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Short research contribution

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INFLUENCE OF LOW TEMPERATURES ON BEHAVIOUR OF MALLARDS (*ANAS PLATYRHYNCHOS* L.)

ABSTRACT: Periods of severe winter weather are associated with increased food consumption and metabolic rates. Depending on food availability birds could use different strategies to maintain homeostasis. Mallards *Anas platyrhynchos* L. numerously winter in urban parks, where people feed waterfowl bread. This food source is easily digestible and provides a high energy, which may affect bird behaviour. Studies were conducted in two consecutive winters in the Gdańsk-Oliwa city park in northern Poland, a place where people feed mallards, bread daily. During the period of lowest temperatures (about -12°C) females spent only 6% of their time foraging, while males spent 17% foraging. During mild winter weather (mean temperature about -2°C) foraging took up 21% of time budget in both sexes. In the colder period a three fold increase in male agonistic behaviour was observed when compared to the mild period observations. Females spent the most of harsh winter period inactive, apparently relaying on accumulated energetic reserves. Males cannot reduce all activities like females, because pairing in mallards takes place mainly in autumn and early winter and males need to attract actively, display for, and defend mates.

KEY WORDS: waterfowl, wintering, time budget, behaviour, *Anas platyrhynchos*

Activity patterns of ducks varied with weather conditions, time of day, and habitat type (Jorde *et al.* 1984). Low temperatures are known to affect not only the distribution of waterfowl during winter, but also their behaviour (Jorde *et al.* 1984, Blüml and Degen 2002). Periods of severe weather are associated with increased food consumption (Owen 1970) and metabolic rates (Smith and Prince 1973). Moreover during harsh winter important changes in body composition and condition occur (Reinecke *et al.* 1982), which influence overwinter survival (Haramis *et al.* 1986, Conroy *et al.* 1989) and reproductive potential during the subsequent breeding season (Krapu 1981, Dubovsky and Kaminski 1994).

The mallard *Anas platyrhynchos* L. is a widespread and abundant dabbling duck species well adapted to man's urban environment (Engel *et al.* 1988, Luniak 2004). Mallards often winter at cold, northern urban areas, where they are fed by people. In urban parks people feed waterfowl bread, which is easily digestible and provides a high energy food source that increases foraging efficiency and minimizes feeding time (Sears 1989). However, bread is deficient in several amino-acids that are required by waterfowl (Joyner *et al.*

1987) and inclusion of aquatic plants in the diet is common even bread provisioning is high (Meissner and Ciopcińska 2007). Despite the fact that thousands of waterfowl reside within urban areas, quantitative data on their behaviour and time budgets are still sparse and are related mainly to breeding season (Jędraszko-Dąbrowska and Dębińska 1993, Luniak 2004).

This study was designed to discover mallards' time-budgets in periods of very low *versus* mild winter temperatures while wintering in one of Gdańsk-Oliwa city parks where abundant and steady food supply was provided by visitors throwing bread to waterfowl.

Studies were conducted in two consecutive winters in the city park in Gdańsk-Oliwa in northern Poland (54°24′40″N, 18°33′43″E). During the winter the number of Mallards in this park usually ranges from about 100 up to 300 with 60–75% of them being males. Daily number of people in the park exceeded 500 of which 30–40% of people fed bread to the waterfowl. There were no other waterbirds in the park except some Black-headed Gull *Larus ridibundus* L. and Common Gull *Larus canus* L. The observed population of mallards consisted of both migratory and resident individuals. Ringing recoveries indicated that some mallards wintering in Gdańsk area breed in Sweden, Finland and Russia, while others stayed the whole year in the city (Meissner – unpublished data). However, proportions of migrants and residents remained unknown.

Birds were observed in 2005 and 2006 between 16–28 January on days without precipitation or strong wind. Mean air temperature in 2005 was significantly higher than in the same period of 2006 (-2.3˚C and -11.9˚C respectively; t-test, t = 6.3, P <0.0001). Mean January temperature for Gdańsk in years 1995–2004 was -1.7˚C. Hence, the temperatures within studied period in January 2005 were similar to the 1995–2004 average, while January 2006 was the coldest winter month since 1987 (www.tutiempo.net).

Observations of mallards were made from a distance of about 30–40 m and the presence of the observer did not appear to have any influence on bird behaviour. Activities of mallards were determined by focal sampling (Altman 1974). Focal sample observations began with the choice of one individual by selecting a random number and counting the number of individuals alternatively from the left and right sides of the flock. Male and female focal birds were chosen alternately. The focal individual was observed continuously during 2 min and its behaviour was recorded on tape recorder. Data were collected from 8 am to 4 pm. This period was divided into 4 equal parts with equal numbers of focal sample observations within them. Scan samplings (Altman 1974) were made at the beginning of each period to assess the total number of birds and the number of people feeding birds. Four main activities were considered in this study: feeding, locomotion (walking and swimming), resting and comfort activities (preening, bathing). However, due to small sample size in further analysis comfort activities and resting were combined. Aggressive interaction included fighting, chasing and bill threat. A total of 32 males and 31 females in 2006 and 37 males and 32 females in 2007 was observed by 2 minutes focal sampling. Statistical analysis of agonistic behaviours was adjusted for differences in sex ratio, for each study year (Hepp and Hair 1984, Johnson and Rohwer 1998). All statistical procedures followed Zar (1996).

Mean number of mallards recorded during scan sampling was 125.7 (SD ± 33.31, n = 16) and 115.4 (SD ± 29.25, n = 16) in 2005 and 2006 respectively (t-test, t = 0.93, P = 0.62). The percentage of males present was greater in 2005 (69%, n = 2861), than 2006 (63%, n = 4435) (G-test, G = 10.9, P <0.001). Median number of people feeding birds during scan sampling did not differ significantly between 2005 (median = 3.5, n = 40) and 2006 (median = 2.0, n = 40) (U-test, U = 657.5, P = 0.17). Thus it was assumed that the food provisioning was similar between years.

In both years, males spent more time than females did on locomotion (G-test, G = 45.8, P <0.001 and G = 20.3; P <0.001 in 2005 and 2006, respectively) and less time on resting and comfort activities (G-test, G = 33.5, P <0.001 and G = 20.6; P <0.005 for 2005 and 2006, respectively) (Table 1). There were no significant differences observed between males and females in proportion of time spent on foraging in 2005 (21% in both sexes; G-test, G = 0.20, P> 0.10). However, in the

Table 1. Activity patterns (% of time budget observations) of mallards during mild (2005, -2.3°C) and severe (2006, -11.9°C) winter periods in Gdańsk-Oliwa city park. Values with the same superscript do not differ significantly according to G-test at P <0.05. Comparisons were made between females and males only within the same season.

Activity	2005		2006	
	Females	Males	Females	Males
Feeding	21[a]	21[a]	6[c]	17[d]
Locomotion	34[a]	42[b]	13[c]	15[d]
Comfort activities and resting	44[a]	37[b]	80[c]	65[d]
Others (including aggressive interactions)	1	0	1	3

Table 2. Frequency (n) of aggressive interaction initiations in mallards observed by sex and expected values, which were calculated from population sex ratios. Period: 2005 – mild winter (mean temperature -2.3°C), 2006 – severe winter (mean temperature -11.9°C).

Interaction	2005		2006	
	Observed	Expected	Observed	Expected
Male - Male	12	9.7	30	26.5
Male - Female	2	4.3	12	15.5
Female - Female	0	0.3	6	5.6
Female - Male	1	0.7	9	9.5
G-test	G = 0.6, P = 0.65		G = 0.7, P = 0.87	

colder weather of 2006, females spent only 6% of their time on foraging, whereas males spent 17% (G-test, G = 417.2, P <0.001) (Table 1).

Percent of time spent on foraging differed significantly between day periods in males and females both in mild and harsh winter (G-test, P <0.001 in all cases) (Fig. 1). In cold winter period females clearly reduced foraging time in all parts of the day, whereas males showed distinct peak of foraging time about midday (Fig. 1).

In 2005, for all focal female observations, a female initiated agonistic behaviour only once. In the harsher weather of 2006, females initiated aggression 15 times during focal sampling observations, most often when they were involved in aggressive interaction with males. In males, the number of agonistic behaviour initiations observed during focal sampling increased about three fold when comparing mild and colder winter conditions (Table 2). Males initiated far more agonistic behaviours than females in 2005 (G-test, G = 13.9, P <0.001) and 2006 (G-test, G =15.9, P <0.001). However, both sexes were likely to interact with either males or females (G-tests with adjusted expected frequencies, P> 0.10 in all cases).

Temperature at a wintering site is an important determinant of dabbling duck time budgets (Guillemain *et al.* 2002). Depending on food availability mallards could use different strategies to maintain homeostasis (Turnbull and Baldassarre 1987). Increasing energetic expenditure in the period of low temperatures is often compensated through more intensive and longer foraging (Jorde *et al.* 1984, Turnbull and Baldassarre 1987). However, during the harshest winter weather observation period in the Gdańsk-Oliwa city park birds reduced activities. Both sexes were found to spend less time on locomotion, but the most striking difference concerned feeding time. Females reduced feeding time to only 1/4th that of milder weather observations, while males remained almost unchanged when comparing mild *vs* colder temperature feeding time budgets. The reduction of feeding time concerned mainly morning hours, when almost no people visited park and birds could feed only on natural food, mostly water plants, which caloric value is considerably lower than bread (Meissner and Ciopcińska 2007). It was suggested that female ducks, being smaller than males, might be more sensitive to cold spells, be-

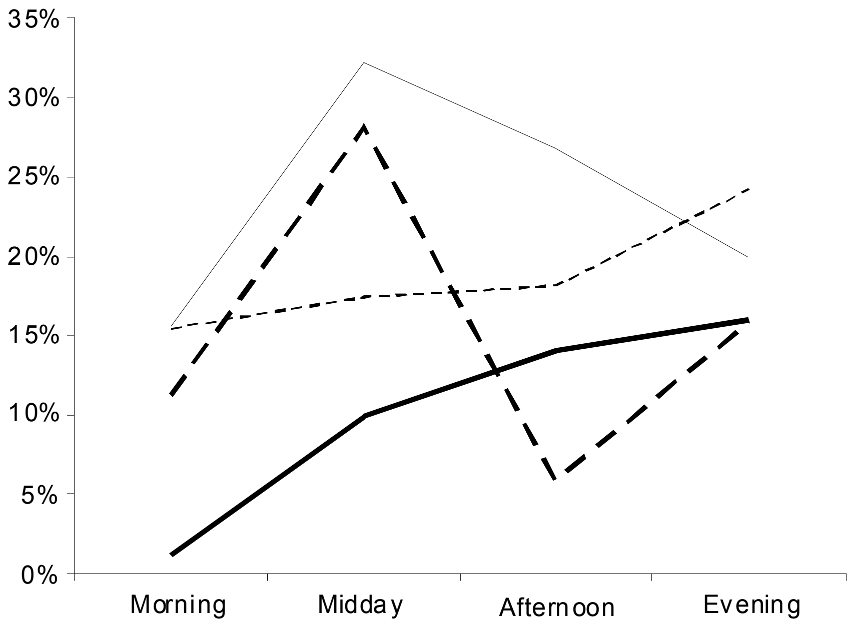

Fig. 1. Mean percent of time spent on foraging in subsequent day periods by males (dashed lines) and females (solid lines) in mild 2005 (thin line) and harsh 2006 winter (thick line).

cause they have a higher specific metabolic rate and lose proportionally more heat than larger males (Calder and King 1974). However, Boos *et al.* (2002) showed that in winter mallard females carry more fat per body mass unit than males, which may increase the ability to withstand fasting periods. Moreover, the relatively higher subcutaneous fat layer of females may counterbalance their energetic disadvantage of having a surface-to-volume ratio higher than males (Boos *et al.* 2002). Female mallards also have lower body protein than males which results in a lower metabolic rate/kg of body mass (Boos *et al.* 2002) and under cold temperature conditions females were found to have on average a 13% lower specific metabolic rate than males (Smith and Prince 1973). Thus, it appears that mallard females could be better adapted to withstand short-term periods of low temperatures than males. In the city park, where ducks winter in high density, females spent most of the brief harsh winter period inactive, probably relying on accumulated energetic reserves.

The overall reproductive output of female ducks is highly dependent on the body lipid content during winter (Krapu 1981, Swanson *et al.* 1985, Pattenden and Boag 1989). During egg production, female mallards rely on lipid reserves to obtain the necessary proteins from diet (Krapu 1981) and low lipid stores during wintering reduce clutch size (Dubovsky and Kaminski 1994). Thus, reducing all activities by females during short-term harsh weather conditions in winter may have an influence on subsequent reproductive performance. Males cannot reduce all activities like females, because pairing in mallards takes place mainly in autumn and winter (Johnsgard 1960, Johnson and Rohwer 1998). Hence in winter they are engaged in display and mate guarding and spent more time on locomotion than females. In harsh winter they also reduced locomotion, but having higher metabolic rates and lower fat reserves than females, they still spent almost 20% of their time foraging. Moreover, aggressive behaviour associated with defence of the mate probably account for the utilization of a significant part of the male's lipid reserves.

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