TÜBİTAK

Turkish Journal of Zoology

http://journals.tubitak.gov.tr/zoology/

Research Article

Turk J Zool
(2014) 38: 538-543
© TÜBİTAK
doi:10.3906/zoo-1304-39

Time-activity budgets of wintering Ferruginous Duck, *Aythya nyroca*, at Gajoldoba wetland, Jalpaiguri, India

Tanmay DATTA*
Department of Zoology, Ananda Chandra College, Jalpaiguri, India

Received: 24.04.2013 • **Accepted:** 16.02.2014 • **Published Online:** 14.07.2014 • **Printed:** 13.08.2014

Abstract: Results indicate resting as the main diurnal activity of *Aythya nyroca*, whereas feeding dominated during the night. Other than resting (56.3%), feeding (16.8%) and swimming (15.2%) were major activities of the diurnal time-activity budget, whereas preening (9.4%) and flying (2.3%) were less frequent and occupied a secondary rank. Feeding and swimming were prevalent during the morning and afternoon hours. During midday, most of the ducks indulged in resting. The small amount of time spent on diurnal feeding was compensated by voracious nocturnal feeding (64.6%), which peaked in the middle of the night. Human interference plays an important role in shaping the diurnal time-activity budget. Ferruginous Ducks used the Gajoldoba wetland for foraging and roosting both day and night all through the wintering cycle, which proves that the Gajoldoba wetland is a stable wintering ground for Ferruginous Ducks.

Key words: Ferruginous Duck, time-activity budget, Gajoldoba, wintering ground

1. Introduction

The Ferruginous Duck, *Aythya nyroca*, is a shy and secretive diving duck widely distributed in Asia, Africa, and Europe. Ferruginous Duck is a winter visitor to the Indian subcontinent and has been facing a variety of human-induced disturbances to its population for a long time (Islam, 2003). From the second half of the 20th century its population has undergone a global, large, long-term decline, mainly due to habitat loss and hunting (BirdLife International, 2001). Not only listed as 'Near Threatened' on the IUCN Red List, *Aythya nyroca* has also been presented as a priority species in 4 prominent international conservation treaties: the European Union Bird Directive, the Bern Convention, the Bonn Convention, and the African-Eurasian Migratory Waterbird Agreement (Robinson and Hughes, 2003). Understanding the gravity of the situation, BirdLife International and the Wildfowl & Wetlands Trust jointly adopted an 'International Single Species Action Plan for the Conservation of the Ferruginous Duck' in 2006 and the action plan will be revised in 2015. However, it is very difficult to take effective conservation measures unless adequate data on the ecology of the species are available (Petkov, 2003; Robinson, 2003). Studies in this area are very few in number (Azafzaf, 2003; Robinson and Hughes, 2003; Muzaffar, 2004; Houhamdi and Samraoui, 2008; Aissaoui et al., 2011) and, more particularly, such studies from India have not been reported so far.

From an animal's time-activity budget, we can learn more about its individual physical condition, social structure, and environmental conditions (Paulus, 1988). Time-activity budgets have been used extensively to provide valuable information on duck habitat use and wintering strategies (Paulus, 1988; Aissaoui et al., 2011). Patterns of daily activity and behavior can vary widely between species and these activity budgets help us to study the life history and ecological adaptations of birds (Hamilton et al., 2002). The amount of time allocated to various behaviors is therefore critical in understanding the ecological needs of the species and the pressures acting upon individuals. The objective of this study was to quantify the time-activity budgets of wintering Ferruginous Duck at the Gajoldoba wetland, Jalpaiguri, India.

2. Materials and method

2.1. Study area

The Gajoldoba wetland (26.763897°N, 88.597498°E) is a barrage-side wetland situated on the left side of the Teesta River in the Jalpaiguri district of West Bengal, India. With an area of about 148 ha, this wetland is a regular wintering ground for 33 winter migrants, Anatidae (17 species) being the major group. About 50% of the Gajoldoba wetland is open water and the rest is covered with floating vegetation including *Eichhornia crassipes*, *Trapa natans*, *Wolffia arrhiza*, *Nymphaea odorata*, *Nymphaea pubescens*,

* Correspondence: tdatta1963@gmail.com

Nymphoides cristatum, *Jussiaea repens*, *Neptunia natans*, and *Hygrophila polysperma*. However, infestation of thick floating vegetation (dominated by *Eichhornia crassipes*) is restricted to only about 20% of the area. Among suspended and submerged vegetation, *Ceratophyllum demersum*, *Utricularia flexuosa*, *Hydrilla verticillata*, and *Vallisneria spiralis* are notable. Prominent emergent hydrophytes are *Ammania baccifera*, *Cyperus corymbosus*, *Cyperus cephalotes*, *Limnophila indica*, *Scirpus articulatus*, *Potamogeton nodosus*, and *Potamogeton pectinatus*. *Typha latifolia* is also a dominant species of this wetland and was found mostly on the elevated portion of the wetland.

2.2. Recording bird activities

Observations were made from a particular vantage point during the period between October 2010 and February 2013. During this study period, a total of 56 days between October and February were used for diurnal observations and only 2 nights (during a full moon) were used for nocturnal observations. A Nikon 20 × 82 Fieldscope and a pair of 10 × 50 binoculars were used for all types of observations and the duration of activity was measured with a stopwatch.

Time-activity budgets were quantified weekly using a scanned-sample approach (Altmann, 1974; Baldassarre et al., 1988; Losito et al., 1989) over winter cycles. The instantaneous behavior was recorded in half-hour intervals between 0600 and 1800 hours for diurnal observations and between 1800 and 0600 hours for nocturnal observations. Furthermore, a randomly selected focal duck (Altmann, 1974) was followed for 10 consecutive minutes and its 5 types of behavior, resting (inactive with eyes open, or sleeping), feeding (including dabbling, up-ending, and diving), preening (including scratching and splash-bathing), swimming, and flying, were recorded carefully. A minimum of 10 birds were monitored weekly with care taken not to sample the same bird repeatedly. For analysis, data were pooled into 2-h blocks beginning at 0600 hours and ending at 1800 hours.

2.3. Statistical analyses

A comparison of the magnitude of each activity between years (among particular dates and time blocks) was made using t-tests, and one-way ANOVA was used to compare each activity among time blocks. For computation and analysis, SPSS was used, and results of those analyses were interpreted using standard statistical procedures.

3. Results

During the 3-year period of this study, the first Ferruginous Duck was spotted once in 2012 in the last week of September and on 2 other occasions during the second week of October. They were regularly seen during the wintering season, mostly in those parts of the wetland where human disturbance was minimal, where the depth of water was not more than 90 cm, and where dense littoral vegetation was abundant. After February, Ferruginous Ducks usually leave this wetland and no Ferruginous Ducks were spotted after the middle of March. Although thousands of different winter migrants visit this wetland every year, during this study period, the highest number of Ferruginous Ducks recorded was only 158.

Resting was the main diurnal activity (56.3%) of the Ferruginous Duck and that did not vary between years ($P > 0.05$), but it significantly varied ($F_{5,48} = 1510.7$; $P < 0.001$) among time blocks (Table 1) with more time spent at rest (mostly sleeping) during the midday hours. The Ferruginous Duck spent an average of 16.8% diurnal time on feeding and that did not vary between years ($P > 0.05$). However, feeding activity was intense (approximately 38%) at the onset of the wintering season, and within 2 weeks it suddenly dropped to about 25%. It then gradually decreased to the lowest level of around 11% during January, and again increased considerably (to about 16%) after the first week of February (Figure 1). Hourly time-budget monitoring from 0600 hours to 1800 hours revealed that feeding activity significantly varied ($F_{5,48} = 673.02$; $P < 0.001$) among time blocks and was higher in the morning and evening hours compared to the middle of the day (Table). Swimming was also a major diurnal activity (15.2%) and

Table. Mean percentage of diurnal time spent in various activities by the Ferruginous Duck in different time blocks.

	0600–0800 hours	0800–1000 hours	1000–1200 hours	1200–1400 hours	1400–1600 hours	1600–1800 hours	Overall
Feeding	33.5	20.2	6.8	3.5	12.6	24.4	16.8
Resting	29.1	40.1	78.6	87.4	63.7	38.7	56.3
Swimming	22.2	20.5	11.3	5.7	14.9	16.6	15.2
Preening	13.4	15.3	2.2	1.8	5.9	17.5	9.4
Flying	1.8	3.9	1.1	1.6	2.9	2.8	2.3

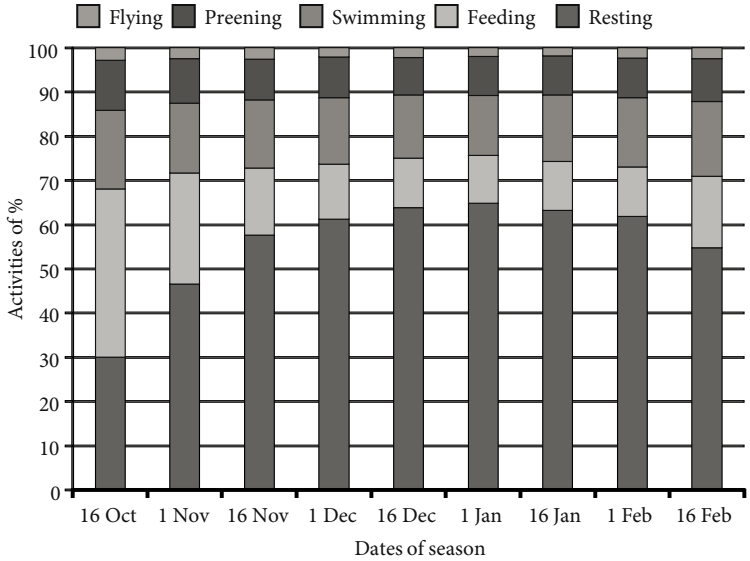

Figure 1. Percentage of time allocated to different activities by Ferruginous Duck at different parts of winter season.

this frequency remained almost unchanged over the years. Like feeding, this activity also gained momentum in the morning and afternoon hours, with lower values during midday (Table). Preening (9.4%) and flying (2.3%) were secondary activities and significantly varied ($F_{5,48}$ = 210.8 and $F_{5,48}$ = 119.25 respectively; $P < 0.001$) among time blocks, with lower values during the midday hours (Table). This activity pattern changed dramatically at night, feeding being the major (64.6%) activity, with swimming (17.6%) and resting (16.3%) coming second and third. Preening (0.4%) and flying (1.1%) were performed at very low rates and these activities were observed mostly at the beginning and at the end of the night (Figure 2).

4. Discussion

The Ferruginous Duck feeds mainly by diving (Green, 1998), but also employs other techniques like up-ending, surface feeding, and even wading in shallow water. Usually this diving duck spends less than 25% of diurnal hours feeding (Petkov, 2003; Muzaffar, 2004; Houhamdi

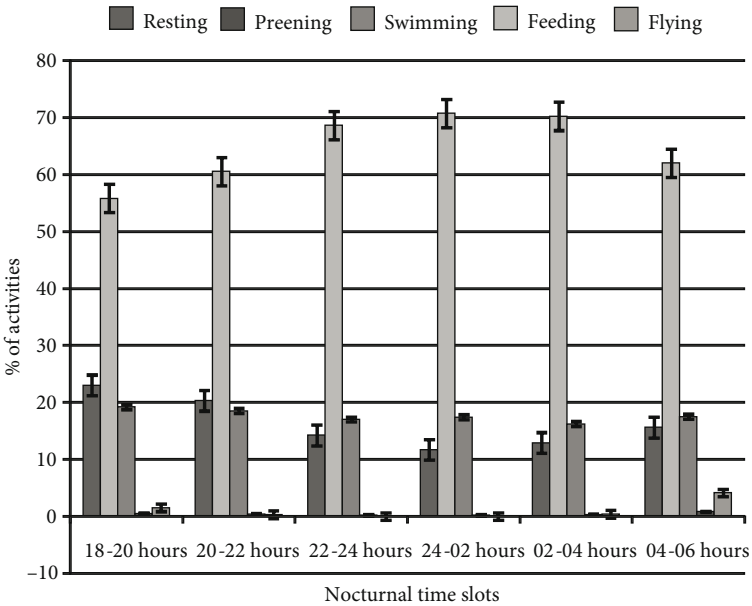

Figure 2. Mean percentage of nocturnal time spent in various activities by the Ferruginous Duck in different time blocks, with standard error bars.

and Samraoui, 2008; Aissaoui et al., 2011). As evident in this study, spending less diurnal time feeding may be a direct attribute of consuming high caloric animal matters (del Hoyo et al., 1992; Poyni, 1994). Foraging in shallow water by diving rather than up-ending or dabbling may also be the result of spending less time feeding. However for feeding, Ferruginous Ducks mainly use night hours, as discussed later. Intense diurnal feeding at the onset of the wintering season may be to compensate for extra energy burned and less time devoted to feeding during migration. Ferruginous Ducks first devoted their time to increasing energy and then adapted their behavior to minimize their energy expenditure during the coldest part of the wintering season (Houhamdi and Samraoui, 2008). Similarly, increased time devoted to diurnal feeding at the end of the wintering season may be in preparation for premigratory fattening (Paulus, 1988).

The Ferruginous Duck had bimodal feeding patterns: once during the morning (0600 to 0900 hours) and again during the evening (1600 to 1800 hours). Many ducks, including the Ferruginous Duck, are known to exhibit feeding maxima early in the morning and late in the evening (Rodway, 1998; Aissaoui et al., 2011). Ferruginous Ducks prefer to forage at night and continue feeding diurnally. The diurnal feeding maxima at the beginning and the end of the day is probably the continuation of the night feeding activity that compensates an for increased thermoregulatory energy requirement due to food availability and quality. Previous studies of the time budgets of wintering waterfowl (Jeske and Percival, 1995; Houhamdi and Samraoui, 2003; Aissaoui et al., 2011) have revealed a similar pattern of feeding, with the waterfowl dedicating a sizeable part of the daytime to this activity.

Resting, being the main diurnal activity accounting for more than half (56.3%) of the time budget, displayed an inverse relationship to feeding, with lower values at the 2 ends of the wintering season (Figure 1). This inverse relationship can be viewed as an 'energy relationship' where ducks first devoted their time to gaining energy and then adapted their behavior to minimize their energy expenditure during the coldest part of the wintering season (Tucakov, 2005; Aissaoui et al., 2011). Diurnal rest represents, on one hand, the best way to restore management and valorization of the essential energy reserves during migratory flights (Rave and Baldassarre, 1989), and, on the other hand, ensures a successful breeding next time (Hill and Ellis, 1984; Hohman and Rave, 1990; Green et al., 1999). Resting also exhibited bimodal patterns with lower percentages at the start and the end of the day (Table). Maximum increases in values of mean time percentage allocated to sleeping were recorded at midday, at a rate that remained more or less stable from 1000 to 1600 hours (Table), representing two-thirds of the total time budget.

Swimming is a major activity of most diving ducks. In this case, it ranked third, at an average of 15.2%. Swimming, as is the case with all Anatidae, is a main activity closely associated with feeding due to the fact that the individuals often feed while moving (Houhamdi and Samraoui, 2008). Prevalence of this activity is observed especially at the onset and at the end of the wintering season. The first period (onset of wintering) represents an effective and rapid means to recover and restore the energy used during migratory flights. By the end of the wintering season, they again become gregarious, preparing for a premarital migration, expressed by displacements and high agitation. As expected, maximum mean time percentage allocated to this activity was recorded between 0600 and 0800 hours (about 22%) and in the late afternoon (1600 to 1800 hours), whereas the midday was characterized by a decrease in the number of ducks (about 10%) devoted to swimming (Table). Indeed, this represents a secondary means of removal of the ducks from the wetland to avoid human interferences.

Preening was a secondary activity and time allocated to preening did not vary significantly ($P > 0.05$) between years. The Ferruginous Duck devoted relatively more time to this comfort activity at the beginning and at the end of the wintering season (Figure 1). After a long migratory journey, ducks need not only more comfort, but also need to replace and rearrange damaged feathers. Similarly, before returning, migrating birds need preparation, which also includes a final polishing-up in the form of preening. Preening activities varied among the daytime blocks ($P < 0.05$) and the highest values were recorded during the morning and late afternoon hours (Table).

Flying occupied also a small proportion (2.3%) of the time-activity budgets of the Ferruginous Duck. Flying, mainly caused by disturbance, also allowed for the rearrangement of the group. Average time spent in flight varied significantly ($P < 0.05$) among the years with higher values in 2010–11 (about 3.9%). This deviation was possibly due to more human interference in 2010–11 in comparison to 2011–12 and 2012–13. Although no substantial data are available in support of this view, human interference (mainly in form of tourists) has definitely decreased in the last 2 years due to some stringent actions taken by the Gajoldoba barrage authority. Generally, flight occurs due to many factors of disturbance, such as the approach of fishing boats and over-flight of raptors like the Eastern Marsh Harrier (*Circus spilonotus*) and the Peregrine Falcon (*Falco peregrinus*). A slight rise in flying activities was also recorded at the beginning of the winter period due to the disturbances caused by the arrival of the first wintering birds. However, natural disturbances were not the most important factor when compared to human activities ($P < 0.05$). The Ferruginous Ducks were forced to

fly away when the fishing boats approached closer than 30 m to the large flocks.

From only 2 nights of observations, it appears that Ferruginous Ducks do not leave the site at night. However, a distinct shift in activity patterns was observed at night, with feeding being a major activity (64.6 %), as was evident in many other studies (Tamisier, 1974; Houhamdi and Samraoui, 2008). Nocturnal feeding gradually increased from dusk to the middle of the night and then the intensity slowly dropped as dawn approached (Figure 2). The intensity of swimming was relatively unchanged (about 18%) during the night cycle. Similarly to what had been found for diurnal activities, resting was inversely related to feeding and reached its lowest values in the middle of the night. Nocturnal flights were rare, only noticeable prior to sunrise. Preening at night was also of a lower magnitude and occurred at all hours with almost the same intensity (Figure 2).

Ferruginous Ducks utilized the night hours mostly for feeding and continued diurnal feeding in order to meet heavy energy requirements not entirely met by nocturnal feeding. Why many species of waterfowl feed mainly at night is still unclear. Various explanations including avoidance of diurnal predators, food availability and the need to visually select food, and thermoregulation have been put forward (Jorde and Owen, 1988; McNeil et al., 1992; Green, et al., 1999). An otherwise nocturnal feeder, the Ferruginous Duck in the Gajoldoba wetland spent a considerable amount of diurnal time feeding, which indicates less human interference in the area. A smaller amount of flying activity was also indicative of less human interference. In all 3 years, Ferruginous Ducks were present in the Gajoldoba wetland from the onset of the wintering season up to the end of the season. Ducks were found to use this wetland even at night as a foraging ground, although the species is known to disperse around wetlands, often feeding on crops at night (Ali and Ripley, 1978). All these findings point to the fact that the Gajoldoba wetland is a safe and supportive wintering ground for Ferruginous Ducks and the authorities should take care of it. However, further surveys are needed in order to assess the availability of trophic resources and their direct relationship and influence on feeding strategies in order to define the carrying capacities of this wetland.

Acknowledgments

The author is grateful to Mr Santanu Ghosh Dastidar for his active cooperation and assistance in data collection and fieldwork and would also like to thank the local people around Gajoldoba for their information and assistance, which greatly helped this study's success.

References

Aissaoui R, Tahar A, Saheb M, Guergueb L, Houhamdi M (2011). Diurnal behaviour of Ferruginous Duck *Aythya nyroca* wintering at the El-Kala wetlands (Northeast Algeria). Bulletin de l'Institut Scientifique, Rabat, section Sciences de la Vie 33: 67–75.

Ali S, Ripley SD (1978). Handbook of the Birds of India and Pakistan: Together with those of Bangladesh, Nepal, Bhutan and Sri Lanka. Delhi, India: Oxford University Press.

Altmann J (1974). Observational study of behaviour: sampling methods. Behaviour 49: 227–267.

Azafzaf H (2003). The Ferruginous Duck in Tunisia. In: Petkov N, Hughes B, Gallo-Orsi U, editors. Ferruginous Duck: From Research to Conservation. Sofia, Bulgaria: Birdlife International, RSPB, and TWSG, pp. 84–87.

Baldassarre GA, Paulus SL, Tamisier A, Titman DRD (1988). Workshop summary techniques for timing activity of wintering waterfowl. In: Weller MW, editor. Waterfowl in Winter. Minneapolis, MN, USA: University of Minnesota Press, p. 23.

BirdLife International (2001). Threatened Birds of Asia: The BirdLife International Red Data Book. Cambridge, UK: BirdLife International.

del Hoyo J, Elliot A, Sargatal J (1992). Handbook of the Birds of the World, Volume 1: Ostrich to Ducks. Barcelona, Spain: Lynx Edicions.

Green AJ (1998). Habitat selection by the Marbled Teal *Marmaronetta angustirostris*, Ferruginous duck *Aythya nyroca* and other ducks in the Göksu Delta, Turkey, in summer. Revue Ecologie (Terre and Vie) 53: 225–243.

Green AJ, Fox AD, Hughes B, Hilton GM (1999). Time-activity budgets and site selection of White-headed Ducks *Oxyura leucocephala* at Burdur Lake, Turkey in late winter. Bird Study 46: 62–73.

Hamilton AJ, Taylor IR, Hepworth G (2002). Activity budgets of waterfowl (Anatidae) on a waste-stabilization pond. Emu 102: 171–179.

Hill DA, Ellis N (1984). Survival and age related changes in the foraging behaviour and time budget of Tufted Ducklings *Aythya fuligula*. Ibis 126: 544–550.

Hohman WL, Rave DP (1990). Diurnal time activity budgets of wintering canvasbacks in Louisiana. Wilson Bull 102: 645–654.

Houhamdi M, Samraoui B (2003). Diurnal behaviour of wintering Wigeon *Anas penelope* at Lac des Oiseaux, northeast Algeria. Wildfowl 54: 51–62.

Houhamdi M, Samraoui B (2008). Diurnal and nocturnal behavior of Ferruginous Duck *Aythya nyroca* at Lac Des Oiseaux, Northern Algeria. Ardeola 55: 59–69.

Islam ZU (2003). Ferruginous Duck in India. In: Petkov N, Hughes B, Gallo-Orsi U, editors. Ferruginous Duck: From Research to Conservation. Sofia, Bulgaria: Birdlife International, RSPB, and TWSG, pp. 104–113.

Jeske CW, Percival HF (1995). Time and energy budgets of wintering Ring-necked Ducks *Aythya collaris* in Florida, USA. Wildfowl 46:109–118.

Jorde DG, Owen RB (1988). The need for nocturnal activity and energy budgets of waterfowl. In: Weller MW, editor. Waterfowl in Winter. Minneapolis, MN, USA: University of Minnesota Press, pp. 169–180.

Losito MP, Mirarchi E, Baldassarre GA (1989). New techniques for time activity studies of avian flocks in view-restricted habitats. J Field Ornithol 60: 388–396.

McNeil R, Drapeau P, Goss-Custard JD (1992). The occurrence and adaptive significance of nocturnal habits in waterfowl. Biol Review 67: 381–419.

Muzaffar SB (2004). Diurnal time-activity budgets in wintering Ferruginous Pochard *Aythya nyroca* in Tanguar Haor, Bangladesh. Forktail 20: 17–19.

Paulus SL (1988). Time-activity budgets of nonbreeding Anatidae: a review. In: Weller MW, editor. Waterfowl in Winter. Minneapolis, MN, USA: University of Minnesota Press, pp. 135–152.

Petkov N (2003). Ferruginous Duck habitat characteristics and daily activity rhythm in Bulgaria. In: Petkov N, Hughes B, Galb-Orsi U, editors. Ferrugionous Duck: From Research to Conservation. Sofia, Bulgaria: Birdlife International, BSPB, and TWSG, pp. 122–130.

Poyni JE (1994). Abundance and feeding of wintering and migrating aquatic birds in two sampling areas of Lake Balaton in 1983–1985. Hydrobiologia 279: 63–69.

Rave DP, Baldassarre GA (1989). Activity budget of Green-Winged Teal wintering in costal wetlands of Louisiana. J Wild Management 53: 753–759.

Robinson JA (2003). A global overview of the ecology of the Ferruginous Duck. In: Petkov N, Hughes B, Gallo-Orsi U, editors. Ferruginous Duck: From Research to Conservation. Sofia, Bulgaria: Birdlife International, BSPB, and TWSG, pp. 114–121.

Robinson JA, Hughes B (2003). The global status and distribution of the Ferruginous Duck. In: Petkov N, Hughes B, Gallo-Orsi U, editors. Ferruginous Duck: From Research to Conservation. Sofia, Bulgaria: Birdlife International, BSPB, and TWSG, pp. 8–17.

Rodway MS (1998). Activity patterns, diet and feeding efficiency of Harlequin Ducks breeding in northern Labrador. Cana J Zool 76: 902–909.

Tamisier A (1974). Etho-ecological studies of teal wintering in the Camargue (Rhone Delta, France). Wildfowl 25: 107–117.

Tucakov M (2005). Migration of common pochard *Aythya ferina* and ferruginous duck *Aythya nyroca* on Kolut Fishpond (Northern Serbia). Aquila 112: 15–22.