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Losing a staging area: Eastward redistribution of Afro-Eurasian ruffs is associated with deteriorating fuelling conditions along the western flyway

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ABSTRACT

The fuelling performance of long-distance migrants at staging areas indicates local conditions and determines the viability of migration routes. Here we present a first case study where long-term fuelling performance was documented along two migration routes with differential population trends. Ruffs (*Philomachus pugnax*) are shorebirds of inland freshwater wetlands that migrate from the sub-Saharan wintering grounds, via Europe, to the northern Eurasian breeding grounds. Assessments from 2001 to 2008 of fuelling during northward migration at the major western and eastern staging site revealed that daily mass gain rates steeply declined across years in the grasslands for dairy production in Friesland, The Netherlands, and remained constant in the Pripyat floodplains in Belarus, 1500 km further east. Migrants in Friesland decreased from 2001 to 2010 by 66%, amounting to a loss of 21,000 individuals when counts were adjusted for length of stay as determined by resightings. In the same period numbers in Pripyat increased by 12,000. Ruffs individually ringed in Friesland were resighted in subsequent springs at increasingly eastern sites including Pripyat. Our results corroborate published evidence for an eastward redistribution of Arctic breeding ruffs and suggest that the decreasing fuelling rates in the westernmost staging area contribute to this redistribution. The shift implies that responses occur within a single generation. The hypothesis that the choice of route during northward migration may be driven by food availability can now be tested by creating greater areas of wet grasslands in Friesland. When local staging conditions improve we predict that ruffs will make the reverse shift.

1. Introduction

Due to global change, animal migrations are rapidly becoming endangered phenomena (Wilcove and Wikelski, 2008). For example, fish and large herbivores may find man-made obstructions and habitat destruction blocking their migration routes (Berger, 2004; Rolls, 2011). Birds that make intercontinental migrations encounter similar problems (Sanderson et al., 2006). Especially the ecologically specialized shorebirds are vulnerable (Piersma and Baker, 2000). Ecological deterioration of staging sites, where fuel stores are rebuilt for subsequent flights (Lindström, 2003), has recently led to flyway-wide population declines in four of the six known subspecies of the red knot *Calidris canutus* (*rufa*, Baker et al., 2004; *islandica*, van Gils et al., 2006; *piersmai* and *rogersi*, Rogers et al., 2010). Red knots may not be able to shift to alternative fuelling areas or migration corridors because they depend on limited intertidal habitats. Migratory shorebirds whose migration corridors are not confined to coastal or otherwise restricted habitats could have such opportunities (Piersma, 2007).

In this light it is pertinent that ruffs *Philomachus pugnax*, using widespread freshwater wetlands including agricultural grasslands, recently showed a large-scale eastward redistribution from the European into the Asian part of their Arctic breeding range (Rakhimberdiev et al., 2011). This was hypothesized to be a consequence of avoidance of staging areas in Western Europe, due to

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deteriorating local ecological conditions. Here we assess this suggestion by comparing fuelling performance at two areas used by ruffs wintering in the savannas of sub-Saharan Africa, the Sahel, during their northward migration (Zwarts et al., 2009).

The total population of ruffs counts >2 million individuals, but this estimate is considered imprecise; there is also little information on trends in the wintering and breeding areas (Girard et al., 2009; but see Rakhimberdiev et al., 2011). The wintering population of ca. 400,000 ruffs in the western Sahel has been stable in this century (Zwarts et al., 2009). In spring these ruffs use two main migration corridors, one over Western Europe mainly leading to breeding grounds in temperate Europe and the European Arctic, and one over Eastern Europe leading to Western and Central Siberia (Fig. 1). Currently, three major staging areas during northward migration, each with over 10,000 ruffs, are known: (i) the agricultural grasslands, intensively managed for dairy production, in the province of Friesland, The Netherlands (Jukema et al., 1995), (ii) the extensively managed floodplain meadows of the Pripyat, Belarus (Mongin and Pinchuk, 1999), and further east (iii) the shallow water lagoons (limans) of the Sivash, Ukraine (Chernichko et al., 1991). During staging, birds increase in mass and store fat (Jukema et al., 1995), and most of the males moult intensely as they develop ruffs, tufts and facial masks (Jukema and Piersma, 2000). The combined activities of fuelling and ornament development increase energetic requirements at their staging areas during northward migration (Buehler and Piersma, 2008).

The passage population of ruffs in Friesland has been in decline, especially in the last decades. Peak numbers in spring decreased from 50,000 to 60,000 during the 1990s to 8000 in 2008 (Wymenga, 2005; Wymenga and Sikkema, 2011). To test whether the ongoing decrease of the Dutch staging area is related to local fuelling performance we assessed population size corrected for individual length of stay (LOS), and we measured rates of seasonal body mass increase in the springs of 2001–2010. A parallel study in the Pripyat, 1500 km further east (Karlionova et al., 2007; Meissner et al., 2011), permitted a comparison between two flyways.

2. Methods

2.1. Field techniques

The study area in Friesland (400 km^2, centred on 52°58′ N 05°24′ E) is dominated by dairy farms and accommodates on average 77% of the ruffs migrating through Friesland in spring (Wymenga, unpubl.). From March until May ruffs feed here on invertebrates found in grasslands. In 2001–2010, the roost sites along shallow lake shores, covering the core staging area, were counted semi-monthly by volunteers (Hooijmeijer et al., 2010). Counts were made within ±3 days of the 1st and 15th of March, April, and May. Additionally, in this period we captured ruffs at a maximum of 10 sites simultaneously with wind-driven clap nets. A flock of artificial decoys and 1–2 live decoys captured at the start of the session and released afterwards, were used to lure flying birds to the net. Captured ruffs were given a numbered metal ring and weighed. Straightened wing length was measured. Birds with wings ⩽170 mm were classified as females, and those with wings >180 mm as males that usually develop ornaments (see Karlionova

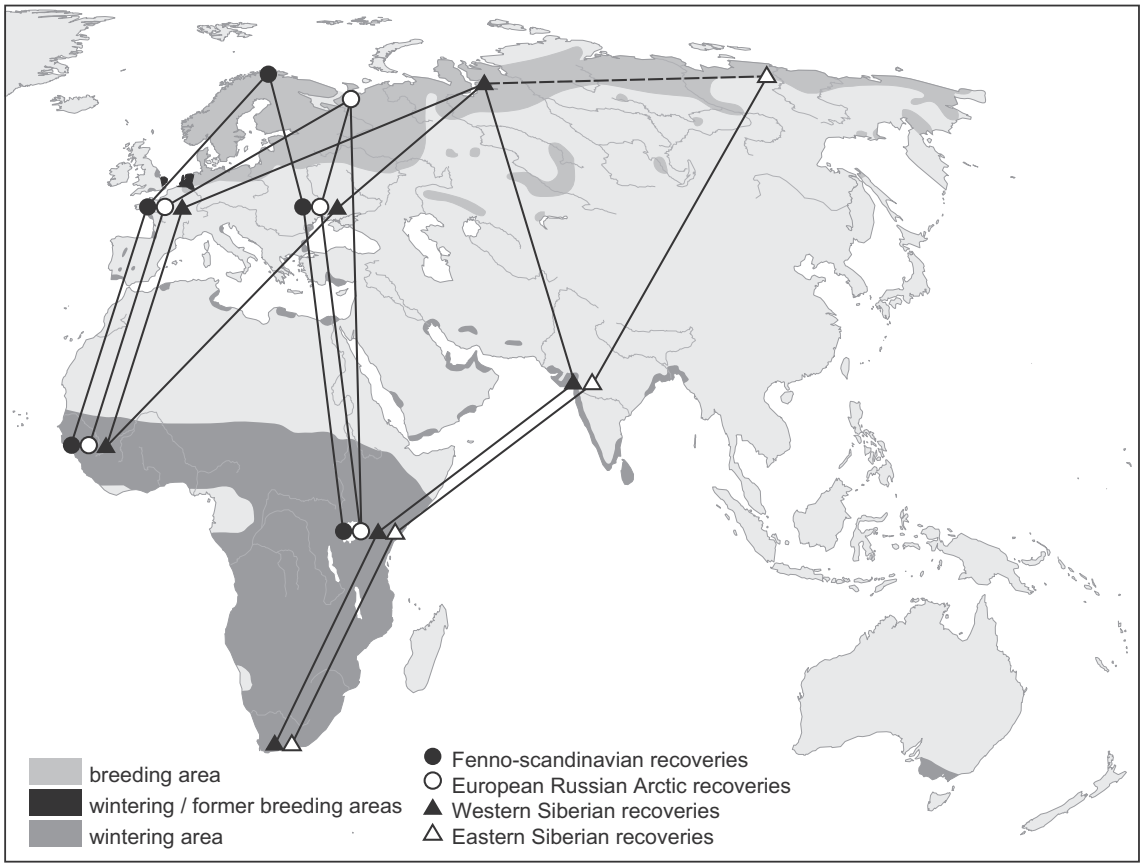

Fig. 1. Schematic overview of the flyways of ruffs *Philomachus pugnax*. The symbols signify four regions of the global breeding range. The lines summarise 364 long-distance recoveries of ruffs ringed in wintering or breeding sites, and >1000 recoveries of ruffs ringed in Western and Eastern Europe and recovered elsewhere. Solid dark grey: wintering areas. Solid light grey: the temperate and arctic breeding areas in Europe and Russia. Note that the Arctic harbours c. 95% of the global population of the ruff; numbers in the temperate breeding areas are minor and strongly declining. In black: former temperate breeding areas (modified after Zwarts et al., 2009).