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Brief report

Absence of haematozoa on colonial White Storks *Ciconia ciconia* throughout their distribution range in Spain

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The White Stork (*Ciconia ciconia*) is distributed primarily in Europe, with about 8000 pairs breeding in Spain out of the 120 000–150 000 European breeding pairs (Tucker & Heath 1994). A large population decrease occurred during the twentieth century, particularly in western Europe, and therefore the White Stork has an unfavourable conservation status in Europe (Tucker & Heath 1994). Therefore, the White Stork is a species for which information about parasites and diseases should be taken into account in managing programs.

Blood parasite surveys are being incorporated in the monitoring of vertebrate species (e.g., Michot *et al.* 1995, Shutler *et al.* 1996). Blood parasites could affect life history traits of their vertebrate hosts (reviewed in Møller 1997), and hence its study is important for a correct and complete understanding of the factors shaping their population trends. On a review paper of the Haemoproteidae of the Ciconiidae, Forrester *et al.* (1977) only reported negative records of a captive White Stork in France. Later, Bennett *et al.* (1982) reported three species of haematozoa for White Storks, including one species of *Haemoproteus*, one *Leucocytozoon* and one microfilaria. However, these authors did not offer data on prevalence in their review. The only review offering prevalence data on this species showed that none of the six White Storks sampled in Western Europe were infected by haematozoa (Peirce 1981). The aim of our study was to determine the prevalence and intensity of blood parasites in Spanish White Storks using a large sample of individuals. To our knowledge, ours is the first study searching for blood parasites on nestling White Storks, and the first specifically focused on this species. Given that infection with blood parasites may show geographical variations in a single host species (Bennett *et al.* 1995, Merilä *et al.* 1995, Sol *et al.* 2000), we sampled several colonies throughout the distribution range of White Storks in Spain.

Field work was conducted during three breeding seasons (1998–2000) in seven different areas (Fig. 1) which hold the highest breeding densities of White Storks in Spain (SEO/BirdLife 1994). Nestlings were bled from the brachial vein, and a thin smear was made using a drop of blood. Blood smears were air dried, fixed with ethanol in the field, and stained in the laboratory with Giemsa stain. A total of 130 blood smears were sampled from nestlings, covering an adequate sampling of the different habitats and geographical areas oc-

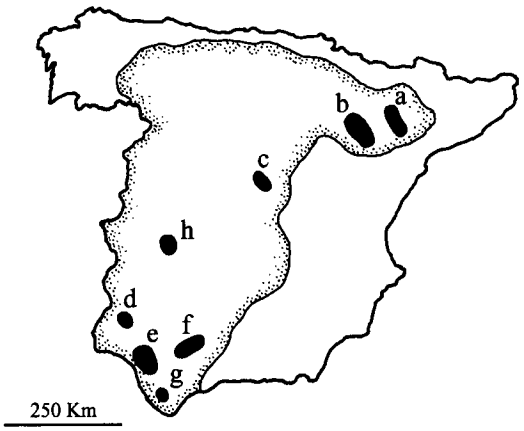

Fig. 1. Location, main habitats surrounding the colonies, and number of White Storks sampled in Spain. **a** — Cinca valley (41°80´N, 0°20´E, freshwater rivers and irrigated cultures, n = 9); **b** — Ebro valley (41°70´N, 1°50´W, freshwater rivers and irrigated cultures, n = 12); **c** — Soto del Real (40°55´N, 3°90´W, humid pastures in low mountains, n = 15); **d** — Huelva (37°60´N, 7°20´W, oak forests and crops, n = 3); **e** — Doñana area (37°00´N, 6°30´W, marshes and Mediterranean scrubland, n = 59); **f** — Guadalquivir valley (37°30´N, 5°40´W, cereal crops, n = 12); **g** — Jerez (36°60´N, 6°15´E, urban area, n = 5); **h** — Cáceres (39°30´N, 6°50´W, oak forests, n = 15). Location of the two wildlife rehabilitation centres coincides with the areas 3 (n = 8) and 5 (n = 14). The geographical distribution of White Storks in Spain is indicated by a point-marked area.

cupied by White Storks in Spain (Fig.1). Nestlings were sampled on average at 55 days old (range: 45–68 days), thus a few days prior to fledging. In addition, 22 adult White Storks were sampled during the breeding season when they arrived to two wildlife rehabilitation centres (Fig.1) in a poor state of health.

Each blood smear was inspected for blood parasites for 10 min under oil immersion (1000×). The average of five smears indicated that about 28 000 erythrocytes were inspected for each blood smear. No parasites were detected in the 152 birds sampled.

The inspection of blood smears is not the best method to detect *Plasmodium* (Forrester *et al.* 1974), *Trypanosoma* or microfilarias (Apanius 1991). However, Merino and Potti (1995) found a high prevalence of *Trypanosoma* in Spanish Pied Flycatchers (*Ficedula hypoleuca*) nestlings by analysing blood smears. Therefore, our results could also be indicative of the absence or very low prevalence of *Trypanosoma* in the sampled birds.

As far as we know no information is available on the prepatent period for any of the blood parasites found neither in White Storks nor for any other species of the family Ciconiidae (Bennett *et al.* 1982). However, the age of nestling White Storks at sampling fairly exceeds the minim prepatent period reported for some blood parasites in nestlings of other European avian species [13 days for Sparrowhawks (*Accipiter nisus*) Ashford *et al.* (1991); 9 days for Pied Flycatchers Merino & Potti (1995); 14 days for Goshawks (*Accipiter gentilis*) Toyne & Ashford (1997)]. Moreover, the number of erythrocytes inspected per blood smear was sufficient to detect infections of high intensity, which are typical in nestlings of several species because of their naive immune system to parasites (Merino & Potti 1995, Dawson & Bortolotti 1999). Therefore, there is no reason to think that nestlings had blood parasites not yet expressed in circulating blood, or undetected by us. The 22 adults sampled in the rehabilitation centres reinforce the results obtained from nestlings, since damaged or diseased birds are presumed to be immunodepressed and thus would favour the relapse of latent blood parasite infections (Blanco *et al.* 1998). Moreover, haematozoa infections usually peak during the breeding season (Allander & Sundberg 1997), when we sampled all the birds. Therefore, the lack of blood parasites reported here could not be explained because of an inappropriate sampling or methodology.

Studies failing to detect blood parasites are as important as those reporting high haematozoa prevalences, because there is the need of comparing infected and non infected bird species or populations to address which host, parasite or habitat characteristics are the important cues shaping avian blood parasite distributions. Studies conducted in Spain have shown a great variability among bird species in their occurrence of blood parasites. Several studied have failed to find blood parasites, or have found very low prevalences (Tella *et al.* 1995, Figuerola *et al.* 1996, Blanco *et al.* 1997, Forero *et al.* 1997, González-Solís & Abella 1997, Blanco *et al.* 1998, Merino & Mínguez 1998, Tella *et al.* 1999, Merino *et al.* 2000). On the contrary,

other studies reported high prevalences (Merino & Potti 1995, Ruiz *et al.* 1995, Bosch *et al.* 1997, Figuerola *et al.* 1999, Sol *et al.* 2000). In the case of White Storks, we can not discern whether the absence of blood parasites is related to the lack of appropriate parasite species, the scarcity of vectors, or both. Spanish raptors inhabiting open habitats, as is the case for the White Stork, have been found to present lower prevalences than those in forested areas (Tella *et al.* 1999). In Feral Pigeons (*Columba livia*), differences in blood parasite prevalence among localities have been experimentally proved to be shaped by variability in vector abundance (Sol *et al.* 2000). Therefore, habitat could play a role in the geographical distribution of blood parasites mediated by vector abundance (e.g. Figuerola 1999). Duration of the embryonic development period could also play a role in some avian species by increasing their ability to fight against haematozoa infections (Ricklefs 1992, Tella *et al.* 1999). However, this possibility has not been investigated in many avian groups and would need further study on the White Stork. In addition, future comparative studies including other places and other Stork species could add insight on the reasons for the absence of blood parasites we have reported.

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Selostus: **Espanjan kattohaikaroilla ei tavattu veriloisia pesimäaikana**

Kattohaikarat ovat vähentyneet viime aikoina erityisesti Länsi-Euroopassa. Koska veriloiset voivat vaikuttaa lintujen kasvuun ja kehitykseen, on uhanalaisille lintulajeille suojeluohjelmia tehtäessä selvitettävä myös veriloisten esiintymistä lintulajeissa. Kirjoittajat analysoivat veriloisten esiintymistä ja infektioiden intensiteettiä espanjalaisissa kattohaikaroissa. Kattohaikarat pesivät seitsemässä koloniassa, joista näytteitä kerättiin 130 poikasesta. Lisäksi näytteet otettiin 22 aikuisesta linnusta, jotka oli tuotu heikkokuntoisina kuntoutuslaitokseen. Yhdestäkään näytteestä ei löytynyt veriloisia. Espanjassa useilla lintulajeilla ei ole havaittu lainkaan veriloisia tai niiden esiintyminen on ollut vähäistä. Toisaalta, joiltakin lajeilta on raportoitu korkeita esiintymisfrekvenssejä. Kirjoittajat arvioivat, että lintujen elinympäristö voi vaikuttaa veriloisten esiintymiseen esimerkiksi väli-isäntien esiintymisen kautta. Myös erot eri lintulajien alkionkehityksen pituudessa voivat vaikuttaa lajien välisiin eroihin veriloisten esiintymisessä. Kirjoittajat eivät olleet varmoja siitä, johtuiko veriloisten puuttuminen espanjalaisista kattohaikaroista sopivien loislajien puutteesta vai loisten väli-isäntien vähyydestä vaiko molemmista edellä mainituista tekijöistä. Kirjoittajien mukaan on yhtä tärkeää raportoida loisten puuttumisesta kuin niiden esiintymisestäkin, jotta veriloisten yleisyydestä ei saada vääristynyttä kuvaa.

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