

Reaction of species within two genera of insectivorous birds (*Parus*, *Sylvia*) to aposematic and artificially non-aposematic *Pyrrhocoris apterus* (Heteroptera: Pyrrhocoridae)

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Introduction

The background for this study were results published in Exnerová *et al.* (2003), describing an important variability of reactions of several passerine birds to the aposematic (=warning-coloured) firebug, *Pyrrhocoris apterus*.

Exnerová *et al.* (2003) used several genera of birds, most of them were represented by a single model species. This wide array of species was selected to describe the diversity in foraging ecology and body size across the Passeriformes. Results of this study showed that the warning signal of the firebug colouration is not "red" properly by granivorous and heavier birds.

Here we have chosen European species of two genera of insectivorous passerines (*Parus* and *Sylvia*) to learn more about the intrageneric variability in the reactions to the firebugs. Species of these two genera differ in their habitats and in their body weight, and we tried to find out whether there are some relations between bird's ecology and body size on the one hand and their reaction to the *P. apterus* on the other.

Methods

- Two colour forms of the red firebug (*Pyrrhocoris apterus*) adults were used as experimental prey: 1) wild red-and-black aposematic one and 2) artificially non-aposematic (brown coloured) one.
- Adult wild-caught individuals of each tested bird species were divided in two groups: one was offered wild aposematic and the other non-aposematic form of *P. apterus*.
- Individual birds were offered five mealworms (*Tenebrio molitor*) and five firebugs of the same colour form (one mealworm and one firebug alternately).
- Reaction of tested birds to each experimental prey item was recorded for 5 minutes.
- Numbers of birds that handled (touched the prey or pecked it by the bill) at least one of offered wild and artificially non-aposematic firebugs were compared using Fisher exact test (for each species separately).

Results

Tab. 1 Numbers of birds that handled and ate any wild or non-aposematic *P. apterus*.

bird species	aposematic <i>P. apterus</i>			art. non-aposematic <i>P. apterus</i>		
	N	handling	feeding	N	handling	feeding
<i>P. palustris</i>	21	0	0	21	2	0
<i>P. montanus</i>	31	5	2	26	11	5
<i>P. cristatus</i>	16	4	4	16	9	6
<i>P. ater</i>	33	12	3	33	17	7
<i>P. major</i>	30	4	0	30	23	13
<i>P. caeruleus</i>	30	4	0	30	15	0
<i>S. atricapilla</i>	23	2	0	22	13	1
<i>S. borin</i>	6	2	1	6	2	1
<i>S. curruca</i>	25	0	0	18	3	1
<i>S. communis</i>	19	2	0	15	5	1

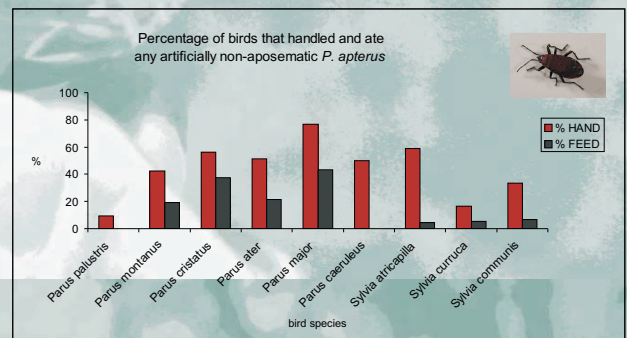
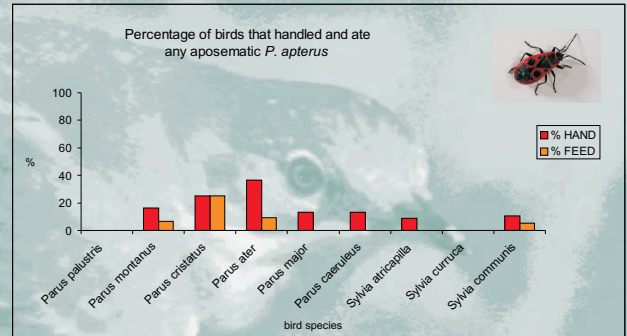
* because of small N, *S. borin* was excluded from subsequent analysis

Tab. 2 Results of comparison of numbers of birds that handled wild vs. non-aposematic *P. apterus*.

bird species	Fisher exact test (p)
<i>Parus palustris</i>	0,488
<i>Parus montanus</i>	0,039
<i>Parus cristatus</i>	0,149
<i>Parus ater</i>	0,321
<i>Parus major</i>	<<0,0001
<i>Parus caeruleus</i>	0,005
<i>Sylvia atricapilla</i>	<0,001
<i>Sylvia communis</i>	0,199
<i>Sylvia curruca</i>	0,066

According to the percentage of birds that handled any wild firebug and to the result of comparison of reaction to wild and non-aposematic firebugs, tested species could be divided into following three groups:

- I. ***P. cristatus*, *P. ater***
 - wild firebugs were attacked relatively frequently
 - both firebug forms were attacked with equal frequency
- II. ***P. montanus*, *P. major*, *P. caeruleus*, *S. atricapilla***
 - wild aposematic firebugs were attacked scarcely
 - non-aposematic firebug form was attacked more often than wild form
- III. ***P. palustris*, *S. communis*, *S. curruca***
 - wild firebugs were attacked scarcely
 - both forms of firebug were attacked with equal frequency



Conclusions

- Generally, wild *P. apterus* was protected better than its artificially non-aposematic form. Only one third of birds that handled any firebug also fed it.

Parus

- We can find possible relationship between reaction of tested *Parus* species and similarity of their habitat and the habitat of *P. apterus*. The red firebug mostly lives and feeds on linden trees (*Tilia cordata*) in broad-leaved forests as well as in urban landscape.
- Species living in similar habitat (*P. major*, *P. caeruleus* and *P. montanus*) strongly avoid wild firebugs but they attack the non-aposematic firebug form more often. They could have higher probability of encounter with the firebug from the field - they know it is unpalatable.
- P. palustris* refuses to attack any form of *P. apterus* and inhabits very similar habitat as well. This implies that the marsh tit is able to recognize the firebug after other parameters (not only the colour). Other possible explanation is that marsh tit does not find the brown-painted firebug suitable prey and it does not recognize it is the firebug as well.
- The aversion of *P. cristatus* and *P. ater* to wild firebugs is the lowest one. There is no difference in their reactions to both firebug forms. These two species inhabit coniferous forests, and their experience with the *P. apterus* in the field is probably relatively scarce. Contrary to findings of Exnerová *et al.* (2003) the smallest *Parus* species, *P. ater*, attacked the firebug relatively intensely.

Sylvia

- All species of genus *Sylvia* strongly avoided wild form of *P. apterus*.
- S. curruca* and *S. communis* avoided also the artificially non-aposematic form of *P. apterus*. Both these species inhabit open landscape where the probability of encounter with the firebug is low. That is why we can not suppose they are able to recognize the firebug when brown-painted. They probably do not find such a prey suitable at all. The fact that *S. curruca* avoided both forms of *P. apterus* most intensely could be explained by its body size - it is the smallest of tested *Sylvia* species.
- S. atricapilla* is the only tested species of genus *Sylvia* that considers *P. apterus* (except the warning colouration) a suitable prey. This species is an habitat and foraging generalist that could have some experience with *P. apterus* as a prey.

Most of discovered differences among the tested species could be explained by probability of encounter of the bird species and the firebug in the field, together with the extent of ecological generalism of the bird species. The effect of body weight on the reaction to aposematic prey does not seem to be important.

Reference

Exnerová, A., E. Landová, P. Štys, R. Fuchs, M. Prokopová and P. Cehláriková (2003): Reactions of passerine birds to aposematic and nonaposematic bugs (*Pyrrhocoris apterus*; Heteroptera). *Biological Journal of the Linnean Society* 78:517-525

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