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# DISTRIBUTION OF THE TUMBES TYRANT (*TUMBEZIA SALVINI*) WITH COMMENTS ON MARGINAL RECORDS

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**Abstract ·** We present an updated potential distribution of the Tumbes Tyrant (*Tumbezia salvini*), a near-threatened species endemic of the Tumbesian region in Peru and Ecuador, and report odd records in its southernmost range. By collecting occurrence records for the species and climatic information across its range, we: 1) modelled the geographic distribution of the species and analysed its climatic niche using multivariate analysis; 2) assessed the position of the odd records across its geographical distribution and climatic niche; 3) assessed the temporal trends of the species occurrence records; and 4) analysed some elements about its conservation status. Our results show that the distribution is highly associated to the dry forest located in the lowlands and the western Andean foothills on the study region. In recent years, the species has been reported at higher elevations, such as our odd records, which may suggest a relatively recent range expansion due to increasing temperatures. However, we did not find a clear increasing temperature trend over the last 40 years in the region. Nevertheless, sampling frequency of occurrence records also increased over time after the year 2000, which may be due to a better recent detection of the species at both its geographical and environmental distribution margins. As the frequency of observed records at high elevations is low, we suggest that our observations are most likely marginal records inside the proposed distributional area for this species. We found that protected areas cover just 5% of the estimated range of the Tumbes Tyrant, despite the fact that the dry forest in the Tumbesian region is under serious threat by anthropic disturbance. Further appropriate monitoring of this species across its range and ecological niche through time will help evaluate its threat and subsequent conservation status.

**Resumen · Distribución del tirano de Tumbes (*Tumbezia salvini*) con comentarios sobre registros marginales**
Presentamos la distribución potencial actualizada del tirano de Tumbes (*Tumbezia salvini*), una especie casi amenazada y endémica de la región tumbesina de Perú y Ecuador. También reportamos registros atípicos de esta especie al extremo sur de su rango de distribución. Utilizando registros de ocurrencia de la especie e información climática en este trabajo, 1) modelamos la distribución geográfica de la especie y analizamos su nicho climático usando un análisis multivariado, 2) determinamos la posición de los registros atípicos a lo largo de su distribución geográfica y nicho climático, 3) analizamos las tendencias temporales de los registros de ocurrencia de la especie y 4) analizamos de manera general elementos sobre su estado de conservación. Nuestros resultados muestran que la distribución de la especie está fuertemente asociada al bosque seco de baja altitud y aquellos localizados en los piedemontes andinos occidentales de la región de estudio. En los últimos años, la especie ha sido reportada en lugares con mayor elevación, como nuestros registros atípicos, lo que sugeriría una expansión relativamente reciente de su rango, quizás debido a un incremento en la temperatura. Sin embargo, los análisis efectuados en este trabajo no permiten evidenciar un patrón claro de incremento de temperatura en la región en los últimos 40 años. Aun así, la frecuencia de muestreo de registros de ocurrencia de la especie muestran un importante incremento a partir del año 2000, lo cual podría ser resultado de una mejor detección reciente de la especie en sus límites geográficos y ambientales de distribución. Puesto que la frecuencia de los registros observados en elevaciones altas es baja, sugerimos que nuestros registros son marginales dentro del área de distribución propuesta en este documento para la especie. Las áreas protegidas cubren solo 5% del rango de distribución estimado para el tirano de Tumbes, además de que el bosque seco de la región tumbesina está seriamente amenazado por disturbios antrópicos. El monitoreo apropiado de esta especie a lo largo de su rango a través del tiempo ayudará a evaluar su amenaza y subsecuente estado de conservación.

**Key words:** Distribution · Marginal records · *Ochthoeca salvini* · Species distribution modelling · Tropical dry forest · Vagrant

## INTRODUCTION

The Tumbes Tyrant (*Tumbezia salvini*), also known as *Ochthoeca salvini* (Farnsworth & Langham 2017), is a bird species mainly found in the dry forests of *Prosopis pallida* and scrubs of the Tumbesian region (Best & Kessler 1995, Barrio 1997) along the Pacific coast of Peru (Stattersfield et al. 1998). It was considered endemic to Peru (Stattersfield et al. 1998) until its discovery in southern Ecuador in July 2009 (Athanas et al. 2009).

Initial studies recorded very few localities for the Tumbes Tyrant (Best & Kessler 1995, Schulenberg et al. 2006), which led it

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**Figure 1.** Tumbes Tyrant (*Tumbezia salvini*) at Quebrada la Taona, La Libertad, Peru.

to be considered a rare species. Moreover, Flanagan et al. (2005) stressed the need of surveying this species in the western foothills of the Andes because additional populations were likely to be found there. The population of the Tumbes Tyrant in Peru has been estimated to be between 15000 to 30000 individuals (Birdlife International 2019), an estimate based on the observation of the number of individuals in specific localities in relation to the available suitable habitat, supposedly the seasonal dry forest of the Tumbesian region.

The dry forest of northern Peru and southern Ecuador has undergone severe habitat degradation, mainly due to agriculture expansion and logging (Best & Kessler 1995, Portillo-Quintero et al. 2010). This has led to suggestions of a potential decline in endemic species populations and an urgent need of adequate management (Escribano-Avila et al. 2017). As the Tumbes Tyrant forages insects living in the dry forest and is territorial (Barrio 1997), it is assumed that habitat degradation would be highly detrimental for its survival (Parker et al 1995). For example, a recent study shows that high logging pressure is inversely correlated with Tumbes Tyrant's abundance (Devenish et al. 2017). Both the habitat reduction and the small distribution range of the Tumbes Tyrant have been considered when assigning it the category of near threatened species (Birdlife International 2019).

On 20 July 2007, O.G. found two Tumbes Tyrant individuals in an extreme southeastern part of its known distribution in the department of La Libertad, where it was considered uncommon because of its geographically marginal position within the range (Ridgely & Tudor 1994). The individuals were found at 1600-1800 m a.s.l., which was much higher than upper limit of 800 m a.s.l. and occasionally 1000 m a.s.l. reported by previous studies (Best & Kessler 1995, Fitzpatrick et al. 2004, Schulenberg et al. 2007).

The records made by O.G. were presumed "odd" because they were outside the known altitudinal range of the species. They could represent vagrant individuals or be due to a recent shift in geographic range. Vagrant individuals are usually spotted in places where they are not supposed to be based on the current knowledge of the species distribution in a given area (Howell et al. 2014). This could be, for example, individuals that are found in climatically marginal areas of the species' known environmental niche that "trespass" the biogeographical barriers. Dias et al. (2010) summarize the causes of bird vagrancy as demographic dispersal, exploration of resources, and disorientation.

Bird species may shift, contract, or expand their distributions due to environmental changes, such as climate or land use change, which could ultimately reshuffle the distribution patterns of biodiversity (Jiguet & Barbet-Massin 2013, Thuiller et al. 2014). Several studies have shown an upward displacement of bird populations due to climate warming (La Sorte & Jetz 2010, Forero-Medina et al. 2011, Sekercioglu et al. 2012). Others have reported a reduction in population sizes due to agricultural expansion (Jetz et al. 2007, Mahli et al. 2008, Loiselle et al. 2010). To our knowledge, in the Tumbesian region none of these processes have been previously identified for bird species and no analysis of historical climate and local species range dynamics has been done. Because the Tumbes Tyrant is an inhabitant of the lowlands, we might expect it to move uphill on the Andes under global warming (Sekercioglu et. al. 2012). However, it is also necessary to consider that this region is dramatically affected by the El Niño Southern Oscillation (ENSO) phenomenon. ENSO has a warm phase known as El Niño and a cold phase known as La Niña (Richter 2005). Extreme El Niño phases have led to high air temperature and high precipitation in the region. Flooding might occur followed by vegetation increases (Richter 2005), which could be beneficial for insectivorous birds such as the Tumbes Tyrant (Jaksic 2004). The three

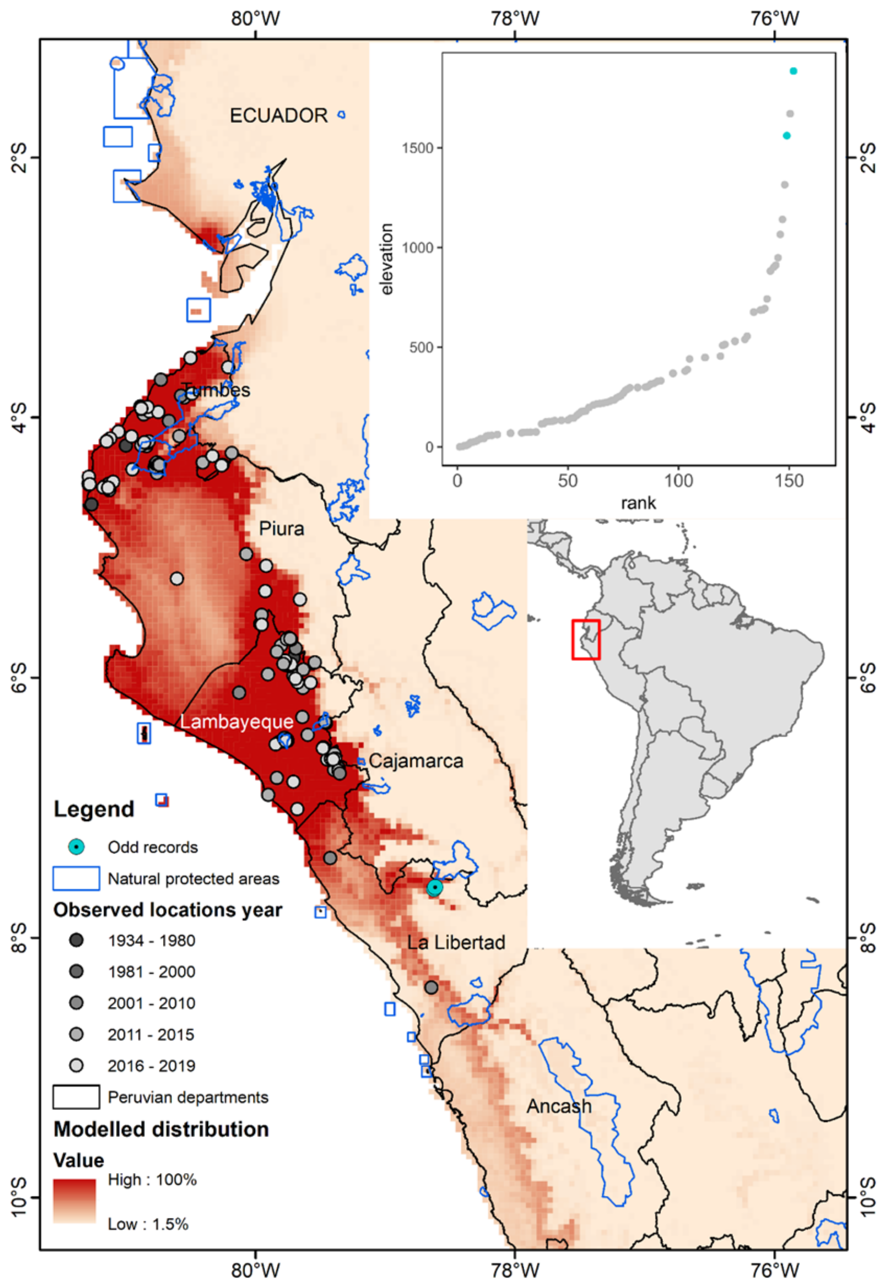


**Figure 2.** Modelled distribution of the Tumbes Tyrant and elevation range obtained from all available records for this species. Records are in different tones of grey in chronological order of detection. Protected areas are the blue polygons and the odd records observed in 2007 by O.G. are in cyan.

most extreme events of the last century occurred in 1972-73, 1982-83, 1997-98, and 2015-2016 (Fraser 2017, Climate Prediction Center 2018).

Here, we aimed to: 1) analyse the geographic distribution and climatic niche of the Tumbes Tyrant, 2) assess whether our odd observations could also be considered geographically and climatically marginal for this species, 3) assess temporal trends of the species' occurrence records in relation to elevation, latitude and habitat suitability, and 4) analyze the territory where the species is present to comment on its conservation status.

## METHODS

**Study area and field observations.** O. G. recorded the Tumbes Tyrant on 20 July 2007 in Quebrada la Taona, Chicama river basin, close to the town of Cascas, department of La Libertad. The location was on the surroundings of the mine Cascajal which is the property of the San Manuel Mining Company. One Tumbes Tyrant individual was sighted among the bushes close to the residential area of this mine (7° 37'36"S, 78°37'26"W, 1800 m a.s.l.) and another one was mist-netted (Figure 1) close to this location, but at a lower elevation (7°36'50"S, 78°36'53"W, 1600 m a.s.l.).

The habitat was a dry scrub with the trees *Bombax* sp., *Bursera graviolens* and *Schinus molle*, usually with epiphytes of genus *Tillandsia*. In the rocky areas, *Fourcroya* sp. and the cactus *Armatocereus* sp. were common. Both locations were highly disturbed by cattle. The *Prosopis* tree, typical of the Tumbes Tyrant's habitat (Barrio 1997), was not common here.

**Species occurrence data.** We collected occurrence records for the Tumbes Tyrant (localities where it was recorded)

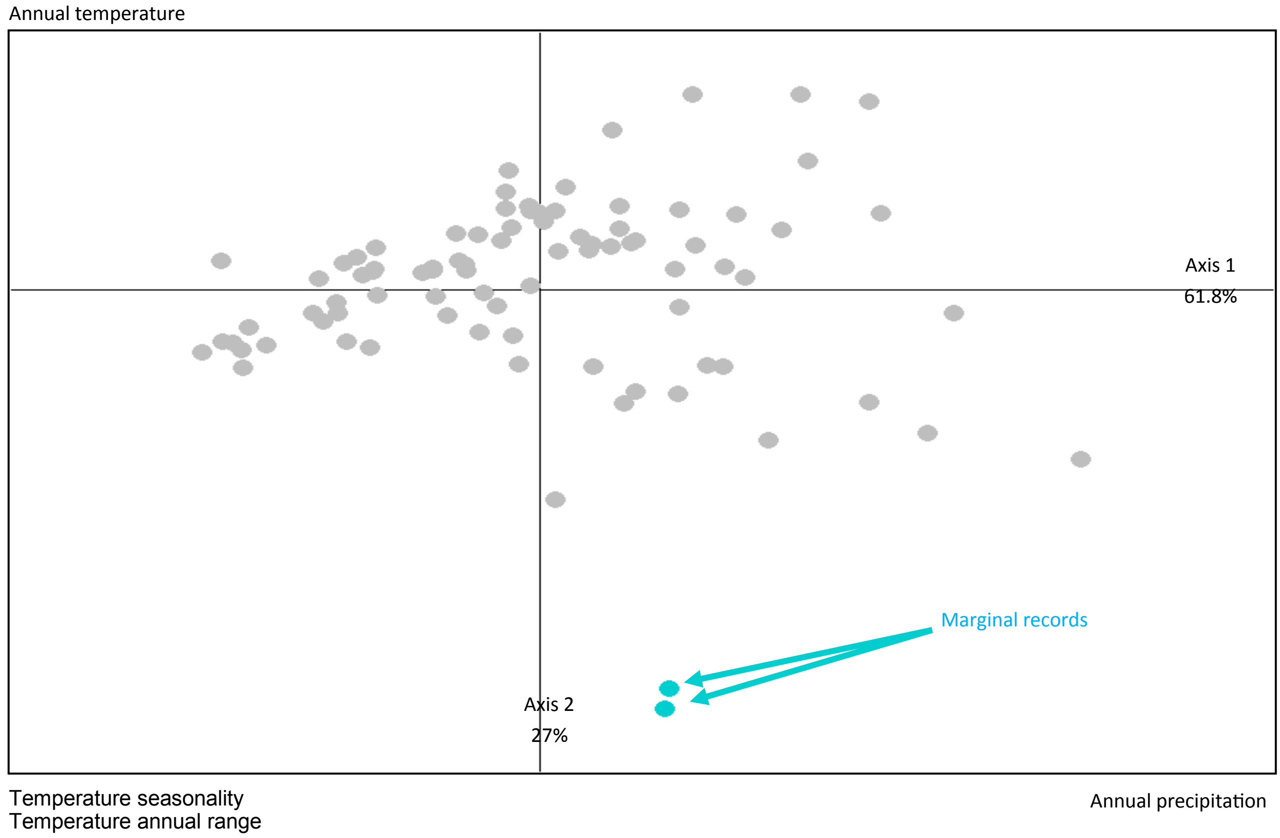


**Figure 3.** Principal Component Analysis biplot of environmental factors that affect the distribution of the Tumbes Tyrant. In cyan the odd records observed in 2007 by O.G.

from VertNet (www.vertnet.org), Xenocanto (www.xenocanto.org), the Internet Bird Collection (https://www.hbw.com/ibc), and eBird (www.ebird.org). Only records providing GPS coordinates and dates of observation were considered. In total, we selected 291 occurrence records that represented points with a unique combination of latitude, longitude, and year of observation. The records, covering the period 1934- 2019, are part of bird surveys done by professional ornithologists with detailed information or occasional sightings done by birdwatchers. Because the Tumbes Tyrant is highly conspicuous and easy to identify (Figure 1), eBird and VerNet data are considered reliable and used by several researchers (Sullivan et al. 2014, Callaghan & Gawlik 2015, Constable et al. 2010, Guralnick & Constable 2010). For example, these data have been used to model the distribution of the endemic Sri Lanka Frogmouth (Mahabal et al. 2016) and to assess the distribution of ovenbirds, a family typical of the Americas, in an important paper on song evolution (Derryberry et al. 2018). The confidence in eBird data as citizen science information was demonstrated in several cases where researchers relied on them to provide useful results (Lagoze 2014, Sullivan et al. 2017, Horns et al. 2018). For all these reasons, we are confident that the records we used constitute a robust dataset.

**Environmental data.** For each of our occurrence records we extracted topographic and climatic data. Elevation data was extracted from HydroSHEDS (Lehner et al. 2008) at a 15 s resolution. Climatic data was extracted from the Worldclim global dataset (Hijmans et al. 2005) covering the 1960-1990 period at a 2.5 arc-minutes resolution (~5 km). After analyzing multicollinearity among the 19 bioclimatic variables provided by Worldclim in the study region using a Principal Component Analysis (PCA) and correlation matrix analyses, we selected the four following variables to analyse the species' ecological niche and model its geographical distribution: annual mean temperature (BIO1), temperature seasonality (BIO4), temperature annual range (BIO7), and annual precipitation (BIO12). We also used historical mean annual temperature time series (1970-2010) from meteorological stations of the Peruvian Meteorological Institute (SENAMHI) in order to analyse temporal climatic trends within the species range in the region (https://www.senamhi.gob.pe/). This provides data per year to estimate a trend, which is not possible from Worldclim because it has an averaged value for the period 1960-1990 for each pixel.

**Species distribution modelling.** We subset the occurrence points to avoid having more than one record per pixel at 2.5 min resolution; this way we avoided spatial autocorrelation in our model. Therefore, we used a total of 85 points for the species distribution modelling. We modelled the distribution of the Tumbes Tyrant using a consensus approach (Marmion et al. 2009) implemented in the biomod2 package in R (Thuiller et al. 2009). Four different probabilistic models were used: Generalized Additive Model (GAM), Generalized Boosting Model (GBM), Random Forest (RF), and Maximum Entropy (MaxEnt). Each model was calibrated using 10 different sets of 500 pseudo-absence points (or backgrounds) selected randomly across the study area. 75% of the original selected data were used for each model calibration and the remaining 25% for their evaluation. We repeated this ran-

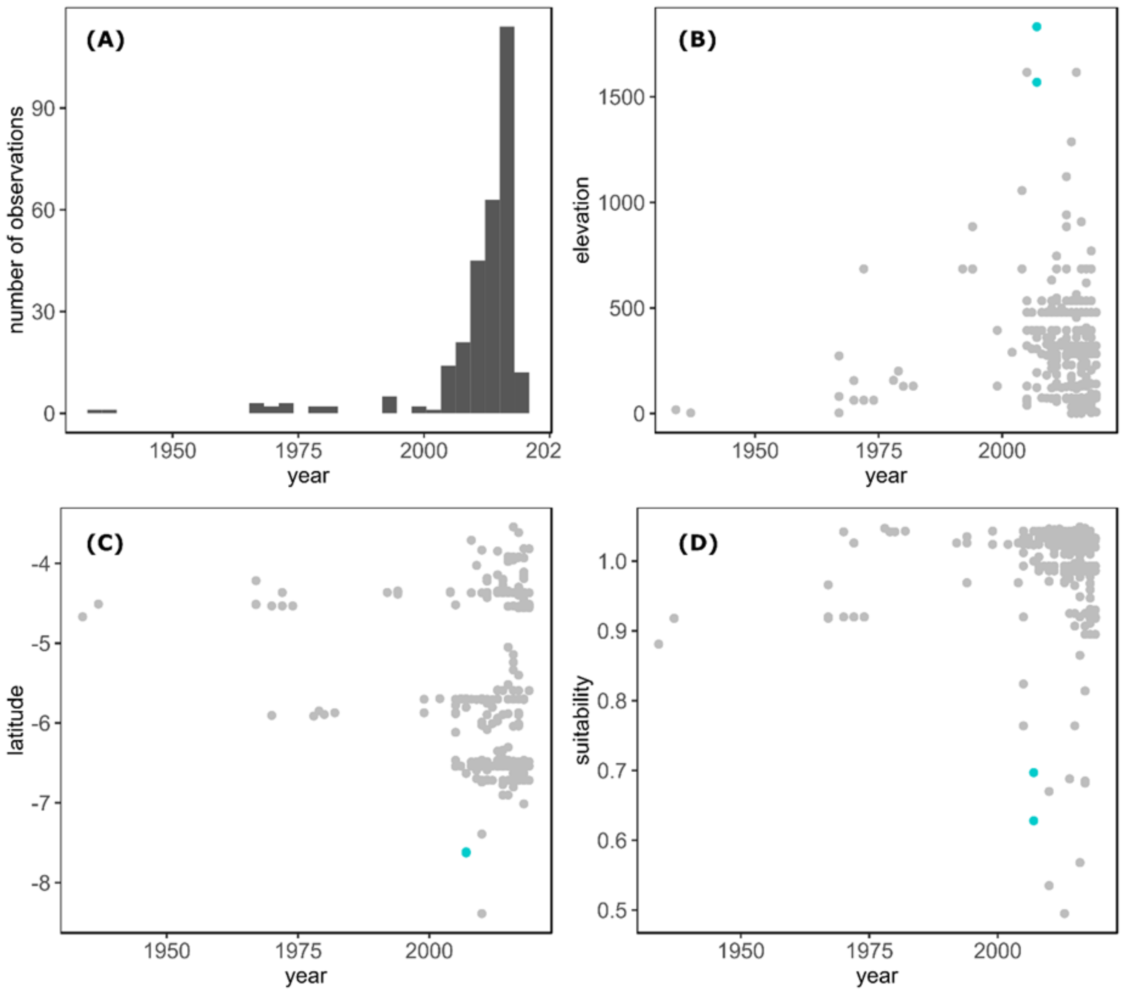


**Figure 4.** Temporal trends in A) sampling effort, B) elevation C) latitude and D) climatic suitability of the recorded observations. In cyan the odd records observed in 2007 by O.G.

dom-splitting strategy 10 times to ensure that it did not affect the models' accuracy (Thuiller et al. 2009). Final models were evaluated using two different indices: True Skill Statistics (TSS) (Allouche et al. 2006) and the area under the Receiver Operating Characteristic curve (ROC) (Hanley & McNeil 1982). By using 4 different statistical models, 10 pseudo-absence selections, 10 repetitions, and 2 evaluation metrics, we therefore ran 800 models in total.

Finally, each model was projected across the study area according to its current climatic conditions. To summarize this ensemble of occurrence probability maps, we then computed a mean of the different projections weighted by each model's predictive accuracy. Models exhibiting TSS and ROC scores below 0.6 and 0.8, respectively, were excluded.

**Climatic niche.** In order to characterise the species' climatic niche, we performed a Principal Component Analysis (PCA) using the ade4 package in R (Dray & Dufour 2007). To do this, we used the four variables considered previously for modelling the species distribution.

**Geographical and environmental marginality**. We analysed the geographical distribution of the species using first a description of the elevation range and then using species distribution modelling to identify whether the observations made by O. G. were geographically marginal. Because peripheral populations may not necessarily be ecologically marginal (Soulé 1973, Pironon et al. 2016), we also assessed whether the two odd records were marginally distributed across the species climatic niche in the climatic space built using the PCA.

**Temporal trends.** We first evaluated the sampling effort through time by analysing the distribution of the number of observations made per year. Then, we evaluated the distribution of elevation and latitude of the observation records through time. Lastly, we extracted the climatic suitability values obtained from the species distribution model at each species observation point and analysed the distribution of these suitability measures over time.

We also evaluated the temporal trend of mean annual temperature using the SENAMHI data (1970-2010 period). We selected all meteorological stations located in areas where the suitability values given by the species distribution model was at least 0.45. We explored whether there was any evidence of recent warming for each of the 12 selected stations (Supplementary Table 1) by performing a Mann-Kendall test with the Kendall package in R. This non-parametric test assesses whether a monotonic upward or downward trend over time is significant and has been widely used for analyzing time series (Wang et al. 2020). We also performed the test over the average of the annual mean temperature of all 12 stations. We verified that no temporal autocorrelation existed in the series as this is an assumption of the Mann-

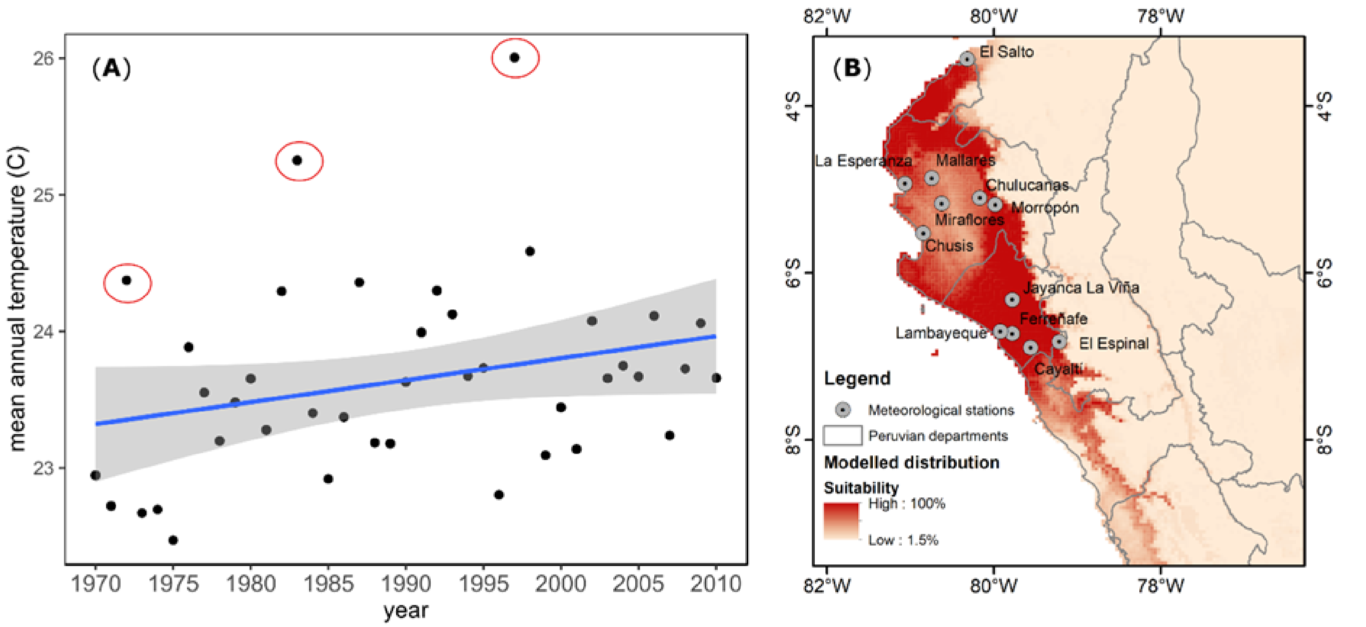


**Figure 5.** Temporal trends in mean annual temperatures. A) Average mean annual temperature between 1970 – 2010 for 12 weather stations. In red circles El Niño years. B) Location of the meteorological stations used to produce 5A.

Kendall test.

**Assessment of protected territory for the species.** We used the national natural protected areas for Peru (https://www.sernanp.gob.pe/el-sinanpe) and Ecuador (http://areasprotegidas.ambiente.gob.ec/es/ mapa#region-costa) to estimate how much of the species' range was covered by existing protected areas recognized by both governments.

## RESULTS

**Geographic distribution of the species and climatic niche.** Species distribution models performed well given the high mean ROC and TSS evaluation scores obtained across the different models (mean ROC = 0.94 ± 0.07; mean TSS = 0.84 ± 0.13).

The modelled distribution of the Tumbes Tyrant is shown in Figure 2. High occurrence probabilities in the southernmost part reach the south of the La Libertad department, while in the north highly suitable areas are recorded up to 2° S in the south of Ecuador. Medium and low suitability values are found in the central west of the distribution map, which is the Sechura Desert.

Regarding the climatic niche, the PCA biplot shows that the first and the second axes explain 88.8% of variability in climatic data (Figure 3). The first axis is related to temperature seasonality, temperature annual range and total annual precipitation, while the second axis is related to mean annual temperature.

**Geographic and climatic marginality of the reported observations.** The analysis of elevation range of the species based on the location of all observations shows that the odd records are at higher elevation than the other records collected from available databases (Figure 2). Besides the odd records, only two others are above 1300 m a.s.l., both located in Abra Porculla, Piura (eBird 2019).

The two odd records found by O.G. were located at the southernmost part of the distribution, with only one more observation located further south of them (Figure 2). The observations are also located at the eastern periphery of the species distribution range.

Our results show that our two odd observations were made in the coldest areas of the species range, but in average precipitation conditions (Figure 3).

**Temporal changes.** We first analysed the change in number of observations through time and found that, after the year 2000, there was a change from less than five observations per year to up to 40 in 2016 (Figure 4A). We also observed that it was only after 2000 that the species was recorded above 1000 m a.s.l. (Figure 4B). When we analysed the changes over time across latitude (Figure 4C), we noticed that after 2000 the observations expanded at both ends of the latitudinal gradient.

The analysis of the temporal change in the suitability index (Figure 4D) showed that, before 2000, the species had only been found in climatically highly suitable areas (climatic suitability of around 0.8), whereas after 2000 it has been found in more marginal areas (with some observations in areas of suitability values around 0.5).

Our analysis using weather stations showed that only three of them had a significant increasing trend over time for the period 1970-2000 (Supplementary Table 1, Supplementary Figure 1). When combining data of all stations to generate average mean annual temperatures, we observed three outliers corresponding to El Niño phases (1972-73, 1982-83, 1997-98), but we also observed no trend of increasing temperature towards the present time for the region (Figure 5, tau=0.173, 2-sided $P$ =0.10873).

**Conservation assessment.** At the core range of the species distribution, we found three protected areas: the Coto de caza El Angolo, Refugio de Vida silvestre Laquipampa, and the Santuario Historico Bosque de Pomac (Figure 2). The protected areas cover fairly 5% of the species distribution. The species has been reported as common in the Bosque de Pomac (Angulo Pratolongo et al. 2012, Barrio et al. 2015, Angulo Pratolongo & Sanchez Perez 2016).

## DISCUSSION

**Species distribution of the Tumbes Tyrant and geographic and climatic marginality of the odd records.** We provide an updated range map for the Tumbes Tyrant (Figure 2), which lies within the Tumbesian region (Stattersfield et al. 1998) and the equatorial seasonally dry forest (Linares-Palomino et al. 2010). This distribution fits in the Tumbesian dry forest ecoregion and is coincident with the *Prosopis* tree as a keystone species for the ecosystem (Brack & Mendiola 2000). Our odd records were found at the southeastern limit of the range, in unsuitable areas surrounded by a few suitable ones.

The first reports of the Tumbes Tyrant assigned its habitat to lowlands below 800 m a.s.l. (Figure 4B; see also Best and Kessler [1995], Fitzpatrick et al. [2004] and Schulenberg et al. [2007]). It is known that the altitudinal barrier of the Andes and climate are the main causes of distribution limits to dry forest birds now and in the past (Oswald et al. 2016). The odd observations that we reported were geographically marginal (above 800 m a.s.l. at the southeastern range limit), but other recent records have shown that this species can be found above this elevation as well (Figure 4B). A few records from eBird (2019) were found at 1300 m a.s.l. in Abra Porculla, the lowest point of the Andes range (Oswald et al. 2016). This probable vagrancy might have an explanation in the evolutionary history of flycatchers in this region. There are some of these birds that have populations in the dry and montane forests of the eastern side of the Andes, and it is known that they originated in the lowlands and moved to the highlands probably using the Abra Porculla corridor (Oswald et al. 2017).

According to Dubay & Witt (2014), there are physiological constraints that restrict the colonization of areas at high elevation regions by species (e.g., the Tit-tyrant in the Andes). They state that these species are confined at different elevations due to competition, but also due to the inability of some of them to produce blood traits that would make them breathe under low atmospheric pressure. Then, altitudinal segregation occurs, even with the possibility that those species could hybridize without reproductive isolation between the groups (Dubay & Witt 2014).

The observation of individuals outside the typical species range is not uncommon in northern Peru. There have been recent reports of other land birds in the equatorial dry forest that were "out of place", such as the sympatric congener of the Tumbes Tyrant, the Piura Chat-Tyrant (*Ochthoeca piurae*). An individual of this species was discovered ~300 km out of its known restricted range (Baumann et al. 2015), but the authors could not rule out sampling bias that interfere in cataloguing this event as a range expansion, a vagrant, or an overlooked record. Another example is the Blue-black Grosbeack (*Cyanocompsa cyanoides*), a seed-eater typical from the rainforest, which has been found in the dry forest of Piura (Devenish et al. 2015). However, the authors suggest that this species could have had a resident population that was overlooked. That might be the case with our marginal records of the Tumbes Tyrant.

The vegetation composition where the odd observations were made was not dominated by *Acacia* or *Prosopis*, where the Tumbes Tyrant is usually found (Fitzpatrick et al. 2004). They were not in the core area of the dry forest, but rather at the border with the nearby ecoregion, which is the Pacific Desert (Brack & Mendiola 2000). The limit of the species distribution coincides with the limit of the equatorial seasonal dry forest in La Libertad department (Linares-Palomino 2004).

The variation in the Tumbes Tyrant's distribution is mainly explained by precipitation, the first axis in the PCA (Figure 3). The two odd records fit in the expected precipitation range (second axis of the PCA), but they are found in much lower temperature conditions than expected (Figure 3). Some populations could be better adapted to weather extremes (Ruegg et al. 2018) but, to our knowledge, no information is available on the intra-specific variation in the thermal tolerance of this species.

**Temporal trends in the Tumbes Tyrant's distribution.** We observed an increase in both latitudinal and elevation ranges over time (Figure 4C & 4D). Recent observations have been recorded mostly in southern regions of Ecuador (Ordóñez-Delgado et al. 2016a) and higher areas. There is also an increase in the range of the occupied climatic conditions by the species over time. Many recent records are located predominantly in areas of high suitability, but others are also found in less suitable areas (i.e., marginal climatic conditions). Furthermore, we did not find any clear evidence that ENSO impacted species distribution because the temperatures measured by NOAA in May-July 2007 were not warmer than usual (Climate Prediction Center 2018). Recent events of flooding in this region related to El Niño events have had serious consequences for human welfare, but have created new corridors of green areas connecting the dry forest along northern Peru (Fraser 2017, Novoa & Finer 2017). It would be interesting if future studies could update the distribution of Tumbesian species considering these flooding events.

Several bird species would likely show range expansion over time due to climate change in areas where an effect of El Niño event was ruled out (see reviews in LaSorte & Jetz 2010, Sekercioglu et al. 2012, and Forero-Medina et al. 2011 for the case of tropical land birds). However, our results do not show any clear pattern of climate warming over the last years (Figure 5A) in the Peruvian northern dry forest, suggesting that climate change may not be the main factor responsible for the recently observed species range shift. Nevertheless, local climatic information was not available at the location of the two odd observations. More meteorological stations or local sensors would be necessary to clearly elucidate potential climate change effects.

Our results suggest that there is an expansion of the species distribution towards higher areas over time, rather than a shift in the range, because we did not observe an upward displacement of the lower range limit. However, rather than colonizing new marginal habitats, the observed upward expansion may be related to sampling effort given that more observations have been made after 2000 (Figure 4A). A better way to sample birds in the field should be recording not just their presence and numbers, but other factors that may influence their occurrence in that specific area as covariates such as habitat quality (Marques et al. 2007). In the case of birds that dwell in the forest, each species has its own environmental requirements, and the sampling method will influence their detectability by overestimating or underestimating populations (Cunningham et al. 2014). In our case, we used secondary data that was in most cases without explanation of sampling effort and detectability, which are important because undersampling may have an effect in bird distribution (Auer et al. 2017, Watson 2017). In the data available for the Tumbes Tyrant, sampling frequency was skewed towards recent years, most probably because ornithologists and birdwatchers share their records now more than before and by the availability of the internet. Detectability should not be an issue with the Tumbes Tyrant because it is highly conspicuous (Figure 1). However, a limitation was that sampling frequency and completeness across its supposed range was not homogeneous in the past. There are more distributional data after year 2000, so recent ecological range shifts can hardly be disentangled from sampling biases.

With no proper analysis of occurrence, climatic, and sampling information, it could be tempting to speculate that this species could be shifting its range towards upper areas due to climate change, if more individuals were observed there. Interpretation of vagrant species occurrence as a climate change effect might lead to erroneous statements on ecology and conservation, so an adequate analysis is important before undertaking any management measure and not to erode public confidence. Occurrence data collected from more systematic and standardized field work across both environmental and geographical gradients, and the use of adequate modelling techniques, will help provide better management strategies.

**Conservation.** Evidence of human presence in the equatorial dry forest of the Tumbesian region dates back to 10,000 BC, but the landscape impact through agriculture has been evident since 3,000 AC (Hocquenghem 2001). Currently, human disturbance continues mainly through recurrent deforestation and fire (Best & Kessler 1995, Knowlton & Graham 2011, DRYFLOR et al. 2016). This habitat destruction is of particular concern because the dry forests of the Tumbesian region host many other endemic birds besides the Tumbes Tyrant (Parker et al. 1995, Ordóñez -Delgado et al. 2016b). In fact, this region is of higher bird endemism than the Amazon rainforest (Stotz et al. 1996).

Using adequate sampling strategies to assess bird conservation status is key. Surveys for the Tumbes Tyrant and other species of conservation concern in the dry forest should consider information from previous field surveys, the geography and ecology of the species, as well as their natural history. It is also necessary to survey, in a standardized way, sites that could be considered geographically or ecologically marginal, as they may represent good indicators of ongoing or future range shifts (Devenish et al. 2017). Marginal habitats such as degraded forests, where we found the odd records of the Tumbes Tyrant, could also be highly valuable for conservation given that they are able to harbour important bird diversity (Sayer et al. 2017). A recent study of the distribution of dry forest birds in the Tumbesian region did not find any significant differences in the Tumbes Tyrant's abundance between populations found at the core and at the edge of its distribution (Devenish et al. 2017). Therefore, pockets of this bird's population could be abundant in different sectors of its range. Knowing that this bird has only 5% of its range protected should concern wildlife managers. Moreover, just 10% of the original cover remains of the neotropical dry forest and the protection status is deficient (DRYFLOR et al. 2016). With the ongoing trend of deforestation that has fragmented this forest (Flanagan et al. 2005), the conservation status of the Tumbes Tyrant might switch from Near Threatened to a more critical level. We recommend appropriate monitoring of this and other dry forest birds across their range and ecological niche margins over time for evaluating the threats they face and to confirm their conservation status.

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