

Brief report

Negative record of haematozoan parasites on Cory's Shearwater *Calonectris diomedea*

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Haematozoan parasites are widely distributed among bird species. Up to now, nearly 4 000 species of birds have been examined. In more than 2 500 species, the presence of at least one species of blood parasite was identified (Bennett et al. 1982, Bishop & Bennett 1992). The most common parasites found in birds belong to the genera *Haemoproteus*, which represent two-thirds of all blood parasite species. However, in 8 of the 25 orders of birds examined no parasite species have ever been detected. One of these orders is the Procellariiformes, in which 30 species out of one hundred species have been examined (Bennett 1993). However, most Procellariiformes are pelagic and this might represent an unsuitable environment for potential vectors needed for infection. Unfortunately, parasite studies usually do not take the presence of potential vectors into account.

In this study, we examined blood smears of Cory's Shearwaters *Calonectris diomedea* (O. Procellariiformes) to detect the presence of blood parasites. Birds are from the Chafarinas Islands (Moroccan Mediterranean coast), where at least the vector for one haematozoan parasite belonging to the genera *Haemoproteus* is present.

Field work was carried out during the incubation period of Cory's Shearwater, between 8 June

and 12 July in 1995. The upper part of Congreso Island cliffs was inspected five times, looking for burrows of Cory's Shearwater. Visits were performed during the morning to minimize nest desertion. Blood smears of 38 incubating Cory's Shearwater, caught under licence, were obtained by venipuncture of the radial vein. Smears were air-dried and fixed for 10 minutes in methanol on the day of sampling. In the laboratory, the slides were stained with GIEMSA and examined under a microscope with oil at 1 000 ×. Prevalence was established through the inspection of 100 fields containing about 100 erythrocytes examined per sample.

No blood parasites were found.

On the Chafarinas Islands there are breeding populations of Audouin's Gulls *Larus audouinii* and Yellow-legged Gulls *L. cachinnans*. In both species, a high prevalence of the parasite *Haemoproteus lari* in adult gulls has been described (Ruiz et al. 1995). Parasites were also found in chicks of both species before the chicks could fly (authors, unpublished data). Therefore, at least the vector of the haematozoan parasite *Haemoproteus lari* must be present at this locality. Blood parasites of the genus *Haemoproteus* are transmitted by dipteran, mainly ornithophilic biting midges

of the genus *Culicoides*. Similarly, the vectors of the most usually encountered genera of avian blood parasites (*Leucocytozoon*, *Trypanosoma* and *Plasmodium*) are also common genera of diptera (Bennett et al. 1992). The Chafarinas Islands are near the Moroccan coast (at 4.5 km), so they are easily colonized by flying insects. Moreover, prevalence values in haematozoan parasitemias are suggested to be mainly dependent on the abundance and activity of parasite vectors, i.e. exposure (e.g. Greiner et al. 1975, Allander & Bennett 1994, Bennett et al. 1995). Since the prevalences of *Haemoproteus* in Audouin's and Yellow-legged Gulls at this locality reach almost 100% (Ruiz et al. 1995), we can expect high densities of the *Culicoides* vector on the Chafarinas Islands. If an *haemoproteus* species with the capacity to infect the genus *Calonectris* exists on the Chafarinas Islands, it seems to encounter favourable conditions. However, no blood parasites were found in any Cory's Shearwaters examined, although they were captured during the breeding period, which is the best time to detect haematozoan infections (Weatherhead & Bennett 1991). Haemoproteids are specific to a host family or a subfamily, and presumably, can not therefore switch from one line to another (Atkinson 1986, Bennett et al. 1992). Hence, *Haemoproteus lari* probably is not able to infect Cory's Shearwaters. A simple explanation for this lack of parasitism is that the appropriate vector or the parasite that is able to infect Cory's Shearwaters could exist, but for some reason, have not colonized the Chafarinas Islands.

Other possible explanations could be based on an evolutionary process. Although only one-third of the species belonging to Procellariiformes have been examined, our results agree with previous studies that have never found evidence for the presence of haemoproteids in this group (Bennett et al. 1982, 1992, Bishop & Bennett 1992). One explanation for a group of birds having no haemoproteid parasites could be that in the evolutionary young orders of birds, there has been insufficient time for the coevolution of host, vector and parasite (Bennett 1993). However, Procellariiformes is one of the most primitive orders of birds. The earliest possible fossil Procellariiformes is dated from the late Cretaceous period and the "molecular clock" placed the Procellariiformes branching

off at about 36 million years ago (e.g. Warham 1996).

Most of the Procellariiformes are pelagic and they breed mainly on isolated islands. These islands usually represent an unsuitable environment for potential vectors of haematozoan parasites, and could explain the lack of blood parasites in such environments (e.g. Little & Earlé 1994). Therefore, coevolution between Procellariiformes and haematozoan parasites could never have taken place because of the different habitats of host and vectors (Greiner et al. 1975, Bennett 1993). However, Procellariiformes is not the only avian order where the lack of haemoproteids has been reported. In the seven most primitive avian orders extant, including Procellariiformes, no haemoproteid have yet been recorded or described (Bennett 1993), and some of these orders occur in a variety of environments where vectors can be present. This suggests that blood parasites appeared later than these primitive bird groups, leaving them free of haematozoan parasites.

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Selostus: Välimerenliitäjäältä ei löydetty veriloisia

Kirjoittajat tutkivat 38 välimerenliitäjäältä pesimäaikaan kerättyjä verinäytteitä *Haemoproteus*-veriloisten löytämiseksi. Yhtään veriloista ei näytteistä löytynyt, vaikka tutkituilla saarilla (Chafarinas saaret) todistettavasti on loisten vektoreita (*Culicoides*-sääskiä). *Haemoproteus*-veriloiset ovat spesifisiä heimo- tai alaheimotasolle, eikä saarilla lokeissa yleisesti esiintyvä *Haemoproteus lari* ilmeisesti pysty tarttumaan liitäjiin. Vaikka ulappalintujen lahkossa (Procellariiformes) on tutkittu noin kolmannes kaikista lajeista, yhdestäkään lajista ei ole löydetty *Haemoproteus*-veriloisia. Evoluutiivinen selitys veriloisten puuttumiselle on, ettei tähän linturyhmään erikoistuneita veriloisia ole

syystä tai toisesta lainkaan kehittynyt. Useimmat tähän lahkoon kuuluvat lajit pesivät kaukana mantereista eristyneillä saarilla, missä olosuhteet usein ovat epäedulliset loisten vektoreille. Tämä selittäisi sen, miksi loisten ja isäntien välistä koevoluutiota ole tapahtunut tässä lintulahkossa. On kuitenkin olemassa yhteensä 7 lintulahkoa mukaanlukien Procellariiformes, joiden lajeista ei veriloisia ole löytynyt. Kaikkia näitä lahkoja pidetään varhain kehittyneinä, primitiivisinä lintulahkoina. On mahdollista, että veriloiset ovat evoluutiivisesti myöhemmin kehittyneet eliöryhmä.

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