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Variability of the sex ratio of Mallards *Anas platyrhynchos* wintering in the Tricity (northern Poland)

Abstract: Mallards were counted in mid-January between 1980 and 2010 in the area of the neighbouring cities Gdańsk, Gdynia and Sopot (called Tricity). The proportion of males wintering in the studied sites varied in different years between 51% and 66% and was significantly lower than in the Puck Bay (ANOVA $F_{1,5}=3.76$, $P=0.006$, Newman-Keuls post-hoc test, $P<0.04$). Linear regression revealed a significant positive trend in the proportion of males in the Oliwa Park and the Zoological Garden, with mean increases of 0.5% and 0.8% per year, respectively. These changes in the Oliwa City Park and the Zoological Garden were correlated ($r=0.74$; $N=10$; $P=0.02$). A gradual shift in the distribution of male mallards to sites with better conditions for wintering may account for their increase and the resulting shift in sex ratio.

Key words: Mallard, sex ratio, urban area, winter

Introduction

The Mallard (*Anas platyrhynchos*) is the most numerous dabbling duck of the world, with its population estimated at about 20 million individuals (Wetlands International 2006). This species inhabits a variety of habitats, including urbanized areas (Cramp & Simmons 1977), and in winter large concentrations are observed in municipal water basins (Figley & Van Druff 1982, Luniak 2004, authors' unpublished data). During winter one of the most important sources of food for waterfowl is bread fed to them by humans, which is a very popular custom in Polish cities (Polańska & Meissner 2008, Meissner & Markowska 2009). Bread is easily digestible and provides a high energy food source that increases foraging efficiency and minimizes feeding time (Sears 1989). Waterfowl prefer bread instead of natural food even in places where the latter is abundant (Sears 1989, Keane & O'Halloran 1992), probably because algae and vascular water plants are of comparatively poor quality with much lower energetic values (Meissner & Ciopcińska 2007).



Therefore, the distribution of wintering Mallards in urban areas is determined mainly by the intensity of feeding by humans (Polakowski *et al.* 2010), and the largest concentration of the species is observed in city parks, embankments and other sites, where people spend their free time (authors' unpublished data). Such places are quite abundant in the Tricity area (Gdańsk, Sopot and Gdynia) and in many of them the water bodies almost never freeze over. Numerous concentrations of Mallards are observed also at the Baltic sea coast in the vicinity of pedestrian piers and embankments (Brewka 1993, authors' unpublished data). Although thousands of waterfowl winter in urban areas, quantitative data on their behaviour and ecology in this kind of habitat are still sparse. The aim of the present study was to check whether the sex ratio of Mallards wintering in the Tricity area shows any long-term trend or spatial diversity.

Material and methods

Mallards were counted between 1980 and 2010 at about mid-January in different parts of Tricity (Fig. 1). For the study five sites in different parts of the city were distinguished

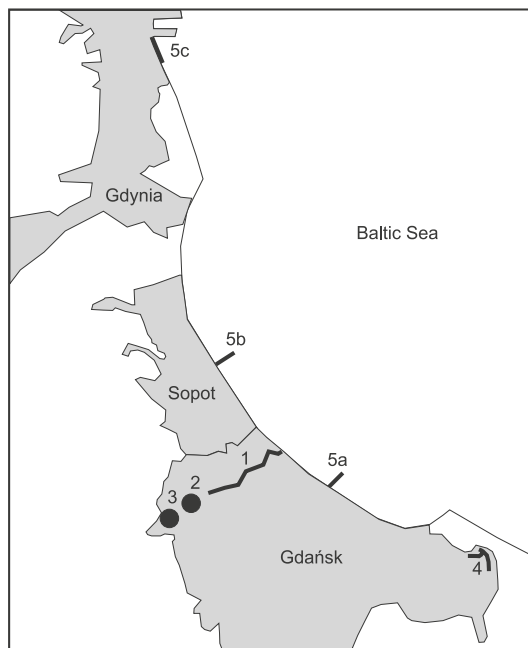


Figure 1. Localization of sites in the Tricity, where Mallards *Anas platyrhynchos* were counted. For explanation of numbers see table 1



(Tab. 1). Four of them covered water bodies within the city, whereas the fifth included three sites along the municipal beach. The number of seasons in which birds were counted differs among sites (Tab. 1). In all sites except the Zoological Garden waterbirds were fed bread by people regularly, with highest intensity during weekends. In the Zoological Garden Mallards take the opportunity of feeding on food provide dregularly for the zoo animals, which stayed at the ponds together with wild birds.

The mean proportion of males wintering in the studied sites was compared with the results of counts on the Puck Bay (for details see Meissner 1997). The data used for that analysis included only the period of ten years (1988–1997) in which the counts were conducted simultaneously in all the mentioned places. To investigate whether the changes in the proportion of males among Mallards wintering in different sites progressed parallel, the Kendall tau correlation coefficient was calculated.

Statistical methods followed Zar (1996). The proportion of males was arcsin transformed before testing for differences in means among sites. Analyses were done with STATISTICA 9.1 software (StatSoft 2010).

Results

The proportion of males among Mallards wintering in the studied sites varied in different years between 51% and 66%, but fluctuated in the following seasons to a large extent. The mean proportion of males wintering in sites localised within the Tricity was significantly lower than in the Puck Bay situated outside the urban area (ANOVA $F_{1,5}=3.76$, $P=0.006$, post-hoc Newman-Keuls test $P<0.05$) (Fig. 2). Thus proportionally more females spent

Table 1. Periods of counts of wintering Mallards *Anas platyrhynchos* and short description of the studied sites within the Tricity

Site number on the map	Site name	Description	Period of counts
1	The Oliwski Stream	Stream flowing through 5 small city ponds	1988 – 1997
2	The Oliwa City Park	Old park with 6 ponds	1980 – 1997
3	The Zoological Garden	Three ponds within the zoo area, placed in the city outskirts	1988 – 1997
4	Motława and Radunia rivers in the City centre	Urban sections of two rivers in the centre of the Gdańsk city	1988 – 1997
5a, 5b, 5c	Pedestrian piers and embankment at municipal beach	Places at the seacoast, a – pier in Gdańsk, b – pier in Sopot, c – embankment in Gdynia	1985 – 2010



the winter on the city water bodies than outside the urbanized areas. There were no significant differences in the proportion of males between the sites within the Tricity (post-hoc Newman-Keuls test $P < 0.05$).

A significant positive trend in the proportion of males was revealed for the Oliwa Park and the Zoological Garden (Fig. 3). According to the regression coefficients the mean increase was 0.4% and 0.8% per year, respectively. The same result was obtained for the Oliwa City Park when the period of simultaneous counts between 1988 and 1997 was taken into account. There were no significant trends in the proportion of wintering males in other sites, neither for the full range of years nor for the ten years period (1988-1997) (n. s., regression analysis).

From the period of the subsequent ten winters from 1988 to 1997) changes in the proportion of Mallard males were correlated for the Zoological Garden and the Oliwa City Park (Kendall's $\tau = 0.47$, $Z = 1.88$, $P = 0.036$) and also for the Zoo and the site along the Oliwski Stream (Kendall's $\tau = 0.56$, $Z = 2.24$, $P = 0.014$). Changes in the proportion of males wintering in these three sites fluctuated greatly, but showed a similar pattern with minimum values in 1988 and a maximum in the period between 1995 and 1997 (Fig. 4).

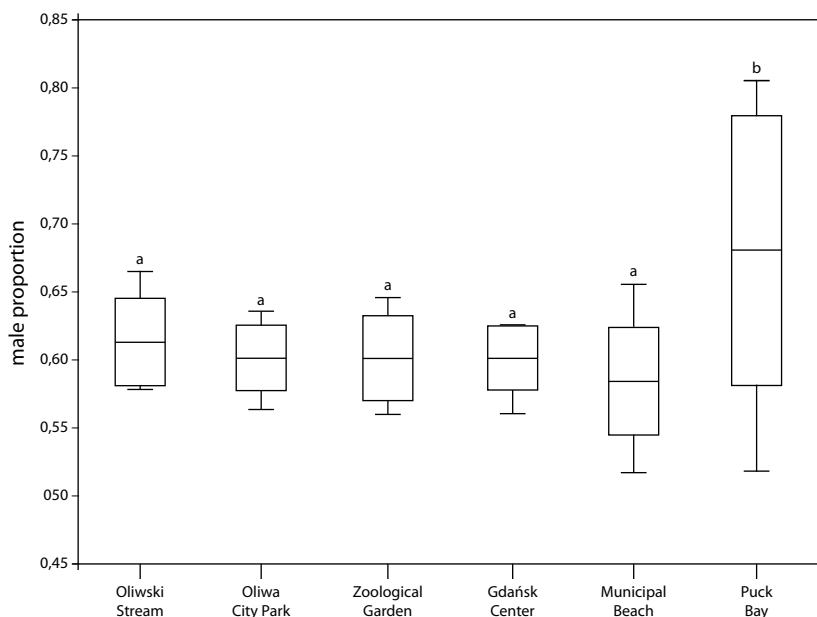


Figure 2. Differences in the mean proportion of males wintering in different sites within the Tricity and outside the urban area along the Puck Bay. Horizontal line – mean value from a 10 years period (1988-1997), rectangle – standard deviation, vertical line – range. Values with the same letter do not differ significantly according to ANOVA and post hoc Newman-Keuls test at $P > 0.05$

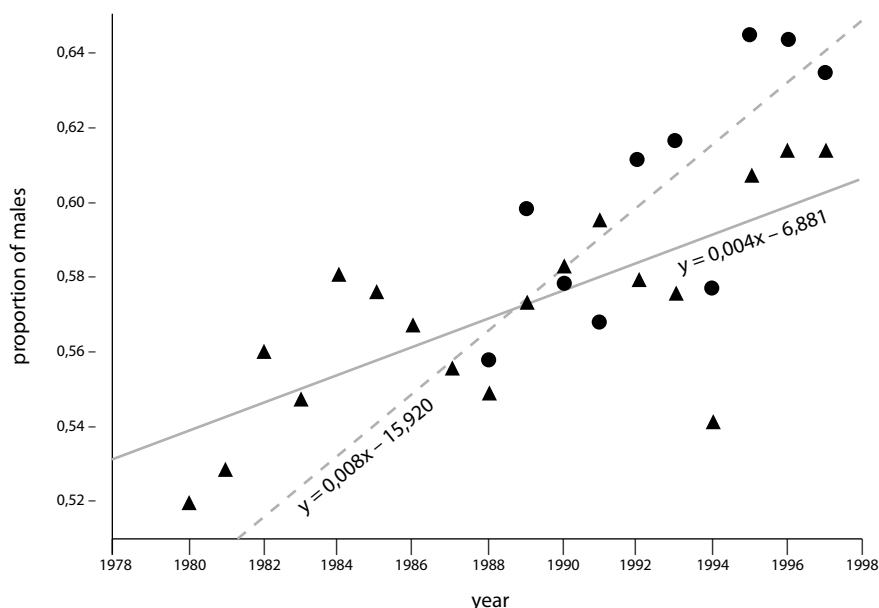


Figure 3. Proportion of males in the following years in the Oliwa City Park (triangles and solid regression line) and in the Zoological Garden (dots and dashed regression line). Linear regression equations were given

There were no statistically significant correlations in proportion of males for the other study sites (Kendall tau, n. s. in all cases).

Discussion

On water bodies localised within the Tricity the proportion of wintering males was lower than on those outside the urbanized area. It is widely accepted that duck females, which are smaller than males, have a lower physiological tolerance to low temperatures and are especially susceptible to periods of harsh weather and food shortage (Nilsson 1970, Nichols & Haramis 1980, Jorde *et al.* 1984). A higher proportion of females was observed in places well protected against wind and with lower susceptibility to waves, a tendency found not only in Mallards (Brewka 1993) but also other duck species (Nilsson 1970, Nichols & Haramis 1980, Meissner & Klawikowska 1993). Wintering sites within urban areas offer not only access to high energetic food resources, but also are better sheltered from the wind. Moreover, winter temperature in urbanized areas is higher than outside the city (Zimny 2005). Thus females find better conditions

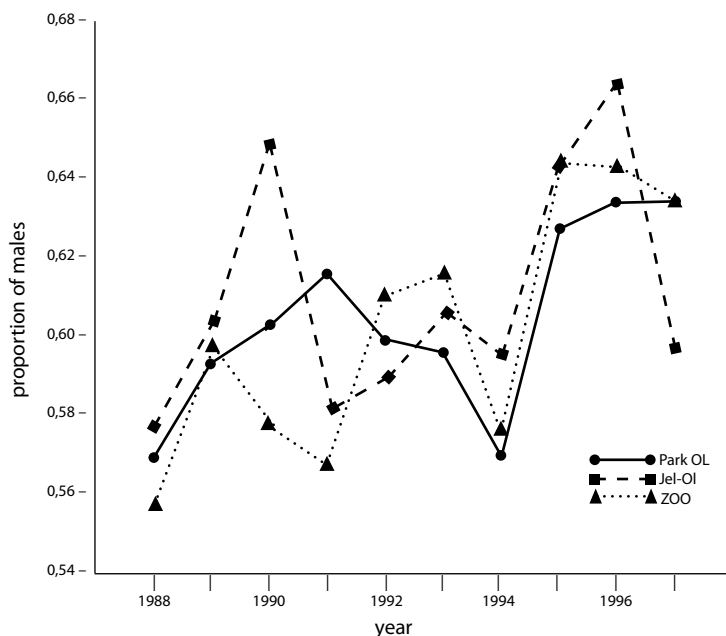


Figure 4. Changes in the proportion of males wintering in the Oliwa City Park (circles, solid line), Oliwski Stream (rectangles, dashed line) and in the Zoological Garden (triangles, dotted line) in the years 1988–1997

in these areas for wintering, explaining why their proportion was higher in the Tricity water bodies than in the Puck Bay.

The proportion of males increased in the following winter seasons only in two sites localised 1.5 km away from each other. Moreover, long-term changes in males' proportion showed a similar pattern in these two sites and along the Oliwa Stream which is situated in the same part of the City (Fig. 1). This increase might be a result of an influx of males from the other sites situated both within the Tricity and outside the urban areas. In the Oliwa City Park and in the Zoological Garden birds were fed intensively by humans. We have no data on the amount of bread delivered by people for birds in different sites, but the number of pedestrians in the Oliwa City Park was much higher than in the other sites. Food supply in Zoological Garden is regular and predictable, which is also important for wintering birds to meet their energy requirements (Guillemain *et al.* 2000, Rogers 2008). Moreover, within these sites there are old and dense tree stands, which offer good protection against the wind. Thus it seems that the Oliwa City Park and the Zoological Garden offer Mallards better conditions for wintering than the other studied sites. Results of previous studies showed that during the period of low temperature wintering males spent more time on foraging than females. In that period they are engaged in display and mate



guarding and spent more time with locomotion than females (Meissner & Markowska 2009), hence also their energy expenditures are higher than in females. A gradual shift in distribution of males to sites offering better conditions for wintering might explain the increase of their proportion observed in these sites. Polakowski *et al.* (2010) suggest that the density and the distribution of wintering Mallards in the urban areas are determined mainly by the intensity of feeding and that birds tended to move during the following winters from the periphery of the city to the centre, where people fed them more intensively.

The temperature is the other factor which may have a great influence on duck behaviour and distribution in winter (Nichols & Haramis 1980, Jorde *et al.* 1984, Legagneux *et al.* 2009). Data on temperature were not included in our analysis. However, results of another study conducted in two sites situated in the Gulf of Gdańsk region 30 km away revealed a very similar pattern of minimum monthly temperature between November and April (Meissner 1993). Moreover, there was no significant trend in mean winter temperature in northern Poland in the period between 1990 and 2008 (Meissner *et al.* 2011). All the studied sites were localized within 25 km, and it may be assumed that differences in temperature among them should be negligible and, therefore, the temperature had no important influence on the obtained results.

Conclusions

In January the percentage of Mallard males fluctuated between 51% and 66%, and the mean values did not differ significantly between studies sites. However, the mean proportion of males wintering in sites localised within the Tricity was significantly lower than in the Puck Bay. Probably females find better conditions for overwintering in urbanized areas due to the access to anthropogenic food resources, better shelter from the wind and higher temperature compared with sites localised outside the city.

A significant positive trend in the proportion of males was revealed for the Oliwa Park and the Zoological Garden. In both sites birds were fed intensively by humans. This increase might be a result of a shift of males to sites offering better conditions for wintering.

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