

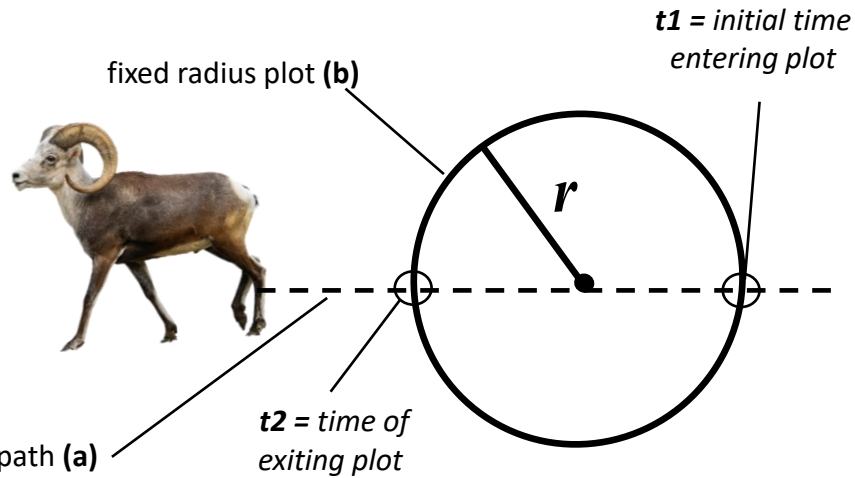
# Applying First Passage Time in GPS-Telemetry Studies of Mountain Sheep

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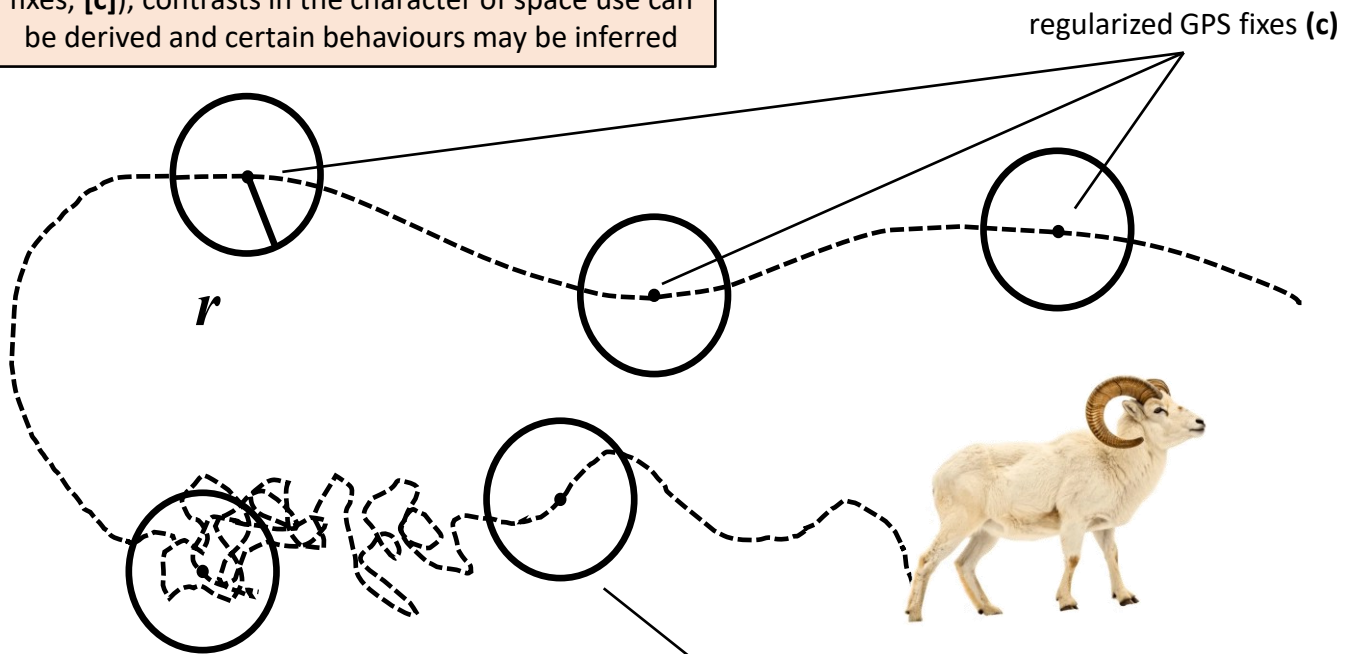
**First passage time (FPT)** is a measure of the concentration of an animals' movement path, **(a)**, in space.

Essentially, FPT is the time it takes for an animal to "pass" through a given space, typically delineated by a fixed radius ( $r$ ) circular plot, **(b)**



When several measures of FPT are taken along an animals' movement path (e.g., centered on GPS fixes, **(c)**), contrasts in the character of space use can be derived and certain behaviours may be inferred

$$t2 - t1 = \text{first passage time}$$



A **higher** concentration of the movement path within the plot equates to **greater** first passage time. This generally reflects **Area Restricted Search**, a movement pattern often associated with foraging or prey handling

A **lower** concentration of the movement path within the plot equates to **lower** first passage time. This typically indicates transitory behaviour

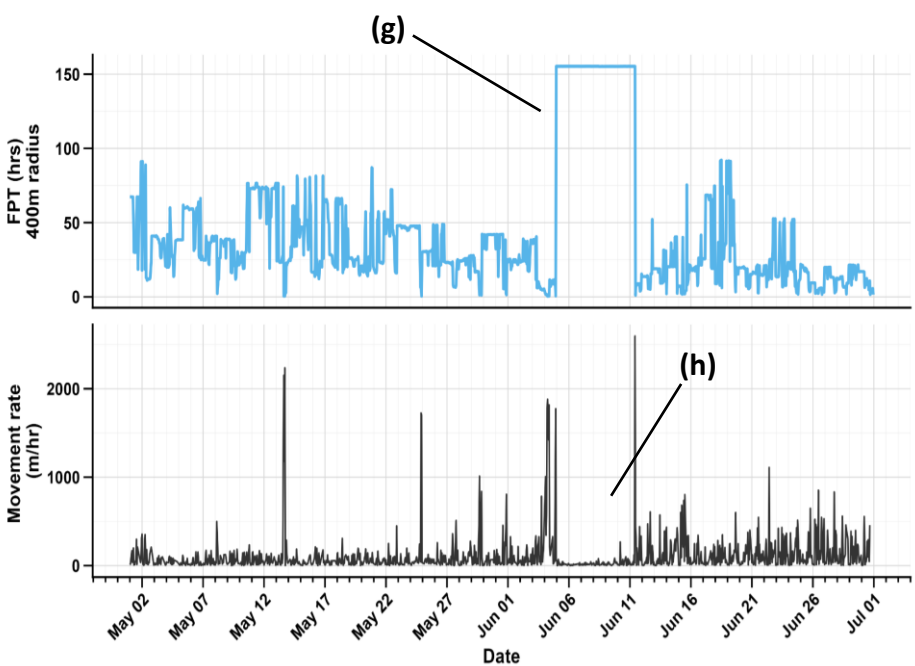
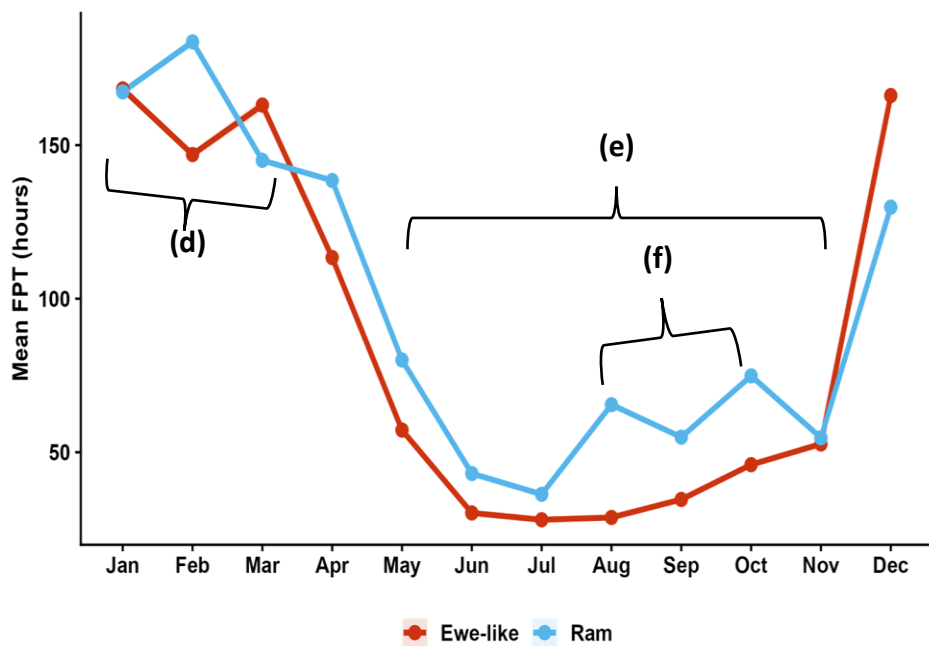
While examples of the use of first passage time are not abundant in the scientific literature, there are several use cases for its application in studies of mountain sheep and other highly mobile animals

# Applications:

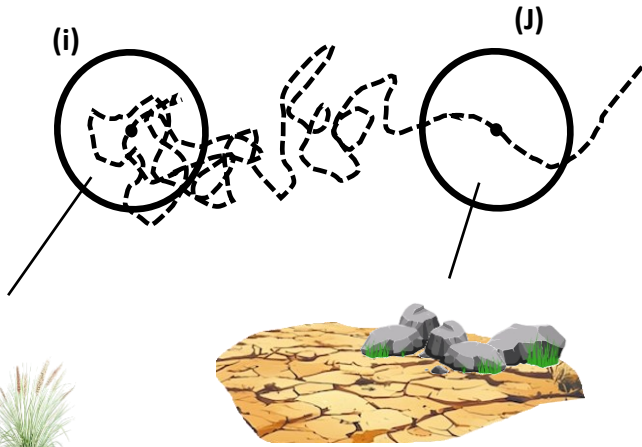
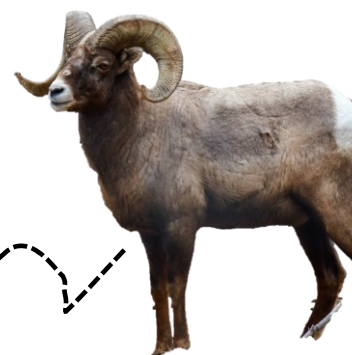
Lower FPT measures during snow-free months, **(e)**, indicate a shift to transitory movement as travel becomes easier and sheep relocate frequently in search of emergent forage

Patterns in FPT can highlight seasonal trends in movement. Elevated FPT measured during the winter months, **(d)**, likely reflect the limitation of deep snow on sheep mobility as animals reduce costly movements across the landscape and concentrate habitat use on concentrated winter range habitat (i.e., windswept ridges)

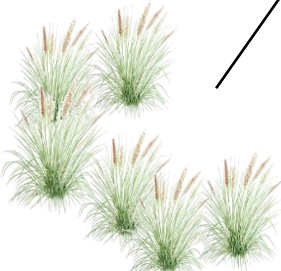
Increased FPT in rams during the fall, **(f)**, could indicate adaptive movement in response to sex-specific hunting pressure



Sustained peaks in FPT of ewes, **(g)**, highlight unusual spatial confinement of movement and can complement lower movement rates, **(h)**, as a signal of parturition events



Environmental characteristics measured in areas of high **(i)** and low **(j)** FPT can be compared to draw linkages between movement patterns and specific habitats



See QR link for references and published examples:

