

DO MOVEMENT PATTERNS AND HABITAT USE DIFFER BETWEEN OPTIMAL- AND SUBOPTIMAL-SIZED NORTHERN BOBWHITE COVEYS?



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The value of non-breeding social groups

- 1) Thermoregulation
- 2) Increased feeding efficiency
- 3) Defense against predators
 - a) Individual vigilance decreases
 - b) Group vigilance increases
 - c) Increased speed of predator detection



Stable Group Size

These variables promote limits to group size

- “stable group size”
the range of sizes that varies between the size at which the group’s members direct fitness equals that of solitaires.

- “optimal group size”
the point in which individual fitness is maximized.

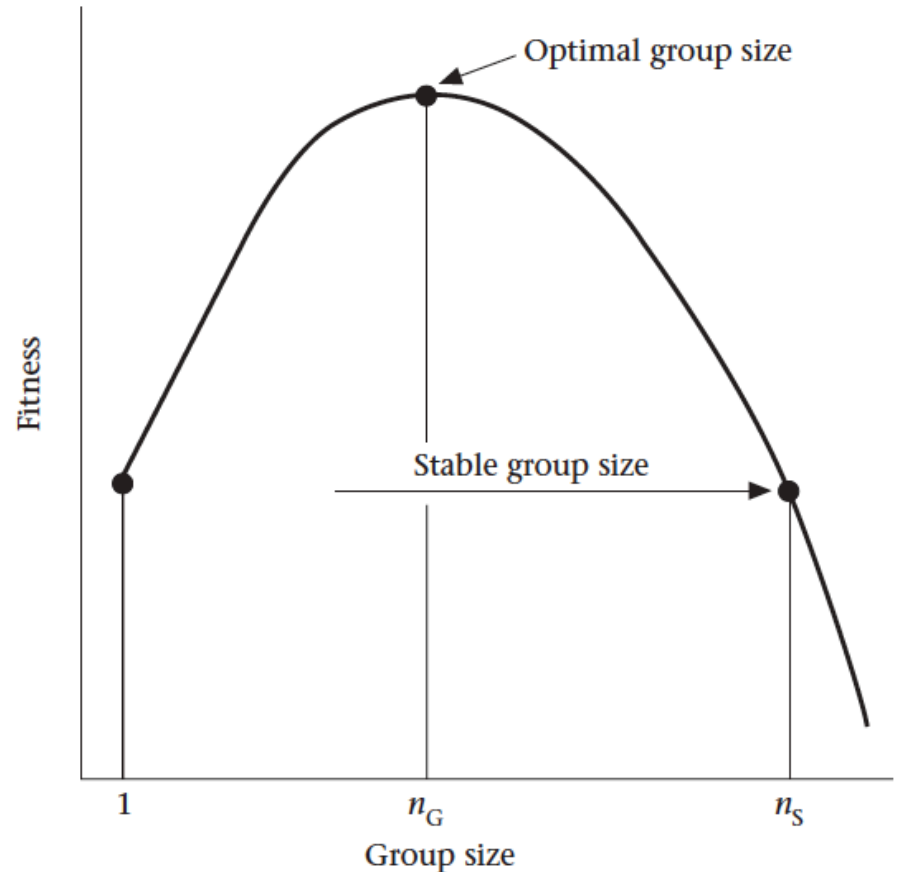


Figure 1. Higashi & Yamamura's (1993) theoretical relationship between group size and individual fitness. A 'stable group size' is expected to occur at a maximum group size n_S when individual fitness equals that of a solitary individual. Consequently, group sizes above n_S are unstable. An 'optimal group size' (n_G) is expected when individual fitness is maximized somewhere between 1 individual and n_S .

Northern bobwhite covey size behavioral dynamics

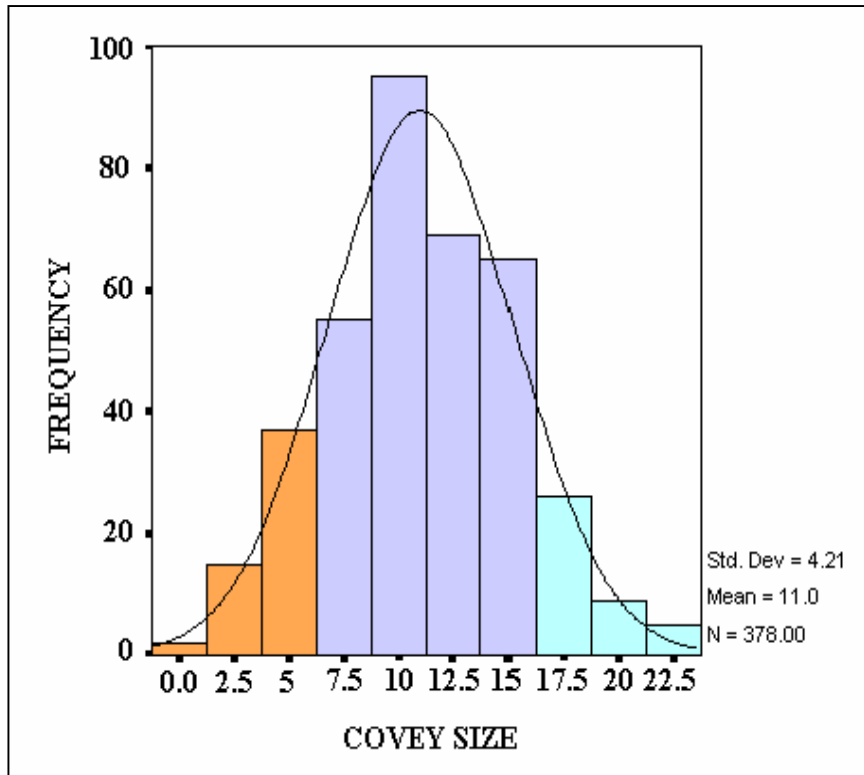
Optimal group size and northern bobwhite coveys

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	≤ 7	8-14	≥ 15
Time feeding	-	0	+
Mass change	+	0	-
Predator vigilance	-	0	+
Thermoregulation	-	+	+
Survival	-	+	-

Covey size and mean daily movement

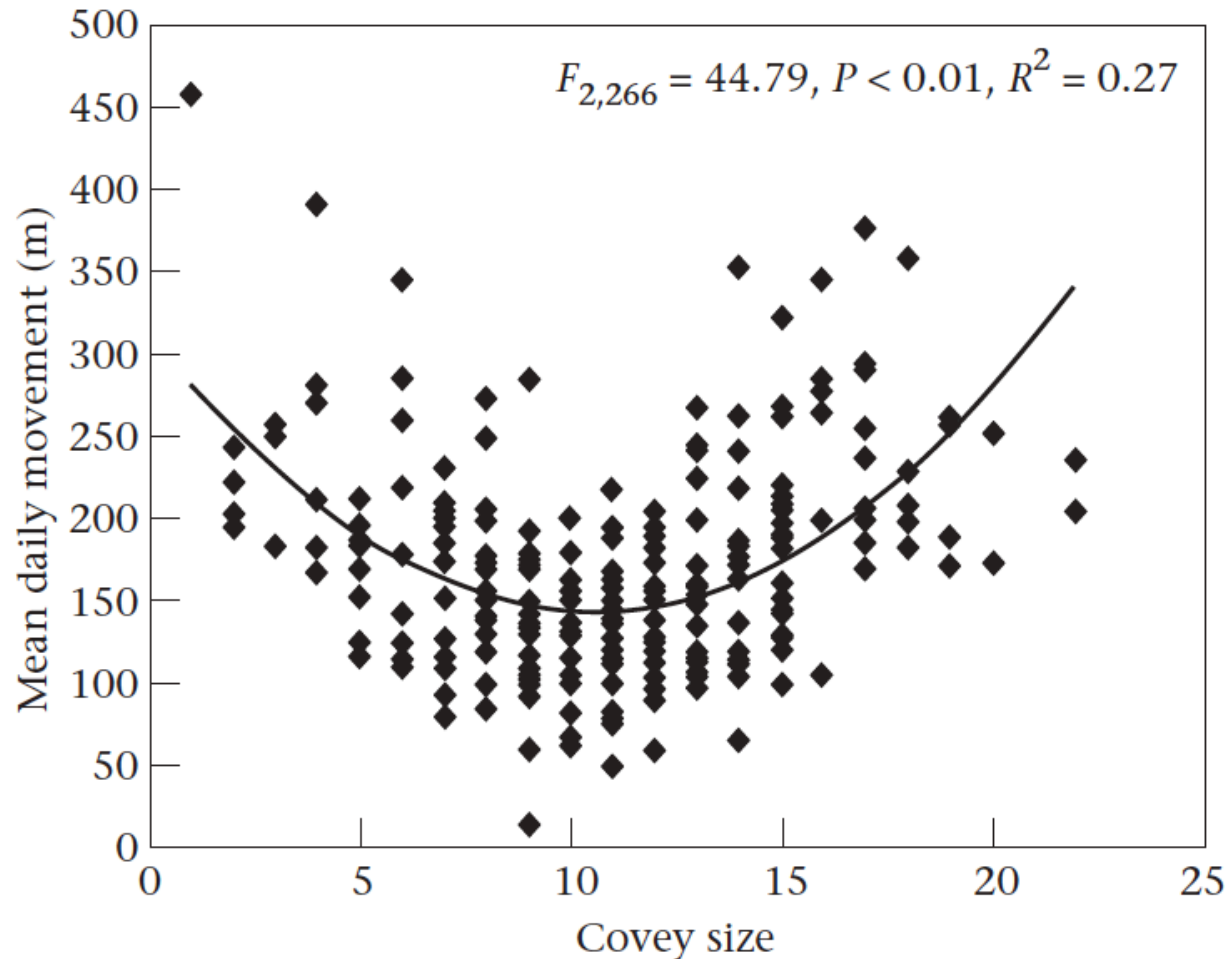


Figure 6. The relationship between covey size and mean daily movement between 8 November and 31 January 1997–2000 in east-central Kansas.

Covey size and mean daily movement

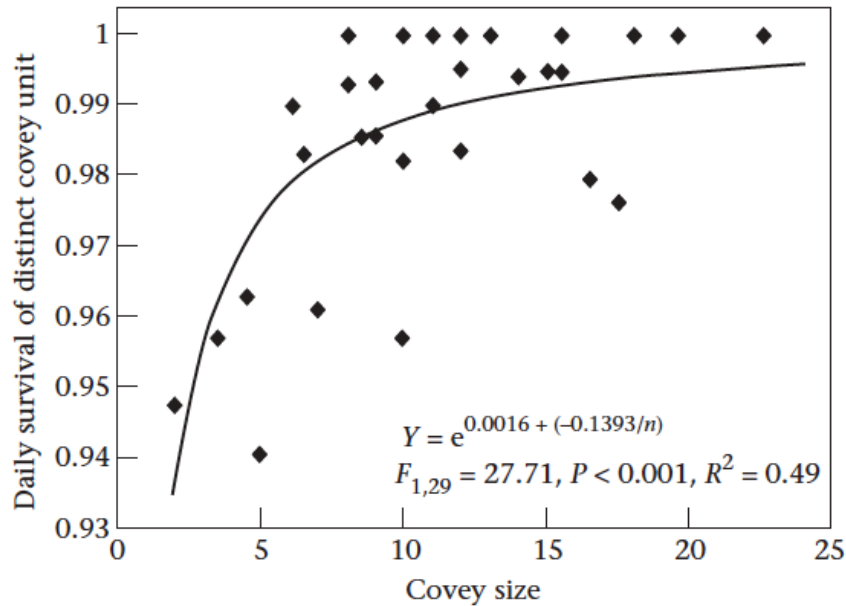
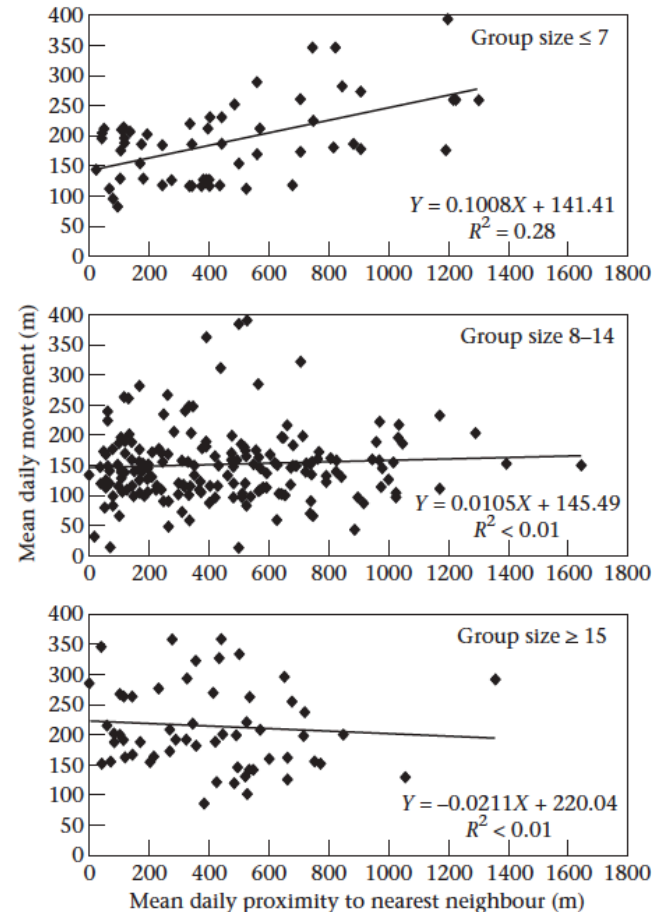


Figure 8. The influence of covey size on a covey's persistence (i.e. the covey did exchange membership) between 9 November and 31 January 1997–1999 in east-central Kansas.



Readily
collapse and
join other
coveys

Rarely
break
apart

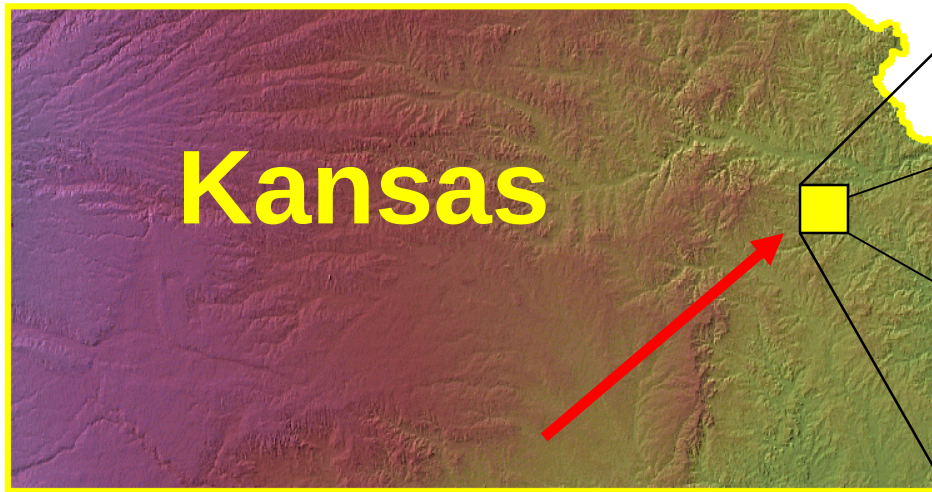
Figure 7. The relationship between the proximity to closest neighbor and mean daily movement in small (≤ 7 individuals), medium (8–14) and large (≥ 15) coveys between 8 November and 31 January 1997–2000 in east-central Kansas.

Goals

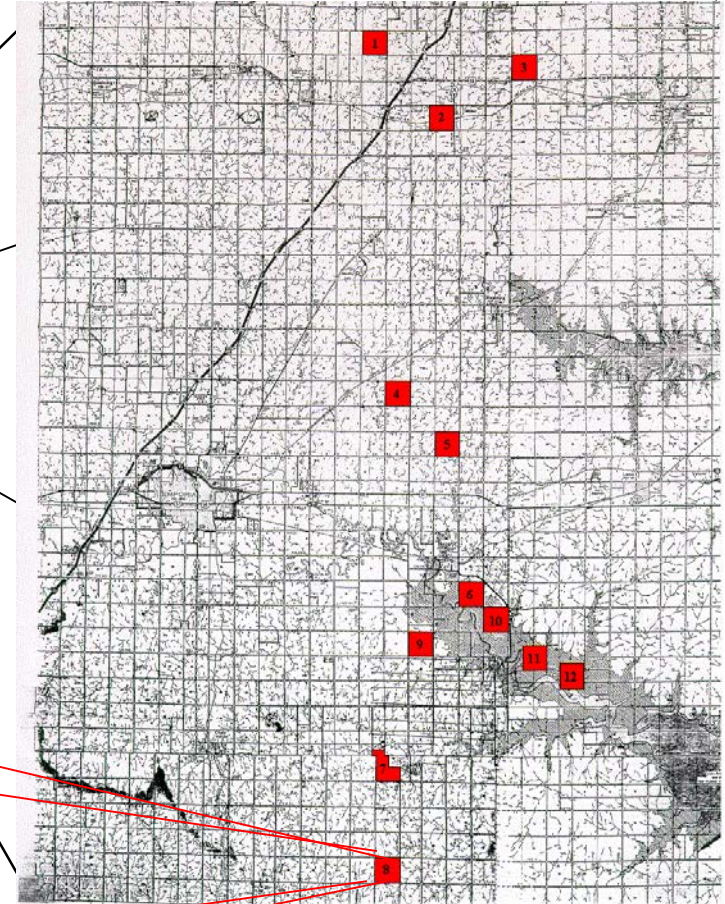
- Small and large coveys are moving more. Is that bounded movement or are they getting the hell out of Dodge? And in either case, why?
 - Quantify movement patterns and habitat use
 - Correlated random walk models
 - Summarize search strategies/ movement patterns into measures of daily movement distances and turning angles
 - Fractal dimension analysis
 - Relate animal movement patterns to the spatial patterns of the distribution of their resources
 - Habitat Use: Compositional analysis



Field study areas

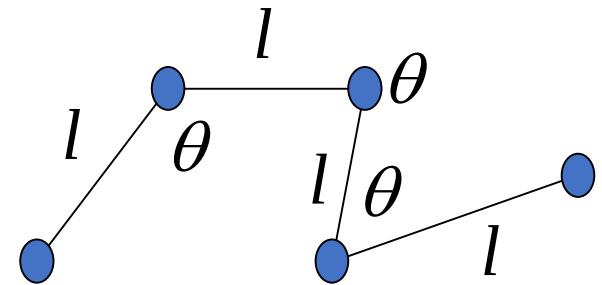
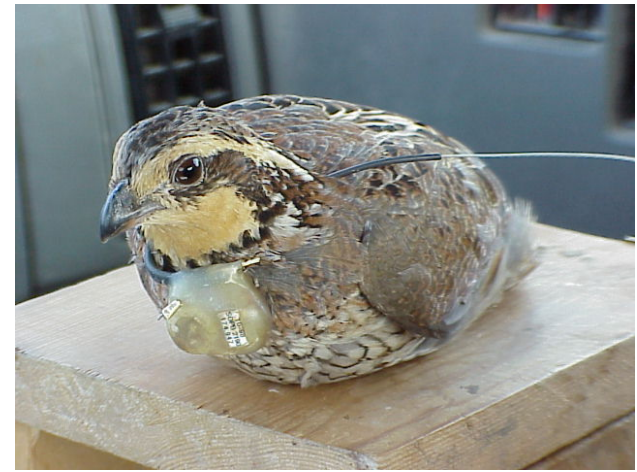


Eastern Lyon,
Western Osage
and Coffee
Counties



Data

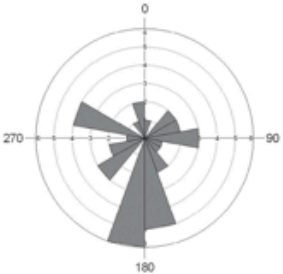
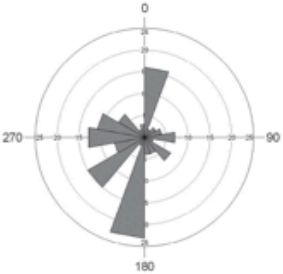
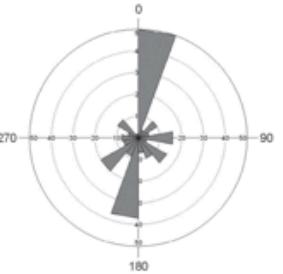
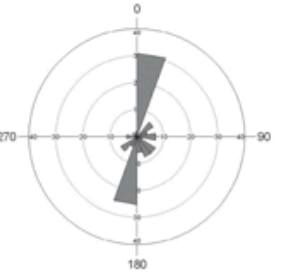
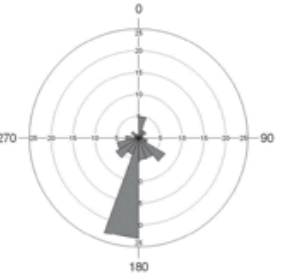
- Covey-week considered independent sampling unit with known covey size and 5 consecutive locations (4 daily path distances [l], 3 turning angles [θ]).
- 195 covey weeks, Oct-Feb 1997-2000



Covey size	Sample size			Mean daily move distance (m) (SE)
	Covey-weeks	Daily path distances	Turning angles	
1-4	12	48	36	278.9 (38.8)
5-8	44	176	132	183.2 (13.2)
9-12	74	296	222	147.0 (6. 5)
13-16	40	160	120	172.4 (13.2)
≥17	25	100	75	237.3 (18.0)

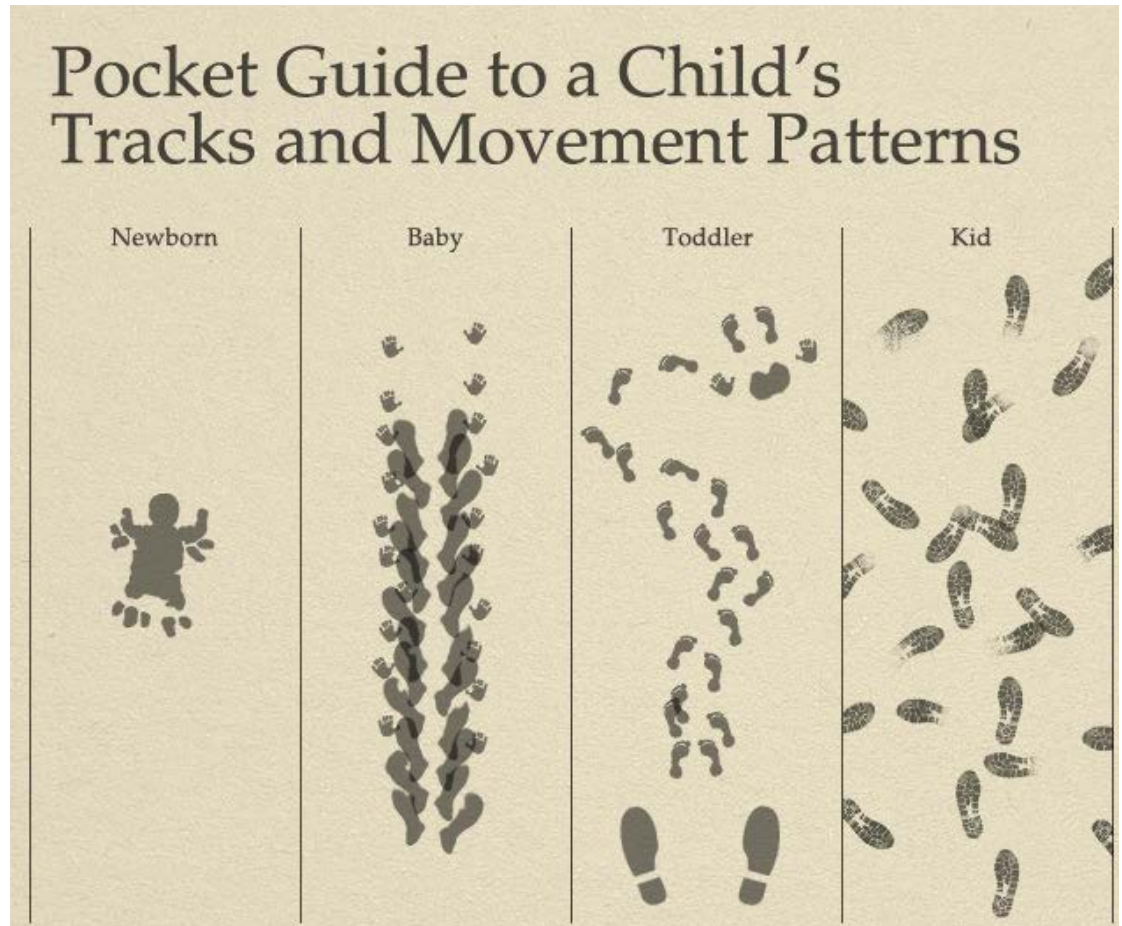
First test: simple random walk model

- Test whether organisms travel in a random fashion with uniform distributions of turning angles
- Smallest coveys (1-4 indiv) are uniform in turning angles.
Small coveys (1-8) different from larger coveys

Covey Size	1-4	5-8	9-12	13-16	>17
Turning angle distribution					
Rayleigh's test of uniformity, <u>P</u>	0.11	<0.01	<0.01	<0.01	<0.01
Chi-Square between group comparison	9-12 13-16	13-16	-	-	-

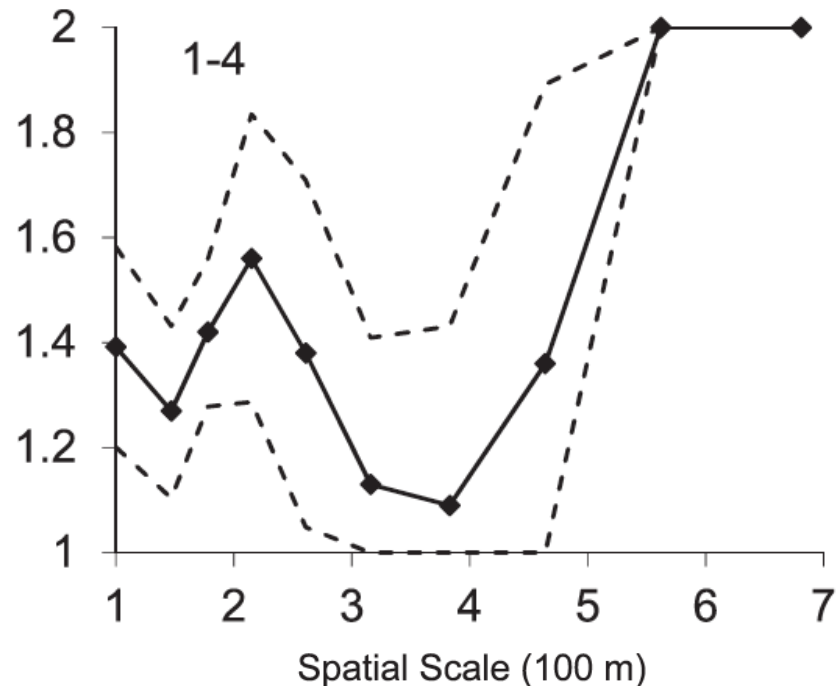
Fractal Dimensions

- The fractal dimension (D) indexes overall complexity of an animal's movement pattern at multiple scales.
 - $D \sim 1$ = directed straight line movements
 - $D \sim 2$ = brownian diffusion that fills a plane



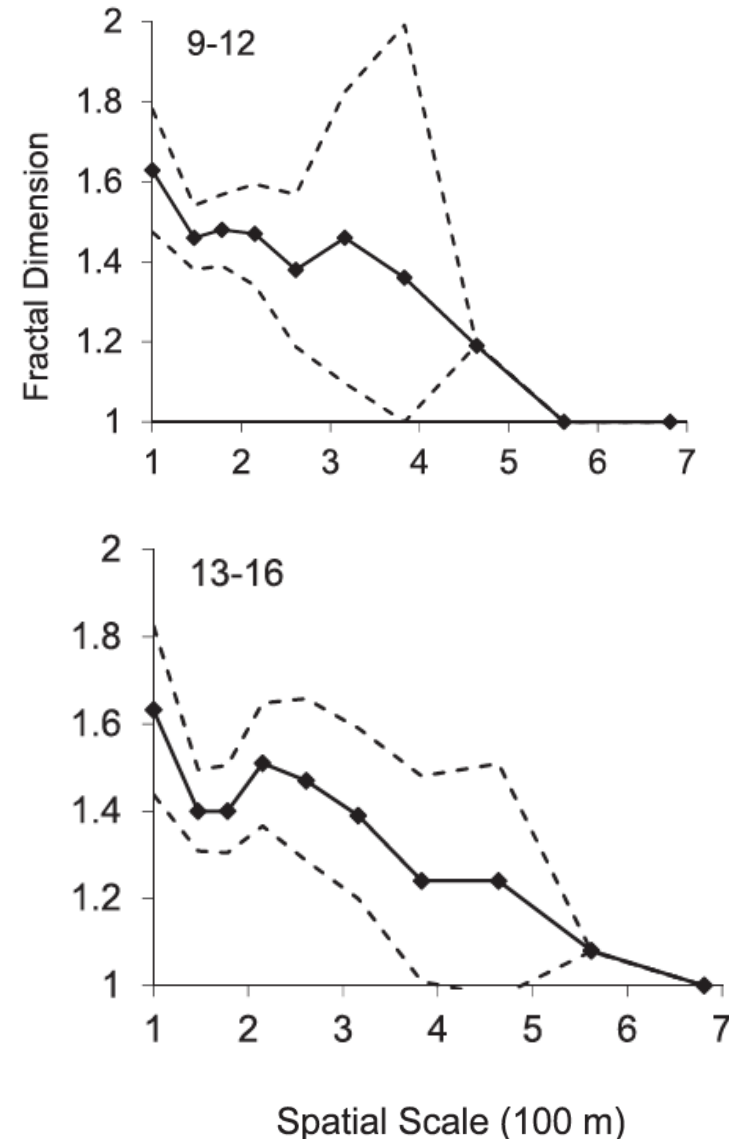
Fractal Dimensions: small groups (1-4)

- Linear searching behavior at small scales (100 m: $D = 1.3$) yet tortuous home range scale (700 m: $D = 2.0$)
- Because habitat patches are typically several hundred meters in diameter, this result suggests that small scale movements are very directed but over a large scale they are searching across multiple habitats.



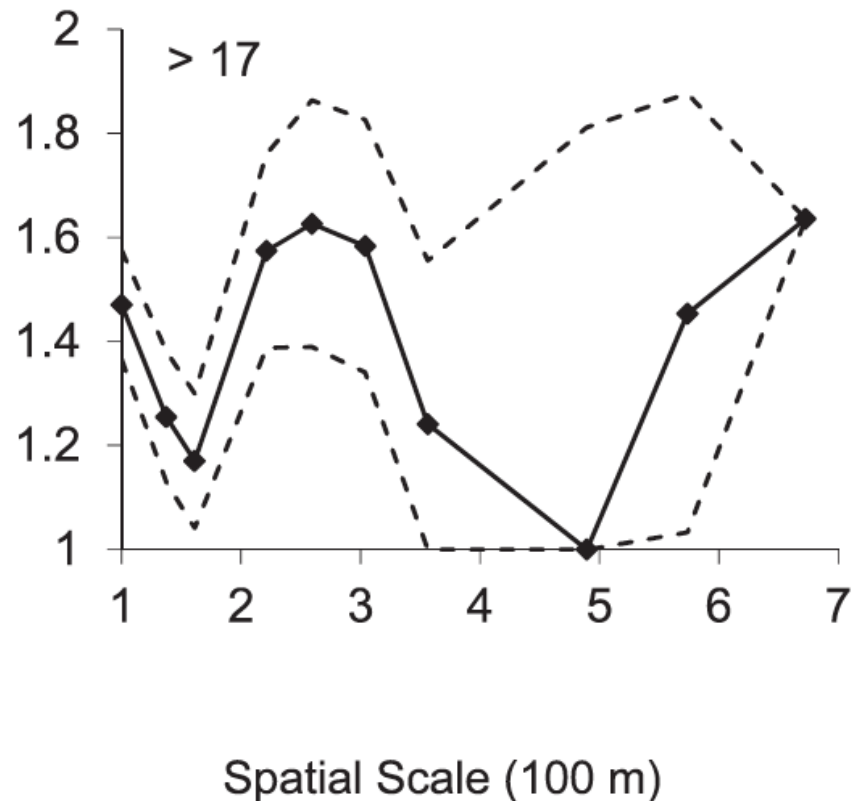
Fractal Dimensions: medium sized groups (9-16)

- Small-scale (100 m) movement patterns are moderately directed ($D = 1.6$), at larger scales their movement patterns become strongly linear ($D = 1.00$).
- Suggests coveys at small scales make a thorough search of habitats for resources, yet at large scales tend to move linearly among habitat types (such as through linear corridors of woody cover).



Fractal Dimensions: Large groups (≤ 17)

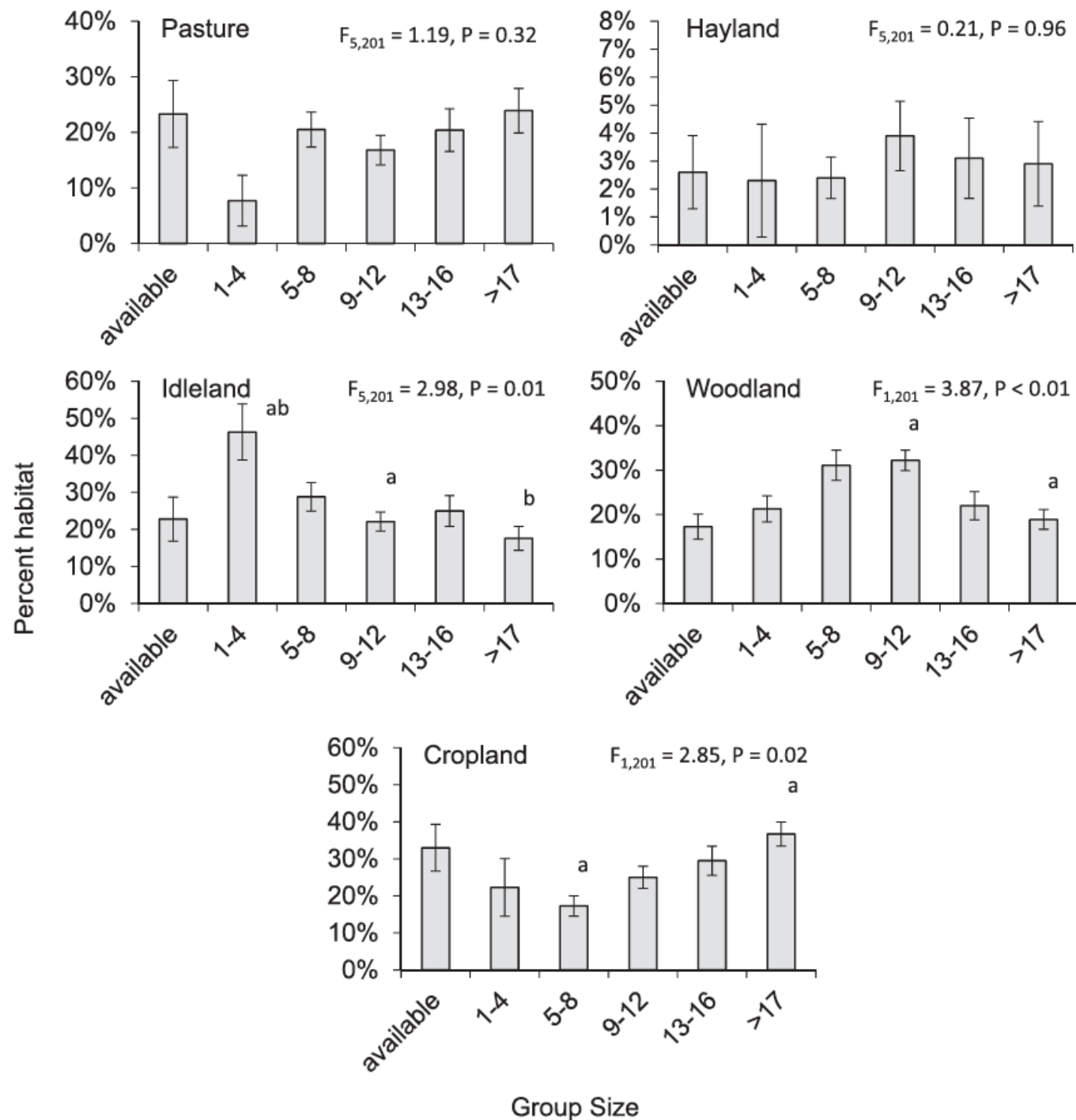
- Although increased daily movement, shows no trend in fractal dimension of their movement across scales ($D = 1.37$).



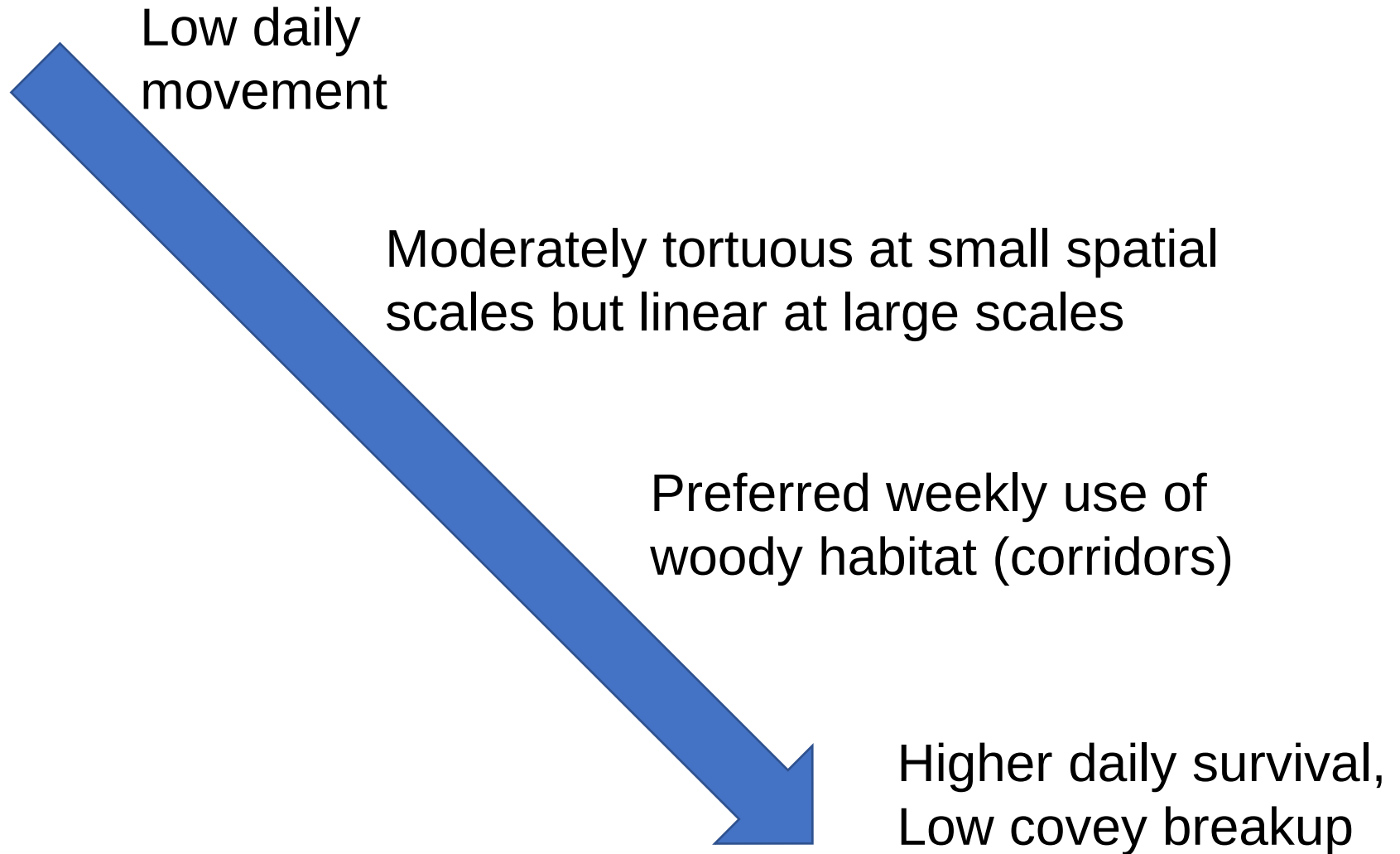
Habitat selection by coveys

- 3rd order compositional analysis to determine preference/avoidance of major land use categories
 - Used habitat – average percentage of cover types observed within the independent covey-week.
 - Available habitat - % within study area.

Habitat selection



Summary: Optimal Coveys



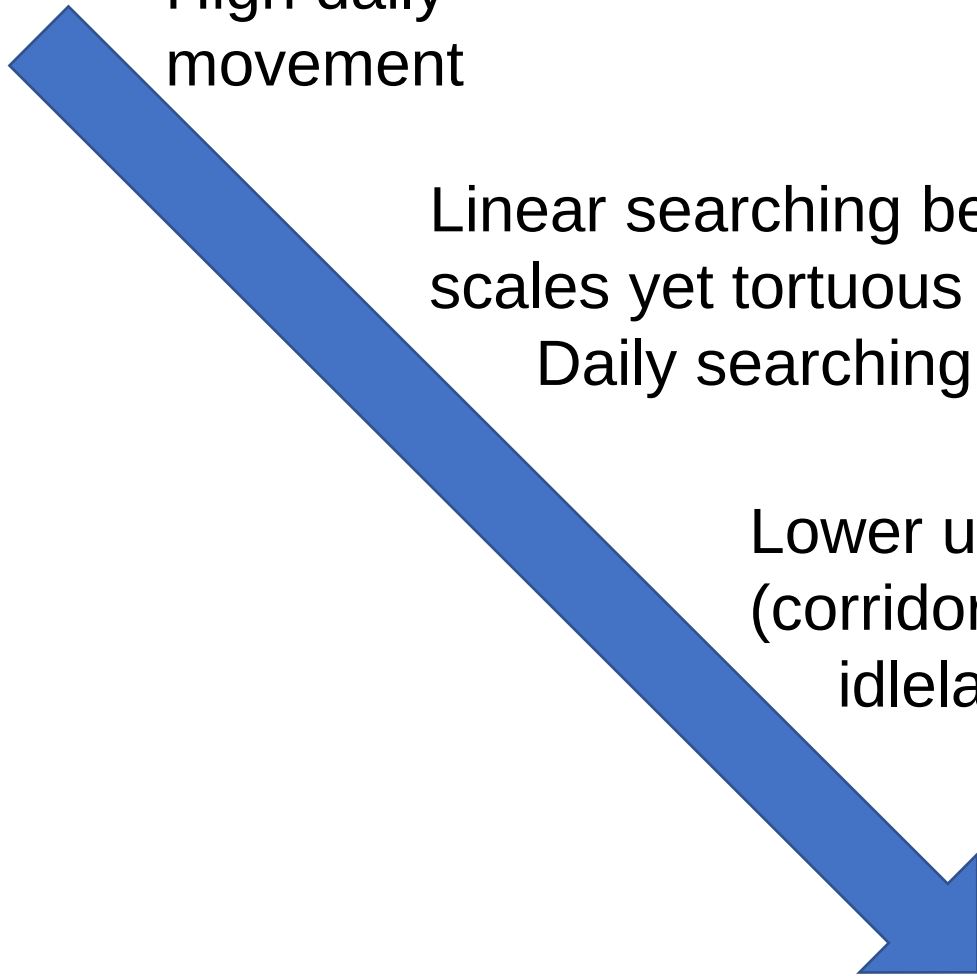
Summary: Small Coveys

High daily
movement

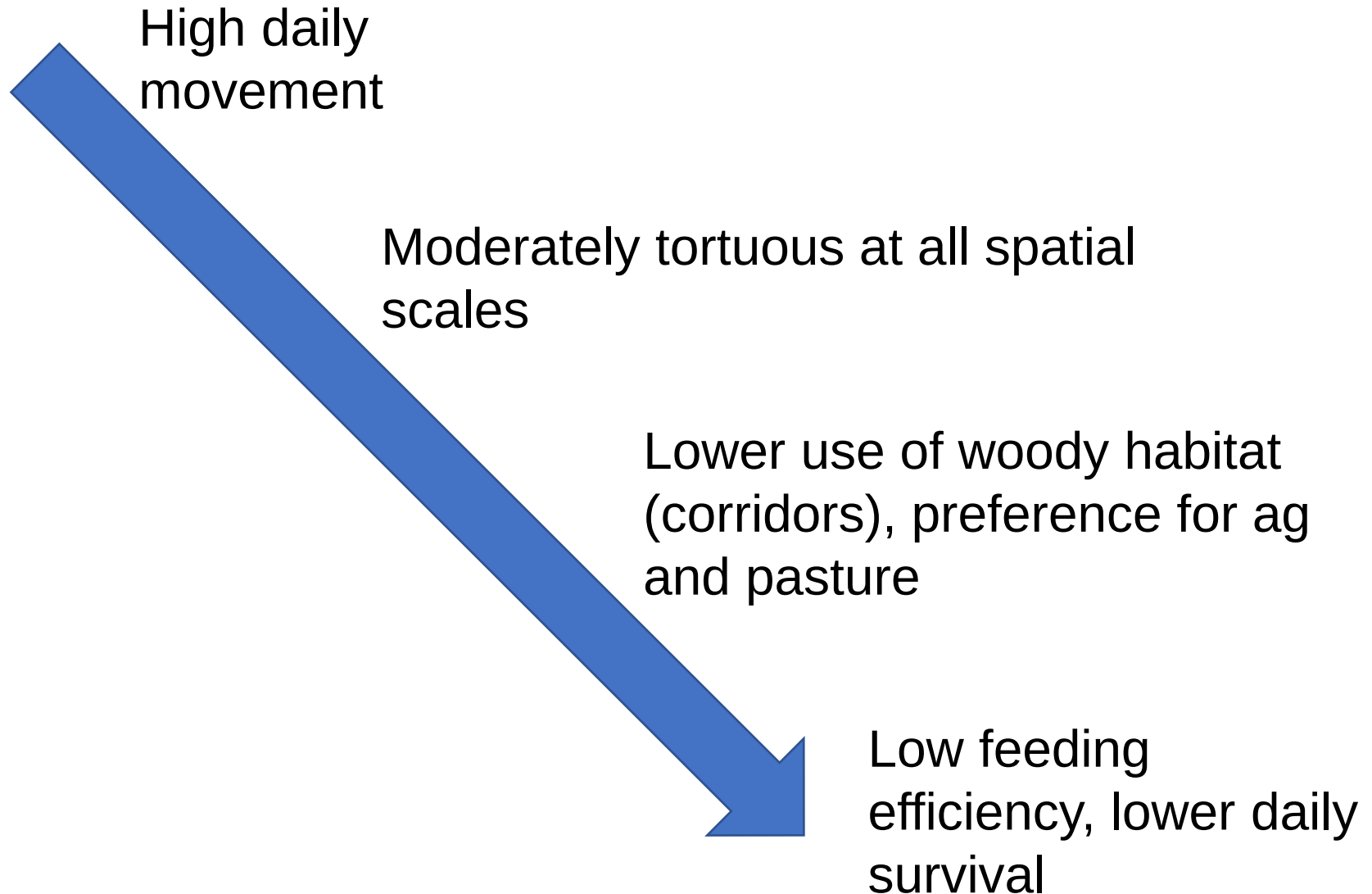
Linear searching behavior at small
scales yet tortuous home range scale.
Daily searching and returning

Lower use of woody habitat
(corridors), preference for open
idleland

Lower daily survival,
High covey breakup



Summary: Large Coveys



Management implications for small coveys and habitat fragmentation

The northern bobwhite decline: scaling our management for the twenty-first century

Christopher K. Williams, Fred S. Guthery, Roger D. Applegate, and Markus J. Peterson

-
- Small coveys are willing to move outside of habitat corridors and across fragmentation for membership change. Increases mortality.
 - In areas with low and isolated populations (and therefore increasing numbers of small coveys), rate of population decline could be even faster.
 - Promote travel corridors and decrease fragmentation at landscape scale. Remember my 2004 challenge to reverse our scale of management!

Acknowledgements

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