SPECIE-SPECIFIC OUTCOMES OF WILD RAPTORS ATTENDED AT A WILDLIFE REHABILITATION CENTRE IN CATALONIA (1997-2005)

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ABSTRACT

Outcome research of rehabilitation of wild birds of prey and owls are scarcely reported. The aim of this study is to investigate specie-specific outcomes of the rehabilitation practice in wild raptor attended in a wildlife center. A total of 6221 hospitalized wild raptors (3241 Strigiformes; 2980 Falconiformes) admitted at a Wildlife Rehabilitation Centre (WRC) of Catalonia from 1995 to 2007 were analysed. The outcomes indicators were based on ratios of Euthanasia (Eᵣᵣ), Mortality (Mᵣᵣ), Release (Rᵣᵣ) and Captivity (Cᵣᵣ). Stratified analyses by main causes of admission were performed for the different raptor species. Species from the Falconiformes order presented higher rates of euthanasia (33.9%) compared to the Strigiformes (18.6%). Species like B. buteo (45.7%) and M. migrans (47.6%) in the Falconiformes and B. bubo (33.6%) in the Strigiformes, presented the highest Eᵣᵣ. Despite no differences between orders could be observed in the row mortality rates, data analysed by the causes of admission showed that the Mᵣᵣ of owls was significant higher than the Falconiformes for the trauma (13.2%; χ² = 49.97; p<0.001), non trauma (12.7%; χ² = 17.41; p<0.001) and orphaned young categories (4.9%; χ² = 5.4; p = 0.02). The release rate was similar between orders. Based on species, G. fulvus (69.2%), C. aeruginosus (56.3%) and A. gentillis (43.1%) in the Falconiformes and O. scops (48.5%) in the Strigiformes showed the highest Rᵣᵣ. In the orphaned young category owls had better Rᵣᵣ than the diurnal raptors, being S. aluco the specie with the best rates of release (84%), whereas B. bubo had the worst values (50%). Specie-specific differences were found in the rehabilitation outcomes according to the different causes of admission. The stratified analysis of outcomes can be useful in order to identify specie-specific risk factors.

Keywords: Wild Raptor Species, Wildlife Rehabilitation, Specie-Specific Outcomes, Quality Indicators

1. INTRODUCTION

The rehabilitation of wild birds of prey and owls, nowadays extensively developed in many countries, has played a significant improvement in wildlife medicine and wildlife conservation of species, including positive input on the recovery of some endangered species (Negro et al., 2007), the identification and understanding of many menaces to the wild populations (Harris and Sleeman, 2007) and the improvement of animal welfare (Grogan and Kelly, 2013). The main goal of the rehabilitation of wild life species is to be able to release individuals to the wild after physical and behavioral recovery, taking into account, not only welfare concerns but also providing a critical evaluation of the chances of individual to survive in the wild after rehabilitation.

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The analysis of the outcomes or final disposition of wild species in the rehabilitation centers is of great importance to assess the quality of the rehabilitation process since such analysis can detect critical points in the hospitalization and rehabilitation practice. In a previous paper (Molina-Lopez et al., 2013) we describe these issues for the whole population of wild raptors at a wildlife rehabilitation centre in Spain. The aim of this study is to analyze the outcomes in a species-specific base, in order to detect risk factors associated at this level.

2. MATERIALS AND METHODS

2.1. Study Design and Animals

A retrospective study was performed using the original medical records of birds of prey admitted at the Wildlife Rehabilitation Centre of Torreferrussa, Catalonia (Spain) from 1995 to 2007. The centre is under the direction of the governmental Catalan Wildlife-Service. Samples were collected in compliance with the Ethical Principles in Animal Research in the wildlife rehabilitation centers. The rehabilitation centers directly depend on the governmental Autonomous Wildlife Services. Thus, protocols, amendments and other resources were done according to the guidelines approved by each Autonomous government following the published law R.D.1201/2005 (10th October 2005, BOE 21st October 2005) of the Ministry of Presidency of Spain. Animals that had to be euthanized for humanitarian reasons were sacrificed by endovenous injection of barbiturates.

2.2. Definition of Variables

The classification of primary causes of admission was described in a previous study (Molina-Lopez et al., 2011). Briefly, the most relevant causes of admission comprised the following categories: Trauma (unknown trauma, gunshot, collision with vehicles and electrocution), non-trauma (fortuity, metabolic/nutritional diseases, captivity and infectious/parasitic diseases) and orphaned young chicks.

The final outcomes were divided into four categories based on previous works (Molina-Lopez et al., 2013): Euthanized animals (based on humanitarian principle), dead animals (mortality with no human intervention), released animals to the wild (result of successful rehabilitation) and captive non-releasable animals (due to its poor prognosis of survivability in wilderness). The final dispositions were calculated by dividing the number of cases of each category by the total number of admissions in each species; in consequence all four categories were expressed as rates: Euthanasia rate ($E_r$), Mortality rate ($M_r$), Release rate ($R_r$) and Captivity rate ($C_r$).

2.3. Statistical Analysis

Descriptive statistics, normality test and inferential analyses were done at 95% of confidence with SPSS Advanced Models ™ 15.0 (SPSS Inc. 233 South Wacker Drive, 11th Floor Chicago, IL 60606-6412). Chi-square ($\chi^2$) or Fisher exact tests were used for comparisons between the $E_r$, $M_r$, $R_r$ and $C_r$ and the covariate specie. For comparisons, only species with more than 25 animals were used.

3. RESULTS

3.1. Descriptive Analyses of the Total Population

A total of 7553 raptor admissions were reported at the WRC during a period of twelve years (from 1995 to 2007). After a critical review of all the admissions, 1332 cases were excluded for not fulfilling the inclusion criteria (739 cases were admitted death and 593 cases included captive birds, captive borne or falconry birds). Thus, the final population of this study was composed by 6221 individuals distributed in the following orders: 3241 Strigiformes (1511 adults and 1730 chicks) and 2980 Falconiformes (2557 adults and 423 chicks). Seven different species were included in the nocturnal raptors group and 23 species in the diurnal group Table 1.

3.2. Euthanasia Rates ($E_r$) of Different Raptor Species

Species from the Falconiformes order presented higher rates of euthanasia (33.9%) compared to the Strigiformes (18.6%) (Table 2). Species like B. buteo (45.7%), M. migrans (47.6%) and M. milvus (40% aprox) were the species with the highest $E_r$ in the Falconiformes and B. bubo (33.6%) in the Strigiformes (Fig. 1).

Regarding causes of admission, 37% B. bubo were euthanized due to the severity of lesions caused by electrocution (Table 3), whereas other species of owls and B. buteo and M. migrans in Falconiformes were mainly sacrificed due to unknown trauma or collision with vehicles (Table 3). In the orphaned group euthanasia rates were very low compared to other categories of animals (Fig. 1).
Table 1. Description of the total number of species analysed in the study

| Species category (n) | Total excluding orphaned category (n) | Only orphaned |
|----------------------|--------------------------------------|---------------|
| **Strigiformes**     |                                      |               |
| Asio flammeus        | 10                                   | 0             |
| Asio otus            | 60                                    | 13            |
| Athene noctua        | 481                                   | 578           |
| Bubo budo            | 137                                   | 13            |
| Otus scops           | 268                                   | 577           |
| Strix aluco          | 230                                   | 437           |
| Tyto alba            | 325                                   | 112           |
| Total                | 1511                                  | 1730          |
| **Falconiformes**    |                                      |               |
| Accipiter gentilis   | 174                                   | 11            |
| Accipiter nisus      | 386                                   | 12            |
| Aquila chrysaetos    | 2                                     | 0             |
| Buteo buteo          | 770                                   | 16            |
| Circus gallicos      | 39                                    | 1             |
| Circus aeruginosus   | 32                                    | 0             |
| Circus cyaneus       | 12                                    | 1             |
| Circus pygargus      | 9                                     | 0             |
| Falco columbarius    | 6                                     | 0             |
| Falco naumanni       | 48                                    | 13            |
| Falco peregrinus     | 86                                    | 7             |
| Falco subbuteo       | 32                                    | 0             |
| Falco tinnunculus    | 802                                   | 355           |
| Falco vespertinus    | 1                                     | 0             |
| Gypaetus barbatus    | 2                                     | 0             |
| Gypus fulvus         | 39                                    | 2             |
| Hieraetus fasciatus  | 8                                     | 0             |
| Hieraetus pennatus   | 26                                    | 2             |
| Milvus migrans       | 21                                    | 1             |
| Milvus milvus        | 5                                     | 1             |
| Neophron percnocterus| 1                                     | 0             |
| Pandion halaites     | 2                                     | 0             |
| Pernis apivorus      | 54                                    | 1             |
| Total                | 2557                                  | 423           |

3.3. Mortality Rates (M_r) in Different Raptor Species

Although there are not statistical differences between total mortality for Strigiformes (31.5%) and Falconiformes (29.6%), when we analyze the mortality for the three general categories of causes, the M_r of owls was significant higher for trauma (13.2%; $\chi^2 = 49.97$; p<0.001), non trauma (12.7%; $\chi^2 = 17.41$; p<0.001) and orphaned young categories (4.9%; $\chi^2 = 5.4$; p = 0.02) compared to Falconiformes.

Among the Falconiformes, A. nisus and F. Subbuteo and with a lower number individual also C. cyaneus and H. fasciatus, presented M_r above 50%. Among the Strigiformes, Asio spp and S. aluco and T. alba were the species with the highest rate of mortality, also around 50% (Fig. 1). The main cause of mortality in these owls and diurnal raptors was unknown trauma (Table 4). Interestingly, the highest M_r due to infectious diseases was observed in F. peregrinus (10.3%) and F. subbuteo (9.5%). In the orphaned category, B. bubo had the highest rates of mortality (33.3%) and, in the diurnal the highest M_r was observed in F. naumanni and F. peregrinus (>50%) (Fig. 1).

3.4. Release Rates (R_r) in the Different Raptor Species

The overall R_r was not statistically different between orders. Strigiformes (33.2%) showed slightly higher release rates than Falconiformes (29.8%). Based on species, G. fulvus (69.2%), C. aeruginosus (56.3%) and A. gentilis (43.1%) showed the highest R_r in the Falconiformes and O. scops (48.5%) in the Strigiformes (Fig. 1). Most of the released species were hospitalized due to unknown trauma (C. aeruginosus, O. scops), fortuity causes (G. fulvus) or gunshot (A. gentilis) (Table 5).

On the other hand, high values of R_r were observed for trauma caused by vehicles in S. aluco (25.7%) and from gunshot (around 40%) in B. buteo, A. gentilis and F. peregrinus (Table 5). By contrast, when the cause of injure was electrocution the lowest rates of release were observed for all the examined species.

In the orphaned young category owls showed, in general, better R_r than diurnal raptors (Fig. 1). Within the Strigiformes, B. bubo presented the worst release rates with only 50% R_r and S. aluco the best rates with up to 84% R_r. In the Falconiformes, the best R_r (>80%) was observed for B. buteo, A. nisus and F. tinnunculus but it was very low for F. naumanni (16.7%) (Table 6).

3.5. Captivity Rates (C_r) in Different Raptor Species

The overall C_r of Strigiformes and Falconiformes were low and similar between groups (2 and 4.1% respectively). The highest Cr values corresponded to F. naumanni (16.1%) and F. tinnunculus (13.7%) in Falconiformes and A. noctua (10.6%) and T. alba (8.7%) in Strigiformes. In the orphaned category, the highest C_r was observed in A. noctua (29.6%) and F. naumanni (25.9%).
Table 2. Resolution rates of the different species attended at the Wildlife Rehabilitation centre according to the animal order

| Species                  | Total raptor admissions, N | Enthuasitized | Dead | Released | Captivity |
|--------------------------|----------------------------|---------------|------|----------|-----------|
|                          | n                          | Rate (E)      | n    | Rate (M) | n         | Rate (C)  |
| Pernis apivorus          | 10                         | 2             | 20.0 | 6        | 60.0      | 20.0      | 0         |
| Falco tinnunculus        | 60                         | 18            | 30.0 | 30       | 50.0      | 6         | 10.0      | 6         |
| Milvus migrans           | 481                        | 104           | 21.6 | 202      | 42.0      | 158       | 32.8      | 17        |
| Bubo bubo                | 137                        | 46            | 33.6 | 53       | 38.7      | 30        | 21.9      | 8         |
| Otus scopos              | 268                        | 26            | 9.7  | 109      | 40.7      | 130       | 48.5      | 3         |
| Strix aluco              | 230                        | 32            | 13.9 | 120      | 52.2      | 74        | 32.2      | 4         |
| Tyto alba                | 325                        | 53            | 16.3 | 157      | 48.3      | 101       | 31.4      | 14        |
| Total                    | 1511                       | 281           | 18.6 | 677      | 44.8      | 501       | 33.2      | 52        |

Table 3. Euthaniasia rates of the different species attended at the Wildlife Rehabilitation centre according to the main cause of admission

| Species                  | Overall | Unknown | Vehicles | Gunshot | Electrocution | Torture | Metabolic | Captivity | Infectious |
|--------------------------|---------|---------|----------|---------|---------------|---------|-----------|-----------|-----------|
|                          | n       | n       | %        | n       | n             | n       | n         | n         | n         |
| Assio flammeus           | 2       | 2       | 100.0    | 2       | 0             | 0       | 0         | 2         | 0         |
| Asio otus                | 10      | 18      | 72.2     | 2       | 11.1          | 1       | 5.6       | 5         | 0         |
| Athene noctua            | 104     | 68      | 65.4     | 26      | 25.0          | 3       | 2.9       | 0         | 0         |
| Bubo bubo                | 46      | 16      | 34.8     | 4       | 8.7           | 1       | 2.2       | 17        | 37.0      |
| Otus scopos              | 26      | 16      | 61.5     | 7       | 26.9          | 0       | 0         | 0         | 0         |
| Strix aluco              | 32      | 18      | 56.3     | 9       | 28.1          | 0       | 0         | 0         | 0         |
| Total                    | 2557    | 867     | 33.9     | 820     | 31.3          | 276     | 29.8      | 109       | 43.0      |

*: Only adults were included (>1 year calendar)

Table 3. Euthaniasia rates of the different species attended at the Wildlife Rehabilitation centre according to the main cause of admission

| Number and percentages of euthanized raptors Principal causes of admission* |
|---------------------------------|---------------------------------|-----------------|----------|---------|---------|---------|---------|---------|---------|
| Species                         | Overall | Unknown | Vehicles | Gunshot | Electrocution | Torture | Metabolic | Captivity | Infectious |
|---------------------------------|---------|---------|----------|---------|---------------|---------|-----------|-----------|-----------|
|                                | n       | n       | %        | n       | n             | n       | n         | n         | n         |
| Assio flammeus                  | 2       | 2       | 100.0    | 2       | 0             | 0       | 0         | 2         | 0         |
| Asio otus                       | 10      | 18      | 72.2     | 2       | 11.1          | 1       | 5.6       | 5         | 0         |
| Athene noctua                   | 104     | 68      | 65.4     | 26      | 25.0          | 3       | 2.9       | 0         | 0         |
| Bubo bubo                       | 46      | 16      | 34.8     | 4       | 8.7           | 1       | 2.2       | 17        | 37.0      |
| Otus scopos                     | 26      | 16      | 61.5     | 7       | 26.9          | 0       | 0         | 0         | 0         |
| Strix aluco                     | 32      | 18      | 56.3     | 9       | 28.1          | 0       | 0         | 0         | 0         |
| Total                           | 2557    | 867     | 33.9     | 820     | 31.3          | 276     | 29.8      | 109       | 43.0      |

* Undetermined and other minority causes (fences, predation, power lines, toxicosis…) have been omitted to simplify data.
Table 4. Mortality rates of the different species attended at the Wildlife Rehabilitation centre according to the main causes of admission

| Species                  | Overall trauma | Unknown trauma | Vehicles | Gunshot | Electrocution | Fortuity | Metabolic | Nutritional | Captivity | Parasitic | Fortuity | Infectious parasites |
|--------------------------|----------------|----------------|----------|---------|---------------|----------|-----------|-------------|-----------|------------|----------|---------------------|
| Aesops flavus            | 6              | 2              | 33.3     | 0       | 0             | 0        | 0         | 0           | 0         | 0          | 0        | 0                   |
| Aesops otus              | 30             | 16             | 53.3     | 5       | 16.7          | 1        | 3.5       | 0           | 2         | 67.4       | 4        | 13.3                |
| Athene noctua            | 202            | 104            | 51.5     | 47      | 23.3          | 6        | 3.0       | 0           | 18        | 8.9        | 10       | 5.0                 |
| Bubo bubo                | 53             | 15             | 28.3     | 9.4     | 2             | 3        | 3.8       | 3           | 5.7       | 7          | 13.2     | 8                   |
| Buteo buteo              | 109            | 58             | 53.2     | 17      | 15.6          | 0        | 0         | 0           | 16        | 14.7       | 6        | 5.5                 |
| Circus aeruginosus       | 120            | 45             | 37.5     | 32      | 26.7          | 2        | 1.7       | 2           | 1.7       | 19         | 15.8     | 8                   |
| Circus cyaneus           | 157            | 52             | 33.1     | 41      | 26.1          | 6        | 3.8       | 2           | 1.3       | 15         | 9.6      | 12                  |
| Falco peregrinus         | 227            | 72             | 31.7     | 10      | 4.4           | 10       | 4.4       | 9.7          | 0         | 0          | 0        | 0                   |
| Falco subbuteo           | 130            | 46             | 35.4     | 11      | 8.5           | 0        | 0         | 0           | 0         | 0          | 0        | 0                   |
| Falco vulpiners          | 251            | 126            | 50.2     | 18      | 7.2           | 35       | 13.9      | 8            | 3.2       | 11         | 4.4      | 6                   |
| Gyps fulvus              | 202            | 107            | 50.0     | 12      | 5.9           | 56       | 27.7      | 0            | 0         | 4          | 2.0      | 6                   |
| Hieraetus fasciatus      | 11             | 6              | 54.5     | 0       | 0             | 0        | 0         | 0           | 0         | 0          | 0        | 0                   |
| Hieraetus pennatus       | 7              | 5              | 71.4     | 0       | 0             | 0        | 2         | 28.6        | 0         | 0          | 0        | 0                   |
| Milvus cuculi            | 11             | 6              | 54.5     | 0       | 0             | 0        | 0         | 2           | 18.2      | 1          | 9.1      | 0                   |
| Milvus migrans           | 3              | 1              | 33.3     | 0       | 0             | 1        | 33.3      | 0           | 0         | 0          | 0        | 0                   |
| Milvus milvus            | 7              | 5              | 71.4     | 0       | 0             | 0        | 2         | 28.6        | 0         | 0          | 0        | 0                   |
| Strix aluco              | 241            | 63             | 26.1     | 23      | 14.6          | 5        | 3.2       | 1           | 0.6       | 33         | 20.9     | 4                   |
| Tyto alba                | 109            | 58             | 53.2     | 17      | 15.6          | 0        | 0         | 0           | 16        | 14.7       | 6        | 5.5                 |

* Undetermined and other minority causes (fences, predation, power lines, toxicosis.) have been omitted to simplify data

Table 5. Number and percentage of species admitted at the rehabilitation centre and released to the wildlife according to the main causes of admission

| Species                  | Overall trauma | Unknown trauma | Vehicles | Gunshot | Electrocution | Fortuity | Metabolic | Nutritional | Captivity | Parasitic | Fortuity | Infectious parasites |
|--------------------------|----------------|----------------|----------|---------|---------------|----------|-----------|-------------|-----------|------------|----------|---------------------|
| Accipiter gentilis       | 46             | 17             | 37.0     | 1       | 2.2          | 20       | 43.5      | 0           | 0         | 1          | 2.2      | 3                   |
| Accipiter masius         | 202            | 107            | 50.0     | 12      | 5.9          | 56       | 27.7      | 0           | 0         | 4          | 2.0      | 6                   |
| Aquila chrysaetos         | 241            | 63             | 26.1     | 23      | 14.6         | 5        | 3.2       | 1           | 0.6       | 33         | 20.9     | 4                   |
| Circus aeruginosus       | 11             | 6              | 54.5     | 0       | 0             | 0        | 0         | 2           | 18.2      | 1          | 9.1      | 0                   |
| Milvus cuculi            | 11             | 6              | 54.5     | 0       | 0             | 0        | 0         | 2           | 18.2      | 1          | 9.1      | 0                   |

* Undetermined and other minority causes (fences, predation, power lines, toxicosis.) have been omitted to simplify data
Table 6. Evolution of the orphaned raptors attended at the Wildlife Rehabilitation centre

| Species          | Euthanized | Dead | Released |
|------------------|------------|------|----------|
| **Strigiformes** |            |      |          |
| T. alba          | 1 (0.9)    | 22 (19.6) | 89 (79.5) |
| O. scops         | 7 (1.2)    | 138 (24) | 431 (74.8) |
| A. otus          | 0          | 3 (25) | 9 (75)  |
| B. bubo          | 2 (16.7)   | 4 (33.3) | 6 (50) |
| S. aluco         | 4 (1)      | 64 (14.7) | 366 (84.3) |
| A. noctua        | 8 (1.4)    | 112 (19.7) | 450 (78.9) |
| **Falconiformes** |            |      |          |
| G. fulvus        | 0          | 1 (100) | 0        |
| C. cyaneus       | 0          | 0     | 1 (100)  |
| M. migrans       | 0          | 0     | 1 (100)  |
| M. milvus        | 0          | 0     | 1 (100)  |
| B. buteo         | 0          | 1 (6.7) | 14 (93.3) |
| P. apivorus      | 0          | 1 (100) | 0        |
| A. nisus         | 1 (9.1)    | 1 (9.1) | 9 (81.8) |
| M. milvus        | 0          | 4 (36.4) | 7 (63.6) |
| H. pennatus      | 0          | 0     | 1 (100)  |
| C. gallicus      | 0          | 0     | 1 (100)  |
| F. tinnunculus   | 20 (5.7)   | 46 (13) | 286 (81.3) |
| F. naumanni      | 0          | 5 (83.3) | 1 (16.7) |
| F. peregrinus    | 0          | 4 (57.1) | 3 (42.9) |

Fig. 1. Euthanized (Er), mortality (Mr) and released (Rr) rates of the different species of raptors admitted in the WRC in Catalonia
4. DISCUSSION

In the present study the outcomes of a long-term retrospective study of wild raptors admitted at a rehabilitation center were presented at specie-specific level. Wildlife rehabilitation outcomes have been focused in the proportion of releases taking into account the causes of admission (Richards et al., 2005) or the species (Harris and Sleeman, 2007), but rarely combining both variables (Ress and Guyer, 2004). Moreover, differences in the number of cases or in the methodological approaches make comparisons of the results difficult. For all these reasons, the presentation of the outcomes in rates can be an optimal approach to compare and extrapolate results of the rehabilitation process in different centers and species.

The criteria for euthanasia of wild birds have been clearly established (Miller, 2012), but the final decision is frequently based on the legal regulations and conservation plans for the different species in each particular region. As a general rule, the highest proportion of euthanasia is applied to animals with disabling complications after trauma. Thus, our results showed Falconiformes as the group with higher rates of euthanatized animals, basically because most of the animals of this group suffered traumatic casualties such as unknown trauma or collisions with vehicles. However, we also observed a high proportion of euthanized birds in B. bubo due to electrocutions. In fact, the worst R, was observed in electrocuted birds of any species (Molina-Lopez et al., 2013). As previously described, electric burns are usually associated with poor prognosis and the majority of the birds are euthanized due to the severity of the soft tissue damage (Cooper, 2008; 2013).

As regards the M, when this rate was estimated based on the different causes of admission, the mortality in owls was significant higher in the three categories of admission (trauma, non trauma and orphaned young). Unfortunately, data about M, is anecdotal in the literature, making difficult to establish comparisons among studies. Thus, further investigation will be required to find the main risk factors associated to owl mortality during the rehabilitation practice. Some authors have described an inverse correlation between having a low body mass and the success of releases (Ress and Guyer, 2004). By contrast, in our study, three diurnal species of small size (A. nisus, F. subbuteo and F. columbarius) and highly specialized species such as P. apivorus presented a high M (40%). Apart from the severity of the lesions, other factors like the management in captivity of high metabolic species, or the difficulty for feeding some specialized species, could increase the mortality risk (Naissbit and Holz, 2004). The M on birds related to traumatic casualties was higher than 50% in the majority of species and specially associated to the unknown trauma and gunshot. In most of the cases, the trauma was associated with severe musculo-eskeletal, neurological and multiorganic damage with very poor prognoses. The low value of the M in the electrocuted birds was explained by the fact that almost all the affected birds were euthanized as commented before. Conversely, the mortality of animals classified as fortuity in our study, especially in owls, were normally observed in birds which presenting poor body condition, dehydration and weakness as a consequence of lack of food and water deprivation when they were inside buildings or other human structures.

The prevalence of primary infectious and parasitic diseases in wild birds of prey admitted at the rehabilitation centers are low compared to traumatic conditions. Nevertheless, the role of infectious diseases as predisposing factor to traumatisms and their severity have been prior suggested (Morishita et al., 1998). In our study, the highest M was related to severe trichomoniasis affecting mainly F. peregrinus, T. alba and S. aluco. In both owl species, the clinical form of the disease was characterized by extensive necrotic lesions in the upper part of the oral cavity, in agreement with previous reports in T. alba in the United States (Pokras et al., 1993) and more recently in S. aluco in the United Kingdom (Couper and Bexton, 2012). Regarding the low proportion of fatalities in the orphaned young category, our results showed that most of the cases were apparently healthy birds with a high chance of survival (Couper and Bexton, 2012). The most part of orphaned chicks were owls and B. bubo was the most susceptible specie to die. In our experience, most B. bubo are only captured as chicks when they are severely injured or ill, while the smallest species of owls are more easily found in the wild when branching and easily captured by humans, in comparison to B. bubo.

Interestingly, the rate of releases seemed to be slightly higher in owls than in diurnal raptors. This result agrees with those reported in the Southeastern United States by Ress and Guyer (2004). Nevertheless the highest overall R, was observed in the G. fulvus population, because it was mainly composed by weak, otherwise healthy, young birds admitted during the end of the summer. Most of those animals were apparently healthy young animals that got disoriented and
accidentally moved out of their colonies. The population of this species in Catalonia has increased in the last years (García and Margalida, 2009) and the number of these incidents has also increased, as has been observed in other centers in Spain (Valenciana, 2010). Comparing our R results with other studies, we found similarities in some rates. For example, R of A. gentillis (43.1%) was similar to that reported by Duke et al. (1981) in United States (46.7%) and R of A. nisus (22%) was similar to that reported by Riojas-Rodríguez et al. (2010) (24.7%) in Tenerife (Canary Islands). In the orphaned group, the highest R were observed in the Strigiformes order, with rates over 75% in all the species with exception of B. bubo. In general, most of these cases are branching young birds, apparently healthy. In the area of study, the breeding sites of most of owl species and also of F. tinnunculus are closely related to human buildings or constructions (Durany et al., 2004) and a high number of chicks or fledging are brought to the rehabilitation centers (Molina-Lopez et al., 2011). By contrast, the lowest R of F. naumanni could be explained by the fact that this small falcon is endangered in Catalonia and a high proportion of the birds admitted at the center are kept in captivity and included in the breeding program developed for the recovery of their wild populations.

The proportion of non releasable birds of prey and owls kept in captivity for education or for captive breeding and reintroduction programs differs extremely between rehabilitation centers depending on legal policies and conservation strategies of the local governments, as stated above. In our center, both F. naumanni and C. pygargus species are subjected to breeding in captivity and reintroduction programs, thus the maximum number of non releasable birds are derived to captivity. On the other hand, within the owls, A. noctua and T. alba are the two species mostly intended to educational programs in the area of the study (Molina-Lopez and Darwich, 2011).

5. CONCLUSION

In conclusion, the stratified analysis of rehabilitation outcomes by species of wild raptors and owls, can be useful to identify specie-specific related risk factors that are essential to make studies comparable and to implement rehabilitation protocols worldwide.

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