

## INVESTIGATION OF WHITE-HEADED DUCK (*Oxyura leucocephala*) SPECIES AND ITS WINTERING SITES IN AZERBAIJAN

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**Abstract.** Azerbaijan is an important region in which to conduct research on avifauna. There are approximately 17 globally threatened bird species in this country (Bird Life International, 2019) and the paper aims to investigate one of them – *Oxyura leucocephala* and to determine what are the main factors affecting their abundance. Bayesian Belief Network - Netica model was used to calculate the probabilities of these factors. Netica model is the first attempt in Azerbaijan towards studying the white-headed duck populations and it paves the way for further study of this species. The results show that, in current situation there's 52.2% chance that the population of white headed duck will decrease in the near future. The strongest negative factors for this species are 1) drought– which causes habitat degradation, 2) pollution and 3) lack of protection measures, because some key sites aren't effectively protected. Proper responses to stop that could be the strict protection of these sites, restoration of wetlands and restriction of fishing and hunting activities in wintering sites of *Oxyura leucocephala*.

**Keywords:** White-headed duck, Endangered, Bayesian Belief Network, Netica Model.

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### 1. Introduction

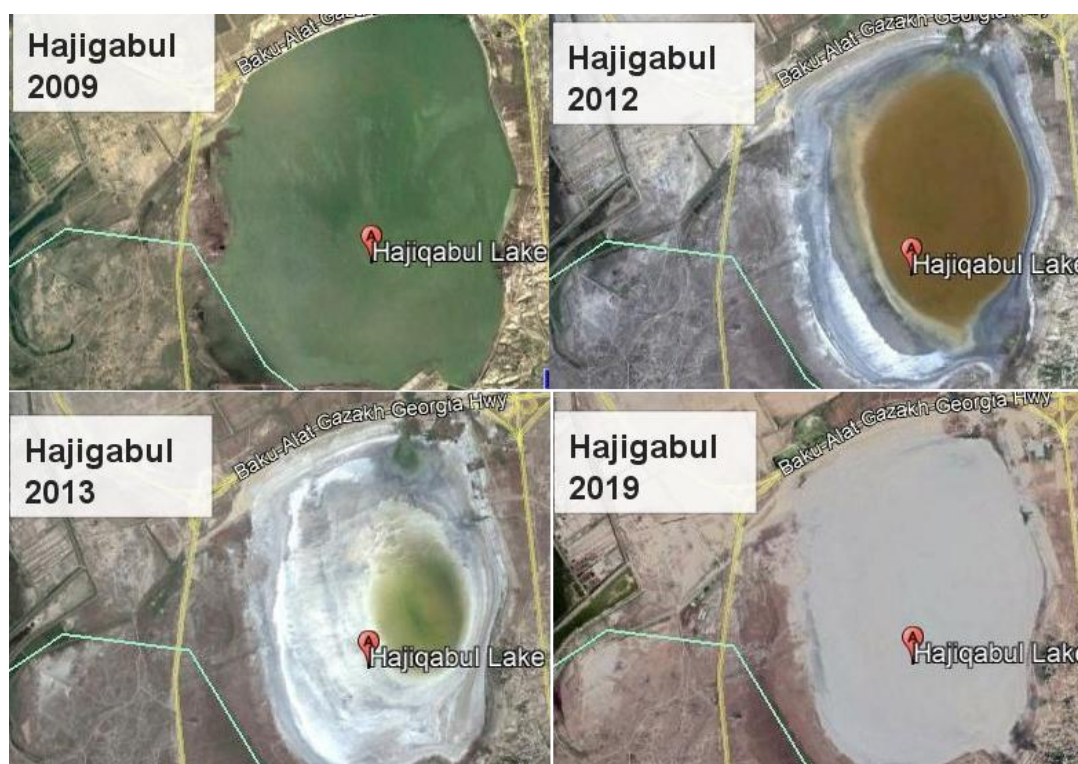
Extinction risk in birds is higher than previously known (Monroe *et al.*, 2019). Data from IUCN (2019) shows that 14% of bird species are globally threatened. The most likely causes of decline of bird species are overhunting, effects of introduced species on native ones, habitat destruction and climate change (Diamond, 1989). Many bird species are migratory. Hunting of these birds, especially waterfowl such as ducks and geese is a popular recreational activity in many parts of the world because they are distributed worldwide. But factors abovementioned caused rapid decline in waterbird diversity as well and therefore conservation attempts to save them have received increasing attention recently (Wang *et al.*, 2018). *Anseriformes* (order of ducks, geese and swans) are especially vulnerable to these changes and some of them such as marbled teal, velvet scoter, white-headed duck species are already on the brink of extinction. This study focuses on white-headed duck species.

White headed duck is included in Red Book of Azerbaijan. The male has white head as the name suggests, blue bill and half-grey half-red plumage, female on the other hand has a dark bill and dull colours. Number of mature individuals range between 5, 300 and 8,700 (IUCN, 2019). The geographic distribution of the species includes Middle East, Caucasus, Eastern Europe, Central Asia, Southern Russia, Northern India and China (Birdlife International, 2020). There is a small population of it in Spain.

Conservation status of white-headed duck is *Endangered*. Habitat type of the species is *inland wetland*. Major threats to *Oxyura leucocephala* are drought, hunting, fishing, pollution which cause habitat loss and spread of ruddy duck- *Oxyura jamaicensis* which can compete or hybridise with them (Hughes 1991, Arenas & Torres 1992, Green & Anstey 1992, Pintos & Rodríguez de los Santos 1992, Anon. 1993, ICONA 1993, Rose 1993, Torres *et al.*, 1994a,b). All these combined resulted in a decrease in the current population trend.

Azerbaijan is very important place in terms of birds and the avifauna of Azerbaijan includes 394 species (CBD 6th report - Azerbaijan, 2019). Many waterfowl species winter here, including white-headed ducks and in the study, I aim to investigate some of the wintering sites of this species and factors influencing their abundance. In 1991, peak winter count for *Oxyura leucocephala* in Azerbaijan was 3,620 (Green & Hughes, 1996).

Environmental conditions change rapidly in Azerbaijan. Compared to base-line temperature and precipitation (1961-1990) annual temperature increased by 2.1° C whereas annual precipitation decreased by 88.1 mm (Statistical Committee of Azerbaijan, 2019). The result of these changes could be seen in Figure 1- lake Hajigabul which was the wintering site of white-headed ducks but it completely dried out. Another wintering site - Red lake, on the other hand is transformed. Figure 2 - illustrates this point clearly.



**Figure 1.** Dried lake-Hajigabul. From left to right - 2009, 2012, 2013 and 2019.  
Latitude - 39°59'34.46"N, Longitude - 48°55'35.37"E  
(Google Earth Pro, historical images)

Hajigabul lake is located in Hajigabul district, near Shirvan town. *Oxyura leucocephala* was observed in this site previously (Cranswick *et al.*, 1998). Area of the

study area is 8000 hectares and the most recent IBA monitoring assessment was in 2013 by Bird Life International in which threat score was *very high* and the condition was *very unfavorable*.



**Figure 2.** Transformation of Gyrgyzgol (Ozero Krasnoye – Red Lake).

From left to right - 2007, 2008 and 2016. Latitude - 40°17'56.10"N, Longitude - 49°44'10.81"E

Gyrgyzgol (Ozero Krasnoye in Russian) is located in the southwest, in Garadagh district. It is also known as ‘Bloody lake’. This is the place where Tennhardt & Kovalev (2001) found 250 white headed ducks.

**Table 2.** Population size of white-headed duck in four sites in Azerbaijan (Sultanov, 2016)

The site	Counts in 1996-2015		Trends
	min	max	
Aggol	2250	3000	Stable
Gyzylagach	520-1840	1840	Stable
Hajigabul	600-250-5-0	1000	Disappearance after 2006
Gyrgyzgol (Red lake)	200-31-0	800	Disappearance after 2008

The number of white-headed duck species fluctuated over years. The species slowly disappeared from Hajigabul and Gyrgyzgol (Ozero Krasnoye) whereas the populations in Aggol and Gyzylagach remained stable.



**Figure 3.** White-headed duck in Zabrat lake (Author A.Abbasov)

Zabrat lake is a contaminated saline waterbody. The pollution mainly originates from VOCs (Toxic Site Identification Program in Azerbaijan, 2018).

## 2. Methodology

To determine environmental stress factors for white-headed duck, Bayesian Belief Network (Netica modelling platform from Norsys) was used. Netica is a powerful and easy-to-use program for working with belief networks (NORSYS.COM). In our belief network, the probabilities were assigned to factors which have influences on the abundance of white-headed duck species and they are shown as nodes. The *nature* node type was selected for the net, which means that variables cannot be controlled by the decision maker and they are determined by nature. There are 2 variable types (*Discrete* – meaning representing finite number of values and *Continuous* – representing infinite number of values) in the program. The model developed has 6 *nature* nodes with *discrete* variables and the nodes are linked together to form a Bayesian net. The nodes have names, which are defined as:

1. **Spread of Ruddy duck** – Binary node with states severe where the population of white-headed duck is severely affected by the spread of ruddy duck and mild in which the effect of ruddy duck invasiveness isn't high enough to deteriorate the situation in white-headed duck population.
2. **Protection:** This node indicates whether protection measures exist or not. It is a binary node where protected sites are shown as 'Yes' and unprotected sites as 'No'.
3. **Drought:** Forecasting the precipitation and the temperature. Depending on the location and the year, this node is shown with two states (More and Less) with respect to base-level air temperature and precipitation in Azerbaijan (1961-1990).
4. **Pollution:** This node contains the assessment of pollution level with Yes – indicating the existence of significant pollutants, and No – 'no pollutants' states.

5. **Hunting:** This node also contains the assessment whether the hunting activities exist or not. They are shown as ‘Yes’ and ‘No’.
6. **Fishing:** Binary node, indicating existence or non-existence of fishing activities. Pollution, Hunting and Fishing are shown as anthropogenic pressures.

### 3. Results

Netica model shown in Figure 4 shows that the strongest negative factor for white-headed duck population in Azerbaijan is drought (65.4%) – which causes habitat degradation. All these effects combined indicate that, in current situation there’s 52.2% chance that the population of white headed duck will decrease in the near future. Spread of ruddy duck causes almost no harm (90.2% mild) for white-headed ducks. Protection measures are still not enough (55.5%) and illegal hunting continues to occur (19.7%).

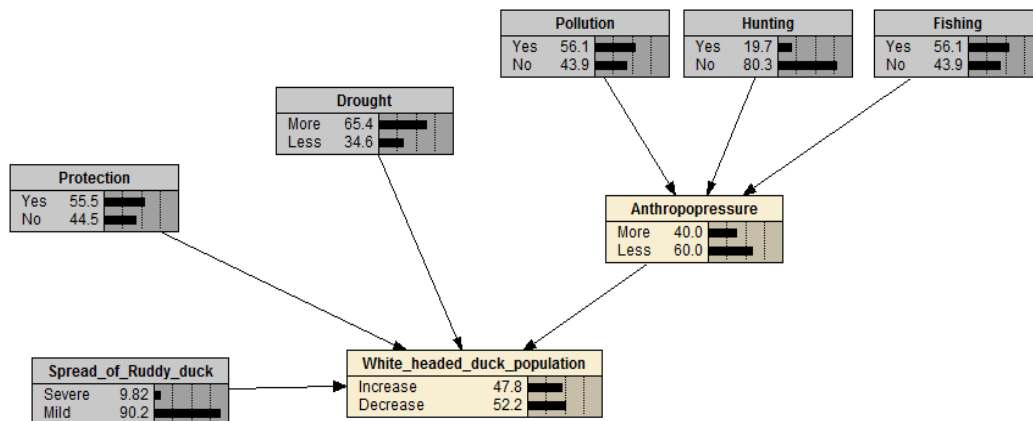


Figure 4. Netica model from Norsys for white-headed duck population

Node:

Chance:  % Probability:

Buttons: Apply, OK, Reset, Close

Spread_of_Ruddy_duck	Anthropopressure	Drought	Protection	Increase	Decrease
Severe	More	More	Yes	10	90
Severe	More	More	No	6	94
Severe	More	Less	Yes	12	88
Severe	More	Less	No	8	92
Severe	Less	More	Yes	15	85
Severe	Less	More	No	20	80
Severe	Less	Less	Yes	51	49
Severe	Less	Less	No	22	78
Mild	More	More	Yes	50	50
Mild	More	More	No	25	75
Mild	More	Less	Yes	75	25
Mild	More	Less	No	30	70
Mild	Less	More	Yes	60	40
Mild	Less	More	No	38	62
Mild	Less	Less	Yes	77	23
Mild	Less	Less	No	51	49

Figure 5. Table for Netica model

#### 4. Discussions

The primary purpose of the study is to determine the likelihood that how the contributing factors will change the population size of *Oxyura leucocephala*– white-headed duck species in the near future. Annual temperature in Azerbaijan increased slightly, whereas precipitation slowly decreased compared to previous decades. High temperature and low precipitation, which result in drought are anticipated to increase and they are the major threats to *Oxyura leucocephala*. Despite ample evidence for invasiveness of ruddy duck for white-headed ducks, the model does not show it as the main negative factor due to the lack of data related to ruddy duck populations in Azerbaijan. However, new findings could change this. The protection measures to safeguard white-headed ducks could lower the risk of rapid decline but they still are not enough. The meat and the eggs of white-headed duck are still consumed by people, despite its *Endangered* status. Besides these, there are too many random variables that might have the effect on abundance of this species, such as outside noises, construction (in the case of Qyrmyzygol) and so on. However, adding those variables to the model will hardly make any difference to the final result.

It should be also mentioned that, in some other countries like United States– ‘Estimates of tidal-marsh bird densities using Bayesian networks’ (Wiest *et al.*, 2018) or Australia - Bayesian Networks and Adaptive Management of Wildlife Habitat (Howes *et al.*, 2010) for instance, similar studies for avian species have already been done. But for Azerbaijan and white-headed duck species, so far – not.

Great efforts are needed to ensure the protection of *Oxyura leucocephala* in Azerbaijan.

Protected areas are a key component in biodiversity conservation strategies (Nord *et al.*, 2019). Therefore, the wetland restoration projects, strict protection of key sites where white-headed ducks winter and cracking down on all types of hunting activities could improve the living conditions of this species.

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