

Season-dependent reproductive performance in a non-seasonally breeding diurnal species, the zebra finch (*Taeniopygia guttata*)

Nidhi Yadav^{1,2}, Mayank Kumar¹, Vatsala Tripathi^{1,3} and Sanjay Kumar Bhardwaj^{1,*}

¹Department of Zoology, Chaudhary Charan Singh University, Meerut 250 004, India

²Department of Zoology, Maharaj Singh College, Saharanpur 247 001, India

³Department of Zoology, Dyal Singh College, University of Delhi, Delhi 110 003, India

The reproduction and its associated behaviour in a non-seasonal species are considered totally independent of seasons. To assess this, we examined seasonal differences in the nest building and reproductive performance in diurnal zebra finches that were hatched and raised in outdoor aviaries. Adult male and female birds were separately housed in cages equipped with two perches stacked in a large aviary, receiving the natural day length (NDL) and temperature conditions. Cages housing male birds were also fixed with a nest box. After two weeks of acclimation, the males and females were paired randomly, and the parameters of nest building and reproductive performance, such as the onset of egg laying, clutch size and hatchlings and fledglings per pair, were recorded in the winter (second week of November 2022 to the first week of February 2023), and subsequently similarly in the summer (third week of April 2023 to the first week of July 2023) seasons. The pairs took more time to initiate (mean $\pm$ SE – winter: 2.92 ± 0.58 ; summer: 2.33 ± 0.45) and complete (mean $\pm$ SE – winter: 6.75 ± 0.52 ; summer: 4.50 ± 0.27) the nest in winter, as compared to that in summer. Per pair, the clutch size was significantly smaller in winter (mean $\pm$ SE: 2.2 ± 0.36) than in summer (mean $\pm$ SE: 3.6 ± 0.34), but the hatchlings ($P = 0.2123$) and fledglings ($P = 0.5302$) were not significantly different between the two seasons, perhaps due to higher temperature and dryness in summer. These results indicated an underlying seasonality in zebra finches, which could be economically useful to those engaged in breeding and raising of pet species.

Keywords: Clutch size, nest building, reproduction, seasons, zebra finch.

in which there is a critical timing for the reproduction-associated behaviour, such as the building of the nest⁶, the onset of egg laying⁷, clutch size⁸ and the number of hatchlings and fledglings⁹.

Studies on both seasonal and non-seasonal birds in the wild suggest that reproductive activity is affected by external influences such as weather¹⁰, mate familiarity¹¹, food resources¹² and habitat¹³. Previous studies have also shown that seasons affect the gonad size^{14,15}. The quality and survival of the offspring have been found to be negatively affected by food provisioning in winter¹⁶. This is clearly shown in migratory species, where reproductive behaviour is often timed with other seasonal life history states, like migration that correlate with food supply and climatic conditions. A study on great tits has shown the effects of arrival time at breeding sites on reproductive outcomes¹⁷.

However, the non-seasonal do not restrict their breeding season based on changes in the photoperiod and temperature if other conditions like food availability are optimal. Here, our concern was whether the reproductive performance in a non-seasonal species was totally independent of the seasons. To address this, we found zebra finch (*Taeniopygia guttata*), a native of central Australia, as an ideal species. Zebra finches breed in captivity and closely mimic those found in the wild and can have 3–4 broods even under constant photoperiod and temperature conditions if food availability is adequate^{5,18}. We studied the effect of seasons on reproduction in zebra finches by comparing the reproduction-associate behaviour (e.g. nest building) and reproductive performance (e.g. egg laying onset, and hatchling and fledgling survival) between winter and summer seasons during which the changes in the day length and temperature progress in opposite directions