


# The State of Sombre Tit *Poecile lugubris* Temminck, 1820 in Armenia

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**Abstract** - The Sombre Tit *Poecile lugubris* is very little studied species, and within Armenia, it occurs only in the south-eastern regions of the country. The current study aims at providing data for the next assessment of the conservation status of Sombre Tit in Armenia, based on the data collected from 2003-2019. The obtained data show that Sombre Tits have slightly expanded their distribution to the north; their current Area of Occupancy makes 94 km<sup>2</sup>, while the Extent of Occurrence covers 1,065 km<sup>2</sup>. The population of Sombre Tit makes from 910 to 1,350 breeding pairs. During observed 17 years (2003-2019), the population trend of the species computed for the Meghri region of Armenia can be considered stable (Imputed Overall Slope: *Additive* = 0.0017 ± 0.0109; *Multiplicative* = 1.0017 ± 0.0109; P > 0.05), although demonstrates relatively strong fluctuations. The conservation status of Sombre Tit in Armenia should be revised, as it can correspond to the category Endangered, according to criteria C2a(ii). The main factors that can influence the species in Armenia are forest fires, which are relatively common in south-eastern Armenia, and the use of pesticides for forest pest control.

**Keywords:** Sombre Tit, *Poecile lugubris*, Armenia, Conservation status, Population dynamics, Threats

## INTRODUCTION

Armenia is a landlocked mountainous country with a relatively small area (29,743 km<sup>2</sup>), and an elevation varying from 375 to 4090 m above sea level (a.s.l., Baghdasarian *et al.* 1971). On various elevations, the different climatic conditions determine various landscapes, including semi-desert, Juniper woodland, deciduous forest, mountain steppe, and sub-alpine meadows and carpets (Aghababyan *et al.* 2015). The terrain is rugged and contains many deep canyons, cliffs, and rocky outcrops (Dahl 1954). Among such a variety of landscapes, the Sombre Tit *Poecile lugubris* Temminck, 1820 (Fig. 1) inhabits a narrow belt of woodlands dominated by Juniper *Juniperus poly-*

*carpos*. Before 2015, the species was found only in the extreme southeast of the country, an area with restricted access during the Soviet era, resulting in a scarce number of publications on the species from Armenia until the late 1990s (Leonovich *et al.* 1970). In 1994-1995 the studies of south-eastern regions of Armenia were intensified and the information on the distribution and ecology of Sombre Tit was updated (Adamian & Klem 1999).

The summary of the background information suggests that Armenia is inhabited by *P. l. anatoliae* E. J. O. Hartert, 1905, which has a rather restricted range, being distributed in Southern Greece, Turkey, Western Georgia, Armenia, Northern Iraq and North-west-



**Figure 1.** Sombre Tit *Poecile lugubris*. Photo by I. Ukolov.

ern Iran (Cramp & Perrins 1993, Gosler *et al.* 2019). The breeding distribution of Sombre Tit is not mentioned in the species' geographic range in the most recent IUCN Global Red List (BirdLife International 2017) and IUCN European Red List (BirdLife International 2021).

Just like the other Tit species, the Sombre Tit is a cavity-nesting species, which makes nests in holes in Juniper trees. Its breeding season was documented from early April till late July – early August (Gosler *et al.* 2019), and the clutch usually consists of 4 to 9 eggs, having two broods per year. The species is a resident in the country with slight local movements (Adamian & Klem 1999). In summer the food mainly consists of insects (Adamian & Klem 1999, Leonovich *et al.* 1970).

The species is classified as Least Concern in the IUCN Global Red List having a stable population trend (BirdLife International 2017). However, in the Armenian Red List it is classified as Vulnerable, according to criteria B1ab(iii)+2ab(iii) – Extent of Occurrence is less than 20,000 km<sup>2</sup>, Area of Occupancy is less than 2,000 km<sup>2</sup>, number of locations is less than 10, and continuing decline projected in the quality of habitat; C1a(i), – projected continuing decline of at least 10% in three generations (Aghasyan & Kalashyan

2010). The estimate provided by Burfield & van Bommel (2004) suggests the presence of 400-600 breeding pairs in Armenia, while the estimate conducted for the second issue of the Red Book of Animals of Armenia (2010) suggests the presence of 250-350 breeding pairs. The recent assessment of Sombre Tit (BirdLife International 2015) mentions its population trend as an unknown for Armenia, as well as at the European Scale (BirdLife International 2021).

After more than ten years since the last assessment of Sombre Tit's conservation status in Armenia, it is time to update it, especially considering that the next edition of the national Red Data Book is planned for 2024-2026. Therefore, the main purpose of the current paper is to provide data on the species distribution, abundance, population trend, and possible threats, to inform its conservation status.

## **MATERIALS AND METHODS**

### **Data collection**

The systematic data collection of the species was started in 2003 in the framework of National Bird Monitoring. Following one of the approaches proposed by the European Environment Agency and considering the 10x10 km square as a unit that can show population changes, the standard European Monitoring Grid ETRS89-LAEA 10x10 km (Peifer 2011) was applied to Armenia, and the territory of the republic was divided into 374 squares.

Two major sources provided the data for the current study: (1) unstandardized observations when the data was mostly collected opportunistically by bird-watchers and (2) standardized counts when the data was collected by a standard protocol. For creating distribution maps, we used both data, while for the estimation of population size and population trend, we used only data collected by the second method (Voříšek *et al.* 2008). Unstandardized observations contain minimum data requirements (Aghababyan *et al.* 2015, 2022). Standardized counts were led by specialists and birdwatchers with proper skills. The identification and counting skills were tested by specialists of BirdLinks Armenia NGO, the organization

responsible for National Bird Monitoring. Counts were implemented on the line transects when an observer was walking a predefined route at a slow pace (about 2 km per hour). The transects have a length of one km and a width of 100 m (50 m on each side). The counts were conducted when birds were most active, from 7 am to 11 am, and in the season of active display, between the 20<sup>th</sup> of March and the 30<sup>th</sup> of April. Five line transects were counted once per year, every year from 2003-2019. The transects were located in the Meghri region of Armenia, with an elevation range of 1,050 – 1,500 meters a.s.l. (with an average of 1,210 m) and covering three 10x10 km squares. These three squares were distributed rather evenly, with a mean distance of 6.80 km (from 5.52 to 8.28 km) between the neighbouring transects. It should be mentioned, though, that in the framework of the National Bird Monitoring scheme, elevations below 1,000 and above 1,600 meters have also been surveyed.

The data required for the standardized counts included the code of the route, geographical coordinates of the beginning and the end of the route, start and end times, number of observed or acoustically recorded individuals, and breeding code. Collected data were entered into a standardized protocol and later inputted into the database of National Bird Monitoring, owned by BirdLinks Armenia NGO and available upon request.

### Data analysis

To estimate the population size, we first computed the density of Sombre Tits on the transects by dividing the number of pairs on the area of the route (0.1 km<sup>2</sup>). Then the total population size was computed by extrapolating the density to the Area of occupancy of the Sombre Tit, which was calculated as 94 km<sup>2</sup> (see details below). The population size was taken as the average for the last three years (2017-2019) ± standard error.

To calculate population trends, we used a multi-year data series. We processed them using TRIM 3.0 software (Van Strien *et al.* 2004), via the “time effect”

basic model, which corrects for over-dispersion and serial correlation and estimates trends based on the imputed slope. We calculated a population index using log-linear Poisson regression; the indices were calculated relative to 2003, which was given a value of 100. TRIM also provides an estimate of the overall trend in the form of the mean annual rate of change ( $r$ ) and its associated standard error (SE) across the full span of years (Pannekoek & van Strien 2005). A linear model was used to compute the trend. To assess the nature and direction of the trend, van Strien *et al.* (2004) recommended considering both the magnitude and statistical significance of the trend's slope according to five categories: (i) substantial decline/increase (confidence interval lies below -20% or above 20% respectively in 20 years), (ii) non-substantial decline/increase (confidence interval lies above -20% or below 20% respectively and excludes zero), (iii) decline/increase (confidence interval includes -20% or 20% respectively and excludes zero), (iv) stable (confidence interval lies above -20%, below 20% and includes zero), and (v) poorly known (confidence interval includes both zero and one or both of -20% and 20). The mapping was implemented using ArcGIS 10.0 software (ESRI 2011). The Area of species occupancy (AOO) and extent of species occurrence (EEO) for Sombre Tit were computed using the IUCN guidelines (IUCN Standards and Petitions Committee 2019). To compute the AOO, we summed areas of all the habitats where the Sombre Tits were observed during the breeding season. To compute the EEO, the rule of minimum convex polygons (the smallest polygon in which no internal angle exceeds 180° and which contains all the sites of occurrence) was applied to the species' AOO, excluding discontinuities and disjunctions within the overall distribution inside the borders of the country.

To estimate the existing and potential threats, we have conducted open-ended interviews with local farmers, the staff of the State Inspectorate for Nature Protection and Mineral Resources and the staff of Arevik National Park. The main questions of the interviews with farmers were aimed at identifying the

logging of old Juniper trees, and the main interviews with the staff of the State Inspectorate and the staff of Arevik National Park were aimed at identification of habitat level threats and their drivers. In total, we conducted interviews with 13 farmers from seven settlements in Meghri region, one interview with two inspectors of the State Inspectorate and two interviews with three senior rangers of Arevik National Park. The interviews with the farmers were announced as confidential in advance to reduce possible tension and risk of hiding information.

## RESULTS

### Distribution in Armenia

During 2003-2019 Sombre Tits have been observed in south-eastern regions of Armenia. Until 2015, they

have only been recorded in the Meghri region (the southern face of the Meghri mountains and the eastern face of the Zangezur mountains). Since 2015, the species has been regularly observed in the north (see Fig. 2), in the Voghji River Gorge and Vorotan River Gorge. Although nest searches were not conducted, birds were singing and chasing invaders, demonstrating the protection of their territories.

During the breeding season, Sombre Tits occupied the belt of Juniper woodland (Fig. 3) and the transition zone to deciduous forest, where Junipers form a mixed woodland with oak *Quercus araxina* (Trautv.) Grossh., at the elevation range 1,000-1,600 m a.s.l. The Area of Occupancy (AOO) for Sombre Tit in Armenia is 94 km<sup>2</sup>, while its Extent of Occurrence (EOO) covers 1,065 km<sup>2</sup>. The species was observed making

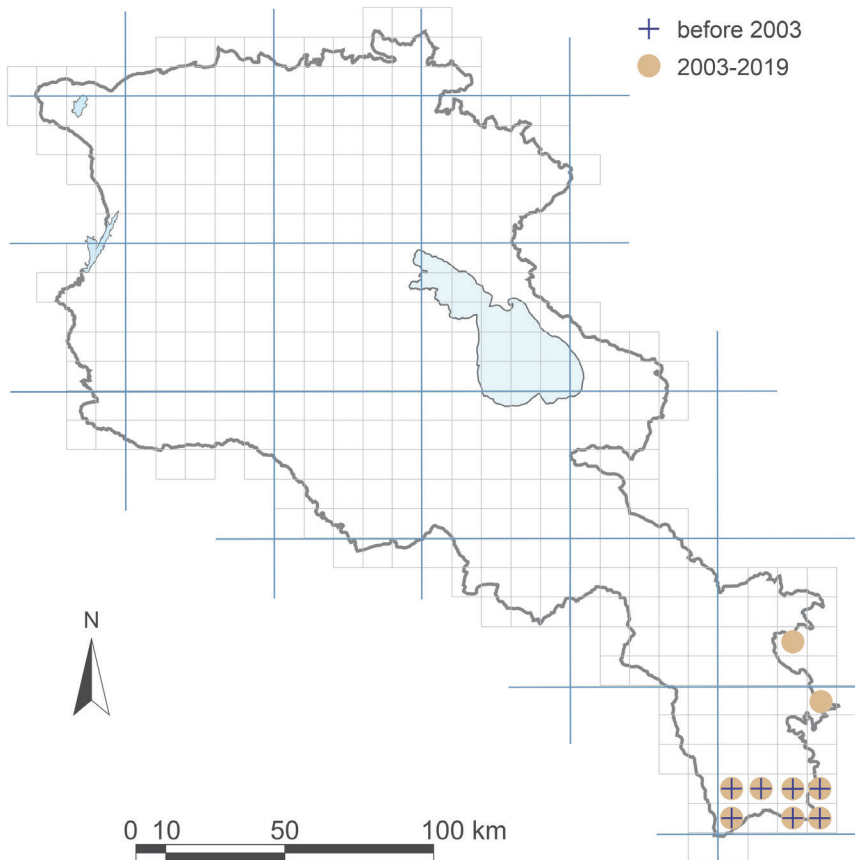


Figure 2. Distribution map of Sombre Tit *Poecile lugubris* in Armenia as of 2019.



nests in Juniper trees (7 nests, 64%), which dominate in the habitat, as well as in willow *Salix* sp. (2 nests, 18%) and poplars *Populus* sp. (1 nest, 9%) available at the riparian zone of juniper woodlands. At the habitat edge, near orchards and villages, one nest (9%) was found in an iron pipe used for orchard fencing.

### Population dynamics

The number of Sombre Tits recorded on each of the five transects between 2003-2019 varied from 0 to 2 pairs. On average ( $\pm$  SE), we recorded  $1.22 \pm 0.22$  pairs per transect, which indicates a density of  $12.19 \pm 2.19$  pairs per km<sup>2</sup>. According to the estimate based on the last three years of data (2017-2019), the Armenian population of Sombre Tits ranges from 910 to 1,350 breeding pairs. During 2003-2019, the species population trend for the Meghri region of Arme-

nia can be considered stable (Imputed Overall Slope: *Additive* =  $0.0017 \pm 0.0109$ ; *Multiplicative* =  $1.0017 \pm 0.0109$ ;  $P > 0.05$ ; Fig. 4), although with relatively strong fluctuations.

### Possible influencing factors

Interviews with farmers show that they do not consider Juniper as a potential fuelwood, but they knew about cases when young Juniper trees were cut by the villagers, as a substitute for the Christmas Tree. They, however, mentioned that after changing the status of the area from Meghri Forestry Enterprise to Arevik National Park in 2009, the protection of Juniper woodlands was significantly improved, and they have never heard about such cases recently.

Interviews with staff of the State Inspectorate and Arevik National Park show that they consider forest



**Figure 3.** Typical habitat of Sombre Tit *Poecile lugubris* in Armenia. Photo by K. Aghababayan.

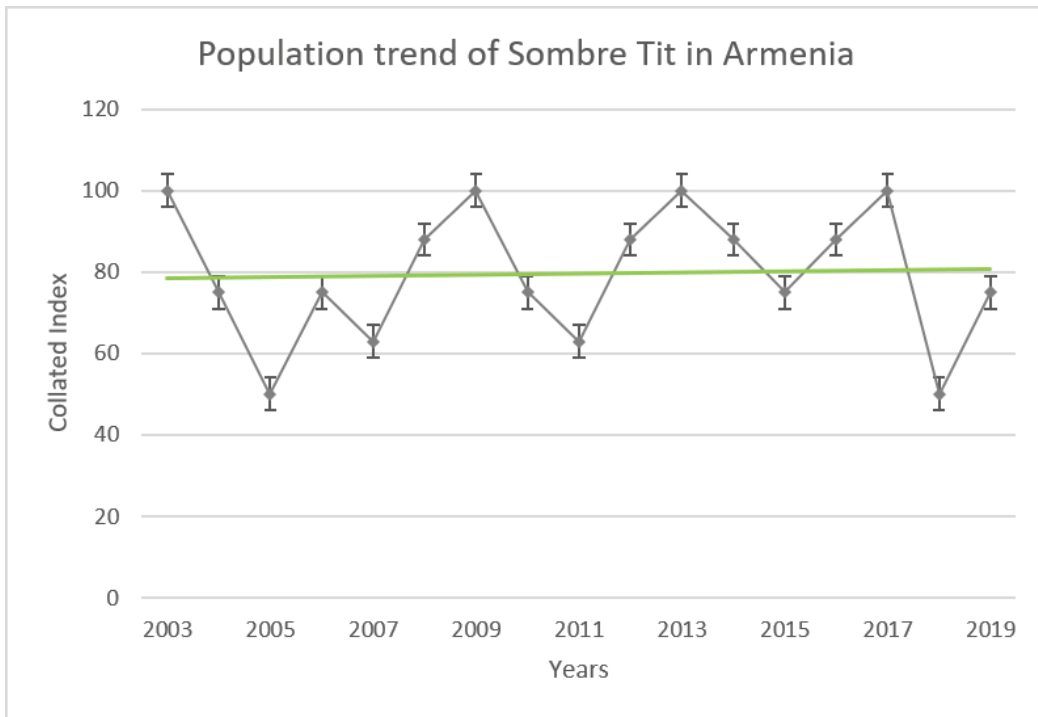


Figure 4. Population trend of Sombre Tit *Poecile lugubris* in Armenia during 2003–2019.

fires as the biggest threat to Juniper woodlands. They have cases of forest fires every 3-4 years, often involving both deciduous forests and Juniper woodlands. According to the interviewed staff, the main causes of the fire are related to inappropriate human behaviour, such as leaving open fires unattended, burning blackberry bushes, and littering the area with glass bottles that act as lenses in the dry period. Also, they informed us that before 2009, Meghri Forestry Enterprise was using pesticides as a treatment method against forest pests; however, after the change of the status into Arevik National Park, the use of pesticides in the forest is prohibited, and the last time the pesticides were used in 2009.

**DISCUSSION**

**Conservation status of the species**

Population trend of the species remains stable within the last three generations of Sombre Tit or 12.6 years (BirdLife International 2017). The projection of the observed population trend to the next period of 12.6

years doesn't reveal a decline either. The EOO of the species is less than 5,000 km<sup>2</sup>, and AOO is less than 500 km<sup>2</sup>, however, the number of locations is greater than 5 (does not fit criteria "a"), and the population doesn't reach the level of extreme fluctuations in the number of mature individuals (does not fit the criteria "c(iv)"), and thus doesn't fully correspond to the category Endangered. From another point, the number of mature individuals in the last three years (2017-2019) ranges from 1,820 to 2,700, averaging 2,260 (so, less than 2,500), while the number of mature individuals in one subpopulation is 95%-100%. Thus, the species can correspond to the category Endangered, according to criteria C2a(ii).

**Distribution and abundance of the species**

The latitudinal distribution of the species was expanded in new areas in the north, in the Voghji River Gorge and Vorotan River Gorge. The expansion of the species range to the north can be caused by climate change, as was shown in several examples within

Armenia (Aghababyan 2024), Great Britain (Gillings *et al.* 2015), Finland (Lehikoinen & Virkkala 2016), North America (Hitch & Leberg 2007), and worldwide (Stewart *et al.* 2022).

According to our data, the species occupies an elevational range from 1,000 to 1,600 m a.s.l., and a comparison with the literature data suggests a possible change in the altitudinal range too. For Armenia, Leonovich *et al.* (1970) mentioned the range from 600 to 1400 m a.s.l., and Adamian & Klem (1999) mentioned the range from 450 to 1450 m a.s.l. The difference in the lower altitudinal limit between our study and these previous studies could be explained by the fact that previous studies do not use exclusively breeding data, as that elevation is occupied by semi-desert, but includes post-fledging and winter movements. The higher elevation in the upper limit of the species in our species could come again as a result of global warming, as it was observed in Armenia for another arid species, Lesser Whitethroat *Curruca curruca* (Aghababyan, unpublished data). Since the species also occupies mixed Juniper-oak woodlands, like in Prespa National Park of Greece (Catsadorakis & Källander 1999), the upper border of its distribution could be shifted into that ecotone.

The specific mechanisms, which cause the movement of the species northwards or higher could be related to the change of some habitat characteristics, as was shown in the study of Sombre Tits' habitat preferences in Bulgaria (Dimitrova *et al.* 2020). Specifically, the study showed that six habitat variables drove Sombre Tits occurrence: tree cover, shrub cover, number of trees along the woodland edge, elevation, solar radiation and woodland edge length. Currently, the specific drivers that can cause a change in the species distribution remain unknown and are the subject of a separate study. Meanwhile, the species seems to partially adapt to human environments, inhabiting the edge of orchards in Armenia (this study), the edge of farmlands in Greece (Catsadorakis & Källander 1999), and orchards in Serbia and Montenegro (Rakovic 2005).

The observed difference in the total number of

breeding pairs between our data and the last Red Book (2010) estimate is due to a rough estimation for the Red Book as the transect data had not yet been processed, while the total population for the current article has been calculated based on counts from 2017-2019. Most probably, the same cause could explain the difference between the estimate of the species population by I. Burfield & F. van Bommel (2004) and the current article.

### **The possible influence of human-induced factors and proposed conservation measures**

As was shown by the interviews, the Juniper woodlands of the Meghri region (over 85% of which belong to the protected area) have been well protected by Arevik National Park since 2010. Before that, the woodlands had been subjected to some human pressure. It never influenced the old Juniper trees, as Junipers have not been used as fuelwood, but, to some extent, it affected the young trees, although their use as Christmas trees was not a common practice. Therefore, the stable population trend of the Sombre Tit can be explained by the relatively low human impact on Juniper woodlands and their protection by Arevik National Park. The strong fluctuations of the species' population, at least until the period of 2009-2011 can potentially be caused by spreading pesticides over the forests, but can also be caused by natural factors, which requires additional study. One of the large-scale threats to the species' habitat appears to be forest fires, relatively common in south-eastern Armenia and mainly due to inappropriate human behaviour in the field, such as unattended fire left after picnics, littered glass bottles that act as lenses in the dry period, and burning of blackberry bushes to clean the areas for horticulture.

Currently, over 80% of the species population is covered by Arevik National Park, which is a part of Zangezur Biosphere Complex, however, there are no other conservation measures in place. Taking into consideration the current and potential threats, the proposed conservation measures should include (1) review of the species conservation status for the

next edition of Red Book of Animals of Armenia; (2) strengthening the capacity of Zangezur Biosphere Complex in rapid response to forest fires; (3) raising awareness of the local communities regarding responsible behaviour to decrease the risk of human-caused fires; (4) cleaning of the major picnic areas from the glass and plastic leftovers, which can start a fire; (5) strengthening the control over burning of the blackberry thickets; (6) review of forestry policy on the use of pesticides to control the forest pests outside the Protected Areas and replacement by other methods of pest management; (7) study of new areas colonized by the species to get a full picture of its distribution, abundance, and threats in the country.

### Acknowledgements

The data collection on the species in Armenia is conducted in frames of National Bird Monitoring and is supported by members of the Armenian Ornithological Society (former Armenian Birdwatching Association). In the period between 2015 to 2017, it was also supported by the European Bird Census Council through a grant from the MAVA Foundation for the European Breeding Bird Atlas - EBBA2 (the grant agreements have not been provided with numbers). The data analysis was supported by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH supported Environmental Programme (grant number 83318294). The administrative support during the study of the species was received from the Arevik National Park and the Ministry of Environment of RA.

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Received: 1 October 2023  
 First response: 2 November 2023  
 Final acceptance: 26 April 2024  
 Published online: 30 April 2024  
 Associate editor: Giulia Masoero