Socio-ecology Part 2: Mating systems and Resource Dispersion

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Biol 417: Evolutionary Ecology

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Review

Review

Last lecture we covered the concept that for long-term associations of multiple adults from both sexes to develop and persist, the benefits of living with conspecifics must outweigh the costs.

We saw how the Pred. Avoid. Hypo. and the Info. Center Hypo. have empirical support, but the PAH struggles to provide a mechanism for the formation of stable groups in the face of competition, and that there are many group-living species that would be expected to benefit from information sharing but don't.

Mechanistically, the PAH and ICH are thus insufficient on their own...

Mate Guarding and Group-Living

Local competition

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Mate guarding brings individuals together and provides a path towards group-formation if aggregations can be maintained (Lukas & Clutton-Brock, 2013).

... but many species form mating pairs that eventually dissipate outside of the breeding season:

Bush dogs,
Speothos venaticus
(Beisiegel & Zuercher, 2005)

Source: Reddit

Honey badgers,
Mellivora capensis
(Vanderhaar & Hwang, 2003)

Source: NatGeo

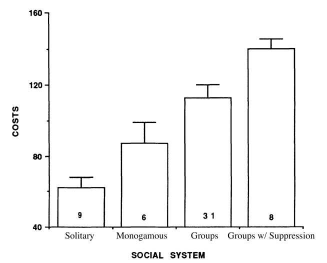
Corsac foxes,
Vulpes corsac
(Clark *et al.*, 2009)

Source: Reddit

Reproductive supression

For anything beyond social monogamy, reproductive competition and reproductive suppression of subordinates poses a serious challenge for translating a mating system into a social system.

Creel *et al.* (1991) found that reproductive suppression in carnivores was more prevalent when the energetic costs of rearing young are high.

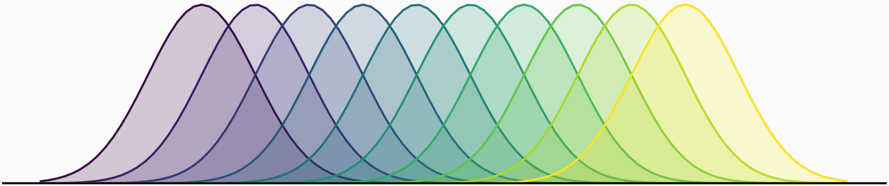


(Creel *et al.*, 1991)

Resources, Competition, and Group-Living

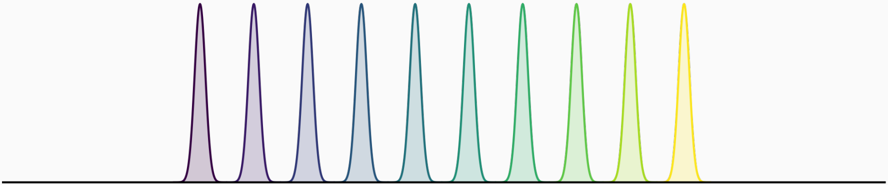
Local competition

An intrinsic aspect of living in a group is competition for local resources.



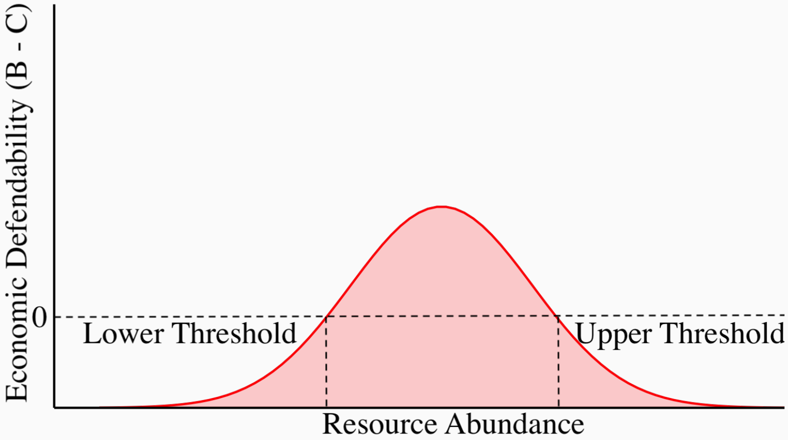
Local competition

Without substantial benefits, local competition will lead to niche separation and will select against group-living... Maybe



Local competition cont.

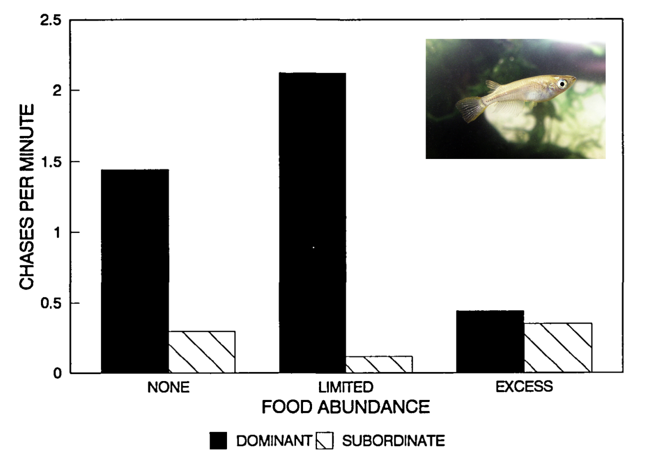
Highly abundant resources are not economic to defend as the benefits do not outweigh the costs.



Redrawn from: Grant (1993)

Local competition cont.

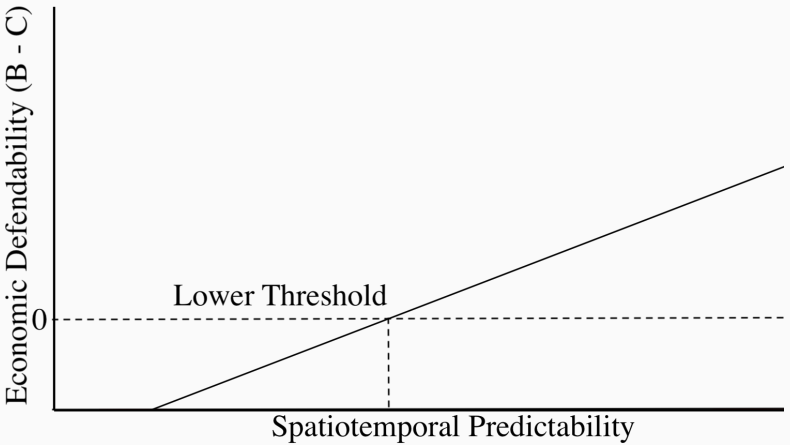
When food is limited, Japanese rice fish (*Oryzias latipes*) defend access, but stop when food is abundant.



Grant (1993)

Local competition cont.

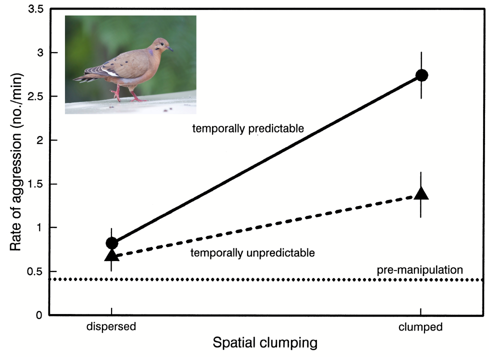
Highly **unpredictable** resources are not economic to defend as the benefits do not outweigh the costs.



Redrawn from: Grant (1993)

Local competition cont.

When food was clumped and predictable, Zenaida doves (*Zenaida aurita*) defend access, but aggression decreased when food became unpredictable.



Goldberg *et al.* (2001)

Resources and Group-Living

Patterns in resource availability and predictability affect the defendability of resources and the potential for group-living.

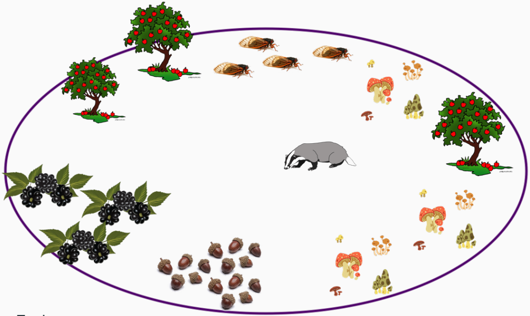
	Unpredictable	**Predictable**
Limited	Undefendable Can't supp. mult. adults	Defendable Can't supp. mult. adults
Abundant	Undefendable Can supp. mult. adults	Defendable Can supp. mult. adults

Resource Dispersion Hypothesis

Resource Dispersion Hypothesis

Macdonald (1983) proposed the Resource Dispersion Hypothesis (RDH) as a passive mechanism towards group formation.

Mechanism: If the dispersion and renewal rate of local resources result in a territory that can viably accommodate multiple individuals, groups can arise without any specific benefits, assuming there are minimal costs to the 'primary territory holder'.



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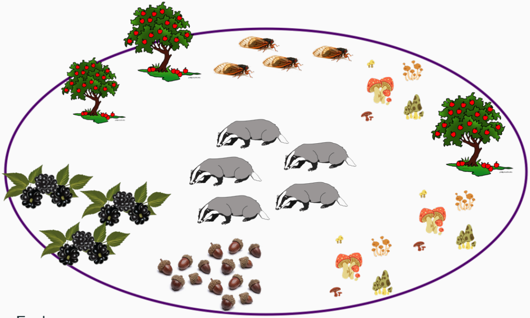


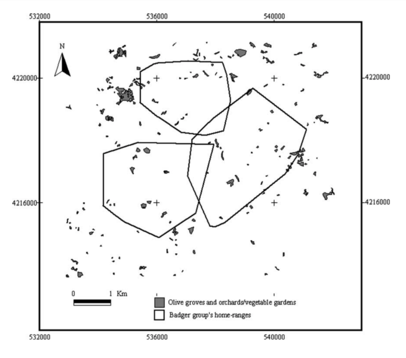
RDH cont.

The ecological conditions favouring the evolution of group-living are best summarised by Macdonald & Johnson (2015):

Table 3 Conditions that make RDH more or less likely to enable group formation in a given species or setting

Domain	Low chance of RDH	High chance of RDH	Explanation
Body size	Small	Large	Larger body size (and lower metabolism) increases tolerance of low food security
Life-history	r-selected	K-selected	Longer life span increases capacity to incur short-term costs for long-term gains (e.g. sharing territory or low food security)
Niche	Generalists	Specialists	Specialist diet reduces choice of alternative prey or feeding areas (and thus increases reliance on the availability of a given set of resource patches)
Key resources	Few	Many	A greater number of limiting resources (e.g. patchy food and water and shelter) is more likely to compel home range overlap or tolerance of secondaries. (Note this does not work for multiple prey types, hence the opposite implication for niche generalists/specialists above)
Prey type	Small	Large	Larger prey more likely to represent concentrated patches of energy (though not always, since small prey can themselves be concentrated)
Body plan	Low body fat	High body fat	Greater body fat increases tolerance of low food security
Topor	Absent	Present	Topor/hibernation increases tolerance of low food security
Food caching	No	Yes	Caching food increases tolerance of low food security
Signalling	Absent	Present	Information transfer allows dispersed resource patches to be found and shared more efficiently, reducing food insecurity
Habitat	Homogenous	Heterogeneous	Diverse habitats more likely to yield patchy resources across space
Climate	Stable/predictable	Variable/unpredictable	Variable/unpredictable climate more likely to yield patchy resources over time

RDH in Spanish Badgers



(Rosalino *et al.*, 2005)

Rosalino *et al.* (2005) found a positive correlation between patch dispersion (water sources, orchards, and olive groves) and HR size in European badgers (*Meles meles*) in Spain.

RDH in cape clawless otters

Source: John Wright - 2008

Somers & Nel (2004) found a positive correlation between the number of reed beds patches and HR size in cape clawless otters (*Aonyx capensis*) in South Africa.

… but cape clawless otters are all solitary.

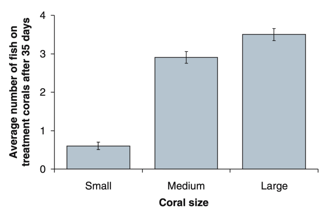
RDH in Golden coral goby

Source: Nature Picture Library

Source: Fishes of Australia

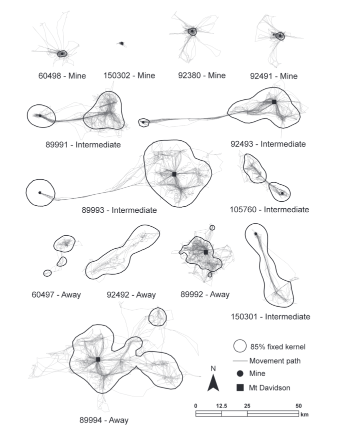
Thompson *et al.* (2007) added new coral reefs to a natural system and studied the occupancy by Golden coral goby (*Paragobiodon xanthosoma*).

They found a + corr. between patch size and group size.



(Thompson *et al.*, 2007)

RDH in Dingoes



Newsome *et al.* (2013)

Source: Juergen & Christine Sohns/Nature PI

Newsome *et al.* (2013) found a +ve corr. between resource abundance and group size in dingoes (*Canis lupus dingo*),

and a -ve corr. between HR size and resource abundance.

Resource Dispersion Hypothesis

There is evidence that more dispersed resources are correlated with larger home ranges (e.g., badgers and otters).

There is evidence the resource abundance is related to larger group sizes (e.g., gobies and dingoes).

... but there is no evidence directly linking resource dispersion **and** abundance to group size.

... and no evidence linking these to the transition from solitary living to group living.

The extent to which the RDH promotes group living is still largely unknown.

Spatial Groups Take Homes

Mate guarding, predator avoidance and information sharing brings individuals together, but often fall short when providing a mechanism for the maintenance of stable spatial groups.

The RDH provides a mechanism for the passive formation of spatial groups without the need for any benefits and many of the mechanisms have empirical support... but the RDH hasn't been explicitly linked to the evolution of group living.

From the pieces we have so far, no individual hypothesis alone is likely to explain group living in any species.

We will continue along this line of thought next lecture...

References

Beisiegel, B.d.M. & Zuercher, G.L. (2005). *Speothos venaticus*. *Mammalian Species*, 783, 1–6.

Clark, H.O., Murdoch, J.D., Newman, D.P. & Sillero-Zubiri, C. (2009). *Vulpes corsac* (Carnivora: Canidae). *Mammalian Species*, 832, 1–8.

Creel, S.R., Creel, S.R., Creel, N.M. & Creel, N.M. (1991). Energetics, reproductive suppression and obligate communal breeding in carnivores. *Behavioral Ecology and Sociobiology*, 28, 263–270.

Goldberg, J.L., Grant, J.W. & Lefebvre, L. (2001). Effects of the temporal predictability and spatial clumping of food on the intensity of competitive aggression in the zenaida dove. *Behavioral Ecology*, 12, 490–495.

Grant, J.W. (1993). Whether or not to defend? the influence of resource distribution. *Marine & Freshwater Behaviour & Phy*, 23, 137–153.

Lukas, D. & Clutton-Brock, T.H. (2013). The Evolution of Social Monogamy in Mammals. *Science*, 341, 526–530.

Macdonald, D. & Johnson, D. (2015). Patchwork planet: the resource dispersion hypothesis, society, and the ecology of life. *Journal of Zoology*, 295, 75–107.

Macdonald, D.W. (1983). The ecology of carnivore social behaviour. *Nature*, 301, 379–384.

Newsome, T.M., Ballard, G.A., Dickman, C.R., Fleming, P.J. & van de Ven, R. (2013). Home range, activity and sociality of a top predator, the dingo: a test of the resource dispersion hypothesis. *Ecography*, 36, 914–925.

Rosalino, L.M., Macdonald, D.W. & Santos-Reis, M. (2005). Resource dispersion and badger population density in Mediterranean woodlands: is food, water or geology the limiting factor? *Oikos*, 110, 441–452.

Somers, M. & Nel, J. (2004). Movement patterns and home range of cape clawless otters (aonyx capensis), affected by high food density patches. *Journal of Zoology*, 262, 91–98.

Thompson, V., Munday, P. & Jones, G. (2007). Habitat patch size and mating system as determinants of social group size in coral-dwelling fishes. *Coral Reefs*, 26, 165–174.

Vanderhaar, J.M. & Hwang, Y.T. (2003). *Mellivora capensis*. *Mammalian Species*, 721, 1–8.