Installing of Artificial Nests as a Method of the Large Birds of Prey Population Management in the Center of European Russia: Successes, Problems, Prospects

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Abstract. Active management of populations of protected animal species is urgent whilst its number is catastrophically low and human disturbance of the habitat remains heavy as well. The article analyzes the success, problems and prospects of a large-scale project to recover the number of rare species of birds of prey through the installing of artificial nests in the Nizhny Novgorod region, which is located in the centre of European Russia, in 1998-2019. At the end of 1990, in the Nizhny Novgorod region the number of large birds of prey was critically low: Osprey – 10-12, Golden Eagle – 2-3, Imperial Eagle – 1-3, Greater Spotted Eagle – 10-15, White-tailed Eagle – 4-7 pairs. The main limiting factor for them was the lack of trees suitable for nesting. In total, during the period from 1998 to 2014, 371 artificial nests for large birds of prey were installed in 19 administrative regions of the region. All five target species (Osprey, Golden Eagle, Greater Spotted Eagle, Imperial Eagle and White-tailed Eagle) has been recorded occupying the artificial nests. The process of developing system of artificial nests has been analyzed. Its influence on the number of target species of birds of prey and changes in the use of artificial nests by birds of prey has been also examined. The development of the system of artificial nests has shown its effectiveness as a method to manage populations of rare species of birds of prey that suffer from the lack of nesting trees. It seems to be truth for the Golden Eagle, the Osprey and rather the White-tailed Eagle, and the installing of artificial nests had a significant positive effect on their population trends. Installing of artificial nests is particularly effective when the number of target species is critically low. The increase in numbers leads to a decrease in the share of birds using artificial nests. We propose to continue the regular monitoring of all the artificial nests for large birds of prey and declare the necessity of implementing a special project to recover the Golden Eagle number in the region.

1. Introduction

Under conditions of heavy human disturbance of habitats, many animals require active population management. It is carried out either to maintain at an optimal level the number of species that are used as bioresources, or to conserve the most vulnerable species. Active human impact on the life of the rescued species is justified where the usual methods of protection (prohibition of hunting, establishment of natural reserves) have no the desired result due to heavy human disturbance of the habitat or catastrophic decrease in the population numbers. This fully applies to large birds of prey in densely populated regions of the center of European Russia.

A large-scale project has been implemented to recover the number of rare species of birds of prey through the installing of artificial nests in the Nizhny Novgorod region (area – 76.6 km²), located in the center of European Russia since 1998. This project has accumulated the experience gained both in Russia [1, 2] and abroad [3-6].
The number of all species of large birds of prey in the Nizhny Novgorod region was critically low at the end of 1990s. We estimated the number of Osprey (Pandion haliaetus L.) in 10-12 pairs, Golden Eagle (Aquila chrysaetos L.) – 2-3, Imperial Eagle (Aquila heliaca Savigny) – 1-3, Greater Spotted Eagle (Aquila clanga Pall.) – 10-15, White-tailed Eagle (Haliaeetus albicilla L.) – 4-7 pairs. These species were listed in the Red Book of the Nizhny Novgorod region as endangered [7]. In our opinion the main factor affecting on them was the lack of trees suitable for nesting. This allowed us to assume that the installation of a sufficiently large number of artificial nests would provide the occupation of some of them and increase the number of target species. Along with field studies we used the GIS-methods of analysis to select locations of artificial nests. It allowed us to identify the centers of sites that most satisfy to nesting habits of rare species of birds of prey [8]. Our experience was subsequently successfully replicated in a number of Russian regions [9-13].

2. Results and Discussion

2.1 Installing of artificial nests for large birds of prey

A total of 371 artificial nests for large birds of prey were installed in 19 administrative regions of the region during the period from 1998 to 2014. The locations of their installation have shown in Fig. 1. Artificial nests were built for 5 target species (Table 1).

| Target species         | Number of artificial nests |
|------------------------|----------------------------|
|                        | installed | destroyed | remained |
| Osprey                 | 118       | 28        | 90       |
| Golden Eagle           | 169       | 58        | 111      |
| White-tailed Eagle     | 37        | 7         | 30       |
| Greater Spotted Eagle  | 40        | 14        | 26       |
| Imperial Eagle         | 7         | 1         | 6        |
| Total                  | 371       | 108       | 263      |

The first nests were installed in areas where the target species was encountered during the breeding period. Choosing places for the nest installation we considered main criteria as follows: the suitable habitats (a combination of nesting and feeding areas), the least level of human disturbance during the nesting period and the legal protection of the territory as well. Artificial nests were mainly installed either on existing protected areas or on sites reserved by the government of the Nizhny Novgorod region to establish the protected areas. In 1998, the first 50 nests were installed in "Kama-Bakaldino Mires" included in the list of Ramsar wetland sites. Another 135 artificial nests were built in 2000.

Next years, the number of artificial nests was not increasing so quickly: other potential habitats of rare birds of prey were gradually covered, as well as destroyed nests were restored. The loss of artificial nests was caused by natural reasons or it was related to human activity. Change in the number of artificial nests suitable for use by birds is shown in Fig. 2.
Figure 1. Locations of artificial nests for rare species of birds of prey
2.2 Influence of the artificial nest installing on the number of large birds of prey

We monitored both the artificial nest conditions and their occupancy by birds almost every year during 1999-2014. After a four-year break, the artificial nests were surveyed once again in 2019.

The artificial nests was found being occupied by all five target species: Osprey, Golden Eagle, Greater Spotted Eagle, Imperial Eagle and White-tailed Eagle (table. 2).

The installation of artificial nests had a greatest effect on the number of Golden Eagles in the region. It had increased almost tenfold by 2006-2007, comparing to the end of the XX century, by the way a half of the birds was noted breeding in the artificial nests. The long-term depression of the number of white hare and grouse birds, being the main prey species of the Golden Eagle, had begun since 2007. Alongside, most of the existing and potential nesting sites of the Golden Eagle were lost as a result of catastrophic fires in 2010. As a result, the regional population of the Golden Eagle, according to optimistic estimates, has decreased by half compared to the maximum reached. In 2019, only pair of Golden Eagles was recorded occupying the artificial nest.

Figure 2. Changes in numbers of artificial nests suitable for use by birds in 1998-2019
Thus, the Golden Eagle population after the fires of 2010, which destroyed the habitat and a significant part of the artificial nests, has been again in a critical condition. The special project is essential to recover this species. We believe it should be designed for 3-5 years and include additional research, installation of artificial nests, winter feeding of birds and monitoring the occupancy of breeding territories as well.

The installation of artificial nests had a pronounced positive effect on the Osprey population in the region. Its number doubled in the first 6-7 years of the project, with half of the pairs occupying artificial nests to breed. The regional osprey population continued to grow later on, and the share of birds occupying artificial nests decreased. The tendency to reduce the use of artificial nests by osprey simultaneously with the growth of the regional population was registered in 2011-2014 and was generally explained by the loss of part of the nests as a result of fires in 2010 and other reasons. The number of osprey pairs occupying artificial nests declined sharply in 2015-2018, when the monitoring of its population was not conducted. Clarification of the scale and explanation of the causes of this phenomenon is the task of future research. We assume the species population recovered has reduced its demand for artificial nests.

This hypothesis is indirectly supported by the situation with the White-tailed Eagle and the Greater Spotted Eagle.

At the turn of the XX-XXI centuries, the White-tailed Eagle population is noted to increase in over the entire area of its range in European Russia [14]. Rapid recovery of the species has begun in the Nizhny Novgorod region since 2000. And the artificial nest installing promoted the growth of the eagle number, although it was not the main reason for this process. In 2006-2007, 15-20% of pairs of eagles breeding in the Nizhny Novgorod region occupied artificial nests. The share of eagles using artificial nests was significantly decreased later on against the background of its simultaneous population growth in the region. The White-tailed Eagle is showing an increase in tolerance towards humans: it feeds in landfills, has become more resistant to the human anxiety, nest habits have not been so definite [15]. Such changes in its ecology have significantly reduced its demand for artificial nests.

The data in the Table 2 have shown a significant increase in the number of the Greater Spotted Eagle at the beginning of the XXI century. There is reason to assume that our estimates of the species number in the 1990s were significantly underestimated, probably the actual number of species in the region was not critically low. A pair of the Greater Spotted Eagle breeding successfully in the artificial nest was registered in 2006. Virtually the installing of a small number of artificial nests has not affected on the breeding condition of this species.

The northern border of the Imperial Eagle breeding range crosses the south of the Nizhny Novgorod region. Several artificial nests for this eagle were installed in all the few potential habitats. Only occupied nest was known in the region in 1988-2004. An artificial nest was installed near it in 2004. The eagles had moved the nest in the artificial platform by 2006, but their breeding attempt was unsuccessful. The reason for this was a decrease in the pasturing on the adjacent steppe meadows, which led to a decrease in the number of large rodents, being main prey species for the raptor. Currently, the Imperial Eagle has disappeared in the Nizhny Novgorod region. We don’t expect it to occupy the artificial nests, since the

Table 2. Number of rare species of birds of prey and their use of artificial nests in the Nizhny Novgorod region

| Species              | Number of occupied artificial nests in different years: | Number of pairs occupied the artificial nests in different years: |
|----------------------|--------------------------------------------------------|---------------------------------------------------------------|
|                      | 2001-2002 | 2006-2007 | 2014 | 2019 | 2006-2007 | 2011-2014 | 2019 |
| Osprey               | 10-15    | 29-37     | 39-47 | 50-60 | 15-18     | 13-16     | 3    |
| Golden Eagle         | 5-6      | 21-23     | 14-24 | 7-16  | 10-12     | 7-9       | 1    |
| Greater Spotted Eagle | 10-15   | 25-30     | 25-30 | 90-100| 1         | 0         | 0    |
| Imperial Eagle       | 1-3      | 1         | 0-1   | 0     | 1         | 0         | 0    |
| White-tailed Eagle   | 7-9      | 31-43     | 45-55 | 70-80 | 5-7       | 6-7       | 1    |

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species distribution depends on the livestock grazing, which is almost complete absent in the potential feeding habitats now.

3. Conclusion
The program on recovering of the rare raptor species by installing artificial nests has been implementing in the Nizhny Novgorod region for 20 years. Significant environmental and economic benefits have been achieved: the target group of wildlife species has been increasing in the population numbers and not longer on the verge of extinction. We have proved that the artificial nest installing allows to increase the number of rare raptor species for a relatively short period of time.

Installing artificial nests is an effective method of managing populations of rare raptor species that are suffered from the lack of nesting trees. It seems to be truth for the Golden Eagle, the Osprey and rather the White-tailed Eagle; and the installing of artificial nests had a significant positive effect.

Construction of artificial nests has a particular effect when the population of target species is critically low. The increase in numbers leads to a decrease in the share of birds nesting on artificial platforms.

The regular control of occupancy of artificial nests allowed to monitor the status of populations of large birds of prey in the center of European Russia in 1998-2014.

The census carried out in 2019 has shown that the share of large birds of prey occupying artificial nests has significantly decreased, but the five-year break in monitoring does not allow us to answer the questions of why and where birds that used previously artificial nests have been redistributed.

We believe that regular monitoring will encourage noting any changes in the population trends of target species and the artificial nests conditions.

The Golden Eagle population in the region has been again in critical condition. A special project requires to restore this species. It should be for 3-5 years and include additional research, installation of nesting platforms, winter feeding of birds, monitoring of occupancy of breeding territories.

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