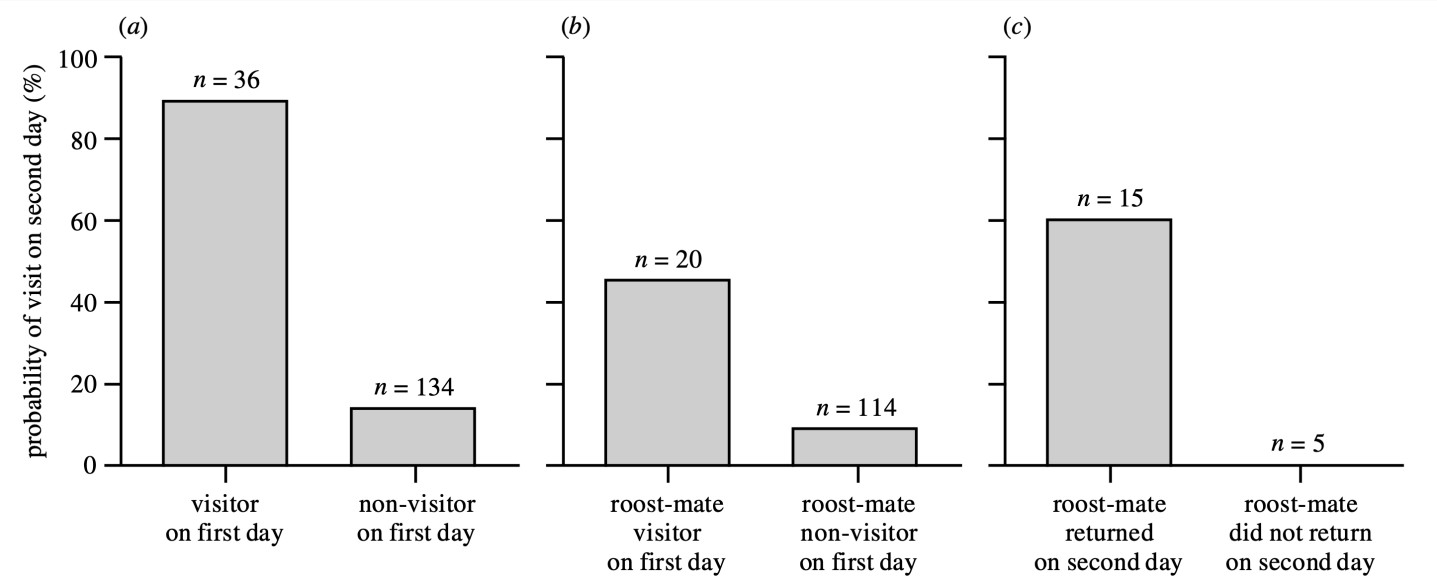
Mechanism: Aggregations provide individuals with information on the foraging activities of conspecifics.

Source: Wikipedia

ICH in hooded crows

Source: Wikipedia

Sonerud *et al.* (2001) provided hooded crows (*Corvus corone cornix*) with access to food patches that varied unpredictably in space and time and studied their foraging behaviour.



Sonerud *et al.* (2001)

ICH in striped mice

Source: Wikipedia

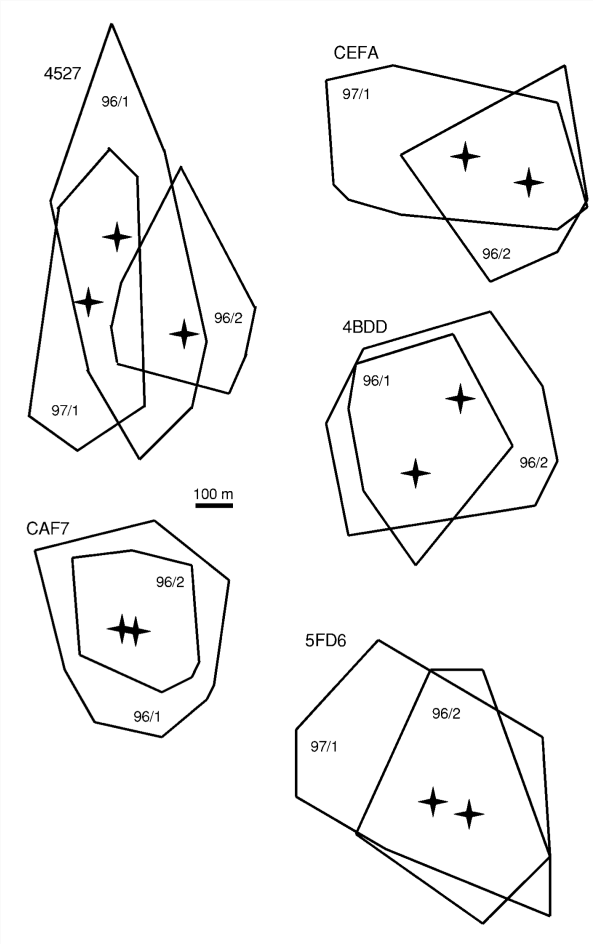
Schradin (2007) provided striped mice (*Rhabdomys pumilio*) with access to food patches that varied unpredictably in space and time and studied their foraging behaviour.

- A mouse that found food at one location visited it again the next day (same as crows).
- Other mice from the same group did not arrive (opposite of crows).
- Groups can consist of up to 30 adult but do not benefit from information transfer.

ICH in Bechstein's bats

Source: Wikipedia

Kerth *et al.* (2001) radio-tracked Bechstein's bats (*Myotis bechsteinii*) to study their foraging behaviour.



Kerth *et al.* (2001)

Females roosted together but foraged apart so information transfer about food is unlikely to explain sociality.

Information Center Hypothesis

The mechanisms underlying the ICH have been demonstrated in many species (Emlen, 1971; Ward & Zahavi, 1973; Mobley & Schenker, 1981; Sonerud *et al.*, 2001)

Source: Mark Watson, Variety of Life

...there are just as many other group-living species that would be expected to benefit from information transfer but don't (Hoogland, 1981; Kerth *et al.*, 2001; Schradin, 2007).

Source: StefaniePayne, Getty Images

Spatial Groups Take Homes

Long-term associations of multiple adults from both sexes are the most derived form of spatial groups, but also least prevalent.

For these groups to develop and persist, the individual level benefits of living with conspecifics must outweigh the costs.

The mechanisms behind the Predator Avoidance Hypothesis have empirical support, but the PAH struggles to provide a mechanism for the formation of stable groups in the face of competition.

The mechanisms behind the Information Center Hypothesis also have support, but there are many group-living species that would be expected to benefit from information transfer but don't.

Spatial Groups Take Homes cont.

The hypotheses we covered today provide a good start towards identifying the mechanisms underlying the formation of spatial groups, but are clearly not sufficient on their own.

We will continue exploring mechanisms for the formation of spatial groups next lecture...

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