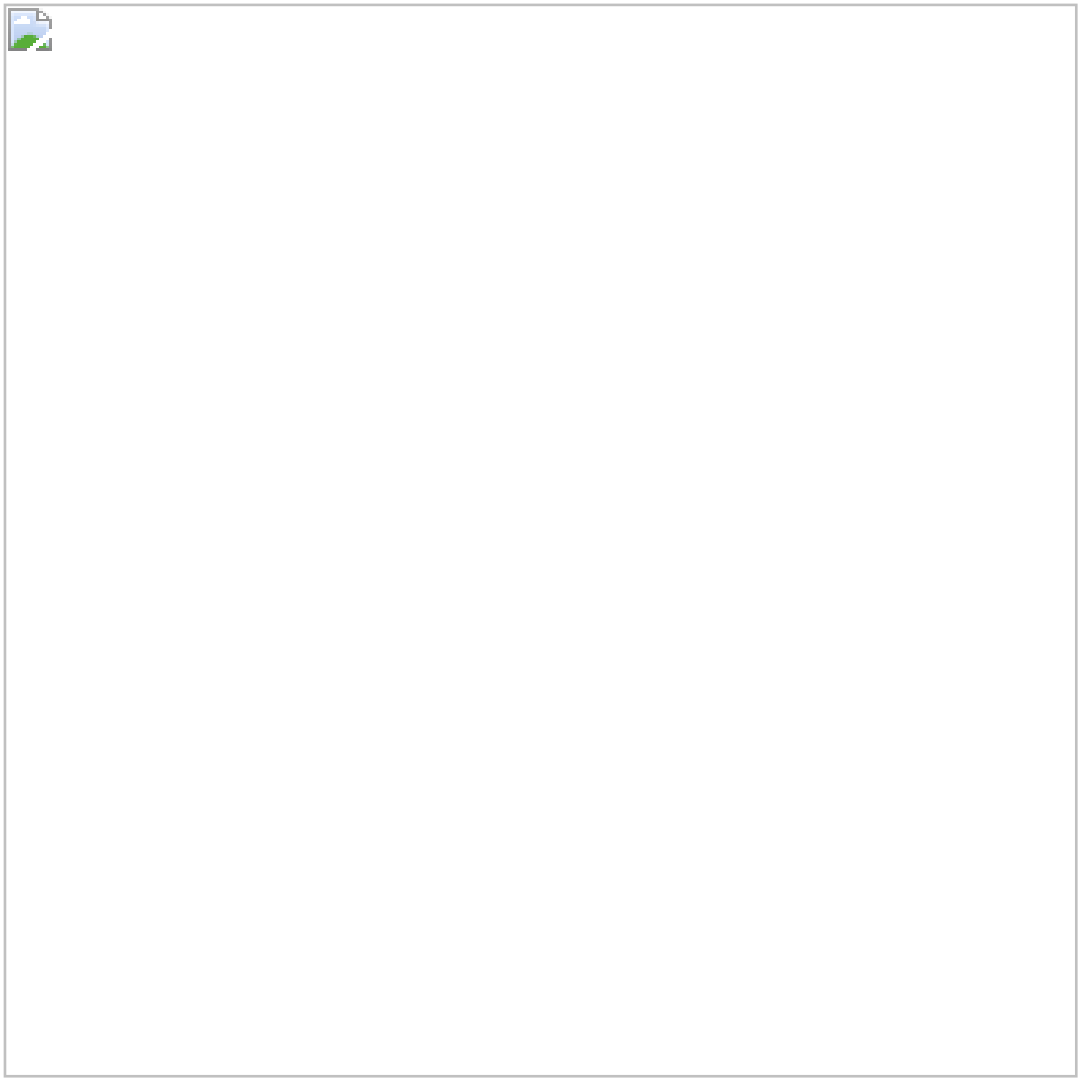

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Human-associated Staphylococcal Infection in Spanish Imperial Eagles

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ABSTRACT: At Doñana National Park, Spain, we compared the prevalence of *Staphylococcus* spp. infections in the Spanish imperial eagle (*Aquila adalberti*) in 66 nestlings handled with bare hands and in 46 nestlings handled with gloved hands, 1986 to 1993. We detected staphylococcal infections in 30 (45%) of 66 chicks handled without gloves, and in two (4%) of 46 chicks handled with gloves.

Key words: Infectious diseases, imperial eagles, *Staphylococcus* spp., human transmission, endangered species, *Aquila adalberti*.

The Spanish imperial eagle (*Aquila adalberti*) is the most endangered bird of prey in Europe, with fewer than 150 pairs in the wild (Ferrer, 1993). The densest population (15 to 16 pairs in 20,000 ha), and the one most intensively managed, occurs in Doñana National Park in southwestern Spain (Ferrer and Hiraldo, 1991). Some management techniques, such as chick translocation, involve handling chicks; this potentially could increase the risk of stress-related and human-induced infections.

Staphylococcus aureus has been known for many years as the causative organism of bacterial infection of the feet of raptors (Baker, 1977; Cooper, 1985). León and Castroviejo (1978) first described *Staphylococcus aureus* infections, locally known as "warts", on talons and periocular zones of the Spanish imperial eagle nestlings.

Needham et al. (1979) found that a high percentage of the trapped or shot goshawks (*Accipiter gentilis*) had *S. aureus* on their feet whereas nestlings did not. Needham (1981) postulated that *S. aureus* was transferred to the birds by their human contacts, as has been documented for other bird species (Blackmore and Francis, 1970).

Our objective was to test the hypothesis that there was no difference in the prevalence of staphylococcal infections among nestling imperial eagles handled with bare hands, and those handled with gloved hands.

The study was carried out in Doñana National Park, southwestern Spain (36°47′ to 37°14′N, 6°13′ to 6°36′W). Three main habitats occur: Mediterranean scrubland formed by *Halimiun* spp., *Cistus libanotis*, *Erica* spp. with scattered cork oak (*Quercus suber*) and small stone pine (*Pinus pinea*) woods; marshes covered mainly by *Scirpus* spp. and which remain flooded during winter and dry during summer; and coastal sand dunes with vegetation mainly of *Ammophila arenaria*, *Corema album*, and *Juniperus phoenicea*. The climate is Mediterranean with Atlantic influence. The nests of the Spanish imperial eagles occurred mainly in cork oaks and stone pines not far from the marsh border. A more detailed description of this area is given in Rogers and Myers (1980).

From 1982 to 1993, we evaluated 112 nestlings from 56 nests; 66 were handled without gloves and 46 with gloves (Table 1). Prior to 1989 all ($m = 58$) nestlings were handled without gloves. In 1989, five nestlings from three nests selected at random, were handled without gloves in 1990, three nestlings from two nests were handled without gloves. From 1991 on, all nestlings were manipulated with disposable gloves.

TABLE 1. The proportion of infected Spanish imperial eagle nestlings handled with and without disposable latex gloves.

Year	Without gloves			With gloves		
	Number sampled	Number infected	Percent infected	Number sampled	Number infected	Percent infected
1982 to 1988	58	26	45	0	0	—
1989 to 1990	8	4	50	18	2	11
1991 to 1993	0	0	—	28	0	0
Total	66	30	45	46	2	4

Seven chicks from other imperial eagle, populations were introduced as nestlings in Doñana nests and handled without gloves (two chicks in 1986, four in 1987, and one chick in 1988).

Handling of the chicks were done while visiting the nest to determine clutch size, hatching rate, and the number of fledglings. During this last visit, when the nestlings were between 50 and 70 days old, the presence of any disease was recorded. Birds were sampled for microbiological analysis directly in the field. The skin first was disinfected with alcohol and then a sterile scalpel was used to slice open the abscesses. Sterile cotton swabs (Swaube, Baxter Canlab, Mississauga, Ontario, Canada) were inserted into the abscesses, placed into sterile 0.5% saline, and submitted to the Department of Microbiology of the Virgen del Rocio Hospital. The swabs were streaked onto 5% bovine blood agar, penicillin blood agar (0.25 μg/ml), Levine eosine methylene blue (EMB), Columbia nadilixic acid blood agar (CNA), and Sabouraud dextrose gentamicine agar (all media from Difco, Detroit, Michigan, USA). After aerobic incubation at 37 C for 72 hr, bacterial colonies were identified using the techniques of Cowan and Steel (1975). Gram-positive cocci in clusters with a positive coagulase, phosphatase and desoxyribonuclease activity were isolated and identified as *Staphylococcus* spp. A general exact test for contingency tables was used to compare differences between percent of infected nestlings (Wells and King, 1980).

Staphylococcus spp. was isolated from 30 (45%) of 66 chicks handled without gloves, and varied from 33% and 66% each year (Table 1). In contrast, staphylococcal infection occurred in two (4%) of 46 chicks handled with gloves, and was not isolated during the last 3 yr (Table 1). This difference was significant ($P < 0.001$), and our null hypothesis of no difference was rejected.

Five of the seven chicks introduced into Doñana population nests from other populations and that were handled without gloves had infections. This proportion was not significantly different ($P = 0.51$) from that of the original chicks from the Doñana population manipulated without gloves.

Three of 32 infected chicks died from the infection. The deaths always took place with infections in the periocular area, followed by an eye loss due to inflammation. Mortality of Spanish imperial eagle nestlings is very low (18%; Ferrer and Hiraldo, 1991). Staphylococcal infection was the cause of death for 15% of the total nestling deaths, for an estimated 2.6% mortality of all hatched chicks.

Spanish imperial eagle nestlings had a much higher prevalence of *Staphylococcus* spp. infection when handling was done without gloves. *Staphylococcus* spp. has not been detected in the usual microbial flora among wild birds, but it is common among human microbial flora (Needham, 1981). Thus, we believe that Spanish imperial eagle nestlings are infected primarily by human handling, as Needham et al. (1979) proposed for other captive and wild raptors. Use of gloves should reduce this problem.

Staphylococcal infections have been detected only at the Doñana population. Garzón et al. (1984) proposed that the isolation of the Doñana population may have caused a loss of genetic polymorphism which might make it more vulnerable to infectious diseases. However, nestlings from other subpopulations transferred to Doñana suffered from the infection as often as the rest. Perhaps the problem occurred only in the Doñana population because the Doñana nestlings have been subject to greater handling in past years.

Our results do not support the conjecture that the frequent infection by coagulase-positive staphylococci in Spanish imperial eagle nestlings is related to the reduced polymorphism shown by the species all over its range (Negro and Hiraldo, 1994). In fact, the imperial eagle seems more vulnerable to this infection than other raptors such as red (*Milvus milvus*) and black kites (*M. migrans*), buzzards (*Buteo buteo*), booted eagles (*Hieräetus pennatus*), and common kestrels (*Falco tinnunculus*), all of which are handled at least as often as Spanish imperial eagles (M. Ferrer and F. Hiraldo, unpubl.). Among these other five raptors, this disease has been detected only in booted eagles (M. Ferrer and F. Hiraldo, unpubl.).

Based on our results, we recommend that gloves always be used when handling birds to reduce the likelyhood of transmitting zoonotic organisms. Disposable latex gloves seem to have been effective in our case.

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