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Rescue behaviour in a social bird: removal of sticky 'bird-catcher tree' seeds by group members

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Abstract

Rescue behaviour is a special form of cooperation in which a rescuer exhibits behaviours directed towards averting a threat to an endangered individual, thereby potentially putting itself at risk. Although rescue behaviour has been well-documented in experimental studies on rats and ants, published cases in other non-human animals are rare. Here, we report observations of rescue behaviour in the cooperatively breeding Seychelles warbler (*Acrocephalus sechellensis*). In this species, individuals sometimes become entangled in seed clusters of 'bird-catcher trees' (*Pisonia grandis*). Just one or a few of these sticky seeds can prevent Seychelles warblers to fly and may lead to mortality. In four cases, individuals were observed displaying behaviour aimed at removing sticky seeds from the feathers of an entangled individual belonging to their group. Intriguingly, the rescuing individuals engaged in this behaviour despite potentially risking entanglement. To our knowledge, this is the first recorded case of rescue behaviour in birds.

Keywords

Acrocephalus sechellensis, cooperative breeding, reciprocity, rescue behaviour, *Pisonia grandis*.

1. Introduction

The question how and why individuals cooperate and engage in seemingly altruistic behaviour has received much attention in the past decades and has

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been listed as one of the 'important 125 questions' in science (Pennisi, 2005). Rescue behaviour is a special form of cooperative behaviour in which a rescuer exhibits behaviours directed towards averting a threat to an endangered individual, thereby potentially putting itself at risk. From an evolutionary perspective, such behaviour is intriguing because it is likely to be costly and not necessarily beneficial for the individual displaying the behaviour in the short term.

Nowbahari & Hollis (2010) proposed a four-point definition of rescue behaviour in order to stimulate research and to aid separating rescue behaviour from other forms of cooperative behaviour: First, an individual must be in danger and likely to suffer physical harm if the hazard is not eliminated. Second, the rescue behaviour is, or may be, costly for the rescuer (i.e., the rescuer risks endangerment). Third, the rescuers' action is appropriate for the type of distress of the victim, independent of the outcome of the rescue event (i.e., the rescue event is not necessarily successful). Finally, the rescuer gains no direct rewards in exchange for the rescue action (e.g., food, mating opportunity), but may indirectly benefit (e.g. future rewards, improve survival and reproduction of family members) (see also Hollis & Nowbahari, 2013a).

Although common in humans, rescue behaviour has only been described in a few other animal taxa. The most well-known examples are experiments on restrained ants and rats, where individuals were shown to exhibit behaviours aimed at rescuing a restrained individual (Bartal et al., 2011; Hollis & Nowbahari, 2013b). In the peer-reviewed literature, observations from vertebrates in the wild are rare and mostly anecdotal. For example, Chimpanzees (*Pan troglodytes*) have been reported to save group members that were attacked by a leopard (*Panthera pardus*) (Boesch, 1991) and white-faced capuchin monkeys (*Cebus capucinus*) have been observed saving group members during an attack by another group (Vogel & Fuentes-Jimenez, 2009). Further, banded mongooses (*Mungos mungo*) have been observed rescuing a group member from an attack by a martial eagle (*Polemaetus bellicosus*) (Rood, 1983) and humpback whales (*Megaptera novaeangliae*) rescue conspecifics and other species from attacks by killer whales (*Orcinus orca*) (Pitman et al., 2017). However, in these examples, individuals are not rescued from an inanimate trap as in experiments on rats and ants, but from a predator. Therefore, it is unclear whether such cases represent rescue behaviour as defined above or can be better described as cooperative self-defence against predators attacking group members (see Barash, 1976). It is likely that rescue behaviour occurs in more group-living animals (Nowbahari & Hollis, 2010; Hollis & Nowbahari, 2013a), but as far as we are aware rescue behaviour has not been reported in any birds yet.

Here, we report four cases of Seychelles warblers (*Acrocephalus sechellensis*) attempting to rescue group members. In this species, individuals sometimes become entangled in seed clusters of the tree *Pisonia grandis* (Figure 1). Just one or a few of the sticky seeds of this 'bird-catcher tree' can prevent a Seychelles warbler from flying, and frequently lead to mortality. In four cases, individuals were observed picking and pulling at sticky seeds that were attached to the feathers of another group member. We discuss why this behaviour qualifies as rescue behaviour and discuss its potential adaptive significance.

2. Methods

The Seychelles warbler is a small passerine (Figure 1) that is currently confined to five small islands in Seychelles. In the population on Cousin Island (4°19′48″S 55°39′48″E, 27 ha), which has been the subject of intensive study since 1985, circa 320 individuals occur in circa 115 territories (Komdeur, 1992; Hammers et al., 2015). Seychelles warblers are cooperative breeders, with groups defending their territory year-round. Fifty percent of territories contain one to four additional independent (i.e., non-juvenile) subordinates in addition to the dominant breeding pair (Brouwer et al., 2006; Kingma et al., 2016). Around 50% of these subordinates show helping behaviour during the breeding season (e.g., territorial defence, nest building, offspring care) (Komdeur, 1994a). Due to the absence of predators and the relatively benign environment, extrinsic mortality is probably lower than in most other passerines (Hammers et al., 2015). Indeed, Seychelles warblers show high annual survival (84% in adults: 61% in juveniles; Brouwer et al., 2006) and the maximum recorded lifespan is 19 years (M. Hammers; unpublished data). Seychelles warblers are insectivorous and glean the vast majority of their food from leaves (Komdeur, 1991). On Cousin Island, native *Pisonia grandis* is the most common tree species and important for Seychelles warblers in terms of food and nesting sites. Importantly, Seychelles warblers glean insects from *Pisonia* leaves, but do not eat *Pisonia* seeds. *Pisonia* seed clusters contain from 12 to over 200 seeds, which become extremely sticky when they are ripe and fall from the tree (Burger, 2005). The seeds easily attach

Figure 1. A Seychelles warbler entangled in a seed cluster of *Pisonia grandis*. The seeds are extremely sticky and easily attach to feathers. This individual (a dominant male) was unable to fly and was attacked by skinks. It was captured by hand and the seeds were removed, after which it survived for another six years. Photo by Martijn Hammers.

to bird feathers and are very difficult to remove (Figure 1). While predominantly ground-nesting seabirds (their long-distance seed dispersal vector; Walker, 1991) become entangled in *Pisonia* seeds, passerines might also risk entanglement (Burger, 2005), especially when they spend some time on the ground (where most ripe seeds are located). Seychelles warblers spend most of their time foraging in the canopy where the risk of entanglement is probably low, but may be exposed to sticky *Pisonia* seeds on the ground when collecting nesting material (mainly dominant female breeders), or during territorial fights (both sexes). Depending on the bird species, just a few seeds are sufficient to prevent an individual flying and may cause mortality, which is likely a negative side effect of selection for extreme stickiness of the seeds to facilitate dispersal (Burger, 2005).

In 1999–2015, in each year during the main breeding season (June to September), and in some years during the minor breeding season (December–March), Seychelles warblers were recorded in all territories across the island (total 21 781 resightings; 1361 ± 181 (mean ± SE) resightings per year; no observations were entered in 2000) and regular mist-netting sessions were performed (total = 3517 catches; 207 ± 20 (mean ± SE) catches per year). Records of birds entangled in *Pisonia* seeds and rescue behaviour were collected opportunistically (i.e., recorded whenever encountered).

3. Results

For Seychelles warblers, who spend most of their time foraging in the canopy, the risk of entanglement in *Pisonia* seeds is generally low. Between 1999 and 2015, 35 individuals (17 dominants: 11♀: 6♂; 12 subordinates: 5♀: 7♂; 3 fledglings: 3♀, 0♂; 3 unringed individuals: unknown sexes) were observed to have *Pisonia* seeds stuck to their feathers, ranging from one or a few (<5) seeds (14 individuals) to individuals being completely covered in seeds (typically > 10 seeds) or with a seed cluster attached (21 individuals). Dominant female breeders were almost twice as likely to become entangled as males, possibly because mainly dominant females engage in nest building behaviour (Komdeur, 1991). At least 60% ($N = 21$) of entangled individuals showed difficulty flying or could not fly at the time of the observation. Seychelles warblers observed to be entangled in *Pisonia* had a high risk of mortality, with 44% ($N = 14$ out of 32 ringed individuals) of individuals not surviving after the current breeding season. The rate of mortality is significantly higher than the previously recorded population average of 8% mortality over a six-month period for adults (binomial test: $p < 0.001$) and the 19.5% mortality recorded for juveniles (binomial test: $p = 0.002$; Brouwer et al., 2006). Thirteen of the 35 individuals with *Pisonia* seeds (37%) were caught by hand (which was possible because these individuals had many seeds attached to their feathers and could not fly) and the seeds were removed. Six of the 13 hand-caught individuals (46%) survived until at least six months later. Three of the 35 individuals with *Pisonia* seeds were caught using mist-nets and one of these three individuals survived. These three individuals had 1–2 seeds attached to their wing or tail and were able to fly. The remaining eleven ringed individuals that survived until at least six months later and were not caught and treated were able to clear the *Pisonia* seeds in a natural way, as they were not observed with seeds in their feathers during later observations.

While one individual was observed to remove seeds (with difficulty) from its own feathers, we recorded four cases where other individuals helped removing the seeds and all these individuals survived (i.e., in four of the eleven cases (36%) where individuals got rid of the seeds naturally and survived until at least six months later). In these cases (twice in May 2004, July 2009, August 2009), the victim was entangled, flight performance was impaired and the bird made alarm calls. One individual had seeds attached to both wings, whereas the other three individuals were entangled in a seed cluster containing several seeds. The rescuing individuals tried to remove seeds by picking and pulling at them. Although we could not establish with certainty whether seeds were successfully removed, none of the individuals had *Pisonia* seeds attached to their feathers on the next occasion that they were observed (i.e., 4, 8, 8 and 40 days later, respectively). The rescuer and the victim always belonged to the same group, but had alternative social and genetic relationships: (1) a dominant male breeder helping a subordinate female (father and daughter); (2) a dominant female breeder helping a dominant male breeder (partners); (3) a subordinate male helping a dominant female breeder (son to mother); (4) a dominant female breeder helping a male subordinate (not genetically related, but the subordinate later became a helper in the same territory).

4. Discussion

We observed rare rescuing behaviour in group-living wild birds, in which a group member showed behaviour aimed at removing sticky seeds from an endangered individual's feathers. The seed removal behaviour fulfils all four criteria for rescue behaviour proposed by Nowbahari & Hollis (2010) and Hollis & Nowbahari (2013). First, the individuals caught in *Pisonia* seeds were clearly in distress and likely to have died if the seeds had not been removed. Currently, we lack detailed information about the sources of extrinsic mortality in the Seychelles warbler and future research should investigate whether *Pisonia* entanglement contributes significantly to mortality in this species. The alarm calls produced by the victims are perhaps 'calls-for-help' to alert other individuals that help is needed. Indeed, in this species, individuals often produce alarm calls to alert and recruit group members, for example when a nest predator approaches the nest or when a conspecific intruder is detected in the territory. The observed behaviour is unlikely to be an extension of typical allopreening (i.e., an individual preening another individual) behaviour, since, despite conducting thousands of hours of field observations, we have not observed allopreening behaviour in this species. Second, although we have not observed rescuers becoming entangled in seed clusters, it appears likely that individuals that help other individuals to remove seeds may put themselves at risk of also becoming entangled. This potential risk of entanglement, and the associated high risk of mortality, may make this behaviour potentially much more costly than other cooperative behaviours regularly observed in this species (e.g., food provisioning and territorial defence). Third, picking and pulling at the seeds is appropriate behaviour to help the victim. Finally, except perhaps in the case of the dominant female breeder helping her partner, warblers do not appear to benefit directly from saving group members, as this does not yield immediate improved access to reproduction or food. However, improving the survival of group members is likely to yield indirect fitness benefits, including maintaining the future reproductive success of related individuals (Brouwer et al., 2012). Interestingly, all four observed cases of rescue behaviour were between members of the opposite sex. Mortality of the entangled bird would have decreased the indirect fitness benefits of the rescuer, because either a new breeder (most likely less related or less experienced) would have taken up the breeding vacancy or the group would have lost a (future) helper (Komdeur, 1994b). Apart from these indirect fitness benefits, in long-lived species like the Seychelles warbler, where social bonds within groups may persist for several years, it is likely that favours are returned later, an example of reciprocal altruism (e.g., Rutte & Taborsky, 2007; Freidin et al., 2015); rescue behaviour may therefore be adaptive in this long-lived cooperatively breeding bird.

There is an ongoing discussion on whether rescue behaviour can be used as evidence for behaviour driven by empathic emotions in non-human animals. Decety et al. (2016) highlighted in a recent review that there is good evidence for basic forms of empathy in non-human animals and that empathic behaviour probably mediates social behaviour, but also that many debates originate from using different definitions of empathy. The authors of a study on rescue behaviour in rats argued that rescue can be interpreted as behaviour driven by empathy (i.e., individuals responding to the needs of others; Bartal et al., 2011), while others have argued that this conclusion is premature and that the results can be interpreted differently (e.g., Vasconcelos et al., 2012; Silberberg et al., 2014). For example, individuals may not show rescue behaviour in order to remove a threat, but merely to stop the distress signals of a distressed animal, or to re-establish a social connection arising from isolation of the rescuer. Unfortunately, our observations do not allow us to conclude if empathy plays a role, but we hope that these observations encourage further study on the causes and consequences of seemingly altruistic rescue behaviour in non-human animals.

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