Long-term changes in duck inter-specific nest parasitism in South Bohemia, Czech Republic

PETR MUSIL & ŠÁRKA NEUŽILOVÁ

Departement of Zoology, Faculty of Science, Charles University, Viničná 7, CZ-128 44 Praha 2, Czech Republic.
E-mail: p.musil@post.cz

Abstract

Inter-specific parasitism in duck species in Central Europe may be an accidental consequence of conspecific breeding parasitism. Analysis of 1,237 nest records for five duck species in South Bohemia from 1999–2008 found that parasitism, where a bird lays its eggs in the nest of another species, had occurred in 6.6% of nests. Three Red-crested Pochard *Netta rufina* clutches were all parasitised and Red-crested Pochard most often laid parasitic eggs in the nests of other species. Gadwall *Anas strepera* was the second most parasitised species, with non-Gadwall eggs found in 16.4% of 152 Gadwall nests checked. Mallard nests were the least likely to be parasitised and Mallard *Anas platyrhynchos* also laid relatively few parasitic eggs. There was a significant correlation between the probability of each species being parasitised and of its being a parasite. The results were compared with those in an earlier publication on the frequency of inter-specific clutch and nest parasitism in South Bohemia. Inter-specific breeding parasitism was more frequent in 1975–1980, in the years of increasing population size for all five species, when 13.9% (*n* = 284 nests) of clutches were found to have been parasitised.

Key words: breeding population size, Common Pochard, inter-specific nest parasitism, Red-crested Pochard, Tufted Duck.

Nest parasitism is an alternative reproductive strategy, where an individual lays its eggs in another bird's nest then leaves the host to incubate the eggs and raise the hatchlings. It is a common feature of the breeding biology of many precocial birds such as waterfowl (Weller 1959; Payne 1977; Yom-Tov 1980; Rohwer & Freeman 1989; Krakauer & Kimball 2009). Inter-specific parasitism seems to be a by-product of facultative parasitism in waterfowl, which occurs in all waterfowl groups and in all geographic regions (Yom-Tov 1980; Rohwer & Freeman 1989; Yamauchi 1995, Geffen & Yom-Tov 2001; Kear 2005; Krakauer & Kimball 2009).

Inter-specific parasitism in duck species in Central Europe seems to be an accidental consequence of conspecific breeding parasitism. There is no direct tendency to lay eggs in the nests of other duck species. Duck females are probably not able to recognise the clutch of the same species (Pöysä 2003). The probability of this misidentification can increase with the level of conspecific breeding parasitism (Sorenson 1993, 1997).

The frequency of nest parasitism in ducks is generally affected by many factors including breeding population density. One reason for an increase in nest parasitism rates under such conditions is the higher competition for good nest sites, so some young females may lay eggs in the nests of other females because they are unable to obtain their own nest site (Andersson & Ericsson 1982; Davies 2000). Secondly, a few nesting females may lay in neighbouring nests as well as in their own. More nesting females may thus provide more opportunities for parasitic laying (Sorenson 1993; Eadie *et al.* 1998; Davies 2000; Semel & Sherman 2000; Pöysä 2003).

An earlier study has described the incidence of nest parasitism for duck species in South Bohemia, Czech Republic, in the late 1970s at a time when duck numbers were increasing in the region (Smrček 1981). The present study aims to compare recent (1999–2007) data on inter-specific breeding parasitism in South Bohemia with the earlier data, and to consider whether any differences may be attributable to changes in population size.

Methods

Duck numbers

Duck numbers were determined by counting adult ducks at 153 fishponds in South Bohemia from 1981 onwards, with one census carried out in the second half of May and one in the second half of June by walking around shore of all fishponds and checking all parts of ponds (Musil & Fuchs 1994). The mean of the May and June counts for each species was used as an indicator of the size of the breeding population for each year. Numbers of all duck species breeding across the Czech Republic increased during the 1950s–1970s (Musil *et al.* 2001 provide a review).

Nest records

Nest surveys in South Bohemia from 1999–2007 were made on the islands in fishponds islands and also around the fishponds in the Třeboň Biosphere Reserve and surrounding area (total of 1,237 nests checked where the incubating female was from one of the five study species; Musil *et al. in litt.*). The 1975–1980 nest surveys were made in the Blatná region of South Bohemia (total of 2,049 nests checked being incubated by a study species; Smrček 1981). Each pond was visited at 7–14 days intervals from May to July, and each nest was checked at least twice over the whole incubation period.

The occurrence of inter-specific nest parasitism was determined by the different colour, size and shape of the eggs (Weller 1959; Payne 1977; Amat 1991; Hudec 1994; Rothstein & Robinson 1998; Davies 2000; Dugger & Blums 2001). For a given species,

we use the term "host clutches" for clutches found to contain eggs of duck species other than the incubating female (Table 2), and "parasitic eggs" for occasions on which a species' eggs were found in the nest of a different species (Table 3).

Results

There has been a major decrease in the number of birds recorded during the breeding season (hereafter breeding numbers) in South Bohemia since the early 1980s. By 2006–2007, breeding numbers of individual species had declined to 47% (Gadwall *Anas strepera*) or as low as 10% (Tufted Duck *Aythya fuligula*) of the breeding numbers recorded in 1981–82. The only exception was Red-crested Pochard *Netta rufina* (the least abundant duck species), whose breeding numbers increased (Table 1).

Inter-specific clutch parasitism was recorded in 284 cases (13.9% of clutches) in 1975–1980, *i.e.* in years when the number of breeding pairs was increasing. After a decline in breeding numbers, 82 cases (6.6% of clutches) of inter-specific clutch parasitism were recorded in 1999–2007 (Table 2). The frequency of inter-specific parasitism was lower in 1999–2007 than in 1975–1980 for all species except the least abundant Red-crested Pochard (only three clutches found) where there was no significant increase (Yates corrected Chi-squared test, $\chi^2_1 = 3.26$, n.s.). In the other species, however, differences in frequency of clutches parasitised by other species were significant between the two study periods (Mallard *Anas platyrhynchos*, $\chi^2_1 = 12.21$; Gadwall, $\chi^2_1 = 16.70$; Common Pochard *Aythya ferina*, $\chi^2_1 = 56.0$; Tufted Duck, $\chi^2_1 = 4.01$; $P < 0.05$ in each case; Table 2).

Red-crested Pochard clutches were the most often parasitised (up to 100% of clutches in 1997–2007), and at the same time Red-crested Pochard most often laid parasitic eggs in the nests of other species (Tables 2, 3). Gadwall was the second most

Table 1. Number of individuals per duck species counted during the breeding season (May and June) at 153 fishponds in South Bohemia.

Species	1981–82	1986–87	1991–92	1996–97	2001–02	2006–07
Mallard	2,035	1,005	1,090	754	580	506
Gadwall	665	511	776	780	452	311
Red-crested Pochard	26	12	38	33	38	43
Common Pochard	2,159	937	1,013	533	861	499
Tufted Duck	5,814	1,825	1,750	1,078	1,004	577
Other species	301	164	99	96	48	458
Total	11,000	4,454	4,766	3,274	2,983	1,981

Table 2: Percentage of hosts (*i.e.* number of nests that were found to contain eggs of other duck species) in 1975–1980 (Smrček 1981) and 1999–2007 (this study) in South Bohemia.

Species	1975–1980		1999–2007	
	No. nests	% host (*n*)	No. nests	% host (*n*)
Mallard	313	10.9 (34)	447	4.3 (19)
Gadwall	135	37.8 (51)	152	16.4 (25)
Red-crested Pochard	32	50.0 (16)	3	100.0 (3)
Common Pochard	310	23.5 (73)	341	5.6 (19)
Tufted Duck	1,259	8.7 (110)	294	5.4 (16)
Total	2,049	13.9 (284)	1,237	6.6 (82)

Table 3. Percentage of parasitising species (*i.e.* the number of occasions on which a species' eggs were found in the nest of a different species) in 1975–1980 (Smrček 1981) and 1999–2007 (this study) in South Bohemia.

Species	1975–1980		1999–2007	
	Total nests containing eggs of each species	% parasitism (*n*)	Total nests containing eggs of each species	% parasitism (*n*)
Mallard	323	3.1 (10)	456	2.0 (9)
Gadwall	156	13.5 (21)	171	11.1 (19)
Red-crested Pochard	53	39.6 (21)	8	62.5 (5)
Common Pochard	440	29.5 (130)	363	6.1 (22)
Tufted Duck	1,361	7.5 (102)	321	8.4 (27)
Total	2,333	12.2 (284)	1,319	6.2 (82)

parasitised species. Mallard nests were the least parasitised and Mallard also laid the lowest number of parasitic eggs (Fig. 1).

A significant inter-specific correlation was recorded between the probability of being parasitised (to be host) and to be a parasite (Spearman rank correlation, $r_s = 0.830$, $n = 10$, $P < 0.01$, Fig. 1), but is should be noted that this relationship was strongly affected by the data point for the least abundant species, *i.e* Red-crested Pochard. Moreover, on testing each study period separately, the correlation proved significant only for the second study period (1999–2007: $r_s = 0.900$, $n = 5$, $P < 0.05$) and not for the first (1975–80: $r_s = 0.700$, $n = 5$, n.s.).

Discussion

Inter-specific breeding parasitism was recorded in 284 cases (with 13.8% of nests containing other birds' eggs) in 1975–1980, in years when the number of birds breeding in South Bohemia was increasing (Smrček 1981). After a strong population decline in 1999–2007, 82 cases (6.63% of clutches) of inter-specific nest parasitism were recorded. On the contrary, the frequency of inter-specific nest parasitism increased in Red-crested Pochard, which numbers also increased during the study period in the Czech Republic as well as in whole Central Europe (see *e.g.* Musil *et al.* 2001; Keller 2006).
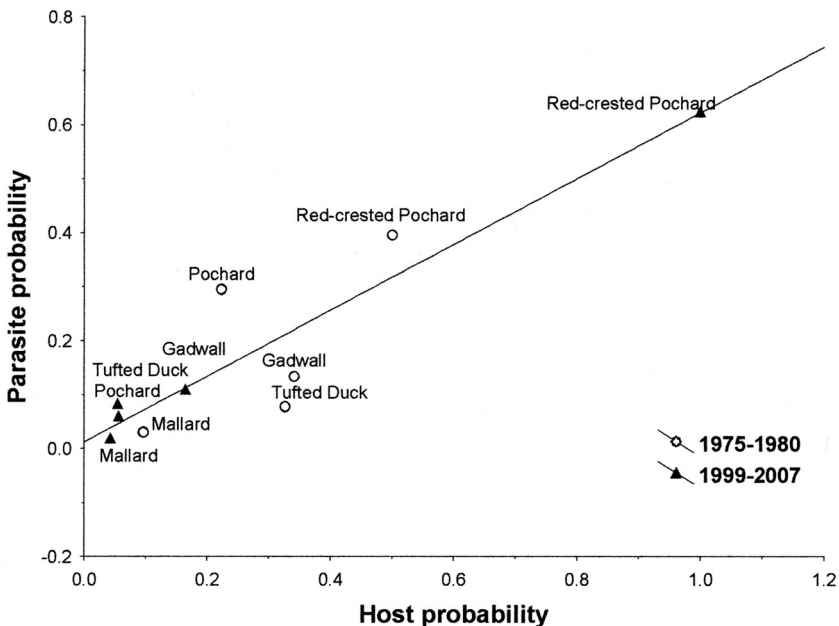
Figure 1. Probability of being parasitised (host probability) in relation to the probability of being a parasite (parasite probability).

Although, the clutch data compared in this study were recorded in different districts of South Bohemia (Blatná in 1975–1980 and Třeboň 1999–2007), both of these regions were affected by similar changes in numbers of breeding birds (Hudec 1994; Musil & Fuchs 1994; Musil *et al.* 2001). It is therefore considered that the lower occurrence of clutch parasitism in 1999–2007 can be attributed to lower breeding density, rather than to regional variation in parasitism in duck species.

These results support the findings of many previous studies which show a density-dependent frequency of nest parasitism in waterfowl (Eadie *at al.* 1998; Davies 2000). Nest parasitism can be considered as an alternative reproductive strategy for non-breeding or unsuccessfully breeding females (Davies 2000; Kear 2005), and hence be more frequent when population size increases.

The Red-crested Pochard was the species that was most frequently parasitised by other birds (100% of clutches), and at the same time Red-crested Pochard most often laid parasitic eggs in the nests of other species. Though these results should be considered with caution, particularly given the small sample sizes in the present study, a similarly high ratio of nest parasitism has also been recorded for this species in southern Spain (Amat 1987, 1991, 1993). The level of nest parasitism recorded for Tufted Duck and Common Pochard in the study area in 1999–2007 agrees with that reported in other studies (Mednis 1968; Bezzel 1969; Mlikovský & Buřič 1983).

A significant inter-specific correlation was recorded between the probability of being parasitised and of being a parasite, albeit that this was on including data for Red-crested Pochard, for which the sample size was small. Further monitoring and research would help to determine whether duck species where the female often lays eggs in the nests of other duck species are more vulnerable to parasitism themselves. They may have a lower ability to discriminate parasitic eggs, and therefore accept eggs of other duck species more easily. A host's low recognition of parasitic eggs has been observed in several other studies (Amat 1993; Sorenson 1997; Dugger & Blums 2001; Pöysä 2003), and Sorenson (1997) showed that host Canvasback *Aythya valisineria* eject similar proportions of parasitic and host eggs. The correlation between the probability of being parasitised and of being a parasite could reflect a balance of the costs and benefits of nest parasitism.

Acknowledgements

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