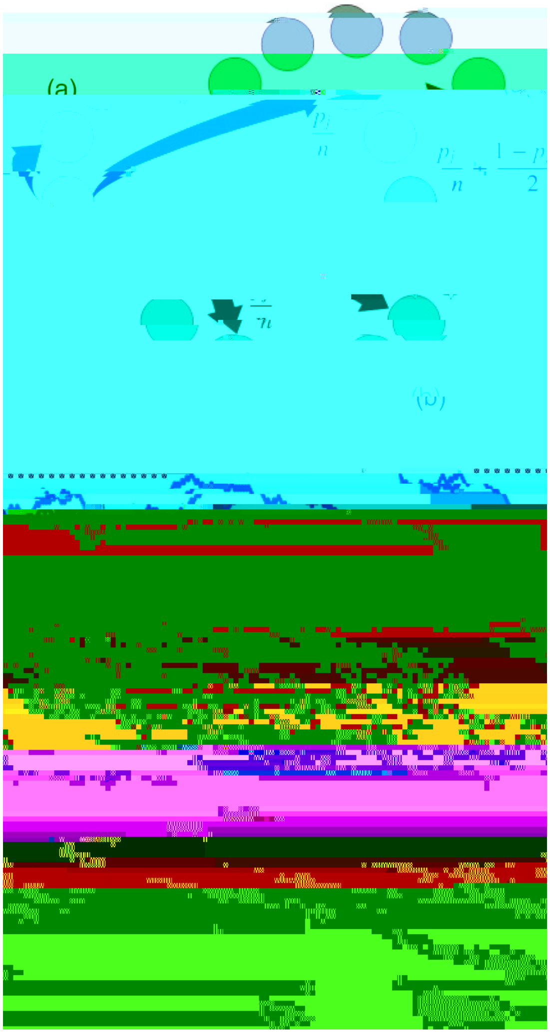


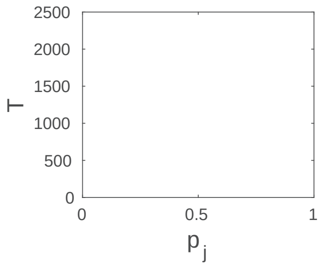
FIG. 1. Jump-diffusion foraging model parametrized by p_j, the probability of jumping. (a) The forager moves to nonadjacent sites with probability $\frac{p_j}{n}$ and to adjacent sites with probability $\frac{p_j}{n} + \frac{1-p_j}{2}$, accounting for the possibility of diffusion. (b)—(d) Example forager paths (blue lines and dots) for $p_j = 0, 1, 0.03$. Green represents sites with food, while white represents empty sites.

jumps with probability p_j, or diffuses with probability $1 - p_j$ [Fig. 1(d)]. Providing our forager with both types of movement allows us to consider how much time the forager should spend exploiting a given location, and how frequently the forager should move to other locations. We demonstrate that the mean lifetime T of the forager varies nonmonotonically with respect to p_j, and the forager's lifetime is maximized through a mixture of jumping and diffusion.

This work extends the recent studies of [7–9]

FIG. 3. (a), (b) Forager lifetime computed from Eq. (9) in the case of pure diffusion (a

drops as we change $s = 1$ to $s = 2$ since in the case of pure diffusion (and $s = 1$) the forager will live at least two time steps, whereas the pure jumper may not. As soon as $s = 2$, this effect becomes negligible. Furthermore, this drop in the ratio becomes less severe for larger values of n since the jumper will almost always live at least two time steps. In Fig. 3(d), we display the ratio as a surface plot along both the s and n axes. Increasing s clearly expands the region (outlined) of n values, for which diffusion is a better strategy. Note that for very small values of n ($n \leqslant 5$) the cover time for diffusion is less than the cover time for jumping, leading to an advantage of jumping over diffusion at those parameter values. When s is large relative to n, the diffusive forager benefits from a larger


2500
2000
1500
1000
500
0
T
0
0.5
1
p j

when using a mixture of these modes of movement. This explanation is further validated by the qualitative similarities of the jump-diffusion and jump-wait models. In either model, making s larger or n smaller lead to situations in which the

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