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HABITAT MODELING OF DAHL'S TOAD-HEADED TURTLE (*MESOCLEMMYS DAHLI*) IN COLOMBIA

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***Abstract.*—Dahl's Toad-headed Turtle (*Mesoclemmys dahli*) is an endemic and threatened species from Northern Colombia. It was originally described by Zangerl and Medem (1958) but information on its distribution, natural history, and ecology has been limited. Recent research and conservation efforts have contributed to the identification of new populations and a broader understanding of its natural history. There is, however, no quantitative assessment of the species' potential distribution in Colombia, or studies of the factors that make certain areas suitable for the species. This type of information is important for developing and continuing species-specific conservation strategies. We modeled the habitat distribution of *M. dahli* at three spatial scales. We first modeled the species geographic distribution at an ecoregional scale in Colombia using presence-only data (known localities) and a maximum entropy (Maxent) model. Second, we evaluated the factors that differentiate the first order streams where the species occurs vs. those where it is absent at the locality of Chimichagua, Cesar (9°17.717'N, 73°47.741'W), during the dry season (December to March). Finally, we evaluated the habitat variables associated with the presence of turtles at trap sites within the streams in Chimichagua. Our model predicts the presence of this species in seven departments in Northern Colombia, occupying an area of about 32,700 km^2. This estimate of the range represents a potential range extension of approximately 9,000 km^2 compared to the previously known distribution. The model, however, does not inform us about habitat quality or abundance of the species throughout this range. The tropical dry forest ecosystem, which was the most important variable explaining the species range, has been heavily transformed by human activities and is remarkable for its low level of formal protection. In Chimichagua, the species was associated with first order streams (1–10 m width), with slow flowing (< 0.22 m/sg) and dark water (< 32 cm clarity). In this same locality, within the streams where it occurs, the species was associated with portions of the stream that had considerable (> 82%) canopy cover and pools deeper than 78cm. This highlights the importance of the riparian vegetation for the species.**

Key Words.—classification trees; Colombia; distribution; geographic range; habitat; Maxent model, *Mesoclemmys dahli*.

INTRODUCTION

Species distribution models have become increasingly important as a tool in conservation planning (Guisan and Thuiller 2005). For studies of imperiled species, these models can provide information on potential areas of occurrence, on the impacts of human activities in their geographic distribution, and/or help to determine potential survey locations (Guisan and Thuiller 2005) guiding decisions for conservation planning (Ferrier 2002). In our study, we use a combination of a Maxent model, Generalized Linear Models, and Classification and Regression Trees (CART) to examine the geographic range and characteristic habitat of Dahl's Toad-headed Turtle *Mesoclemmys dahli* (Zangerl and Medem 1958; Fig. 1) in Colombia. This species is endemic to northern Colombia and is restricted to a small geographic area. For more than 40 years after its description (Zangerl and Medem 1958), it was only known from the region of the type locality, with all observations (< 10) restricted to the department of Sucre (Medem 1966; Ernst and Barbour 1989; Iverson 1992; Ceballos-Fonseca 2000). It was later found to occur in the departments of Córdoba, Bolívar, and Atlántico (Castaño-Mora and Medem 2002; Rueda-Almonacid et

FIGURE 1. Juvenile *Mesoclemmys dahli* from Chimichagua, Cesar, Colombia. (Photographed by Guido F. Medina-Rangel).

al. 2007), and it was suspected to occur in other departments from the Caribbean coast, namely Cesar and Magdalena (Castaño-Mora and Medem 2002).

The IUCN ranked *Mesoclemmys dahli* as Critically Endangered (CR) under criteria B1+2c (IUCN, IUCN Red List of Threatened Species. Version 2012.1. 2012. Available from http://www.iucnredlist.org [Accessed 04 September 2012]), while the Red List of Colombian Reptiles designated it as Vulnerable (VU; Castaño-Mora and Medem 2002). The difference in ranking was due to the suspected but unconfirmed presence of the species at some localities at the time of the national assessment. Recently, a population was identified outside the previously known range in the department of Cesar (Medina-Rangel and Forero-Medina 2008; Fig. 2), confirming the suspicion that the range was larger than originally thought.

The high threat level attributed to *M. dahli* is primarily due to its restricted distribution (< 30,000 km^2) and the decline on the quality of its habitat (e.g., loss of vegetation cover, fires, and land use changes). The species inhabits slow-moving watercourses, including quiet pools in first order streams, ponds, creeks, and cattle tanks in open pastures, in the "*zonobioma seco tropical del Caribe*," or tropical dry forest biome (Castaño-Mora and Medem 2002; Rueda-Almonacid et al. 2007; Fig. 3). This biome has been subjected to increasing destruction, fragmentation, burning, and alteration for human uses, such as pastures and agriculture (Instituto de Hidrología, Meteorología y Estudios Ambientales [IDEAM] et al. 2007) and has a remarkably low level of formal protection (Forero-Medina and Joppa 2010). The species is also occasionally consumed by local fishermen (Rueda-Almonacid et al. 2004).

A better understanding of the species' distribution in Colombia is required to estimate the size of its range and to reconcile the differences between the national and global Red List ranks. This understanding is also important for developing national and regional conservation strategies, such as creating protected areas for the species or restoring degraded habitat. As this species has disappeared from the type locality (Castaño-Mora and Medem 2002), only a few populations are currently known. Thus, information on the potential distribution of this species can also guide the search for new populations in Colombia.

Recent studies have gathered information on new localities, abundance, population structure, and diet of *M. dahli* in the department of Córdoba (Rueda-Almonacid et al. 2007; Rueda-Almonacid et al. 2004). Our study addresses the unresolved issue of the species geographic distribution and quantitatively characterizes species habitat. We examine the distribution of *M. dahli* in Colombia at three spatial scales. First, we identify the species distribution at a broad, ecoregional scale, using

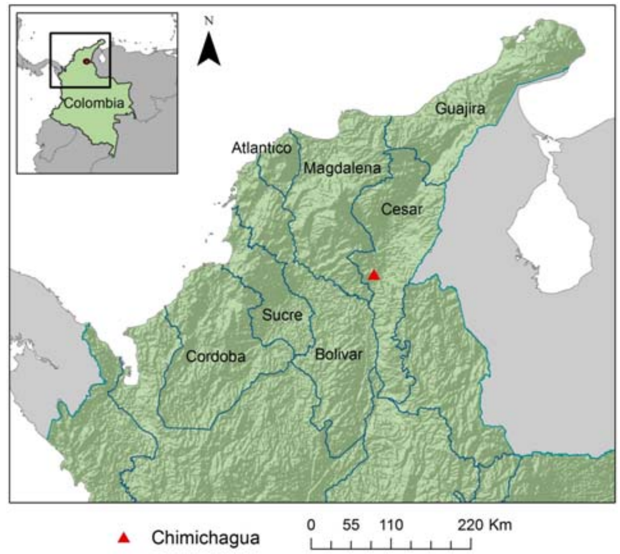

FIGURE 2. Northern Colombia and the study site, Chimichagua, in the department of Cesar.

environmental variables at the corresponding resolution (500 m) to determine which of these variables affect the species distribution at this scale. Second, at a local scale, we investigated the factors that determined the presence of *M. dahli* in particular streams while other streams were not occupied. We examined the variables associated with the presence or absence of *M. dahli* in first order streams in the locality of Chimichagua, Cesar (Fig. 2) during the dry season (December to March). Finally, within those streams where the species occurred, we evaluated the conditions associated with the presence and absence of individuals at trapping sites. A better understanding of habitat suitability characteristics along specific stream reaches will help manage these areas.

MATERIALS AND METHODS

Study site.—We used locality records spanning years 1958–2009 from the departments of Córdoba, Sucre, Bolivar, Atlántico, and Cesar in northern Colombia (Fig. 2). This region corresponds to the tropical dry forest formation, which has an average temperature of 24° C and annual precipitation between 700 and 2,000 mm, with one or two dry seasons per year (Espinal 1985; Murphy and Lugo 1986). The data used for the analysis of stream and site selection within streams corresponds only to the locality of Chimichagua, department of Cesar, Colombia (9.28°N, 73.79°W), where we have conducted a mark-recapture study since 2008 (Fig. 2).

Regional distribution.—We developed a predictive model for the regional distribution of *M. dahli* using a maximum entropy method (Maxent; Phillips et al. 2006),

FIGURE 3. Two streams sampled for the presence of *Mesoclemmys dahli* in Chimichagua, Cesar, Colombia. Top: species presence verified. Bottom: species presence not recorded. (Photographed by German Forero-Medina).

data corresponding to 144 known locality points for the species in Northern Colombia, and 11 environmental variables. For the maximum entropy estimation, the true distribution of a species is represented as a probability distribution over the set of sites in the study area (Phillips and Dudík 2008). We obtained locality points from the literature (Rueda-Almonacid et al. 2004; Rueda-Almonacid et al. 2007); from our own records (Castaño-Mora et al. 2005), and from captures we made in the department of Cesar (Forero-Medina et al. 2011). The environmental variables we used for analyses of the regional distribution were: (1) elevation (m); (2) slope of the terrain (degrees); (3) distance to lentic water bodies (m); (4) distance to lotic water bodies (m); (5) ecosystem type; (6) annual mean temperature (° C); (7) temperature seasonality (standard deviation x100); (8) minimum temperature of coldest month (° C); (9) maximum temperature of warmest month (° C); (10) annual precipitation (mm), and (11) precipitation seasonality (Coefficient of Variation; IDEAM et al. 2007; Jarvis et al. 2008). The last six variables correspond to bioclimatic variables from WorldClim version 1.4 (Hijmans et al. 2005). We conducted all spatial analysis using ArcMap version 9.3 (Environmental Systems Research Institute [ESRI], Redlands, California, USA), and the maximum entropy modeling using the Maxent software (Phillips et al. 2006). We used 20% of the data as test data for the Maxent model, and estimated response curves for the variables, as well as jack-knifed tests for evaluating the importance of each predictor (Phillips et al. 2006). In the jack-knifed test, models are created in an iterative process, with and without each variable to determine its contribution to the model (Phillips et al. 2005). We selected the best cut-off probability value as the one that maximized sensitivity (the true positive rate) plus specificity (true negatives; Phillips et al. 2006). In this case, we defined specificity using predicted area rather than true commission (Phillips et al. 2006). We used this threshold value for converting the prediction probabilities of the model into a binary classification of habitat for the species (Peterson et al. 2008).

Stream selection.—We sampled seven first order streams in the locality of Chimichagua, Cesar, where we have been conducting a mark-recapture study since 2008 as part of a monitoring program for the species (Forero-Medina et al. 2011). The method for capturing turtles along the streams consisted of setting two parallel 10 m × 2 m seine nets (2.5-cm mesh size), enclosing a 20 m portion of the stream, and then directing the turtles into the nets by beating the water. We then moved forward along the stream and repeated the process. The nets were placed in the streams making sure that the weights at the bottom always touched the bottom of the stream, while the top was floating on the surface. At each trap site, we measured 10 habitat variables: (1) type of water body (e.g., continuous stream, isolated pool within stream, or isolated pond outside any stream); (2) type of vegetation predominant in a 10 m buffer from the edge (e.g., herbaceous, mixed herbaceous, mixed with shrubs predominant, mixed with trees predominant); (3) water flow rate (m/sg); (4) maximum depth of pool (cm); (5) maximum width of pool (cm); (6) presence/absence of basking sites; (7) presence/absence of submerged roots from trees or other vegetation; (8) superficial water temperature (° C) at the time and site of capture; (9) water clarity (cm) measured with a Secchi disc; and (10) percentage canopy cover (estimated percentage covered by riparian vegetation over the area sampled). We sampled each stream at least three times throughout the dry season to confirm the presence/absence of the species. Each sampling consisted of walking and setting the nets along approximately 1 km for each stream. The species was present in only two of the seven streams sampled. We used only data collected during the dry season for the stream selection analysis, while we excluded data collected during other seasons (only at the streams where the species occurred) from this analysis to avoid confounding effects caused by temporal differences in depth and water clarity related to rain patterns. The species is not hunted for human consumption in this locality, so we assumed that the absence of turtles at some streams was due solely to biological (or habitat) factors and not anthropogenic ones.

To investigate how the inhabited streams differed, we used logistic regression, a common form of General Linear Model (GLM) in ecological applications (Yee and Mitchell 1991). To determine which variables were important for differentiating the streams, we also used classification and regression trees. Classification and regression trees (CART) are a flexible and robust analytical method for distinguishing differences among groups, and can deal with non-linear relationships, high-order interactions, and missing values (De'ath and Fabricius 2000). The result is a binary decision tree, which ultimately allows for the classification of new data (Vayssiéres et al. 2000). All analyses were conducted using R version 2.9.1 (R Development Core Team, Vienna, Austria) and the contributed package rpart (Therneau et al. 2008).

Habitat associations within streams.—We examined if the presence/absence of the species at trap sites within the two inhabited streams was related to differences in habitat variables. For this analysis, we used only samples from the two streams where *M. dahli* was recorded year round and the variables measured at each trap site, as previously described. Samples included trap locations where the species was found and trap locations where it was not captured. We used the CART analysis in combination with Maxent to identify the variables that were most important for explaining the presence of individuals at trap sites along the stream, and to develop a model to classify new data as presence/absence for the species. For the Maxent analysis, we used the capture sites (locations) as samples and the complete set of sampled locations were used as background data. We post-processed the logistic predictions resulting from the Maxent model to identify the best cut-off value for converting the prediction probabilities from the model into a binary classification of habitat. We identified the best cut-off value using a function that maximizes the sum of sensitivity and specificity (true positives and true negatives). To run this function, we used data on presence (captures) and absence at sampling sites. Therefore, although absences were not used for the Maxent model of habitat, they were used to tune the logistic predictions. Finally, we generated a confusion matrix with the model fits and the actual data, to estimate an index of accuracy. We conducted post-processing analyses using R version 2.9.1 and the contributed package ROCR (Sing et al. 2005).

RESULTS

Regional distribution.**—**We used the obtained threshold value (0.132) to generate a binary prediction (habitat/non-habitat) map for the habitat of *M. dahli* in the study area. The map of the distribution indicates the probability value (range 0.13–0.95) for the area considered as habitat according to the threshold (Fig. 4). The species distribution range resulting from the Maxent model indicates the presence of the species in the departments of Antioquia, Bolívar, Córdoba, Sucre, Atlántico, Magdalena and Cesar (Fig. 4). The total area of this range is around 32,700 km^2.

The area under the curve for the test data was 0.99, with the model classifying successfully 100% of the true positives. The environmental variables with the highest relative contributions to the Maxent model were ecosystem type (30.4%), elevation (23.9%), precipitation seasonality (22.7%), and temperature seasonality (10.2%). The results for the jackknifing procedure showed that the variable with the highest gain used in isolation was ecosystem type followed by annual precipitation. Ecosystem type was also the environmental variable that decreased the gain the most when it was omitted according to the jackknife results.

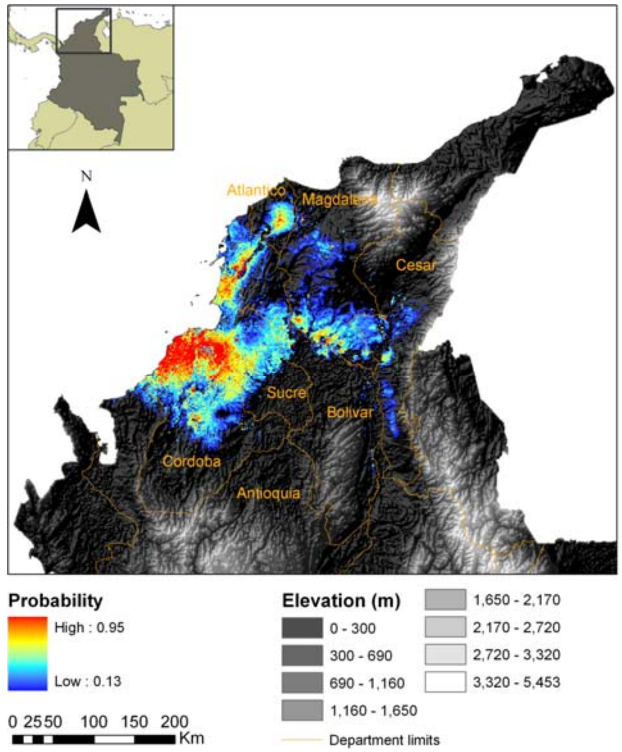

FIGURE 4. Result from the habitat distribution model for *Mesoclemmys dahli* in Colombia using Maxent. The range is presented only for the areas with a probability higher than the selected threshold of 0.132.

Stream selection.**—**The fitted model resulting from the stepwise regression was significant ($P < 0.0001$) and explained 43% of the variation in the response variable (presence in a first order stream; $r^2 = 0.429$). The model only retained seven variables, from which five were significant; water flow rate, maximum depth, water clarity, stream width, and vegetation type (Table 1). The best cut-off according to the maximization function was 0.83. Classification of the probabilities using this value as threshold resulted in a success of 78%, based on the confusion matrix.

The CART analysis resulted in a pruned tree with three branches, with a classification success of 87%, based on the confusion matrix generated by comparing the predicted values with the data. The most important variables for classifying the streams (presence of *M. dahli*/absence of *M. dahli*) were water flow rate and water clarity. The classification tree indicates that presence of the species was associated with flow rates of less than 0.22 m/sg and water clarity less than 32 cm. These results agree with the results from the GLM, which included these two variables.

Habitat association within streams.**—**The maximum entropy model had an area under the curve of 0.72. Comparisons of the predictions from the model with the data using the selected threshold (0.44) resulted in a classification success of 79%. The environmental variables with the highest relative contributions to the Maxent model, most associated with turtle presence at trap sites, were canopy cover (35.7%), and vegetation type (29.3%). These variables also appeared as having the most useful information by themselves and the most information that was not present in the other variables in the jackknife test of variable importance. Other variables that had important relative contributions were superficial water temperature at trapping site (12.9%), water flow rate (11.5%), and maximum stream depth (6.9%).

The classification tree had a classification success of 79% when comparing the predictions from the model with the observed data. The tree shows that the most important variable was canopy cover (Fig. 5), with species presence along the stream associated with sites that presented a canopy cover higher than 82.5%. Within these sites, presence was related to a maximum depth greater than 78 cm. There was also a positive and significant correlation between carapace length (CL) and water depth ($r = 0.42$; $t = 3.33$, df = 52, $P = 0.001$). According to the classification tree, the few presences at sites with low riparian canopy cover were associated with vegetation dominated by shrubs or herbaceous plants, to water temperatures higher than 26.15° C

TABLE 1. Results from the GLM logistic regression for classifying the sampled streams in Chimichagua, Colombia, according to presence and absence of *Mesoclemmys dahli.*

Variable	Estimate	Std. Error	Deviance	*P*
(Intercept)	-19.7	2103		0.99
Type	18.4	2100	8.41	0.99
Vegetation type	1.35	0.680	0.73	0.047
Water flow rate	-0.589	0.286	4.77	0.001
Maximum depth	0.054	0.015	16.79	0.000
Percent canopy cover	-0.024	0.014	1.19	0.098
Water clarity	-0.058	0.021	3.61	0.019
Width	-0.006	0.002	7.95	0.008

and water clarity higher than 16.6 cm (Fig. 5).

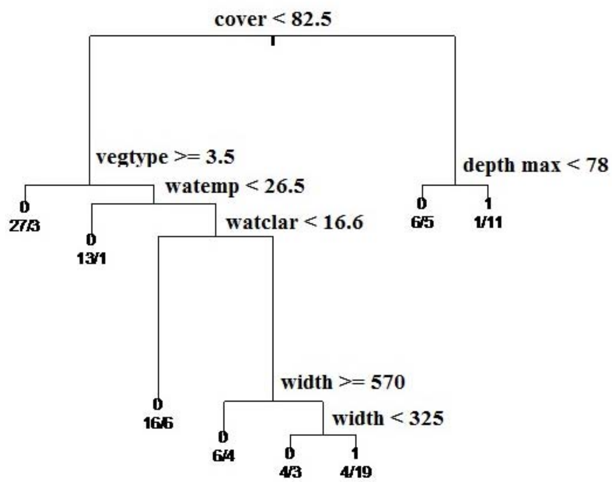

FIGURE 5. Classification tree for trap sites within the two streams where *Mesoclemmys dahli* occurs in Chimichagua, Cesar, Colombia. Ones indicate presence of *M. dahli* on the trap site; zero indicates the species was not captured at that trap site. Variables correspond to the splits of the data into the binary classification. Variables in higher positions are more important.

DISCUSSION

Regional distribution.—This study provides an extended, up to date, geographic distribution map for the species, which includes the departments of Magdalena, Cesar and a small portion of Antioquia. This last department does not have any records for the species and its presence here should be confirmed with field surveys. The estimated expansion of the range into the departments of Magdalena and Cesar represents a potential increase of > 9,000 km^2 from its previous known range. The modeled distribution of *M. dahli* is restricted to the Caribbean region of Colombia and lies within the tropical dry forest biome. The range of the species seems to be limited to the east by the eastern branch of the Andes, the Cordillera Oriental ranges. To the west, the range is constrained by the transition of the dry forest into more humid ecosystems. *Mesoclemmys* species are known to have restricted distributions, in some cases strictly tied to certain ecosystems (Bour and Zaher 2005). Such is the case of the Tuberculate Toad-headed Turtle (*Mesoclemmys tuberculata*), whose range coincides with the *Caatinga* ecosystem in Brazil, or the Common Toad-headed Turtle (*Mesoclemmys nasuta*) and Hoge’s Side-necked Turtle (*Mesoclemmys hogei*), which have relatively small, isolated ranges (Rhodin et al. 1982; Bour and Zaher 2005).

The most important variable for classifying the species distribution at the regional scale was ecosystem type. Most of the localities occurred in ecosystems within the biome *zonobioma seco tropical del caribe*, which is the tropical dry forest, or ecosystems within the biome *helobioma del Magdalena y el Caribe*, which corresponds to areas with poor drainage, that are temporally or permanently flooded (IDEAM et al. 2007). The Caribbean tropical dry forest is influenced mostly by climatic conditions. This in turn determines the vegetation types, with dominance of the families Leguminosae and Bignoniaceae (Mendoza-C. 1999).

The second biome, *helobioma del Magdalena y el Caribe*, is more influenced by characteristics of the soil, in this case type of soil and hydrologic factors determine the vegetation. This combination of climatic and edaphic controlling factors may explain the dominance of ecosystem type over the climatic variables in the model. Other important variables were elevation and seasonality of precipitation and temperature. The species presented the highest probability of presence for a standard deviation of approximately 4.5° C, meaning it tolerates a limited range of temperature changes between the coldest and the hottest months. This may be because the species does not bask above the water surface as regularly as other tropical or subtropical species from the Chelidae family (Webb 1978; Souza and Abe 2001); therefore reducing its potential for thermoregulation, and being more limited by temperature fluctuations. However, there may be sub-surface basking acting as an alternative means of thermoregulation (Chessman 1987). The study of the thermoregulatory behavior of the species would help understand its potential role on the tolerance of different levels of temperature seasonality.

For precipitation, the coefficient of variation suggests the species tolerates a monthly variation close to 60% of the mean value. Precipitation is an important factor for freshwater turtles. It determines the availability of ephemeral ponds and water productivity. Seasonality in climatic conditions can affect the activity patterns of South American species within the family Chelidae (Souza 2004). It can also affect periodic process like reproduction (Kennett and Georges 1990) or aestivation (Grigg 1986). The behavior and habitat requirements of *M. dahli* may be coupled to the seasonal variation in rainfall of the tropical dry forest (Rueda-Almonacid et al. 2004; Forero-Medina et al. 2011).

Our results indicate that the extent of the potential distribution is around 32,700 km^2, occurring over seven departments. The model predicts absence of the species in the large marsh complexes from the Cesar River (Cienaga de Zapatosa) and lower San Jorge River. This agrees with previous descriptions of the species habitat (Rueda-Almonacid et al. 2007). Fishermen who work in these large lakes do not know the species and say it is not caught in fishing nets. In comparison, its close relative, the Zulia Toad Headed Sideneck (*Mesoclemmys zuliae*) from Venezuela inhabits the marsh systems of the Maracaibo basins (Rojas-Runjaic 2009).

We propose that our map (Fig. 4) constitutes an important reference for searching new populations of this species, which was long believed to have a very restricted distribution in Colombia. The predicted distribution is also a key tool in the reassessment of the IUCN threat category for the species. Results from this study along with the research conducted in other portions of the range (Rueda-Almonacid et al. 2004; Rueda-Almonacid et al. 2007) may lead to a change in the category of the species. *Mesoclemmys dahli* is listed as critically endangered due to a very small extent of occurrence (< 100 km^2) or area of occupancy (< 10 km^2). The area of occupancy estimated using all locations and a 4 km × 4 km grid as recommended by the IUCN would be approximately 1,100 km^2. If model predictions are correct, the range of the species is larger than previously believed. However, although the model indicates a range extension, it does not inform us about the quality of the habitat across this range, which lies entirely within highly transformed, cultivated, and regularly burned areas, that are intensively used for cattle. The viability of populations in such unnatural habitat is unknown. Clearly, the species is now surviving in what is not its original habitat (Medem 1966; De la Ossa-Velasquez 1998). The tropical dry forest ecosystem, although heavily transformed by human activities, is still under represented by Colombia's protected area network (Forero-Medina and Joppa 2010). This highlights the importance of considering the number of individuals and viability of the populations when determining the IUCN category, and not only the species geographic distribution.

Stream selection.—In Chimichagua, *M. dahli* occupied small streams and occasionally, isolated ponds in cattle pastures. These streams seem to be very similar in environmental conditions to streams where the species was absent. However, according to our results, the species is present in streams where the water is more still and presents greater turbidity (related to suspended soils). This may favor the cryptic habits of this species. Streams where it occurs were also wider, and had deeper pools compared to the ones where it was absent. It is a combination of adequate depth, turbidity, flow rate, and vegetation cover that characterizes the streams where *M. dahli* occurs. Species of *Mesoclemmys* are known to inhabit small streams and lakes, but quantitative information on habitat selection is usually very limited (Barrio-Amorós and Narbaiza 2008). Habitat variables like presence of spring-fed pockets of shallow water, the type of substrate, the type of dominant vegetation, water depth, and velocity have been related to local abundance of freshwater turtles (Chase et al. 1989; Reese and Welsh 1998). Our results confirm the association of *M. dahli* with waters with high turbidity (Ernst and Barbour 1989). The variable percentage of canopy cover appears to be a significant variable in the results from the GLM, which indicates that the riparian vegetation is also important to some degree for stream selection; it can affect the water temperature as well as provide refuges.

Habitat association within streams.—The trap sites along the streams where turtles were captured differ in their characteristics from the locations where no turtles were found. The most important variables explaining these differences were canopy cover and vegetation type. Turtle presence is associated with places with high percent cover by riparian vegetation (> 82%). This confirms the importance of the maintenance of the riparian vegetation along the streams. Riparian vegetation is important for many species of freshwater turtles, providing habitat, protection, and nesting sites (Bodie 2001). Our results also indicate that conservation plans oriented to the recovering of the riparian vegetation along the streams where the species occurs, like the ones that have been conducted in Córdoba (Rueda-Almonacid et al. 2004), are adequate strategies that must be included in the management of this species. Deeper pools (> 78 cm) were also associated with the presence of *M. dahli* at trap sites. However, juveniles inhabit smaller, shallower parts of the stream while adults seem to be selecting relatively deeper parts of the streams, as was confirmed by the positive correlation between water depth and carapace length.

The CART analysis allowed for a more detailed understanding of the interactions among the variables influencing the presence of turtles at different locations along the streams. When found in locations of low canopy cover, presence of turtles was associated with high temperature and clear water. This may indicate that they are selecting specific places for thermoregulation. Because this cryptic species does not seem to bask aerially, underwater thermoregulation may be important. More open, exposed locations with clear water allow more sunlight and heat to reach the water, providing better conditions for underwater thermoregulation. Water temperature can be an important variable determining body temperature of aquatic turtles, mainly for species that are thermoconformers (Souza and Martins 2006). The species may prefer sites with high canopy cover for foraging, but may benefit, or even require occasional gaps on the riparian vegetation for thermoregulatory activities. Further research is required.

The most important variable defining the distribution of *M. dahli* at a regional scale is ecosystem type. *Mesoclemmys dahli* was highly associated with the tropical dry forest formation in the Caribbean region of Colombia. Elevation, a relatively low seasonality in monthly temperature, and a considerable variation in monthly precipitation were also associated with the distribution of *M. dahli* in the ecoregion. At a more local scale, the species is associated with deeper streams with slow moving and turbid water. In such streams where the species is known to occur, it prefers sites with high canopy cover by the riparian vegetation and deeper pools. Understanding the factors associated with the species' habitat at different scales can help to include the species and its habitat in multi-species conservation efforts (Compton et al. 2002). In addition, knowing the conditions that define suitable sites for the species will permit the design of proper conservation efforts oriented to improving the quality or quantity of habitat for the species.

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