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Review

A review of flight-initiation distances and their application to managing disturbance to Australian birds

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Abstract. Disturbance – the response of birds to a stimulus such as the presence of a person – is considered a conservation threat for some Australian birds. The distance at which a bird flees from perceived danger is defined as the flight-initiation distance (FID), and could be used to designate separation distances between birds and stimuli that might cause disturbance. We review the known FIDs for Australian birds, and report FIDs for 250 species. Most FIDs are from south-eastern Australia, and almost all refer to a single walker as the stimulus. Several prominent factors correlated with FID are discussed (e.g. body mass and the distance at which an approach begins). FIDs have not been used extensively in the management of disturbance, for a variety of reasons including lack and inaccessibility of available data. We call for standardised data collection and greater application of available data to the management of disturbance.

Additional keywords: buffers, human–wildlife conflict, human–wildlife interactions, escape, flightiness, response.

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Introduction

The response of birds to the presence of a stimulus, such as a potential predator or a human, is referred to as 'disturbance' (Van Der Zande and Verstrael 1985; Fox and Madsen 1997). A diverse range of *stimuli* can disturb birds. Although natural stimuli, such as predators, cause disturbance (e.g. Ward *et al*. 1994; Burton *et al*. 1996), most studies focus on anthropogenic sources of disturbance. These include humans themselves, their companion animals, motorised transport such as aircraft, vehicles and boats, and non-motorised activities such as wind and kite surfing (e.g. Kushlan 1979; Andersen *et al*. 1989; Buick and Paton 1989; Kirby *et al*. 1993; Burger 1998; Delaney *et al*. 1999).

The *response* of birds to disturbance takes many forms, but most reported responses are behavioural and can be considered vigilance or flight responses (Hediger 1934; Ydenberg and Dill 1986; Hockin *et al*. 1992), where vigilance involves birds stopping their current activity to monitor the approaching human (e.g. Fernández-Juricic *et al*. 2001) and flight involves fleeing on foot or on the wing, or by swimming and diving (e.g. Cooke 1980). An increasing number of studies have observed physiological responses to stimuli, such as changes in heart rates, body temperature and plasma corticosterone levels, which can occur in the absence of any obvious behavioural responses (e.g. Gabrielsen *et al*. 1977; Kanwisher *et al*. 1978; Culik *et al*. 1990; Wilson *et al*. 1991; Culik *et al*. 1995; Nimon *et al*. 1995, 1996; Regel and Pütz 1997; Weimerskirch *et al*. 2002; Walker *et al*. 2006). Responses to disturbance can vary greatly between species. For example, some shorebirds do not leave their nest until humans are nearby, whereas others leave their nests when humans are several hundred metres distant (e.g. Page *et al*. 1983; Watson 1988; Yalden and Yalden 1989).

These behavioural and physiological responses are presumed to be costly, and non-benign consequences of human disturbance have been observed among many species. Disturbance induced by humans can result in ecologically significant shifts in behaviour, such as changes in habitat use (e.g. Burger 1981), reduced foraging, diminished parental care (e.g. Weston and Elgar 2005), compromised parental defence resulting in reproductive failure (e.g. Vos *et al*. 1985), among other changes. Behavioural changes, such as those associated with disturbance, are often assumed to be brief, yet may ultimately have long-lasting effects on populations (e.g. Flemming *et al*. 1988). At the population level, high species sensitivity to disturbance, that is long 'flight-initiation distances' (FIDs), is associated with population declines among European birds (Møller 2008) and, in the Cordoba Mountains of Argentina, human presence negatively influenced avian communities, guilds and populations (Heil *et al*. 2007).

Increasing exposure of birds to disturbance, the possibility of significant negative effects on the conservation of at least some species, and the legislative requirements to conserve birds and safeguard the welfare of birds, have contributed to a dramatic increase in the number of publications on disturbance to birds over the last 35 years (Hockin *et al*. 1992; Hill *et al*. 1997; Price 2008). This considerable body of work has emphasised the great variation in the forms and consequences of disturbance to birds. Many studies of disturbance examine factors that mediate responses to disturbance. For example, physical factors such as habitat, internal factors such as learning, and attributes of the stimulus, such as number, height and width, and speed of approach can all influence avian responses (e.g. Stalmaster and Newman 1978; Burger 1986; Keller 1989; Rodgers and Smith 1995; Jorden 2007). An almost universal theme in the literature is that most forms of disturbance to birds are already common and are likely to occur with greater frequency in the future. Increases in disturbance to birds have been predicted for Europe, North America and Australia (e.g. Boden and Ovington 1973; Goss-Custard and Verboven 1993; Kirby *et al*. 1993; Flather and Cordell 1995; Gill *et al*. 1996; Hill *et al*. 1997).

Here, we briefly review FIDs among Australian birds and some of the factors that may mediate FID. Specifically, this review critically describes FID and associated concepts, describes some prominent factors that mediate FID, and considers why FID estimates have not enjoyed greater application in the management of avian disturbance. We redress one barrier to the use of FID data in management by providing available FID data for Australian birds. We are unaware of any published reviews dedicated to this topic to date (but see Lane 2003).

Bridging the theoretical–applied divide: flight-initiation distances

One of the most consistent findings of disturbance research is that the response of birds is inversely related to the distance between the bird and the stimulus. The distance at which a behavioural escape response occurs is known as the FID (Stankowich and Blumstein 2005), a concept apparently first described by Hediger (1934). FID is also known as Flush Distance (Stankowich and Blumstein 2005), Displacement Distance (Dandenong Valley Authority 1979) or Flight Distance (Hediger 1934). The concept of FID is broadly applicable to wild living birds, though for aggressive, highly habituated or domesticated birds, the response often involves an approach to humans, and FID may not adequately reflect the distance at which normal activities are disrupted.

The distance at which a vigilance response is initiated is the alarm-initiation distance (AD), also known as agitation distance (Dandenong Valley Authority 1979) (Fig. 1). Alarm responses vary between species, but many involve raising the head and communicating with nearby conspecifics via alarm calls or other signals, such as tail-flicking among the Rallidae (Woodland *et al.* 1980). Conspicuous promulgation of alarm may also signal to threatening stimuli that they have been detected (Woodland *et al.* 1980). The AD is always greater than or equal to the FID (Blumstein *et al*. 2005; Cárdenas *et al*. 2005).

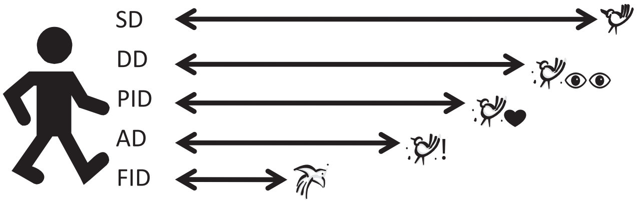

Fig. 1. Visual representation of the detection distance (DD), physiological-initiation distance (PID), alarm-initiation distance (AD) and flight-initiation distance (FID). Presented to illustrate a conceptual framework; distances are not to scale.

There are two other important distances that are often overlooked: (1) the possible existence of detection distance (DD), which is the distance that a bird can first detect a stimulus without reacting in other ways; it is generally assumed that such detection is visual, although auditory cues could be used to detect loud stimuli, such as some motorised craft, or the sounds of approaching predators in closed habitats and (2) the physiological-initiation distance (PID), which is the distance that a physiological response, such as increased heart rate or corticosteroid secretion, is initiated (Fig. 1). Birds can detect stimuli while not being overtly vigilant and thus the DD is greater than or equal to the AD (Lima and Bednekoff 1999). The few studies of PID suggest that it is longer than either AD or FID (Nimon *et al*. 1996), at least in non-startle responses (see following).

Starting distance (SD), is the distance at which an investigator approach begins and is usually positively related to FID (Blumstein 2003, 2006, 2010). However, where the FID and DD are very similar or the same, the response of the birds can be considered a startle response, which is defined as an instantaneous flight response upon detection of a stimulus. In research studies, some startles occur when the SD is less than the FID (e.g. where a bird does not otherwise detect a stimulus until well within its FID). Maximum startle distance can be estimated from the regression of FID and SD as the point where the FID equals the SD for a given species. DD is currently not measurable, so startles occur when the distance at which an approach begins (SD) is equal to or very similar to the FID. Essentially, this represents the presentation of a stimulus to a bird rather than an approach. For species with long FIDs, caution must be exercised in relation to achieving sufficient starting distances during approaches; insufficient starting distance may result in only the least-sensitive individuals contributing to the measure of FID.

Prominent factors correlated with FID

Life-history characteristics influence many aspects of the behaviour of birds, and can be reasonably expected to influence key aspects of decisions in relation to escape behaviour, such as flight (Møller and Garamszegi 2012). For example, males and females, old and young individuals, and low- and high-quality individuals could differ consistently in direction and magnitude of their FID. However, studies that examine these attributes in relation to FIDs are few (but see Thiel *et al*. 2007). FID itself can be considered a life-history trait, whereby FID represents the risk an individual is willing to take, which is expected to be influenced by residual reproductive value (the remaining reproductive value for an individual of a particular age, given its particular condition, quality etc.). Thus, associations between FID and other life-history traits represent correlations and do not necessarily imply causation.

Body mass, a life-history trait, explains most of the variation in FID among species (Blumstein 2006). To highlight the importance of body mass, residuals from a regression of FID on body mass (both logged$_{10}$) for species with at least ten estimates of FIDs and with adequate mass data are presented in Appendix 1 (no phylogenetic corrections; $F_{1,135} = 124.614$, $P < 0.001$, $R^2 = 0.480$, slope = 0.293; Fig. 2). Higher positive residual values indicate species most sensitive to human approaches whereas negative values of higher magnitude indicate species least sensitive to human approaches. The Hooded Plover (*Thinornis rubricollis*) has the highest residual value, and is a species considered to be threatened by human disturbance (Dowling and Weston 1999). The least-sensitive species analysed was the Australian Brush Turkey (*Alectura lathami*), which frequently inhabits gardens, parks and other human-dominated environments (Marchant and Higgins 1993).

There are several possible reasons for the general finding that FIDs and body sizes are positively correlated between species. First, if larger-bodied species are more at risk from predators owing to their higher detectability, they may reduce their risk of predation by initiating the flight response earlier (Holmes *et al.* 1993). Second, if larger-bodied species are less agile or aerodynamic than smaller species, they may require more time or space to escape (Fernández-Juricic *et al.* 2002). Third, smaller-bodied species may require more foraging time to fulfil their relatively higher energy requirements and thus may react later to disturbance to maximise foraging time (Bennett and Harvey 1987; Blumstein 2006). Other possibilities include that humans may have discriminately hunted or hunt larger species, or that larger species may live longer (i.e. have, on average, higher residual reproductive values) and so minimise risk associated with perceived threats. Several parameters correlated with body mass may also be correlated with FID, including the size of sensory organs and brain and the height of the eye above the substrate; some of these parameters are positively correlated with FID once body mass has been accounted for (Møller and Erritzøe 2010) and others remain to be investigated.

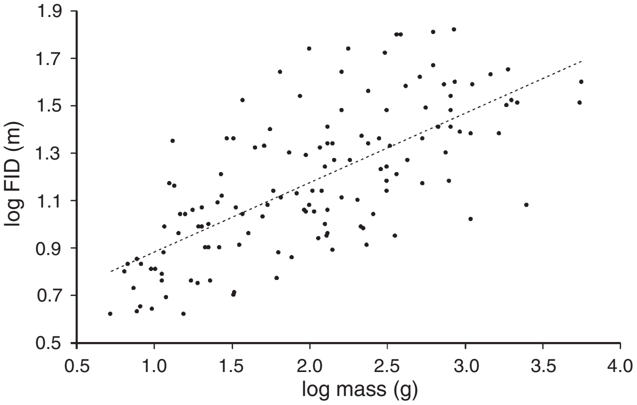

Fig. 2. Linear regression of mean flight-initiation distances (FIDs) (from Appendix 1, where $n \geq 10$), on mean body mass (g; averaged across sexes and Australian masses only; Dunning 2008 supplemented with Higgins *et al.* 1990, 2006; Marchant and Higgins 1990, 1993; Higgins and Davies 1996; Higgins 1999; Higgins and Peter 2002; Higgins *et al.* 2006). Residual values and ranks are presented in Appendix 1.

Larger group sizes are, at least sometimes, associated with longer FIDs, possibly because the response of a group or flock is dependent on the reaction of the most alert, sensitive or risk-averse constituent of the flock (Cooke 1980; Hilton *et al.* 1999; Fernández-Juricic *et al.* 2002), and because at least some birds may initiate a response when nearby birds respond (Hingee and Magrath 2009). However, the reduction in individual vigilance associated with an increase in group size is a frequently reported relationship and is generally thought to result from a decrease in predation risk to flock members or an increase in competition among members of foraging flocks (Roberts 1996; Beauchamp 2001; Randler 2005). Flocking species may be more susceptible to disturbance from humans than species that do not flock, both at the individual and, possibly, the population levels. More studies are required to determine if a threshold in group size exists above which FIDs do not increase, but theory predicts that because the benefits of increasing group size attenuate quickly, studies of animals in smaller group sizes will be important to describing this function.

Learning is an oft cited influence on escape behaviour, such as FID, but no studies on birds known to us unambiguously describe changes in FID with experience, that is learning (see below). Learning, if it occurs, could potentially influence FIDs in two directions: (1) facilitation (or sensitisation) where FIDs increase with increasing exposure to humans and (2) habituation where FIDs decrease with increasing exposure to humans. The former is generally suggested to be associated with dangerous, irregular, rapid and unpredictable stimuli, such as hunters (Thiel *et al.* 2007) and dogs, which are most commonly unleashed in many bird habitats (see Williams *et al.* 2009). In contrast, habituation is suggested to result from frequent benign, slow and predictable stimuli, like walkers (Weston and Elgar 2007). Both types of learning might potentially occur within a species. This might explain examples of behaviour, such as the Pacific Black Duck (*Anas supercisliosa*), which in urban parks where the species is fed actually approaches humans closely, whereas in areas where it is hunted, flushes at many hundreds of metres (M. A. Weston and P.-J. Guay, unpubl. data, but see below). The capacity of learning by birds, if any occurs, to change FIDs is little studied and poorly known (but see Gould *et al.* 2004), although within species variation in FID might at least partly reflect learning.

Learning has been inferred from the responses of birds in particular habitats in relation to the prevalence of humans in those habitats (i.e. a space–experience substitution). For example, FIDs of Black Swans (*Cygnus atratus*) in response to walkers have been measured in many different studies, and vary from 149 m in the rather undisturbed Coorong of South Australia (Paton *et al.* 2000), to only 3.6 m at the extremely busy Albert Park Lake, in urban Melbourne, Victoria (Monie 2011). Such variation has been used to infer habituation. However, evidence of this type does not necessarily demonstrate learning, and several problems arise when using space–experience substitution studies to infer learning. First, dispersal and site-fidelity of the species measured will influence the experience of birds at a site and few such studies determine the underlying regimes in the occurrence of stimuli (e.g. density or frequency of humans), which are often assumed (but see Glover *et al.* 2011). Additionally, comparisons between sites are often confounded with habitat, and many comparisons of these types involve urban and rural or natural comparisons (e.g.

Cooke 1980). Space–experience substitutions may also be confounded by the possibility of selection for, or biased recruitment of, less-responsive birds in more disturbed habitats. Observed patterns may thus reflect selective pressure or differential recruitment, rather than learning *per se*. We are unaware of any study that examines the actual experience of free-living individual birds and their response to humans, and we are similarly unaware of any study that discriminates between the potential mechanisms underpinning reported differences in bird responses between birds inhabiting sites experiencing different disturbance regimes. The capacity, if any, for learning on the part of the birds and subsequent adjustment of FIDs thus remains virtually unstudied and is ripe for future work.

As discussed above, SD is positively related to FID for most species (Blumstein 2003, 2006). It has been hypothesised that this intriguing finding results from a judgement regarding the value of a 'habitat patch' under increasing risk (i.e. an approaching human; Blumstein 2003, 2006). However, an alternative explanation may be that birds monitor approaches and tolerate them for a certain time (and thus maintain a temporal margin of safety; Dill 1990) perhaps a measure of the 'persistence' of the approach. Or, individuals may tolerate approaches to a certain proportion of AD, such as is seen in Galahs (*Cacatua roseicapilla*; Cárdenas *et al*. 2005) and perhaps other species (Gulbransen *et al*. 2006). Alternatively, animals may tolerate approach until a threshold in the perception of the stimulus (e.g. increasing size) is reached (Jorden 2007). Many species of birds do not have a large binocular overlap region frontally (Martin *et al*. 2007) and thus may not be able to estimate distance efficiently. Obviously, time and distance are highly correlated during a human approach at a constant speed, which could explain the significant correlation between SD and FID, although distance *per se* may not be used by birds to decide when to respond to stimuli (but see Cárdenas *et al*. 2005). Further research into teasing apart these alternative mechanisms remains to be conducted.

The factors listed above are those that feature prominently in the literature. Blumstein (2006) suggested that, after body size, diet and sociality (i.e. whether a species is a co-operative breeder) also explained significant variation in avian FID. However, many other potential correlations with FID remain to be investigated thoroughly. For example, birds with more pointed wings have longer FIDs and fly further when disturbed compared with birds with more rounded wings (Fernández-Juricic *et al*. 2006) and 'personality' may also explain some of the variation of FIDs seen within species. More 'exploratory' individual Collared Flycatchers (*Ficedula albicollis*) tend to have smaller FIDs than less exploratory individuals (Garamszegi *et al*. 2009). Other potential influences on FID include age, sex, site-attributes, including distance from cover and the presence of barriers to human movement, such as fences or canals, weather, clothing colour and others mentioned throughout this review (see, for example, Fruziski 1977; Gutzwiller and Marcum 1993; Gould *et al*. 2004; Thiel *et al*. 2007; Fong *et al*. 2009).

FID as a management tool: strengths and shortcomings

One of the attractions of documenting FIDs is that they provide a scientific basis for the designation of buffers or separation distances between important habitat and incompatible surrounding land-uses, often recreational activities (Blumstein and Fernández-Juricic 2010). Other approaches to mitigate the effects of disturbance include altering the behaviour of the stimulus, for example by implementing 'codes of conduct', hiding the stimulus (e.g. hides) or by promoting habituation, such as through the use of fences (Ikuta and Blumstein 2003), which make stimuli more predictable and physically separate them from birds so rendering them less threatening (Gates and Gysel 1978). Despite the potential of buffers to restrict any negative effects of disturbance (Davies and Lane 1995), and because of a range of competing factors, FIDs have rarely been used in this way in Australia (Weston *et al*. 2009). Their use has been limited by several ecological, scientific and social factors that are discussed below.

Few studies in Australia have provided measures of FIDs, although data on some species with global distributions are available from overseas (e.g. Møller and Erritzøe 2010). Many early studies of FID relied on subjective measurement of distance and so used distance categories (e.g. Woodland *et al*. 1980). However, the availability of cost-effective eye-safe laser rangefinders, which permit accurate measurements of distances at scales relevant to bird FIDs, means collecting data on FIDs is now fairly cheap and accurate. Despite this, data on FIDs of Australian birds are only available for 29.4% of the 851 species of birds that occur in Australia (Table 1). Thus, comparatively few FIDs are readily available to managers. Of the 348 FIDs on Australian birds we located, only 48.0% were published in peer-reviewed literature. The remaining FIDs were published in reports with limited circulation, or reports that are difficult to access (e.g. Honours theses or other 'grey literature'; a finding that is paralleled on other continents). The lack of suitable data on which to make management decisions could be addressed by collecting more FID on more species in more locations and encouraging its publication in a form usable for managers. In the interim, estimates from the widespread, positive relationship between body mass and FID, and the species specific residuals from the relationship (Blumstein 2006), may be used as a first approximation or to identify particularly sensitive species and these estimates can be tested and refined with future study. Clearly, the later approach relies on information regarding the species present at a site, and assumes the site is not already avoided by particularly sensitive species.

There has been a taxonomic bias in available FIDs for Australian birds. FIDs are available for 33.7% of Australian passerines (of 371 species) and 46.5% of non-passerines (of 480 species). In particular, most research has targeted waterbirds, in particular shorebirds (75.8% of 223 species; Table 1). As a result, there are many groups of birds for which few or no FIDs are available. There has also been a regional bias in studies of the FIDs of Australian birds, with most data from temperate areas (usually coastal) in eastern Australia (where most of the human population resides; Fig. 3), and a habitat bias, with most FIDs available from wetlands, few from grasslands, and few studies that specify the microhabitat of focal birds, such as substrate (e.g. for wetland birds, margin or water) (but see Blumstein 2006).

Most reported FIDs involve non-breeding birds, although disturbance can reduce reproductive success in some species (Davidson and Rothwell 1993) and disturbance has been asso-

Table 1. Families in Australia, and its territories, for which flight-initiation distances (FIDs) from Australia are available are listed
Figures exclude extinct species. Species data are presented in Appendix 1. Blanks indicate no FIDs have been located

Order (family)	Stimulus Walker	Dog	Boat	Canoe	Percentage of species in group
Casuariiformes					50.0
Casuariidae	1				50.0
Galliformes					30.8
Megapodiidae	2				66.7
Phasianidae	2				25.0
Anseriformes					35.7
Anatidae	10	1	2	1	37.0
Podicipediformes					50.0
Podicipedidae	2				50.0
Columbiformes					35.5
Columbidae	11				35.5
Caprimulgiformes					25.0
Podargidae	1				33.3
Eurostopodidae	1				50.0
Phalacrocoraciformes					29.4
Anhingidae	1				100.0
Phalacrocoracidae	4				57.1
Ciconiiformes					58.6
Pelecanidae	1				100.0
Ardeidae	11				50.0
Threskiornithidae	5		1	1	100.0
Accipitriformes					28.6
Accipitridae	6				28.6
Falconiformes					33.3
Falconidae	2				33.3
Gruiformes					26.1
Rallidae	6				30.0
Charadriiformes					32.8
Burhinidae	1				50.0
Haematopodidae	2				66.7
Recurvirostridae	3	2	3	3	100.0
Charadriidae	10				52.6
Scolopacidae	16	3	5	5	36.4
Turnicidae	1				14.3
Laridae	7				21.9
Psittaciformes					30.2
Cacatuidae	7				50.0
Psittacidae	9				23.1
Cuculiformes					31.3
Cuculidae	5				31.25
Coraciiformes					50.0
Alcedinidae	1				33.3
Halcyonidae	4				44.4
Meropidae	1				100.0
Coraciidae	1				100.0
Passeriformes					30.5
Menuridae	1				50.0
Climacteridae	3				50.0
Ptilonorhynchidae	4				40.0
Maluridae	3				13.6
Acanthizidae	16				39.0
Pardalotidae	1				25.0
Meliphagidae	24				32.4
Pomatostomidae	2				50.0
Orthonychidae	2				100.0
Psophodidae	1				12.5
Campephagidae	3				42.9
Pachycephalidae	5				35.7

(*continued next page*)

Table 1. (*continued*)

Order (family)	Stimulus				Percentage of species in group
	Walker	Dog	Boat	Canoe	
Oriolidae	2				66.7
Artamidae	7				50.0
Dicruridae	1				100.0
Rhipiduridae	3				50.0
Corvidae	2				28.6
Monarchidae	5				35.7
Corcoracidae	2				100.0
Paradisaeidae	1				25.0
Petroicidae	5				22.7
Cisticolidae	1				50.0
Acrocephalidae	1				50.0
Megaluridae	2				40.0
Timaliidae	1				20.0
Hirundinidae	2				28.6
Pycnonotidae	1				100.0
Turdidae	3				60.0
Sturnidae	2				33.3
Nectariniidae	1				33.3
Estrildidae	5				23.8
Passeridae	2				100.0
Motacillidae	1				12.5
Fringillidae	1				25.0
Families with FIDs	64 (63.4%) of 101				
Species with FIDs	250 (29.4%) of 851				

ciated with decline among breeding populations of others (Møller 2008). Breeding birds potentially respond very differently to disturbance compared with non-breeding birds (Glover *et al.* 2011), and few studies report FIDs for dependent or flightless young.

Fig. 3. Locations in Australia where substantial numbers of flight-initiation distances (FIDs) have been reported (Paton *et al.* 2000; Blumstein *et al.* 2003; Price 2003; Blakney 2004; Gould *et al.* 2004; Cárdenas *et al.* 2005; Adams *et al.* 2006; Boyer *et al.* 2006; Taylor 2006; Kitchen *et al.* 2010; Monie 2011). Many FIDs are not associated with locations that could be mapped, and incidental collections of small numbers of FIDs have been omitted.

FIDs are reported in non-standard ways in the scientific literature, and are presented as averages (e.g. Blumstein 2006) sometimes without measures of variation, as 95th percentiles (e.g. Taylor 2006), or as maxima (Glover 2009). Moreover, a central repository for FID data is not available to managers. Given that almost nothing is known about the thresholds of response frequencies or intensities that can be tolerated by birds, the precautionary principle suggests that an upper limit is required, this could be 95th percentiles (which still assumes thresholds in tolerance) or maxima (if sampling is sufficient), which would be most appropriate for the designation of buffers for conservation purposes. In at least some cases the FIDs evoked by tangential approaches exceed those evoked by direct approaches (e.g. Fernández-Juricic *et al.* 2005; but see Burger *et al.* 2010) suggesting that such effects should be investigated before designating buffers, leading some authors to propose various inflation factors to FIDs (Fernández-Juricic *et al.* 2005; Blumstein and Fernández-Juricic 2010). We believe that it would seem prudent to present full summary statistics and methodological details of all FIDs in publications, to enable managers access and ready interpretation of the data (thus, see Table 2). Additionally, studies of experimentally implemented buffers, derived from FIDs, could inform how FIDs can be used to create effective buffers, and could account for a variety of stimulus types and behaviour, and if studies occur long enough, account for learning on the part of the birds. Studies that examine different methods of calculating buffers in relation to actual FIDs (Fernández-Juricic *et al.* 2005; Glover *et al.* 2011) are both needed and useful.

FIDs from mixed-species flocks are not available either because studies have generally approached only single-species flocks (e.g. Paton *et al*. 2000) or because they assume that no species interactions occur and use a focal bird approach (Blumstein *et al*. 2003). However, many species usually or often occur in mixed flocks (e.g. shorebirds, small passerines) and mixed flocks of shorebirds are known to 'share' vigilance with other species in flocks (Metcalfe 1984). It may be that in mixed flocks the FID is that of the most sensitive individual irrespective of species, especially for closely or highly coordinated flocking species, that is the 'sentinel' hypothesis (Metcalfe 1984; Paton *et al*. 2000). Alternatively, it is possible that species respond only to the flight of conspecifics. These possibilities can be envisaged as the extremes of a spectrum. Interspecies-interactive FIDs remain unstudied and their study may generate novel and practical insights into managing human disturbance at multi-species sites.

Another limitation of the FID data currently available is the emphasis on a single walker as the stimulus (92.0% of 348 FIDs). FIDs in response to other stimuli including walkers with dogs, joggers, powerboats and canoes have only been reported for 11 species (some authors discuss the influence of different stimuli without directly reporting the FIDs, e.g. Glover *et al*. 2011). Although walkers are a useful standard for comparative studies, FID can vary depending on the stimulus involved. For example, shorebirds have larger FIDs towards walkers with dogs than walkers without dogs (Paton *et al*. 2000; Glover 2009) and cars do not elicit as strong a response as walkers or cyclists among ducks (Pease *et al*. 2005). Larger groups of people may evoke longer FIDs (Geist *et al*. 2005). Aspects of the behaviour of stimuli also influence responses: for example, tangential approaches evoke different responses, sometimes longer FIDs, in comparison with direct ones (Blumstein and Fernández-Juricic 2010; Burger *et al*. 2010) and the behaviour of a human can dramatically influence the duration of a response (Weston *et al*. 2011). Owing to the strong effect of stimulus type, proper management decisions can only be made if FIDs for the prevailing human activities are available for the appropriate species. The use of FIDs for single walkers would underestimate the required buffer needed to protect birds from walkers with dogs. More studies of the influence of stimulus type on FID may enable some extrapolation of FIDs across stimulus types, which could be cautiously used by managers until better information becomes available. Indeed, currently it is not known whether birds respond specifically to each stimulus or generalise responses into classes. Different classes of FID are presumably correlated between individuals or species; understanding such patterns might provide general principles regarding what stimuli are likely to cause greatest disturbance. Ultimately, FID-based buffer zones should be viewed as hypotheses ripe for testing and studied in an adaptive management framework (Blumstein and Fernández-Juricic 2010).

Different authors have used various protocols to measure FIDs. The standard protocol, which has received the broadest patronage and thus seems logical to promote to future investigators, involves a slow continuous approach towards the target bird and the recording of AD and FID as the bird behaviour changes (Blumstein 2003). This would also seem to best mimic the behaviour of most recreationists (except possibly birdwatchers or photographers). Other researchers have opted for stepwise advances towards birds with behavioural observations in between each step to monitor vigilance within flocks (Paton *et al*. 2000). For birds in elevated positions, horizontal and vertical components of FID should be recorded and documented (Møller 2010). SD should be maximised or standardised (see Møller and Garamszegi 2012). Standardisation of the FID measuring protocol would enhance compatibility of different datasets and we advocate that the simple method described by Blumstein (2003) should be adopted whenever possible.

Table 2. Recommended data fields for documenting flight-initiation distance (FID) assuming basic methods are fully described

SD, starting distance; AD, alarm-initiation distance

Aspect	Fields
Stimulus	Stimulus type (e.g. walker) and number of stimuli per approach
	Clothing colour
	Speed of approach
	Relative angle of approach (direct or tangential)
	Distance at which approach ceased (if required)
Response	SD (m)
	AD (m) if evident
	FID (m) if evident
	Type of escape (e.g. run, hide, swim, dive)
	Relative direction of escape
	Distance at which escape behaviour ceases
Context	Flock size and composition (e.g. number of conspecifics within 10 and 50 m)
	Age
	Sex
	Life-history stage (e.g. non-breeding)
	Barriers (e.g. fences, channels)
	Height (m) if perched
	Starting behaviour
	Substrate
	Weather, particularly wind speed and direction
	Date, location (including tenure and indices of human presence), species or subspecies being approached

Finally, FIDs may be impractical for planners, policy makers and other stakeholders such as the public, researchers and birdwatchers (see Glover *et al*. 2011). Some species exhibit FIDs of more than 100 m; the maximum FID recorded for any Australian species to date is 196 m for the Eastern Curlew (*Numenius madagascariensis*) (Glover *et al*. 2011); longer FIDs are likely to occur. Although many Australians accept the need for buffers against human disturbance (Glover *et al*. 2011), large buffers that exclude humans threaten coexistence, including with birdwatchers who at least occasionally cause disturbance (Clarke 1965; Sekercioglu 2002). Additionally, close personal encounters with wildlife such as birds can be a powerful tool for public education and the recruitment of bird researchers, conservationists and advocates; strict buffers would exclude such experiences. However, FIDs can provide information on managing disturbance in ways other than exclusion zones. For example, constraining the extent of human presence (through formed paths or barriers such as fences or canals), and the promotion of habituation (by encouraging predictable and unthreatening behaviour of the stimuli), remain tantalising management responses to disturbance.

If response to humans is considered a major issue for bird conservation, then the lack of published FID data, and its limited use in management, seems at odds with the concept of scientific management. The divide between science and its application is hardly new, but it is frustrating and challenging to managers and scientists alike (Australian Biosecurity CRC 2009). The publication of raw FID data often does not fulfil the more theoretical expectations of scientific journals, or aspirations of potential authors. Nevertheless, such data are required if the management of disturbance to birds is to improve. We encourage the development of a common data standard and sharing of these data to enhance the conservation of Australian birds.

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Appendix 1. Flight-initiation distances (FIDs) for birds in Australia (including introduced species) from published sources plus a partial, unpublished database provided by D. T. Blumstein

Each row represents the FIDs reported by separate studies or in relation to treatment variables used in studies (e.g. different habitats), so some taxa are in multiple rows. Only figures given numerically in the cited text are presented, and data have not been estimated from graphical presentation of results in source documents. Residual values (and ranks, where 1 is the highest positive residual value) are also presented (see Fig. 2 and text), with highly positive values indicating FIDs substantially above that predicted by body mass, highly negative values indicating FIDs substantially below that predicted by body mass. Sources: 1, Blumstein (2006); 2, Monie (2011); 3, Paton *et al.* (2000); 4, Taylor (2006); 5, Glover *et al.* (2011); 6, Blakney (2004); 7, Price (2003); 8, Kitchen *et al.* (2010); 9, Blumstein *et al.* (2003); 10, D. T. Blumstein, unpubl. data; 11, Dandenong Valley Authority (1979). Taxonomy and nomenclature follow Christidis and Boles (2008). N/A, not available

Family	English name	Scientific name	Mean	s.d.	*n*	95th percentile	Residual (rank)	Source
Casuariidae	Emu	*Dromaius novaehollandiae*	58.7	36.2	6	118.1		10
Megapodiidae	Australian Brush-turkey	*Alectura lathami*	12.0	13.0	11	33.4	–0.51 (137)	1
Megapodiidae	Orange-footed Scrubfowl	*Megapodius reinwardt*	25.9	8.8	4	40.4		10
Phasianidae	Stubble Quail	*Coturnix pectoralis*	1.9	0.5	2	2.8		10
Phasianidae	Brown Quail	*Coturnix ypsilophora*	5.5	4.7	5	13.1		10
Anatidae	Musk Duck	*Biziura lobata*	18.9	1.5	2	21.4		10
Anatidae	Black Swan	*Cygnus atratus*	50.4	35.8	19	109.3	–0.09 (89)	1
Anatidae	Black Swan	*Cygnus atratus*	3.6	3.8	92	9.9		2
Anatidae	Black Swan[A]	*Cygnus atratus*	149.0	0.0	1	149.0		3
Anatidae	Black Swan[A,B]	*Cygnus atratus*	113.0	0.0	1	113.0		3
Anatidae	Black Swan	*Cygnus atratus*	N/A	N/A	90	159		4
Anatidae	Black Swan	*Cygnus atratus*	40.0		N/A			11
Anatidae	Black Swan[C]	*Cygnus atratus*	53.0		N/A			11
Anatidae	Australian Shelduck[A]	*Tadorna tadornoides*	145.0	0.0	1	145.0		3
Anatidae	Australian Shelduck	*Tadorna tadornoides*	N/A	N/A	35	270		4
Anatidae	Australian Wood Duck	*Chenonetta jubata*	25.5	24.9	44	66.5	–0.04 (74)	1
Anatidae	Australasian Shoveler	*Anas rhynchotis*	19.2	0.0	1	19.2		10
Anatidae	Grey Teal	*Anas gracilis*	41.6	22.8	23	79.1	0.24 (22)	1
Anatidae	Grey Teal[A]	*Anas gracilis*	106.9	10.1	2	123.5		3
Anatidae	Grey Teal[A,B]	*Anas gracilis*	59.0	8.5	2	73.0		3
Anatidae	Grey Teal[A,D]	*Anas gracilis*	49.5		1			3
Anatidae	Grey Teal	*Anas gracilis*	N/A	N/A	72	330		4
Anatidae	Chestnut Teal	*Anas castanea*	46.5	21.4	55	81.7	0.25 (17)	1
Anatidae	Chestnut Teal	*Anas castanea*	N/A	N/A	20	260		4
Anatidae	Northern Mallard	*Anas platyrhynchos*	12.8	5.0	3	21.1		10
Anatidae	Pacific Black Duck	*Anas superciliosa*	38.9	29.0	50	86.6	0.10 (39)	1
Anatidae	Pacific Black Duck	*Anas superciliosa*	N/A	N/A	28	205		4
Anatidae	Hardhead	*Aythya australis*	37.1	20.9	9	71.5		10
Podicipedidae	Australasian Grebe	*Tachybaptus novaehollandiae*	23.4	14.1	19	46.6	0.09 (46)	1
Podicipedidae	Hoary-headed Grebe	*Poliocephalus poliocephalus*	23.8	7.3	4	35.8		10
Columbidae	White-headed Pigeon	*Columba leucomela*	26.0	34.5	2	82.7		10
Columbidae	Spotted Dove	*Streptopelia chinensis*	12.9	9.0	52	27.7	–0.13 (98)	1
Columbidae	Brown Cuckoo-Dove	*Macropygia amboinensis*	8.1	4.8	11	16.0	–0.38 (134)	1
Columbidae	Emerald Dove	*Chalcophaps indica*	14.2	8.8	2	28.7		10
Columbidae	Common Bronzewing	*Phaps chalcoptera*	21.6	9.1	21	36.6	0.00 (61)	10
Columbidae	Crested Pigeon	*Ocyphaps lophotes*	12.7	9.2	31	27.8	–0.16 (107)	1
Columbidae	Peaceful Dove	*Geopelia striata*	12.1	7.8	27	24.9	–0.02 (67)	10
Columbidae	Bar-shouldered Dove	*Geopelia humeralis*	22.1	14.8	93	46.4	0.13 (32)	1
Columbidae	Wonga Pigeon	*Leucosarcia picata*	18.5	10.9	22	36.4	–0.10 (89)	1
Columbidae	Pied Imperial-Pigeon	*Ducula bicolor*	21.5	11.3	4	40.1		10
Columbidae	Topknot Pigeon	*Lopholaimus antarcticus*	15.0	7.2	6	26.7		10
Podargidae	Tawny Frogmouth	*Podargus strigoides*	6.2	4.4	2	13.3		10
Eurostopodidae	Spotted Nightjar	*Eurostopodus argus*	10.8	0.0	1	10.8		10
Anhingidae	Australasian Darter	*Anhinga novaehollandiae*	24.0	14.9	20	48.5	–0.15 (106)	1
Phalacrocoracidae	Little Pied Cormorant	*Microcarbo melanoleucos*	19.8	14.3	58	43.3	–0.14 (102)	1
Phalacrocoracidae	Great Cormorant	*Phalacrocorax carbo*	32.3	20.6	34	66.2	–0.06 (79)	1
Phalacrocoracidae	Little Black Cormorant	*Phalacrocorax sulcirostris*	24	15.3	38	49.2	–0.10 (92)	1
Phalacrocoracidae	Pied Cormorant	*Phalacrocorax varius*	31.3	18.0	25	60.9	–0.05 (77)	1
Pelecanidae	Australian Pelican	*Pelecanus conspicillatus*	32.6	25.4	39	74.4	–0.17 (108)	1
Ardeidae	Australasian Bittern	*Botaurus poiciloptilus*	10.0	0.0	1	10.0		10
Ardeidae	Australian Little Bittern	*Ixobrychus dubius*	12.9	4.5	4	20.2		10

(*continued next page*)

Appendix 1. (*continued*)

Family	English name	Scientific name	Mean	s.d.	*n*	95th percentile	Residual (rank)	Source
Ardeidae	White-necked Heron	*Ardea pacifica*	N/A	N/A	26	170		4
Ardeidae	White-necked Heron	*Ardea pacifica*	45.3	36.9	2	106.0		10
Ardeidae	Eastern Great Egret	*Ardea modesta*	39.9	24.8	79	80.7	0.15 (31)	1
Ardeidae	Eastern Great Egret	*Ardea modesta*	N/A	N/A	31	155.0		4
Ardeidae	Intermediate Egret	*Ardea intermedia*	N/A	N/A	27	210.0		4
Ardeidae	Intermediate Egret	*Ardea intermedia*	42.7	36.9	4	103.4		10
Ardeidae	Cattle Egret	*Ardea ibis*	63.1	46.8	11	140.1	0.46 (5)	10
Ardeidae	Striated Heron	*Butorides striata*	31.7	18.9	8	62.83		10
Ardeidae	White-faced Heron	*Egretta novaehollandiae*	31.2	20.1	33	64.3	0.10 (43)	1
Ardeidae	White-faced Heron	*Egretta novaehollandiae*	N/A	N/A	25	215		4
Ardeidae	Little Egret	*Egretta garzetta*	52.4	23.0	10	90.2	0.40 (9)	1
Ardeidae	Eastern Reef Egret	*Egretta sacra*	31.1	13.6	2	53.5		10
Ardeidae	Nankeen Night-Heron	*Nycticorax caledonicus*	16.6	5.8	4	26.1		10
Threskiornithidae	Glossy Ibis	*Plegadis falcinellus*	N/A	N/A	35	195		4
Threskiornithidae	Glossy Ibis	*Plegadis falcinellus*	83.1	0.0	1	83.1		10
Threskiornithidae	Australian White Ibis	*Threskiornis molucca*	32.8	20.4	48	66.4	–0.04 (76)	1
Threskiornithidae	Australian White Ibis[A]	*Threskiornis molucca*	80.8	2.5	2	84.9		3
Threskiornithidae	Australian White Ibis[A,B]	*Threskiornis molucca*	62.2	26.2	3	105.3		3
Threskiornithidae	Australian White Ibis[A,D]	*Threskiornis molucca*	58.3	37.8	2	120.5		3
Threskiornithidae	Australian White Ibis	*Threskiornis molucca*	N/A	N/A	20	130.0		4
Threskiornithidae	Straw-necked Ibis	*Threskiornis spinicollis*	42.4	25.2	10	83.9	0.11 (36)	1
Threskiornithidae	Straw-necked Ibis	*Threskiomis spinicollis*	N/A	N/A	15	135.0		4
Threskiornithidae	Royal Spoonbill	*Platalea regia*	44.4	24.9	24	85.4	0.10 (44)	1
Threskiornithidae	Royal Spoonbill	*Platalea regia*	N/A	N/A	25	70.0		4
Threskiornithidae	Yellow-billed Spoonbill	*Platalea flavipes*	N/A	N/A	24	80.0		4
Threskiornithidae	Yellow-billed Spoonbill	*Platalea flavipes*	51.0	41.5	4	119.2		10
Accipitridae	Black-shouldered Kite	*Elanus axillaris*	23.1	14.9	10	47.6	0.05 (50)	1
Accipitridae	Pacific Baza	*Aviceda subcristata*	18.0	0.0	1	18.0		10
Accipitridae	Whistling Kite	*Haliastur sphenurus*	28.2	12.3	3	48.5		10
Accipitridae	Black Kite	*Milvus migrans*	57.0	0.0	1	57.0		10
Accipitridae	Grey Goshawk	*Accipiter novaehollandiae*	24.6	0.0	1	24.6		10
Accipitridae	Spotted Harrier	*Circus assimilis*	22.0	0.0	1	22.0		10
Falconidae	Nankeen Kestrel	*Falco cenchroides*	43.4	44.1	14	116.0	0.40 (10)	10
Falconidae	Brown Falcon	*Falco berigora*	34.1	28.1	2	80.3		10
Rallidae	Purple Swamphen	*Porphyrio porphyrio*	34.5	21.8	68	70.4	0.40 (8)	1
Rallidae	Purple Swamphen	*Porphyrio porphyrio*	65.0	0.0	N/A	65.0		11
Rallidae	Lewin's Rail	*Lewinia pectoralis*	4.3	0.0	1	4.3		10
Rallidae	Buff-banded Rail	*Gallirallus philippensis*	8.0	0.0	1	8.0		10
Rallidae	Baillon's Crake	*Porzana pusilla*	8.2	4.6	3	15.8		10
Rallidae	Dusky Moorhen	*Gallinula tenebrosa*	14.8	10.7	37	32.4	–0.22 (117)	1
Rallidae	Eurasian Coot	*Fulica atra*	19.2	15.8	10	45.2	–0.03 (71)	1
Rallidae	Eurasian Coot	*Fulica atra*	23.0	0.0	N/A	23.0		11
Burhinidae	Bush Stone-curlew	*Burhinus grallarius*	25.9	20.7	13	59.9	–0.01 (62)	1
Haematopodidae	Australian Pied Oystercatcher	*Haematopus longirostris*	38.5	18	23	68.1	0.15 (30)	1
Haematopodidae	Australian Pied Oystercatcher[A]	*Haematopus longirostris*	82.5	64.4	2	188.4		3
Haematopodidae	Australian Pied Oystercatcher	*Haematopus longirostris*	41.5	16.2	21	68.1		5
Haematopodidae	Sooty Oystercatcher	*Haematopus fuliginosus*	30.5	15.8	59	56.5	0.04 (52)	1
Haematopodidae	Sooty Oystercatcher	*Haematopus fuliginosus*	64.3	43.1	14	135.1		5
Recurvirostridae	Black-winged Stilt	*Himantopus himantopus*	38.3	21.1	63	73	0.24 (21)	1
Recurvirostridae	Black-winged Stilt[A]	*Himantopus himantopus*	39.3	22.9	3	77		3
Recurvirostridae	Black-winged Stilt[A,C]	*Himantopus himantopus*	43.5	15.0	2	68.0		3
Recurvirostridae	Black-winged Stilt[A,B]	*Himantopus himantopus*	33.5	2.1	2	37.0		3
Recurvirostridae	Black-winged Stilt[A,D]	*Himantopus himantopus*	35.8	14.5	2	59.7		3
Recurvirostridae	Black-winged Stilt	*Himantopus himantopus*	N/A	N/A	42	80		4
Recurvirostridae	Black-winged Stilt	*Himantopus himantopus*	38.0	16.7	20	65.4		5
Recurvirostridae	Black-winged Stilt	*Himantopus himantopus*	30.0	0.0	N/A	30.0		11
Recurvirostridae	Red-necked Avocet[A]	*Recurvirostra novaehollandiae*	60.4	7.8	3	73.2		3
Recurvirostridae	Red-necked Avocet[A,B]	*Recurvirostra novaehollandiae*	57.0	0.0	1	57.0		3
Recurvirostridae	Red-necked Avocet[A,D]	*Recurvirostra novaehollandiae*	43.0	0.0	1	43.0		3

(*continued next page*)

Appendix 1. (*continued*)

Family	English name	Scientific name	Mean	s.d.	*n*	95th percentile	Residual (rank)	Source
Recurvirostridae	Red-necked Avocet	*Recurvirostra novaehollandiae*	N/A	N/A	20.0	110.0		4
Recurvirostridae	Red-necked Avocet	*Recurvirostra novaehollandiae*	73.0	39.2	5	137.4		5
Recurvirostridae	Banded Stilt[A]	*Cladorhynchus leucocephalus*	32.8	23.7	8	71.8		3
Recurvirostridae	Banded Stilt[A,C]	*Cladorhynchus leucocephalus*	40.2	11.0	2	58.3		3
Recurvirostridae	Banded Stilt[A,B]	*Cladorhynchus leucocephalus*	28.8	8.1	4	42.1		3
Recurvirostridae	Banded Stilt[A,D]	*Cladorhynchus leucocephalus*	24.7	7.7	5	37.4		3
Charadriidae	Pacific Golden Plover	*Pluvialis fulva*	21.9	12.1	21	41.8	0.12 (34)	1
Charadriidae	Pacific Golden Plover	*Pluvialis fulva*	49.3	10.1	3	65.9		5
Charadriidae	Grey Plover	*Pluvialis squatarola*	36.0	18.7	41	66.8	0.27 (16)	1
Charadriidae	Grey Plover	*Pluviali squatarola*	44.0	0.0	1	44.0		5
Charadriidae	Red-capped Plover	*Charadrius ruficapillus*	22.0	7.7	16	34.7	0.46 (4)	1
Charadriidae	Red-capped Plover	*Charadrius ruficapillus*	N/A	N/A	18	45.0		4
Charadriidae	Red-capped Plover	*Charadrius ruficapillus*	32.8	15.4	20	58.1		5
Charadriidae	Double-banded Plover	*Charadrius bicinctus*	32.1	7.5	7	44.5	0.03 (53)	5
Charadriidae	Double-banded plover	*Charadrius bicinctus*	13.9	6.1	10	23.8		10
Charadriidae	Lesser Sand Plover	*Charadrius mongolus*	16.7	7.7	7	29.4		10
Charadriidae	Black-fronted Dotterel	*Elseyornis melanops*	22.7	9.3	46	37.9	0.32 (14)	1
Charadriidae	Black-fronted Dotterel	*Elseyornis melanops*	23.9	8.2	17	37.3		5
Charadriidae	Hooded Plover	*Thinornis rubricollis*	54.4	35.4	30	112.7	0.56 (1)	6
Charadriidae	Hooded Plover	*Thinornis rubricollis*	41.1	17.1	8	69.3		5
Charadriidae	Hooded Plover	*Thinornis rubricollis*	26.3	3.3	4	31.6		10
Charadriidae	Red-kneed Dotterel	*Erythrogonys cinctus*	N/A	N/A	22	40.0	0.23 (24)	4
Charadriidae	Red-kneed Dotterel	*Erythrogonys cinctus*	21.2	6.2	10	31.3		5
Charadriidae	Red-kneed Dotterel	*Erythrogonys cinctus*	15.4	1.5	2	17.8		10
Charadriidae	Banded Lapwing	*Vanellus tricolor*	74.0	0.0	1	74.0		5
Charadriidae	Masked Lapwing	*Vanellus miles*	46.8	30.5	37	96.9	0.45 (6)	1
Charadriidae	Masked Lapwing	*Vanellus miles*	62.6	43.1	55	133.5		5
Scolopacidae	Latham's Snipe	*Gallinago hardwickii*	18.6	9.6	30	34.5	0.05 (51)	5
Scolopacidae	Latham's Snipe	*Gallinago hardwickii*	13.7	7.8	8	26.6		10
Scolopacidae	Black-tailed Godwit	*Limosa limosa*	31.3	3.3	4	36.7		5
Scolopacidae	Black-tailed Godwit	*Limosa limosa*	21.0	11.3	6	39.7		10
Scolopacidae	Bar-tailed Godwit[A]	*Limosa lapponica*	48.6	0.9	2	50.1	0.06 (49)	3
Scolopacidae	Bar-tailed Godwit[A,B]	*Limosa lapponica*	53.5	7.8	2	66.3		3
Scolopacidae	Bar-tailed Godwit[A,D]	*Limosa lapponica*	41.9	4.5	2	49.3		3
Scolopacidae	Bar-tailed Godwit	*Limosa lapponica*	59.5	10.5	4	76.8		5
Scolopacidae	Bar-tailed Godwit	*Limosa lapponica*	22.1	14.8	196	46.5		10
Scolopacidae	Whimbrel	*Numenius phaeopus*	37.7	30.4	28	87.7	0.22 (25)	1
Scolopacidae	Whimbrel	*Numenius phaeopus*	90.0	0.0	1	90.0		5
Scolopacidae	Eastern Curlew	*Numenius madagascariensis*	65.5	41.6	42	133.9	0.37 (12)	1
Scolopacidae	Eastern Curlew[A]	*Numenius madagascariensis*	97.5	23.3	2	135.8		3
Scolopacidae	Eastern Curlew	*Numenius madagascariensis*	126.1	29.2	22	174.2		5
Scolopacidae	Common Sandpiper	*Actitis hypoleucos*	43.0	0.0	1	43.0		5
Scolopacidae	Grey-tailed Tattler	*Tringa brevipes*	17.3	8.6	45	31.4	0.03 (55)	1
Scolopacidae	Grey-tailed Tattler	*Tringa brevipes*	23.0	0.0	1	23.0		5
Scolopacidae	Common Greenshank[A]	*Tringa nebularia*	70.0	11.8	3	89.4	0.49 (3)	3
Scolopacidae	Common Greenshank[A,C]	*Tringa nebularia*	80.3	13.0	2	102.0		3
Scolopacidae	Common Greenshank[A,B]	*Tringa nebularia*	60.7	4.0	3	67.3		3
Scolopacidae	Common Greenshank[A,D]	*Tringa nebularia*	51.5	3.5	2	57.3		3
Scolopacidae	Common Greenshank	*Tringa nebularia*	N/A	N/A	17	75.0		4
Scolopacidae	Common Greenshank	*Tringa nebularia*	55.4	27.8	17	101.2		5
Scolopacidae	Common Greenshank	*Trigna nebularia*	47.6	17.8	7	77.0		10
Scolopacidae	Marsh Sandpiper	*Tringa stagnatilis*	N/A	N/A	20	105.0	0.52 (2)	4
Scolopacidae	Marsh Sandpiper	*Tringa stagnatilis*	44.1	23.2	20	82.3		5
Scolopacidae	Ruddy Turnstone	*Arenaria interpres*	13.8	6.4	51	24.3	–0.06 (78)	1
Scolopacidae	Ruddy Turnstone	*Arenaria interpres*	29.7	14.3	6	53.2		5
Scolopacidae	Red Knot	*Calidris canutus*	21.3	9.2	8	36.4		10
Scolopacidae	Sanderling	*Calidris alba*	32.0	7.9	5	44.9		5
Scolopacidae	Red-necked Stint	*Calidris ruficollis*	16.4	8.7	61	30.7	0.20 (26)	1
Scolopacidae	Red-necked Stint[A]	*Calidris ruficollis*	20.0	3.5	4	25.8		3

(*continued next page*)

Appendix 1. (*continued*)

Family	English name	Scientific name	Mean	s.d.	*n*	95th percentile	Residual (rank)	Source
Scolopacidae	Red-necked Stint[A,C]	*Calidris ruficollis*	32.6	14.0	3	55.3		3
Scolopacidae	Red-necked Stint[A,B]	*Calidris ruficollis*	28.1	1.8	3	31.1		3
Scolopacidae	Red-necked Stint[A,D]	*Calidris ruficollis*	17.3	4.2	3	24.2		3
Scolopacidae	Red-necked Stint	*Calidris ruficollis*	18.7	8.7	23	33.0		5
Scolopacidae	Pectoral Sandpiper	*Calidris melanotos*	23.0	9.9	2	39.3		5
Scolopacidae	Sharp-tailed Sandpiper	*Calidris acuminata*	14.8	8.7	28	29.1	0.16 (28)	1
Scolopacidae	Sharp-tailed Sandpiper[A]	*Calidris acuminata*	33.2	3.9	5	39.6		3
Scolopacidae	Sharp-tailed Sandpiper[A,C]	*Calidris acuminata*	39.3	3.7	2	45.4		3
Scolopacidae	Sharp-tailed Sandpiper[A,B]	*Calidris acuminata*	35.7	4.2	3	42.6		3
Scolopacidae	Sharp-tailed Sandpiper[A,D]	*Calidris acuminata*	28.1	4.0	4	34.7		3
Scolopacidae	Sharp-tailed Sandpiper	*Calidris acuminata*	N/A	N/A	30	55.0		4
Scolopacidae	Sharp-tailed Sandpiper	*Calidris acuminata*	20.3	7.5	31	32.7		5
Scolopacidae	Sharp-tailed Sandpiper	*Calidris acuminata*	20.0	0.0	N/A	20.0		11
Scolopacidae	Curlew Sandpiper[A]	*Calidris ferruginea*	34.8	6.0	4	44.7	0.30 (15)	3
Scolopacidae	Curlew Sandpiper[A,B]	*Calidris ferruginea*	29.8	4.8	3	37.7		3
Scolopacidae	Curlew Sandpiper[A,D]	*Calidris ferruginea*	26.8	2.9	3	31.6		3
Scolopacidae	Curlew Sandpiper	*Calidris ferruginea*	25.2	6.4	21	35.7		5
Scolopacidae	Curlew Sandpiper	*Calidris ferruginea*	24.9	6.0	8	34.8		10
Turnicidae	Red-chested Button-quail	*Turnix pyrrhothorax*	3.6	2.1	5	7.0		10
Laridae	Little Tern	*Sternula albifrons*	21.5	7.9	18	34.5	0.24 (20)	1
Laridae	Caspian Tern	*Hydroprogne caspia*	35.0	10.4	12	52.1	0.10 (41)	1
Laridae	Whiskered Tern	*Chlidonias hybrida*	21.4	8.5	3	35.3		10
Laridae	Common Tern	*Sterna hirundo*	20.5	10.9	8	38.4		10
Laridae	Crested Tern	*Thalasseus bergii*	17.3	10.7	37	34.9	–0.09 (86)	1
Laridae	Kelp Gull	*Larus dominicanus*	24.4	11.4	14	43.2	–0.08 (82)	1
Laridae	Silver Gull	*Chroicocephalus novaehollandiae*	16.8	12.1	136	36.7	–0.09 (87)	1
Cacatuidae	Red-tailed Black-Cockatoo	*Calyptorhynchus banksii*	10.9	15.2	3	35.9		10
Cacatuidae	Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*	11.7	6.7	4	22.8		10
Cacatuidae	Gang-gang Cockatoo	*Callocephalon fimbriatum*	7.5	5.6	2	16.6		10
Cacatuidae	Galah	*Eolophus roseicapillus*	8.9	5.6	64	18.1	–0.39 (135)	1
Cacatuidae	Long-billed Corella	*Cacatua tenuirostris*	3.8	0.0	1	3.8		10
Cacatuidae	Little Corella	*Cacatua sanguinea*	20.0	15.2	8	45.0		10
Cacatuidae	Sulphur-crested Cockatoo	*Cacatua galerita*	15.3	14.9	41	39.8	–0.26 (123)	1
Psittacidae	Rainbow Lorikeet	*Trichoglossus haematodus*	10.0	8.1	11	23.3	–0.21 (113)	1
Psittacidae	Scaly-breasted Lorikeet	*Trichoglossus chlorolepidotus*	1.0	0.0	1	1.0		10
Psittacidae	Australian King-Parrot	*Alisterus scapularis*	8.7	3.8	9	14.9		10
Psittacidae	Red-winged Parrot	*Aprosmictus erythropterus*	32.3	11.1	5	50.5		10
Psittacidae	Crimson Rosella	*Platycercus elegans*	9.1	6.4	83	19.6	–0.25 (121)	1
Psittacidae	Eastern Rosella	*Platycercus eximius*	13.9	8.8	31	28.4	–0.04 (75)	1
Psittacidae	Pale-headed Rosella	*Platycercus adscitus*	21.0	8.7	3	35.2		10
Psittacidae	Australian Ringneck	*Barnardius zonarius*	14.1	9.5	3	29.7		10
Psittacidae	Red-rumped Parrot	*Psephotus haematonotus*	11.2	6.6	9	22.1		10
Cuculidae	Pheasant Coucal	*Centropus phasianinus*	30.5	42.8	14	101.0	0.16 (29)	10
Cuculidae	Eastern Koel	*Eudynamys orientalis*	4.6	2.2	2	8.2		10
Cuculidae	Horsfield's Bronze-Cuckoo	*Chalcites basalis*	3.5	1.6	2	6.1		10
Cuculidae	Pallid Cuckoo	*Cacomantis pallidus*	8.5	1.1	2	10.3		10
Cuculidae	Fan-tailed Cuckoo	*Cacomantis flabelliformis*	10.6	5.7	19	19.9	–0.06 (80)	1
Alcedinidae	Azure Kingfisher	*Ceyx azureus*	11.7	4.5	10	19.1	0.03 (56)	10
Halcyonidae	Laughing Kookaburra	*Dacelo novaeguineae*	13.8	12.3	54	34.0	–0.18 (110)	1
Halcyonidae	Blue-winged Kookaburra	*Dacelo leachii*	23.0	0.0	1	23.0		10
Halcyonidae	Forest Kingfisher	*Todiramphus macleayii*	11.0	4.3	11	18.1	–0.01 (66)	10
Halcyonidae	Sacred Kingfisher	*Todiramphus sanctus*	20.9	6.8	16	32.1	0.24 (19)	1
Meropidae	Rainbow Bee-eater	*Merops ornatus*	23.0	17.8	10	52.3	0.34 (13)	10
Coraciidae	Dollarbird	*Eurystomus orientalis*	25.9	22.5	23	62.9	0.20 (27)	1
Menuridae	Superb Lyrebird	*Menura novaehollandiae*	10.5	8.6	26	24.6	–0.46 (136)	1
Climacteridae	White-throated Treecreeper	*Cormobates leucophaea*	5.8	2.9	17	10.6	–0.23 (118)	1
Climacteridae	White-browed Treecreeper	*Climacteris affinis*	3.1	0.0	1	3.1		10
Climacteridae	Brown Treecreeper	*Climacteris picumnus*	5.1	3.1	13	10.2	–0.33 (131)	1
Ptilonorhynchidae	Spotted Catbird	*Ailuroedus melanotis*	18.7	16.2	16	45.3	0.02 (58)	10

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Appendix 1. (*continued*)

Family	English name	Scientific name	Mean	s.d.	*n*	95th percentile	Residual (rank)	Source
Ptilonorhynchidae	Green Catbird	*Ailuroedus crassirostris*	9.7	4.1	16	16.4	–0.29 (127)	1
Ptilonorhynchidae	Tooth-billed Bowerbird	*Scenopoeetes dentirostris*	5.2	1.1	2	7.1		10
Ptilonorhynchidae	Satin Bowerbird	*Ptilonorhynchus violaceus*	9.5	5.1	22	17.9	–0.30 (128)	1
Maluridae	Superb Fairy-wren	*Malurus cyaneus*	6.5	3.4	93	12.1	–0.07 (81)	1
Maluridae	Variegated Fairy-wren	*Malurus lamberti*	4.5	3.4	38	10.1	–0.21 (112)	1
Maluridae	Southern Emu-wren	*Stipiturus malachurus*	7.0	3.3	13	12.4	–0.01 (63)	1
Acanthizidae	Pilotbird	*Pycnoptilus floccosus*	16.9	10.0	3	33.4		10
Acanthizidae	Rockwarbler	*Origma solitaria*	17.1	4.0	2	23.8		10
Acanthizidae	Yellow-throated Scrubwren	*Sericornis citreogularis*	5.6	4.3	51	12.7	–0.22 (116)	1
Acanthizidae	White-browed Scrubwren	*Sericornis frontalis*	4.2	2.5	41	8.3	–0.32 (129)	1
Acanthizidae	Atherton Scrubwren	*Sericornis keri*	4.9	4.5	11	12.3	–0.22 (114)	10
Acanthizidae	Large-billed Scrubwren	*Sericornis magnirostra*	4.4	4.4	17	11.6	–0.24 (119)	1
Acanthizidae	Chestnut-rumped Heathwren	*Hylacola pyrrhopygia*	11.4	0.0	1	11.4		10
Acanthizidae	Striated Fieldwren	*Calamanthus fuliginosus*	8.6	0.0	1	8.6		10
Acanthizidae	Brown Gerygone	*Gerygone mouki*	4.2	1.9	32	7.3	–0.18 (109)	1
Acanthizidae	Western Gerygone	*Gerygone fusca*	5.4	0.0	1	5.4		10
Acanthizidae	White-throated Gerygone	*Gerygone albogularis*	5.1	3.8	3	11.4		10
Acanthizidae	Striated Thornbill	*Acanthiza lineata*	4.2	2.0	4	7.5		10
Acanthizidae	Yellow Thornbill	*Acanthiza nana*	6.3	2.4	17	10.2	–0.03 (73)	1
Acanthizidae	Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	6.6	3.7	4	12.7		10
Acanthizidae	Buff-rumped Thornbill	*Acanthiza reguloides*	4.3	1.8	14	7.3	–0.22 (115)	1
Acanthizidae	Brown Thornbill	*Acanthiza pusilla*	6.7	9.9	28	22.9	–0.01 (65)	1
Pardalotidae	Spotted Pardalote	*Pardalotus punctatus*	4.0	1.9	7	7.1		10
Meliphagidae	Eastern Spinebill	*Acanthorhynchus tenuirostris*	5.8	2.6	39	10.1	–0.14 (101)	1
Meliphagidae	Lewin’s Honeyeater	*Meliphaga lewinii*	8.2	6.0	32	18.1	–0.13 (100)	1
Meliphagidae	Yellow-faced Honeyeater	*Lichenostomus chrysops*	5.8	3.6	29	11.7	–0.19 (111)	1
Meliphagidae	Singing Honeyeater	*Lichenostomus virescens*	12.0	0.0	1	12.0		10
Meliphagidae	Yellow Honeyeater	*Lichenostomus flavus*	6.4	1.2	6	8.4		10
Meliphagidae	White-eared Honeyeater	*Lichenostomus leucotis*	8.8	3.7	7	14.8		10
Meliphagidae	Fuscous Honeyeater	*Lichenostomus fuscus*	14.6	0.0	1	14.6		10
Meliphagidae	White-plumed Honeyeater	*Lichenostomus penicillatus*	9.8	5.6	23	19	0.01 (59)	1
Meliphagidae	Bell Miner	*Manorina melanophrys*	5.0	3.0	44	9.9	–0.34 (132)	1
Meliphagidae	Noisy Miner	*Manorina melanocephala*	7.5	14.9	37	32	–0.24 (120)	1
Meliphagidae	Spiny-cheeked Honeyeater	*Acanthagenys rufogularis*	9.2	1.3	3	11.4		10
Meliphagidae	Little Wattlebird	*Anthochaera chrysoptera*	7.3	3.0	40	12.2	–0.28 (126)	1
Meliphagidae	Red Wattlebird	*Anthochaera carunculata*	8.7	6.4	15	19.2	–0.25 (122)	1
Meliphagidae	White-fronted Chat	*Epthianura albifrons*	22.6	7.8	23	35.4	0.43 (7)	1
Meliphagidae	Dusky Honeyeater	*Myzomela obscura*	2.0	0.0	1	2.0		10
Meliphagidae	Tawny-crowned Honeyeater	*Glyciphila melanops*	9.8	6.7	11	20.8	0.02 (57)	1
Meliphagidae	Brown Honeyeater	*Lichmera indistincta*	9.8	5.6	16	19.0	0.09 (48)	1
Meliphagidae	New Holland Honeyeater	*Phylidonyris novaehollandiae*	7.9	6	47	17.8	–0.08 (85)	1
Meliphagidae	White-cheeked Honeyeater	*Phylidonyris niger*	2.3	0.0	2	2.3		10
Meliphagidae	Blue-faced Honeyeater	*Entomyzon cyanotis*	30.8	0.0	1	30.8		10
Meliphagidae	Helmeted Friarbird	*Philemon buceroides*	12.0	9.6	20	27.8	–0.10 (91)	10
Meliphagidae	Noisy Friarbird	*Philemon corniculatus*	11.1	5.3	55	19.8	–0.14 (103)	1
Meliphagidae	Little Friarbird	*Philemon citreogularis*	6.8	3.1	2	11.9		10
Meliphagidae	Striped Honeyeater	*Plectorhyncha lanceolata*	4.6	2.3	5	8.4		10
Pomatostomidae	White-browed Babbler	*Pomatostomus superciliosus*	16.9	4.4	2	24.1		10
Pomatostomidae	Chestnut-crowned Babbler	*Pomatostomus ruficeps*	11.8	4.0	2	18.3		10
Orthonychidae	Australian Logrunner	*Orthonyx temminckii*	4.5	1.5	5	7.0		10
Orthonychidae	Chowchilla	*Orthonyx spaldingii*	4.0	0.0	3	4.0		10
Psophodidae	Eastern Whipbird	*Psophodes olivaceus*	5.9	3.3	50	11.3	–0.35 (133)	1
Campephagidae	Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	21.1	13.2	20	42.8	0.13 (33)	1
Campephagidae	White-bellied Cuckoo-shrike	*Coracina papuensis*	7.1	2.6	4	11.4		10
Campephagidae	Varied Triller	*Lalage leucomela*	38.7	0.0	1	38.7		10
Pachycephalidae	Crested Shrike-tit	*Falcunculus frontatus*	8.5	6.6	4	19.4		10
Pachycephalidae	Olive Whistler	*Pachycephala olivacea*	3.8	1.6	6	6.5		10
Pachycephalidae	Golden Whistler	*Pachycephala pectoralis*	7.9	3.9	18	14.3	–0.11 (94)	1
Pachycephalidae	Rufous Whistler	*Pachycephala rufiventris*	5.2	2.0	4	8.5		10

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Appendix 1. (*continued*)

Family	English name	Scientific name	Mean	s.d.	*n*	95th percentile	Residual (rank)	Source
Pachycephalidae	Grey Shrike-thrush	*Colluricincla harmonica*	12.8	11.4	15	31.6	–0.02 (68)	1
Oriolidae	Australasian Figbird	*Sphecotheres vieilloti*	7.8	3.7	12	13.9	–0.33 (130)	10
Oriolidae	Olive-backed Oriole	*Oriolus sagittatus*	11.3	5.9	33	21.0	–0.12 (97)	1
Artamidae	White-breasted Woodswallow	*Artamus leucorynchus*	15.8	1.6	2	18.5		10
Artamidae	Masked Woodswallow	*Artamus personatus*	6.5	4.9	2	14.6		10
Artamidae	Black-faced Woodswallow	*Artamus cinereus*	11.8	5.6	3	21.1		10
Artamidae	Grey Butcherbird	*Cracticus torquatus*	19.3	13.3	10	41.2	0.11 (35)	1
Artamidae	Pied Butcherbird	*Cracticus nigrogularis*	9.5	4.9	8	17.5		10
Artamidae	Australian Magpie	*Cracticus tibicen*	10.9	8.7	91	25.2	–0.26 (124)	1
Artamidae	Australian Magpie[E]	*Cracticus tibicen*	40.3	28.2	21	86.6		7
Artamidae	Australian Magpie[F]	*Cracticus tibicen*	11.1	5.9	27	20.8		7
Artamidae	Pied Currawong	*Strepera graculina*	15.1	11.6	26	34.2	–0.15 (104)	1
Dicruridae	Spangled Drongo	*Dicrurus bracteatus*	15.4	5.3	9	24.1		10
Rhipiduridae	Rufous Fantail	*Rhipidura rufifrons*	6.4	2	11	9.7	–0.08 (83)	1
Rhipiduridae	Grey Fantail	*Rhipidura albiscapa*	6.8	4.3	37	13.9	–0.03 (72)	1
Rhipiduridae	Willie Wagtail	*Rhipidura leucophrys*	11.8	9.7	46	27.8	0.10 (45)	1
Rhipiduridae	Willie Wagtail[E]	*Rhipidura leucophrys*	23.5	12.1	21	43.4		7
Rhipiduridae	Willie Wagtail[F]	*Rhipidura leucophrys*	8.7	4.5	20	16.2		7
Corvidae	Australian Raven	*Corvus coronoides*	25.8	22.2	63	62.3	–0.01 (64)	1
Corvidae	Torresian Crow	*Corvus orru*	19.0	6.2	5	29.2		10
Monarchidae	Leaden Flycatcher	*Myiagra rubecula*	10.0	0.0	1	10.0		10
Monarchidae	Satin Flycatcher	*Myiagra cyanoleuca*	9.7	8.1	2	22.9		10
Monarchidae	Black-faced Monarch	*Monarcha melanopsis*	11.0	9.2	6	26.2		10
Monarchidae	Spectacled Monarch	*Symposiarchus trivirgatus*	5.7	2.9	3	10.4		10
Monarchidae	Magpie-lark	*Grallina cyanoleuca*	19.0	10.5	97	36.3	0.38 (11)	1
Monarchidae	Magpie-lark[E]	*Grallina cyanoleuca*	35.0	N/A	N/A	N/A		8
Monarchidae	Magpie-lark[F]	*Grallina cyanoleuca*	12.0	N/A	N/A	N/A		8
Monarchidae	Magpie-lark[E]	*Grallina cyanoleuca*	35.4	13.9	22	58.3		7
Monarchidae	Magpie-lark[F]	*Grallina cyanoleuca*	11.5	7.6	33	24.0		7
Corcoracidae	White-winged Chough	*Corcorax melanorhamphos*	16.2	7.3	14	28.2	–0.13 (99)	1
Corcoracidae	Apostlebird	*Struthidea cinerea*	20.7	23.8	4	59.9		10
Paradisaeidae	Victoria's Riflebird	*Ptiloris victoriae*	6.5	0.7	2	7.7		10
Petroicidae	Scarlet Robin	*Petroica boodang*	8.0	0.0	1	8.0		10
Petroicidae	Rose Robin	*Petroica rosea*	13.1	9.8	2	29.2		10
Petroicidae	Pale-yellow Robin	*Tregellasia capito*	8.5	1.7	3	11.3		10
Petroicidae	Eastern Yellow Robin	*Eopsaltria australis*	9.9	5.6	77	19.1	0.01 (60)	1
Petroicidae	Grey-headed Robin	*Heteromyias cinereifrons*	9.2	6.9	26	20.6	–0.10 (90)	9
Cisticolidae	Golden-headed Cisticola	*Cisticola exilis*	5.4	3.0	41	10.3	–0.11 (95)	1
Acrocephalidae	Australian Reed-Warbler	*Acrocephalus australis*	11.5	9.4	20	26.9	0.10 (40)	1
Megaluridae	Tawny Grassbird	*Megalurus timoriensis*	6.0	3.6	7	12.0		10
Megaluridae	Little Grassbird	*Megalurus gramineus*	6.5	5.1	6	14.9		10
Timaliidae	Silvereye	*Zosterops lateralis*	6.1	3.8	34	12.4	–0.11 (96)	1
Hirundinae	Welcome Swallow	*Hirundo neoxena*	11.0	5.6	32	20.2	0.11 (38)	1
Hirundinidae	Fairy Martin	*Petrochelidon ariel*	8.9	4.5	2	16.4		10
Pycnonotidae	Red-whiskered Bulbul	*Pycnonotus jocosus*	18.4	13.2	25	40.1		1
Turdidae	Bassian Thrush	*Zoothera lunulata*	8.9	3.1	31	13.9	–0.26 (125)	1
Turdidae	Russet-tailed Thrush	*Zoothera heinei*	11.0	6.2	4	21.1		10
Turdidae	Common Blackbird[E]	*Turdus merula*	35.5	17.5	20	64.2	–0.10 (93)	7
Turdidae	Common Blackbird[F]	*Turdus merula*	11.6	8.4	30	25.3		7
Sturnidae	Common Starling	*Sturnus vulgaris*	13.6	9.0	32	28.4	–0.02 (69)	1
Sturnidae	Common Myna	*Sturnus tristis*	11.6	9.4	40	27.1	–0.15 (105)	1
Nectariniidae	Olive-backed Sunbird	*Nectarinia jugularis*	10.9	5.7	7	20.2		10
Estrildidae	Zebra Finch	*Taeniopygia guttata*	14.7	11.3	10	33.2	0.25 (18)	10
Estrildidae	Double-barred Finch	*Taeniopygia bichenovii*	6.2	3.5	7	12.1		10
Estrildidae	Red-browed Finch	*Neochmia temporalis*	7.5	5.1	51	15.9	–0.03 (70)	1
Estrildidae	Nutmeg Mannikin	*Lonchura punctulata*	11.0	6.3	43	21.4	0.10 (42)	1
Estrildidae	Chestnut-breasted Mannikin	*Lonchura castaneothorax*	14.4	4.5	10	21.8	0.23 (23)	1
Passeridae	House Sparrow	*Passer domesticus*	13.2	8.6	18	27.3	0.11 (37)	1
Passeridae	Eurasian Tree Sparrow	*Passer montanus*	8.0	3.0	15	12.9	–0.08 (84)	1

(*continued next page*)

Appendix 1. (*continued*)

Family	English name	Scientific name	Mean	s.d.	*n*	95th percentile	Residual (rank)	Source
Motacillidae	Australasian Pipit	*Anthus novaeseelandiae*	12.4	5.2	63	20.9	0.09 (47)	1
Fringillidae	European Goldfinch	*Carduelis carduelis*	9.2	2.5	18	13.3	0.03 (54)	1

[A] Data were not collected using the direct continuous method.

[B] Stimulus was boat.

[C] Stimulus was dog.

[D] Stimulus was canoe.

[E] Data collected in rural habitats.

[F] Data collected in urban habitats.