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***Fotografía portada* / Cover photograph**
The first ever published photograph in life of Santa Marta Wren *Troglodytes monticola*, an Endangered and Colombian endemic species restricted to a highly degraded timberline ecotone in the Sierra Nevada de Santa Marta. By Juan Carlos Luna.

Conservación Colombiana *es publicada gracias al apoyo de nuestros donantes:*

Contenidos — Contents

First Record for the Black-and-white Tanager *Conothraupis speculigera* in Colombia

Primer registro del Frutero Blaquinegro Conothraupis speculigera en Colombia

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Abstract

We report the first record for Colombia of the Black-and-white Tanager *Conothraupis speculigera*, based on a Field Museum of Natural History specimen collected by Kjell Von Sneidern on 16th October 1969. We also gathered all available locality data for this poorly known species to model its potential geographical range using the program MAXENT. We conducted habitat suitability modeling using the whole dataset compiled and on subsets of the data for presumed breeding and non–breeding season records because of the poorly understood movements in this species. Our results suggest that the species might be looked for in a number of areas in Peru, Ecuador, Colombia, Brazil and Bolivia where it has not yet been recorded, but there is clearly much to learn about this enigmatic species.

Resumen

Reportamos el primer registro en Colombia del Frutero Blanquinegro Conothraupis speculigera, basados en un espécimen de museo del Field Museum of Natural History colectado por Kjell Von Sneidern el 16 de octubre de 1969. Ademas reunimos toda la información disponible de registros de localidad de esta especie poco conocida para modelar su distribución geográfica potencial usando el programa MAXENT. En una primera serie de ensayos realizamos estudios de modelamiento del hábitat usando la totalidad de los datos y en un segundo grupo de experimentos se manejaron por separado los registros de las presuntas zonas reproductivas y no reproductivas debido a lo poco que se conoce aun sobre los movimientos de la especie. Nuestros resultados sujieren la exploración de varias nuevas áreas de Perú, Ecuador, Colombia, Brasil y Bolivia donde aún no ha sido registrada la especie, Pero claramente es necesario aprender más sobre esta enigmática especie.

Introduction

The Black-and-white Tanager, *Conothraupis speculigera* Gould 1855, is an unusual thraupid first described from two males collected by Hauxwell in 1852 with type locality "Rio Ucayali, east Peru" (Carriker 1934). Carriker considered this type locality improbable, since the majority of other specimens he located at the time came from west of the Andes. Today, the species is known to exhibit a disjunct and local distribution on both slopes of the Peruvian and Ecuadorean Andes and the adjacent lowlands in Ecuador, Peru, Brazil and extreme northeastern Bolivia (Ingels 2007). In Ecuador, this species has been recorded in the south, on the western slopes of the Andes in the provinces of Azuay, Oro and Loja, and along the eastern slope in the Province of Morona–Santiago (Ridgely and Tudor 1989; Ridgely *et al*. 2005). The northernmost known record for the species until now is from Pichincha Province (InfoNatura 2009).

Conothraupis speculigera is found at elevations ranging from sea level to 1,800 m and occupies habitats such as the Gallery Forest, Riparian Thickets and the Tropical Deciduous Forest (*sensu* Stotz *et al*. 1996). It is an uncommon species with its center of abundance located in the Upper Tropical zone (900–1,600 m), although seasonal variation in site–to–site abundance is still not well understood. The species is believed to breed in the mountains during the rainy season, in the first half of the year, and later disperse to the lowlands during the dry season, in the second half of the year (Ingels 2007). Stotz *et al*. (1996) considered the Black–and–white Tanager as a species with medium conservation priority and more recently BirdLife International (2010a) has included it in the Near Threatened (NT) species list, since it is believed that the species has a relatively small population, which is being reduced due to deforestation and land degradation throughout its range.

We report here the first record for Colombia, a specimen collected by Kjell Von Sneidern from the state of Putumayo on the eastern slope of the Andes. We also review known records and create habitat suitability models predicting the potential geographical range of this species using these data.

Methodology

Compilation of Records and Georeferencing Uncertainty.

We retrieved all available records from the Global Biodiversity Information Facility (GBIF) internet portal (http://www.gbif.org). In total, we retrieved 66 records of which 15 had detailed locality data, 13 of which were georeferenced. We also gathered all records from the Ornithological Information System (ORNIS) internet portal (http://olla.berkeley.edu/ornisnet/). These included 35 additional records of which 10 had a detailed locality and only one was georeferenced. Localities from both portals were explored to determine their general features. Using both datasets and retrieving independently the databases from specific museums or data providers a larger dataset was compiled, improving the quality of the information, especially in terms of the georeference of described localities. We also added records available from NatureServe (InfoNatura 2009) and the literature. In total, we compiled 59 records with 28 described localities and 26 different georeferenced points.

We estimated the positioning uncertainty attached to each locality using the guidelines of Wieczorek *et al*. (2004, 2006). Thus, when the locality description was simple, as for example "Samne, Libertad, Peru", the uncertainty was calculated as the error in precision in each pair of coordinates, and was calculated using the equations suggested by the mentioned authors. Otherwise, when the description included an offset distance, as for instance "10 km S Catacocha, Loja, Ecuador", the uncertainty was calculated as the maximum error, which takes into account the precision error and the specified offset distance. The maximum error was calculated using the on–line Georeferencing Calculator (Wieczorek 2001).

We also determined the slope value associated to each locality. The slope was produced from the NASA Shuttle Radar Topographic Mission (SRTM) Digital Elevation Model (DEM) data at 90 m processed by Jarvis *et al*. (2004), which was projected to Lambert Equal Area Azimuthal Equatorial in Arc View 3.3 and aggregated at 5 km. Both slope values and the estimated error were explored using simple descriptive statistics to determine the grain for habitat suitability modeling and produce consensus range maps of the species.

Niche Modeling

We used MAXENT 3.2.1 and 3.3.3e to produce potential range maps of *Conothraupis speculigera*. MAXENT uses the principle of "Maximum Entropy", estimating a unique probabilistic distribution that maximizes information available and assumes nothing from what is not known (Jaynes 2003; Phillips *et al*. 2006). The probabilistic distribution estimated is considered the least biased and most uniform distribution, given the constraint: Phillips *et al*. (2004).

A first set of habitat suitability modeling exercises was conducted in 2008 using MAXENT 3.2.1. Prior to starting, the 19 Bioclimatic variables available from WorldClim (http://www.worldclim.org) were downloaded and clipped to north South America. All layers, originally at ≈1 km grain size, were projected to Lambert Equal Area Azimuthal Equatorial in Arc View 3.3 and aggregated at 5 km. To make the modeling process more efficient, we conducted a Principal Component Analysis. The analysis was performed separately for both temperature (BIO1 to BIO11) and precipitation (BIO12 to BIO19) variables in order to select those that explained greatest variation in each group. Thus, layers for modeling were reduced to a total of 6 biovariables (BIO1, BIO2, BIO3, BIO12, BIO13 and BIO14). We used bootstrapping to produce 100 replicates and each time 30% of the data to evaluate model performance through the AUC statistic calculated by the software.

Following recommendations of Anderson *et al*. (2003), final presence/absence maps were produced based in "best model subsets". Thus, raw results of logistic probability obtained from MAXENT were given thresholds using two different approaches. First, the "equal test sensitivity and specificity threshold (ETSS) value" and, second, the "equate entropy of thresholded and non–thresholded distributions (EETNTD) threshold value". The first approach selected models that showed training omission lower than or equal to 0.278 and where the binomial test of omission was significant at the 5% level. Thirty–four models fulfilled these conditions, and we selected the 20 with the highest test AUC statistic values. For the second approach, we selected models that showed a training omission lower than or equal to 0.056 and for which the binomial test of omission proved to be statistically significant at the 5% level, which resulted in a total of 14 models. Using a simple batch file, selected models in each approach were imported into PCRaster, thresholded and added in each case. The linear addition of each subset was exported and final consensus range maps prepared in Arc View 3.3.

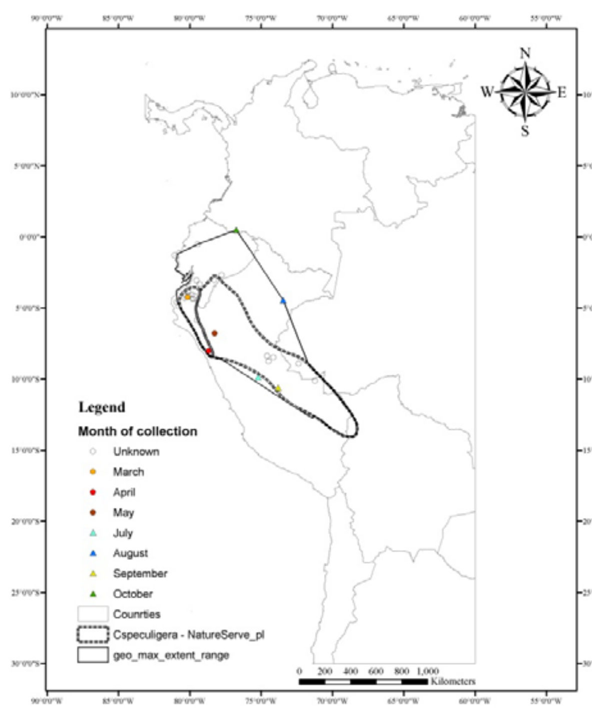
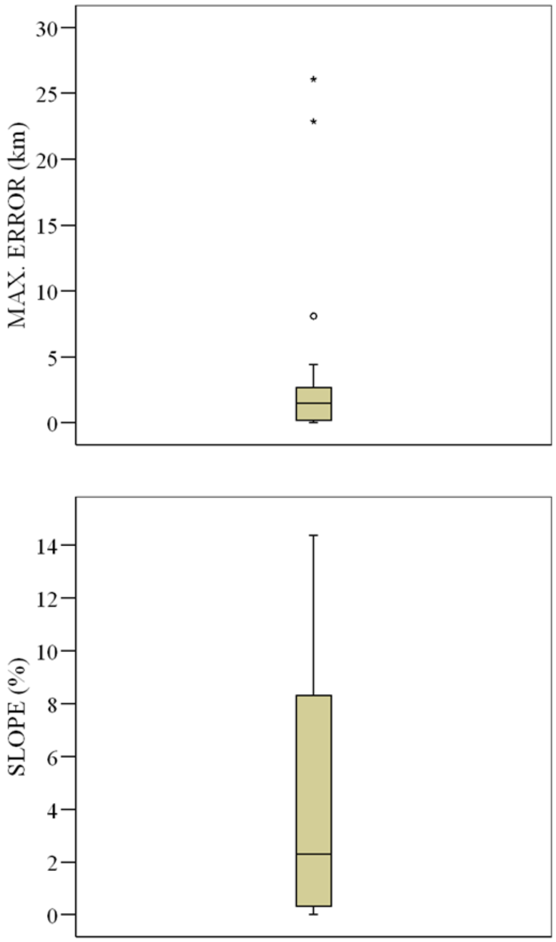


Figure 1. Map of localities of collection by month.



Figures 2a-b. Plot of georeferencing uncertainty (above, b) and average slope (below, b) values distribution for the localities where the Black-and-white Tanager (*Conothraupis speculigera*) have been recorded.

A second set of habitat suitability modeling exercises was conducted in 2011 using MAXENT 3.3.3e. This time a series of experiments were performed to test the effect of the use of the total of bioclimatic variables from WorldClim in the performance and the spatial predictions of the potential maps generated, as well as the sensitivity of models to changes in the prevalence assigned to the species. Models were produced using the 19 BioClim variables (unprojected) at ≈1 km grain size in the following manner: (1) 25 replicas evaluated with 30% of the data, using simple sub–sampling and with prevalence = 0.5 (ep05); (2) 25 replicas evaluated with 30% of the data, using simple sub–sampling and with prevalence = 0.3 (ep03); (3) 25 replicas evaluated with 30% of the data, using simple sub–sampling and with prevalence = 0.1 (ep01); (4) a unique model, no evaluated and with prevalence = 0.5 (nep05); (5) data split in Andes and Lowlands records, a unique model no evaluated in each case and with prevalence = 0.5 (nepA05 and nepL05); (6) data split in Andes and Lowlands records, a unique model no evaluated in each case and with prevalence = 0.3 (nepA03 and nepL03); (7) data split in Andes and Lowlands records, a unique model no evaluated in each case and with prevalence = 0.1 (nepA01 and nepL01). Potential range maps were produced in this case using the "equate entropy of thresholded and original distributions (EETOD) threshold value". In exercises with replicas we used the averaged raw results maps to produce presence/absence maps. Otherwise, we added linearly potential range maps generated through all the experiments to evaluate which areas were more robustly predicted as presences through all the different experiments.

Results and Discussion

First record of *Conothraupis speculigera* for Colombia

This specimen (FMNH #287617) was collected by Kjell Von Sneidern on 16th October, 1969 at San Antonio de Guamuez, Putumayo, Colombia. The specimen was originally catalogued as "*Piranga sp*." It is a bird in yellowish–green "female" plumage, but it is labeled with a question mark "?" as a male. There are no gonad data and Von Sneidern left no field notes. Von Sneidern collected intensively at this site and other species collected on the same date include species typical of both Amazonian river edge and swampy forest (e.g., *Pilherodias pileatus, Xiphorynchus ocellatus, Schistocichla luecostigma and Stelgidopteryx ruficollis*). Also collected on this date were several *terra firme* forest/bamboo specialists such as *Denconychura stichtoleama* and *Drymophila devillei*, which along with *Rhegmatorhina melanosticta* and *Ramphotrigon fusciicauda* were first records for Colombia (Fitzpatrick and Willard 1982, Stotz 1990); suggesting this is still a little explored region of the country. We also note that Von Sneidern collected Black–and–white Seedeater *Sporophila luctuosa* at this site. Witt (2005) has hypothesized that adult males of *C. speculigera* mimic males of this species. The species was previously added to the Colombian checklist and field guides based on this record (Donegan *et al*. 2009, Salaman *et al*. 2010, McMullan *et al*. 2010, 2011), but full details have not previously been published.

The Von Sneidern record constitutes an extension of the known geographical range, approximately 322 km NE from an "unnamed place" west of the Andes in Pichincha Province, Ecuador – 13.3 km E from La Bramadora (Manabi), 12.4 km NW from Consumulo (Los Rios) and 14.5 km SW from Puerto Limon (Pichincha) – (InfoNatura 2009). Additionally, this record is about 371 km from Tayuntza in Morona-Santiago, Ecuador, the nearest point where the species was reported east of the Andes (Ridgely and Greenfield 2001; Ridgely *et al*. 2005), and 398 km NNE from the expert based geographical range drawn polygon (InfoNatura 2009). This record also has other implications for the natural history of the species. The 16th October date is of note because this is outside the months that the species is generally encountered in what is currently considered to be its primary non–breeding range in Amazonian Peru

(June–September) (Schulenberg *et al*. 2010). Thus, the Colombian record may represent an important extension of the non–breeding season range of the species or may represent a migrating or vagrant individual (Fig. 3a). However, we need further surveys in that region in the Colombian Amazon to confirm one or the other hypothesis. Also, if the bird is indeed a male, this suggests that young males do not achieve adult plumage until the end of their non–breeding season.

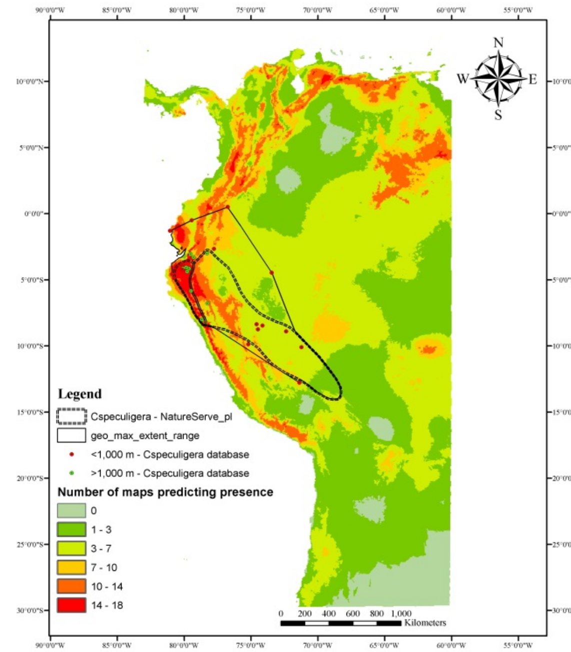
Georeferencing and slope.

The calculated error for the georeferences proved to be, in most cases, lower than 5 km (Fig. 3b). Just in four cases the positioning uncertainty attached to georeferencing was higher than this value: 1) "Macas, 54 km SE, Tayuntza, Morona–Santiago, Ecuador", 2) "Playas, 26 km SW, Loja, Ecuador", 3) "10 km N El Empalme, NE Celica, Loja, Ecuador", and 4) "10 km S Catacocha, Loja, Ecuador". The average slope across all localities was less than 15% (Fig. 1c), which corresponds to relatively flat areas where great variability in the bioclimatic variables used to conduct the niche modeling is not expected. Furthermore, when the slope map was aggregated at 25 km grain size, the mentioned localities with values of error higher than 5 km lay in areas with average slope lower than 10%.

Modeling experiments and potential distribution

During the first set of exercises, results showed that about 75% of the models had high Test AUC values, ranging those between ≈0.70–0.92, and exhibited confidence interval limits at the 95% probability for the mean between 0.731–0.763 (μ = 0.747, n = 100). Additionally, during this first phase, the two types of threshold used in our analyses to generate presence/absence maps produced differences in final results. Although in both cases selected models had high accuracy values (EETNTD ≈0.76–0.92 and ETSS ≈0.78–0.87), in general, the ETSS models showed higher values in the training omission rate than the EETNTD, while it showed lower values for the total predicted area. Thus, when used in the ETSS, training omission values exhibited confidence interval limits at the 95% probability for the mean between 0. 179–0.223 (μ = 0.201, n = 100) and predicted area values between 0. 328–0.361 (μ = 0.344, n = 100), whilst when we used the EETNTD, training omission values exhibited confidence interval limits between 0. 088–0.120 (μ = 0.104, n = 100) and predicted area values between 0. 441–0.472 (μ = 0.456, n = 100).

The presence/absence maps produced by linear addition using the ETSS threshold on the best models subset, predict as suitable the well known areas of occurrence in south Ecuador and in northwest Peru, as well as some new areas from where the species has not been recorded in northern Ecuador and in central west Peru (Fig. 3a). Thus, results predict that the Black–and–white Tanager may occur (linear addition scores ≥ 15) in Imbabura, Manabi, Guayas, El Oro and Loja provinces in Ecuador, and in Tumbes, Piura,



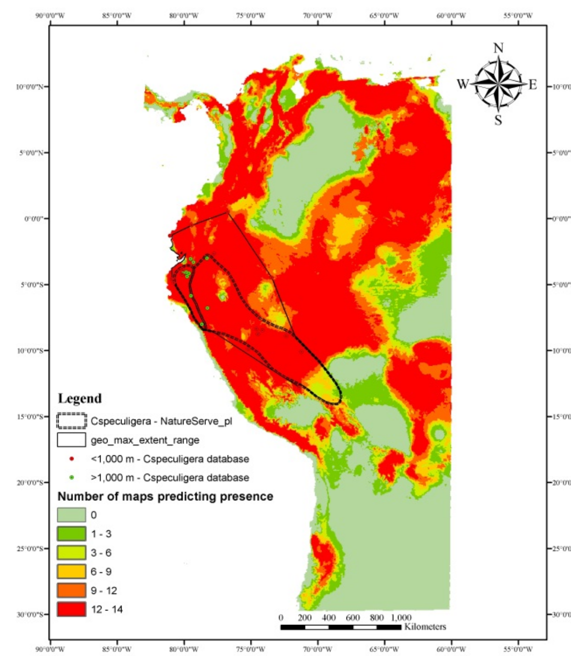


Figure 3 a-b. Potential range of *Conothraupis speculigera* modeled using MAXENT 3.2.1. Based on results from the linear addition of the best models subset, using the ETSS (a) "equal test sensitivity and specificity threshold value" and EETNTD (b) "equate entropy of thresholded and non–thresholded distributions threshold value" during the first set of MAXENT modeling experiments conducted in this study in 2008.

Lambayeque, Cajamarca, La Libertad, Ancash and Lima departments in Peru. Also, it may be present in some small and or isolated pockets in Carchi, Pichincha, Cotopaxi, Bolivar, Chimborazo, Cañar, Azuay and Zamora–Chinchipe Provinces in Ecuador and in Arequipa in southern Peru. Interestingly, Witt (2005) had documented the species in recent years in Lambayeque, and Cajamarca. Additionally, our models predict suitable habitat for the species along the Andean slopes from Colombia to Bolivia and possibly in some areas to the east of the Andes (Fig. 3a). Also the models predict the species as likely to occur (linear addition scores ≥ 8 and ≤ 14) in Nariño and Putumayo departments in Colombia; in Esmeraldas, Sucumbíos, Orellana, Tungurahua, Pastaza, Morona–Santiago and Los Rios provinces in Ecuador; in Amazonas, San Martin, Huánuco, Pasco, Junín, Huancavelica, Ica, Ayacucho, Cusco, Arequipa, Moquegua, Tacna, Puno, Ucayali and Madre de Dios departments in Peru; and in southwest Amazonas and northeast Acre states in Brazil.

Our results also identify as suitable some areas that are well outside the known range of the species. These include the Andean slopes of Colombia and Venezuela, and east of the Andes in southern Venezuela in the state of Amazonas and in Brazil in north Roraima and Amazonas states (Fig. 3a), which seem unlikely to be part of the specie's range. Additionally, suitable climatic conditions may exist in northeastern Rondonia and northwestern Mato Grosso in Brazil, and around the boundary of the departments of Cochabamba, Santa Cruz and Chuquisaca in Bolivia. Included in these areas is the only known locality for the rare, poorly known and Critically Endangered (CR) Cone–billed Tanager (*Conothraupis mesoleuca*), the only other member of the genus (BirdLife–International 2010b). Maps produced using the EETNTD predict coarsely suitable areas for the species in both the Andes and the Lowlands that are of much less specificity than the ones obtained using the ETSS threshold (Fig. 3b).

During the second set of modeling exercises, results showed that models generated had a significant better performance than those models produced above. Thus, average Test AUC values obtained for the first three experiments with evaluations and replicas (ep05, ep03 and ep01) ranged between 0.842–0.871. Those values are well above average values observed for the earlier models and were not different among them (Confidence Interval of the Mean, all P < 0.05), suggesting no sensitivity in model performance to changes in the prevalence of the species (Fig. 4a). Furthermore, average Training AUC showed values even higher than these, becoming particularly high in experiments conducted only using Andean records (nep05A, nep03A and nep01A) (Fig. 4b). On the other hand, using the EETOD threshold value, the average training omission showed values in the same ranges, although values of omission tended somehow to be slightly lower than those observed previously (Fig. 4c), while predicted area was significantly lower in all experiments, with exception of those conducted only using Lowland records (nep05L, nep03L and nep01L) (Fig. 4d). It is important to highlight that similarly to what was observed for the AUC, the training omission and the predicted area showed no sensitivity to changes in the prevalence of the species (Confidence Interval of the Mean, all P < 0.05).

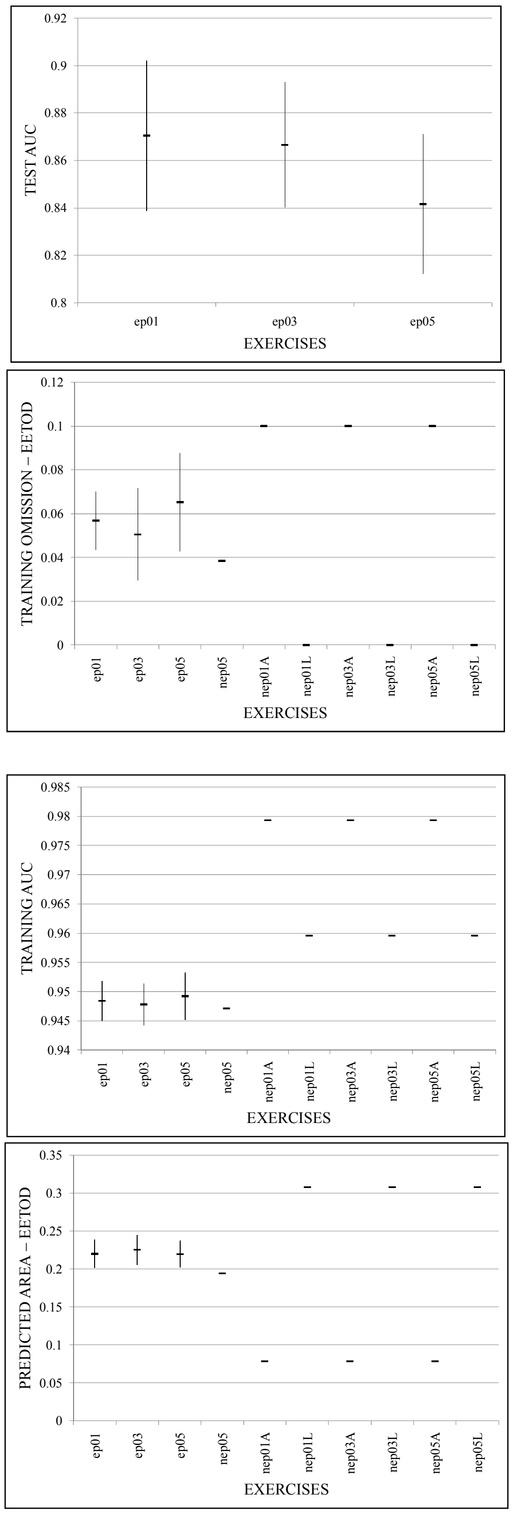
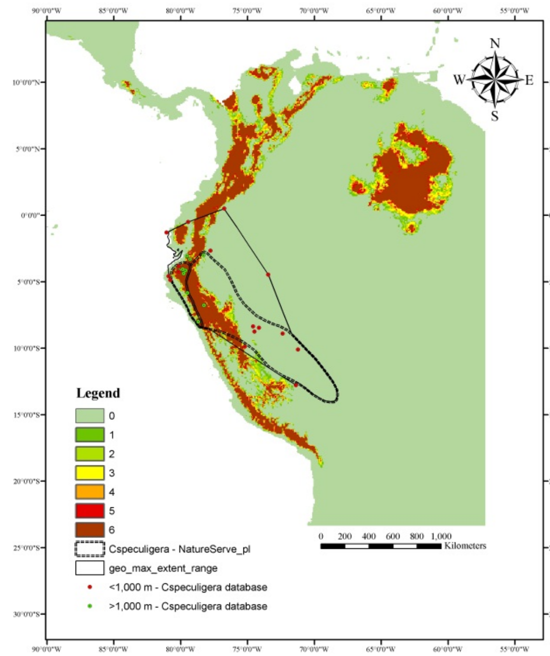
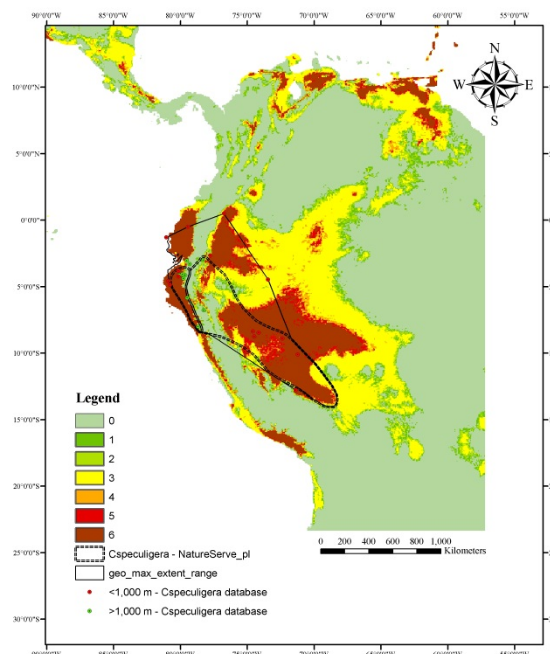


Figure 4 a-d. Performance of MAXENT 3.3.3e models during the second set of modeling experiments to model the potential range of the Black-and-white Tanager (*Conothraupis speculigera*). Test AUC (a, above), Training AUC (b, second from above), Training Omission (c, third from above), and Predicted Area (d, fourth from above). In case there were replicates in a single experiment are plotted the confidence intervals of the mean at the 95% probability. Exercises key: e= evaluated, ne = not evaluated, p01 = prevalence 0.1, p03 = prevalence 0.3, p05 = prevalence 0.5, A = Andes and L = Lowlands (for more details see text).

During this second stage, spatial predictions of suitable habitat for the Black–and–White Tanager were more robust between the different experiments and more restricted spatially, particularly in the Lowlands (Fig. 5a). Some areas became better defined as suitable in the eastern slope of the Peruvian Andes, from the department of Amazonas to the department of Madre de Dios, in the departments of Acre and Amazonas in Brazil and in some areas in southern Venezuela (Fig. 4a). Otherwise, when data was split in Andes and Lowland records, habitat suitability maps generated using only Andean data showed similar areas predicted for presence as before (Fig. 5b), while maps generated using only Lowland records resulted in more robust predictions than before; particularly in adjacent areas to the Andes in Ecuador and northern Peru, further south in Peru from the departments of San Martin and Loreto to the department Madre de Dios, and extending further in some areas of the departments of Acre and Amazonas in Brazil (Fig. 5c).





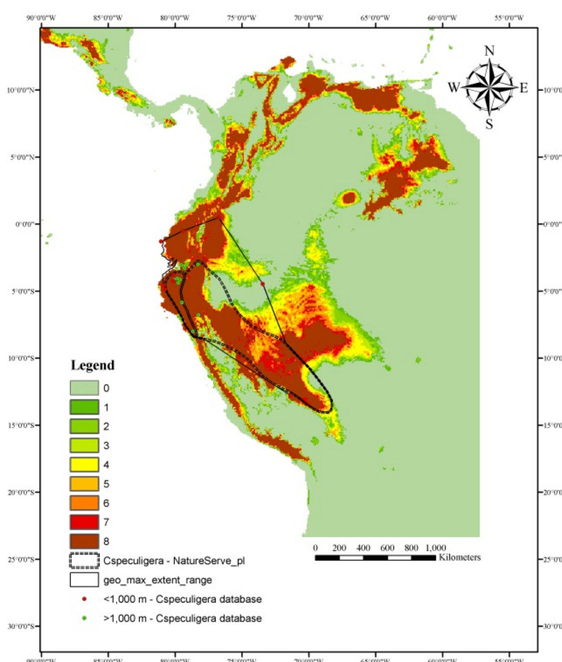


Figure 5 a-c. Potential geographical range of the Black–and–white Tanager (*Conothraupis speculigera*) modeled using MAXENT 3.3.3e. Based on results from the linear addition of presence/absence maps obtained using the EETOD "equate entropy of thresholded and original distributions" threshold value during the second set of MAXENT modeling experiments. Models were generated using the totality of data in the database (a) and splitting the data in Andes (b) and Lowlands (c) records.

There is clearly much to be learned about *C. speculigera* and its sister taxon *C. mesoleuca*. This new record for Colombia, once again, illustrates the long–term value of general collecting. The use of habitat suitability modeling provides new insights into additional areas where this species might occur seasonally based on the currently available data. However, seasonal disappearances in some areas and heavy fat loads suggest migratory movements that may still not be effectively incorporated into the current modeling.

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