

Does intruder group size and orientation affect flight initiation distance in birds?

C. Geist, J. Liao, S. Libby & D. T. Blumstein

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Abstract

Does intruder group size and orientation affect flight initiation distance in birds?— Wildlife managers use flight initiation distance (FID), the distance animals flee an approaching predator, to determine set back distances to minimize human impacts on wildlife. FID is typically estimated by a single person; this study examined the effects of intruder number and orientation on FID. Three different group size treatments (solitary person, two people side-by-side, two people one-behind-the-other) were applied to Pied Currawongs (*Strepera graculina*) and to Crimson Rosellas (*Platycerus elegans*). Rosellas flushed at significantly greater distances when approached by two people compared to a single person. This effect was not seen in currawongs. Intruder orientation did not influence the FID of either species. Results suggest that intruder number should be better integrated into estimates of set back distance to manage human visitation around sensitive species.

Key words: Flight initiation distance, Intruder group size, Intruder orientation, Human disturbance, Set-back distances.

Resumen

¿El tamaño y la orientación del grupo intruso afecta a la distancia de iniciación al vuelo en aves?— Los gestores de la fauna utilizan la distancia de iniciación al vuelo (FID), la distancia a la que los animales huyen cuando se les acerca un depredador, para determinar las distancias de respuesta a fin de minimizar el impacto humano en la fauna. La FID es estimada típicamente por una sola persona; este estudio examinó los efectos del número y de la orientación del intruso en la FID. Se aplicaron tres tratamientos distintos de tamaño del grupo (persona solitaria, dos personas una al lado de la otra, dos personas una detrás de la otra) a currawongs cálidos (*Strepera graculina*) y a pericos elegantes (*Platycerus elegans*). Los pericos elegantes huían a distancias perceptiblemente mayores cuando se le acercaban dos personas que cuando se le acercaba una sola. Este efecto no fue observado en los currawongs pálidos. La orientación del intruso no influyó en la FID de ninguna especie. Los resultados sugieren que el número de intrusos debería ser considerado en las estimaciones de las distancias de respuesta, para poder gestionar las visitas de personas cerca de especies sensibles.

Palabras clave: Distancia de iniciación al vuelo, Tamaño del grupo intruso, Orientación del intruso, Molestia humana, Distancias de respuesta.

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C. Geist, J. Liao, S. Libby & D. T. Blumstein, Dept. of Ecology and Evolutionary Biology, 621 Young Drive South, Univ. of California, Los Angeles, CA 90095–1606, U.S.A.

Corresponding author: D. T. Blumstein. E-mail: marmots@ucla.edu

Introduction

The distance at which an animal begins to flee an advancing predator is commonly referred to as "flight–initiation distance" (Ydenberg & Dill, 1986) or "flush distance" (Holmes et al., 1993). There should be strong selection for successful animals to flee at an optimal FID. Early flight might reduce foraging efficiency, while late flight could end with accidental predation. Successful individuals should balance the costs of flight with the benefits of remaining. Ydenberg & Dill (1986) developed an economic model to qualitatively predict optimal flight distances from approaching predators. Subsequent studies have demonstrated that optimal FID can be influenced by many variables (e.g., species –Blumstein et al., 2003; flock size –Burger & Gochfeld, 1991; speed of predator –Cooper, 2003; distance from protection –Dill & Houtman, 1989; type of disturbance –Rodgers & Smith, 1997; intruder starting distance –Blumstein, 2003; dangerousness of the predator –McLean & Godin, 1989; availability of cover –LaGory, 1987).

Ecotourism and outdoor activities have grown increasingly popular, but the effects of humans are not entirely benign to wildlife (Wearing & Neil, 1999; Christ et al., 2003). Wildlife managers try to reduce human disturbance by assuming that approaching humans are perceived as predators (e.g., Frid & Dill, 2002), and then using FID to develop set back distances –the minimum distance that a human may approach before the bird is disturbed (e.g., Holmes et al., 1993; Rodgers & Smith, 1995). Such distances are often used to establish seasonal tourist limits and to restrict recreational access (Fernández–Juricic et al., 2001).

Tourist numbers vary considerably, yet we are aware of no experimental studies studying whether there is an effect of intruder number on FID. This study examined whether birds modified their FID when faced with one or two approaching humans. By increasing the number of advancing intruders, we generated an effect similar to increasing predator density. Theory is not clear on how increased predator densities affect antipredator behavior in prey because the effects of predator density may vary with ecological circumstances (Abrams, 1994). FID was used as a quantitative measurement of a bird's assessment of risk (Ydenberg & Dill, 1986; Frid & Dill, 2002). If intruder number increased the perception of risk, then it was expected that more intruders would result in larger FIDs.

This study also examined how birds assessed risk when two humans approached side–by–side, or directly behind one another. The side–by–side orientation treatment was executed with one intruder approaching tangentially while another intruder approached directly. Previous studies have found that prey perceive tangential approaches as less evocative than direct approaches (e.g., great black–backed gulls (*Larus argentus*) –Burger & Gochfeld, 1981; black iguanas (*Ctenosaura similis*) –Burger &

Gochfeld, 1990; broad–headed skinks (*Eumeces laticeps*) –Cooper, 1997). This evidence suggests that some animals can perceive subtle differences in intruder behavior and adjust their responses accordingly (Burger & Gochfeld, 1990). In order for the prey to react, the intruder must be within the prey's field of view (Cooper, 1997). If the prey and predator look at each other, then there is a greater probability that the predator has detected the prey and poses a greater risk to the prey. If birds can detect and make eye contact with two intruders side–by–side better than two intruders directly behind one another, then the side–by–side orientation approach would be expected to have a higher FID.

Methods

Study sites

The study focused on two common Australian birds, (Pied Currawongs, *Strepera graculina*; Rosellas, *Platyercus elegans*) found in the forests of Booderee National Park (150° 43' N, 35° 8' W), 200 km S of Sydney.

From 23 X–6 XI 03, the effects of intruder number and orientation on FID were studied by walking towards these two species at ten locations around the park. The locations included a commonly visited beach (Murray Beach), camping areas (Bristol Point, Cave Beach, Green Patch, Iluka Beach), native bush land (Hole in the Wall, Steamers Beach, Telegraph Creek), a managed natural garden (The Booderee Botanic Gardens), and an Australian naval college (HMAS Creswell). The sites were chosen because they contained hiking trails surrounded by moist forests and woodlands. At each of these locations, data were collected while walking along the trail. Locations were geographically grouped into six regions to study for location effects.

Data collection

To measure FID, perched or foraging subjects that were not initially disturbed by the observer's presence were identified. Highly vigilant or nesting birds were not approached. The subject was then flushed by walking towards it at a constant pace of approximately 1.0 m/s, while maintaining eye contact. Before data were collected, observers trained themselves to maintain a consistent stride length and a constant pace. Paces were converted to meters for analysis. Observers recorded the distance from the focal bird at the start of the experimental approach, the height off the ground at the start of the approach, and the distance the bird initiated flight. Each flush was conducted using one of three different treatments listed below: (1) one person directly approached a bird, (2) two people, separated by 1.5 m, and oriented side–by–side approached a bird, and (3) two people, separated by 1.5 m, and oriented directly behind one another approached a bird.

The location and distance to vegetation cover was also noted because these additional factors could influence FID (Burger & Gochfeld, 1991). Subjects at the same site were selected if it was not possible for them to have seen previous experimental approaches, because previous exposure could have influenced their response (e.g., Runyan & Blumstein, in press).

Data analysis

For each species, general linear models were fitted to study the effect of treatment on FID. We used the "direct" FID, calculated with the Pythagorean Theorem, as our measure of FID because, for some birds, FID is influenced by the height a bird is in a tree (Blumstein et al., in press). The effect of FID was determined based on the direct distance between the prey and the predator. Moreover, because FID typically is influenced by intruder starting distance (Blumstein, 2003), starting distance must be included in models. Such models must be forced through the origin because, logically, a starting distance of 0 m must have a FID of 0 m. Doing so, however, makes the main effect of treatment uninterpretable. Hence, to understand the effect of treatment on the expected relationship between starting distance and FID, the interaction between starting distance and treatment was examined.

Analyses focused on flushes with starting distances that ranged between 10 m and 50 m. The currawong data set contained 23 single, direct approaches, 19 paired, side-by-side approaches, and 20 paired, one-behind-another approaches. The rosella data set contained 20 single, direct approaches, 20 paired, side-by-side approaches, and 27 paired, one-behind-another approaches.

Other factors could influence FID. The effect of the regions where the birds were flushed, and the distance a subject was from vegetation on FID were examined by fitting general linear models and examining the interaction of these factors with starting distance. No significant interactions were found (location effect: $P_{\text{Currawong}} = 0.605$, adjusted $R^2_{\text{Currawong}} = 0.830$, model $P_{\text{Currawong}} = 0.0001$, $P_{\text{Rosella}} = 0.979$, adjusted $R^2_{\text{Rosella}} = 0.759$, model $P_{\text{Rosella}} = 0.0001$; distance to vegetative cover: $P_{\text{Currawong}} = 0.239$, adjusted $R^2_{\text{Currawong}} = 0.839$, model $P_{\text{Currawong}} = 0.0001$; $P_{\text{Rosella}} = 0.810$, adjusted $R^2_{\text{Rosella}} = 0.766$, model $P_{\text{Rosella}} = 0.0001$), and we therefore do not believe that our main results (discussed below) are confounded by their effect.

Results

Currawongs

Variation in FID was not significantly explained by the interaction of treatment type and starting distance ($P_{\text{interaction}} = 0.337$, adjusted $R^2 = 0.837$, $P_{\text{model}} = 0.0001$), intruder number and starting dis-

tance ($P_{\text{interaction}} = 0.121$, adjusted $R^2 = 0.841$, $P_{\text{model}} = 0.0001$), or between the two, two-person approaches ($P_{\text{interaction}} = 0.279$, adjusted $R^2 = 0.846$, $P_{\text{model}} = 0.0001$; fig. 1A).

Rosellas

Variation in the FID was significantly explained by the interaction of treatment and starting distance ($P_{\text{interaction}} = 0.0009$, adjusted $R^2 = 0.843$, $P_{\text{model}} = 0.0001$), intruder number and starting distance ($P_{\text{interaction}} = 0.0004$, adjusted $R^2 = 0.843$, $P_{\text{model}} = 0.0001$), but there was no difference between the two, two-person approaches ($P_{\text{interaction}} = 0.220$, adjusted $R^2 = 0.860$, $P_{\text{model}} = 0.0001$; fig. 1B).

Discussion

The objective of this study was to determine whether intruder number and orientation had an effect on birds' decision to flee approaching humans. While neither studied species responded to variation in the orientation of the paired intruders, rosellas flushed at significantly greater distances when approached by two intruders, than by a single intruder. This finding suggests that rosellas assessed a higher risk of predation when approached by two intruders than by one. More importantly, the finding that intruder number effects flight decisions has important implications for the estimation of set back distances as well as for strategies to reduce human disturbance on vulnerable wildlife.

Our results were likely not influenced by habituation; at our sites, both species appeared reasonably habituated to humans. Rather, variation in response may result from variation in the species' natural history. Crimson Rosellas are seedeaters and Pied Currawongs are omnivores (Higgins, 1999; Fagg, 2002). Foraging for non-plant items is relatively time consuming (Naoki, 2003) and, for a given level of risk, currawongs may experience a greater cost of flight. In contrast, animals foraging on seeds could always return. Hence, currawongs might be more tolerant of intruders and less sensitive to variation in risk. To properly evaluate this natural history hypothesis, more species with variable diets must be studied in a formal comparative analysis (e.g., Blumstein et al., in press).

While an effect of intruder orientation was expected, none was found. Further experiments must be conducted to determine why, but it is likely that the intruders were too close together to reflect distinctly different risks. More generally, developing a fundamental understanding of how birds perceive groups of humans will be important to better manage human disturbance.

This study demonstrated that birds may respond differently to multiple intruders. Somewhat remarkably, the effect was present with the addition of a single person. Future studies conducted with larger group sizes would be needed to determine the precise shape of the function of this

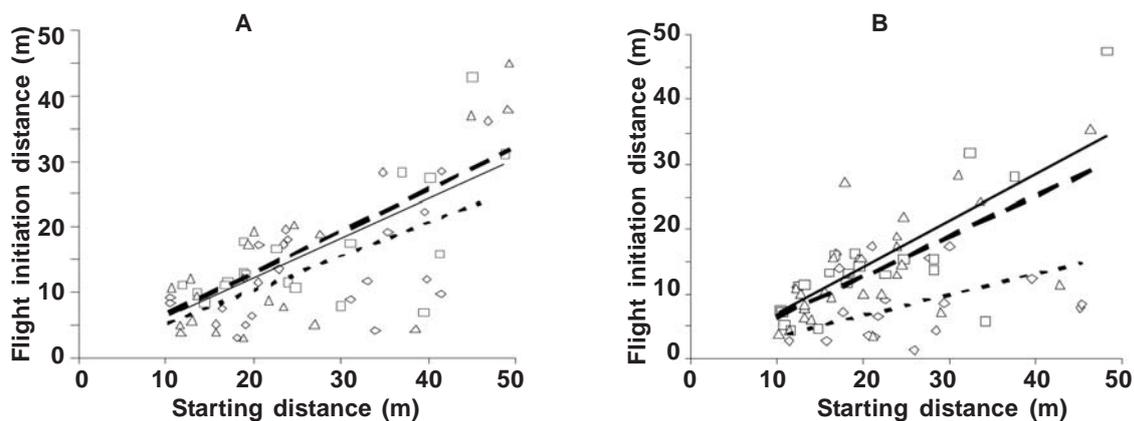


Fig. 1. The relationship between starting distance and treatment on FID for Pied Currawongs (A) and Crimson Rosellas (B): single flushes, diamonds and small dashed line; side-by-side flushes, squares and solid line; one-behind the other, triangles and large dashes.

Fig. 1. Relación entre la distancia de inicio y el trato en FID para currawongs pálidos (A) y pericos elegantes (B): aproximaciones solitarias, rombos y líneas de puntos pequeños; aproximaciones lado a lado, cuadrados y líneas continuas; aproximaciones uno detrás de otro, triángulos y líneas de puntos grandes.

effect. Coordinating larger groups in an experiment will be difficult, but it is essential to document the size beyond which effects of additional people are no longer experienced. Such findings could assist in establishing acceptable visitor densities in buffer areas. A first step towards determining whether visitor number might be important could be obtained by replicating our experimental design on vulnerable species.

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