Author's Accepted Manuscript

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www.elsevier.com/locate/yjtbi

PII: S0022-5193(16)30157-6
DOI: http://dx.doi.org/10.1016/j.jtbi.2016.06.023
Reference: YJTBI8711

To appear in: *Journal of Theoretical Biology*

Received date: 29 February 2016
Revised date: 27 May 2016
Accepted date: 18 June 2016

Cite this article as: William E. Cooper, Fleeing to refuge: Escape decisions in the race for life, *Journal of Theoretical Biology* http://dx.doi.org/10.1016/j.jtbi.2016.06.023

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ACCEPTED MANUSCRIPT

Fleeing to refuge: Escape decisions in the race for life

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Accepted manuscript

Abstract

Economic escape theory that predicts that flight initiation distance (FID = predator-prey distance when a prey begins to flee from an approaching predator) increases as predation risk increases has been overwhelmingly supported. However, the vast majority of empirical tests have focused on effects of single predation risk factors. Even studies that have included multiple risk factors have not predicted how they jointly affect FID. I present a model that predicts joint effects of several predation risk factors that affect the outcome of a race between predator and prey to the prey's refuge. As a prey's distance to refuge and predator attack speed increase, and as the prey's location forces it to flee more toward a predator to reach refuge, FID increases. A published model proposed and experiment showed that FID is longer when prey flee directly toward than directly away from a predator to a refuge. We present a new geometric model that predicts FID for all angles between the prey's and predator's paths to refuge, distance of the prey from refuge when escape begins, predator and prey speeds, and a margin of safety allowing the prey to reach refuge before the predator. The model provides many new, testable predictions about relationships among its variables and FID. Most notably, it predicts that FID

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