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The Use of Key Features

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Abstract

In the first chapter, we summarize methodological approaches in the research of predator recognition. In the second chapter, we summarize results of studies showing the ability of birds to differentiate predators from harmless animals, particular predators from different ecological guilds (predators of adults and of chicks) and even particular predator species. In the third chapter, we describe the means used by birds during the recognition process. Most of the studies prove the importance of so-called key features. Some studies altering multiple features suggest that the perception of predators is rather complex in birds. In the fourth chapter, we try to link the knowledge on predator recognition by untrained birds and the psychological point of view based on studies observing the recognition process of birds trained with the use of operant conditioning. Given together, such studies show that birds are surprisingly flexible during the recognition process and are able to respond according to the features available for recognition. For future research, we find great potential in studies focusing on assessing the relative importance of different feature types and processes used by birds in object categorization.

Keywords Antipredatory behaviour · Raptor · Owl · Passerine · Nest defence · Mobbing · Categorization · Learning · Cognition

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Contents

Chapter 1
How to Study Predator Recognition

If we wish to learn how preys recognize their predators, we have to accomplish two tasks. In the first place, their mutual encounter must be arranged. We can either search for spontaneous predatory events in the wild, which is rather inefficient, requiring expenditure of quite an effort from the observer (particularly in terms of the required amount of time), or we can employ an experimental approach. The meeting of a prey and a predator can be organized both in the wild and in captivity. Both methods have their strengths and weaknesses. What brings problems in the wild is the standardization of experiments, as the experimental animals are never under our full control. In captivity, the representativeness of experiments is mainly a problem, since the conditions here never fully tally with those in the wild.

If we have arranged an encounter of the prey and the predator, we have yet to find sensitive and reliable markers indicating that the prey has recognized the predator. A sensitive marker should detect not only whether the prey distinguishes the predator from a harmless animal (or even from another neutral object), but also various groups or even kinds of predators from each other. A reliable marker should yield identical results at each meeting of the predator and the prey. The second requirement in particular is undoubtedly a maximalist one. The reaction of the prey is influenced by its own situation (e.g. physical condition) on the one hand and by external factors (e.g. the availability of shelters) on the other. Taking into account these complications, physiological parameters indicative of fear seem to be suitable markers, since undeniably they are more directly linked with the process of recognizing the predator than a behavioural response. Their use, however, is complicated by methodical limitations. Therefore, directly observable behavioural markers, using a variety of defensive reactions, play and will keep playing a major role.

Researching how birds recognize their predators has never been very intense; nonetheless, it has a long tradition dating back to the very beginning of behavioural ecology and ethology. On that account, the existing studies differ not only in their methodologies but also in the correctness of the design. This chapter aims to provide an overview of the procedures applied in researching the recognition of predators,

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compare their strengths and weaknesses and try to assess their impact on the results achieved.

1.1 Observation in the Wild

The majority of animals are under the risk of predation for most of their lives; therefore, antipredator behaviour is an integral part of their everyday life (Caro 2005). However, antipredator behaviour involves a number of partial consecutive elements (Lima and Dill 1990). Primarily, animals on the edge of the flock or herd or solitary individuals spend a considerable part of the day being vigilant, monitoring their surroundings in order to detect the predator before it discovers them (Elgar 1989). If successful, they have a chance to avoid the predator without directly confronting it (Sansom et al. 2009). Subsequently, the observer has no chance of noticing any interaction between the predator and the prey.

Providing the prey does encounter the predator, it is usually very short (e.g. Smith 1970), and therefore the observer is unlikely to be present at that particular moment. In addition to that, escape is a universal response in case of birds (Simmons 1955; Lima 1993; Hilton et al. 1999; Martin et al. 2006; van den Hout et al. 2010a). The most common interaction of birds with predators thus usually provides little information about their ability to recognize predators.

However, birds are very distinctive with one manifestation of their behaviour, which enables us to assess by simply observing to what extent they recognize predators, and that is the nest defence. A nest with eggs—or even more a nest with chicks—presents an extremely valuable and at the same time vulnerable object for the parents. Naturally, the chicks in the nest have only a limited possibility to defend themselves (Redondo and Carranza 1989; Goławski and Meissner 2007; Hagelin and Jones 2007; Tillmann 2009; Londoño et al. 2015). Therefore, parental investment into defending the nest significantly increases their fitness (Knight and Temple 1986a; Redondo 1989; Tryjanowski and Goławski 2004; Müller et al. 2005; Remeš 2005; Goławski and Mitrus 2008). This is particularly true for birds of temperate and cold climate zones, which usually have only a limited opportunity of substitute nesting (Skutch 1949) and whose survival up to the next season is often uncertain whether they migrate or are residents. Nevertheless, even in the case of defending the nest, the main form of its defence is not to draw the predator's attention to it. This can be primarily achieved by being cautious when building the nest as well as during the incubation of eggs and feeding the young ones (Dale et al. 1996; Burhans 2000; Ghalambor and Martin 2000; Roos and Pärt 2004; Eggers et al. 2005; Amo et al. 2008; Peluc et al. 2008). However, if the nest is discovered by the predator, active defence called 'mobbing' usually remains the only way to prevent predation (Montgomerie and Weatherhead 1988). The active defence usually takes longer than a flight, also including a larger number of activities varying in risk, which the defending birds carry out (Sordahl 1990). Choosing which one to use depends, besides other aspects, on the dangers that the predator present poses for the defending parents and/or for their offspring (Ash 1970; Curio 1975; Gottfried 1979; Curio et al. 1983; Curio and Regelmann 1985; Elliot 1985; Curio and Onnebrink 1995; Hogstad 2005).

With most birds, predation represents the most common cause of nesting failures (Ricklefs 1969; Nilsson 1984; Martin and Roper 1988; Martin 1993a, b), the proportion of predated nests ranging from 1.4% (Holway 1991) in the case of well-concealed nests of the Black-throated Blue Warbler (*Setophaga caerulescens*) to 85% in the case of the Northern Cardinal (*Cardinalis cardinalis*—Filiater et al. 1994) or some South American species of songbirds (Skutch 1996). Still, the probability of capturing a predation attempt on a particular nest remains rather low as such an occurrence usually lasts no more than minutes (Weidinger 2010). In recent decades, the possibility of continuous nest monitoring by using video cameras has arisen (reviewed by Cutler and Swann 1999 and more recently by Cox et al. 2012); nonetheless, it has not been used for studying the defending birds' recognition of predators heretofore, one possible cause being that only few specialized predators cause the nesting losses with most birds (e.g. Conner et al. 2010; Conkling et al. 2012; Friesen et al. 2013; Murray 2015).

In spite of that, monitoring the encounters of nesting birds and predators brought some pieces of knowledge regarding their recognition, albeit it may not have been the main objective of the studies in question. Very often, these were ground-nesting species, whose nests in an open terrain can be, at least theoretically, easily discovered by all passing birds. These characteristics are often met by members of the Charadriiformes order, out of which the following have been studied: the plovers (Brunton 1986, 1990; Byrkjedal 1987; Amat and Masero 2004), the lapwings (Green et al. 1990; Walters 1990), the godwits (Green et al. 1990), the stilts and avocets (Sordahl 2004) and the gulls and terns (Kruuk 1964; McNicholl 1973; Cavanagh and Griffin 1993; Brunton 1997, 1999; Palestis 2005; Stenhouse et al. 2005), but also, e.g. the cormorants (Siegel-Causey and Hunt 1981) and ducks (Jacobsen and Ugelvik 1992).

The effectiveness of such researches was strengthened in most of the studied species by the fact that their breeding is colonial or semicolonial. Similar studies could therefore be made on colonially breeding songbirds as well, e.g. the swallows (Guillory and LeBlanc 1975; Winkler 1992) or momots (Murphy 2006). A breeding colony is undoubtedly more noticeable for predators (and researchers for that matter) than an individual nest, representing also a more attractive prey, with another advantage being that it allows you to monitor the behaviour of a large number of individuals differing in the degree of imminent threat as well as in the motivation to defend, which primarily depends on the value of their offspring as far as the age and the number of chicks or eggs are concerned (Barash 1976; Andersson et al. 1980; Knight and Temple 1986b; Conover 1987; Montgomerie and Weatherhead 1988; Burger et al. 1993; Clode et al. 2000). The number of birds involved in the antipredator behaviour can, for instance, be employed as a criterion of the extent to which a particular predator was considered a danger (Fuchs 1977; Shields 1984; Brown and Hoogland 1986; Burger and Gochfeld 1992; Clode et al. 2000; Arnold 2000; Bosque and Molina 2002).

However, besides these colonially breeding species, the ability to recognize naturally occurring predators even when defending the nests was observed with solitarily breeding species, such as the sparrows (Nice and Ter Pelkwyk 1941), magpies (Buitron 1983) and phainopeplas (Leger and Carroll 1981).

To observe natural antipredator behaviour, it is not needful to watch nesting birds. Trail (1987), for instance, observed the behaviour of Guianan Cock-of-the-rock (*Rupicola rupicola*) towards various potential predators on leks, where the males collectively utter the mating call. Foraging constitutes another situation in which birds are readily observable, one advantage being that some groups of birds group together in order to search for food. In the temperate zone of the northern hemisphere, e.g. winter, flocks of songbirds have been observed, especially the tits (Hill 1986; Gentle and Gosler 2001; Davies and Welbergen 2008; Soard and Ritchison 2009; Courter and Ritchison 2010; Tvardíková and Fuchs 2010, 2011, 2012; Suzuki 2011), but also the fringillid (Whittingham et al. 2004; Quinn and Cresswell 2005) and the corvid birds (Hauser and Caffrey 1994; Griesser 2008, 2009). Similarly, you can also use foraging flocks of the starlings (Conover and Perito 1981), pigeons (Griffin et al. 2005) or waders (Minderman et al. 2006; Mathot et al. 2009). Regrettably, under normal circumstances, such flocks do not provide the opportunity of continuous monitoring, since they are very agile not only over long time but also during the day (Tvardíková and Fuchs 2010, 2011, 2012).

What brought interesting data regarding the ability to recognize predators were studies where authors systematically observed species noticeable due to their behaviour, such as the drongos (*Dicrurus*), which hunt using the sit-and-wait strategy, thus being very well visible in the undergrowth of a tropical forest (Nijman 2004). Despite that the study was still based on 8 years of data collection. When studying the socially living Arabian babblers (*Turdoides squamiceps*—Edelaar and Wright 2006), the authors used the fact that a migration of Palaearctic predators runs through this location in their research in the Israeli Arava Rift Valley. During the 9-week research (1–6 h a day), they managed to gather almost 250 contacts of babbler flocks with potential predators.

1.2 Experiments

It is evident that the observational approach only provides very limited possibilities for studying predator recognition. Most of the existing pieces of knowledge therefore come from different types of experiments, which primarily increase the efficiency of research by staging a meeting of a prey and a predator, the latter not being an accidently present one, but an intentionally selected predator. If the research focuses on the recognition process, an experimental approach is of an essential importance, which requires manipulation of potential recognition features enabled by decoy predators (Edwards et al. 1950; Curio 1975; Scaife 1976; Smith and Graves 1978; Gill et al. 1997a; Davies and Welbergen 2008; Trnka et al. 2012; Beránková et al. 2014).