Herpetological Review, 2018, 49(1), 5–12.
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Are We Ready for Successful Apex Predator Conservation in Colombia? Human-Crocodilian Interactions as a Study Case

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"Human-wildlife interactions" are defined by positive and negative encounters between humans and wildlife, followed by an assessment of what occurred (Organ et al. 2006; Frank 2016). A more informed understanding of these interactions should allow better conservation planning and management. However, many actual management scenarios only consider negative interactions (Redpath et al. 2015). This creates the use of quick technical (e.g., translocation of nuisance animals) or lethal measures (e.g., killing the animal) rather than employing tolerance and/or coexistence solutions (Carter and Linnell 2016). In many cases this can cause more harm than good to humans and wildlife and does not resolve the root of the conflict (Fisher 2016; Pooley et al. 2017).

Humans have been interacting with crocodilians throughout recorded history (e.g., rock paintings, ancient written documents), often attaching cultural significance as well as using them as

sources of meat, leather, and medicine (Webb 2014; Pooley 2016). However, as several crocodilian species became locally extinct due to overhunting during the 19th and 20th centuries (Thorbjarnarson 1999), human-crocodilian interactions became less frequent and the local common knowledge of how to coexist with them slowly vanished (Balaguera-Reina and Gonzalez-Maya 2010). Data collected from the Colombian Caribbean showed a negative relationship between general ecological knowledge regarding crocodilians and the age of the person interviewed, mainly because the lack of interaction of the young population with these species (Balaguera-Reina and Gonzalez-Maya 2010). Thus, effective communication, education, and public awareness programs could help to recover knowledge and transform attitudes towards crocodilian conservation (van der Ploeg et al. 2011).

Crocodilians commonly play an important role as apex predators in the communities and ecosystems where they belong, regulating other populations (Grigg and Kirshner 2015). The lack of apex predators has caused drastic changes functionally and structurally in the ecosystem (Prugh et al. 2009), having important repercussions for humans regarding ecosystem services (e.g., fishing; Medem 1981). Fruitful efforts in many parts of the world to preserve, restock, and sustainably use these species started between 1960 and 1980 with a subsequent increase in population numbers of several species in countries such as the United States (American Alligators, *Alligator mississippiensis* and American Crocodiles, *Crocodylus acutus*; Elsey and Woodward 2010; Thorbjarnarson 2010), Mexico (Morelet's Crocodile, *Crocodylus moreletii*; Platt et al. 2010), Argentina (Broad-snouted Caiman, *Caiman latirostris*; Verdade et al. 2010), South Africa (Nile Crocodile, *Crocodylus niloticus*; Ferguson 2010), and Australia (Saltwater Crocodile, *Crocodylus porosus*; Webb et al. 2010). However, as crocodilians start to recolonize habitats where they were previously extirpated, as well as colonize new areas near people (e.g., towns, cities), conflicts are bound to arise due to local communities not knowing how to share the space and resources in a safe way with these species (Balaguera-Reina and Gonzalez-Maya 2010).

Species such as the American Crocodile, the Orinoco Crocodile (*Crocodylus intermedius*), and the Black Caiman (*Melanosuchus niger*) were locally extirpated in the 19th century from large areas in Colombia in the Magdalena, Orinoco, and Amazonas rivers, respectively, to supply the European leather market (Medem 1981). These species persisted in small rivers, creeks, and swamps away from human habitation. However, federal protection (e.g., hunting ban, protected areas, farming; Balaguera-Reina and Densmore 2014) as well as conservation practices developed in specific areas of the country (e.g., Cispata and Portete Bays, Ulloa-Delgado and Sierra-Diaz 2008; Gomez-Gonzalez et al. 2017) over the past 40 years have allowed crocodilian species to increase population numbers and recolonize habitats from which they were eradicated (Balaguera-Reina et al. 2015). These policy changes have coincided with an increasing number of human-crocodilian conflict reports by media and scientific literature (Balaguera-Reina 2012a), which is of concern when attempting to create integrative conservation and coexistence practices.

Colombia has one of the richest crocodilian faunas in the world with six out of the 24 currently described species (American and Orinoco crocodiles, Black Caiman, Spectacled Caiman [*Caiman crocodilus*], Cuvier's Dwarf Caiman [*Paleosuchus palpebrosus*], and Schneider's Smooth-fronted Caiman [*P. trigonatus*]; Medem 1981). Of the native Colombian crocodilians, American Crocodiles are most commonly involved in attacks on humans and translocations (nuisance animals being moved either to wildlife centers or areas not inhabited by humans; Balaguera-Reina 2012a) and the Spectacled Caiman is commonly the subject of illegal trafficking (Balaguera-Reina and Densmore 2014). Some 48 million people also live in Colombia (DANE 2016), of which over 30% inhabit rural areas (PNUD 2011); furthermore, there may be up to 400,000 people dependent on fisheries (Ustate-Duarte ND). Colombia has an area of ~ 1.14 million km^2, of which ~ 9,500 km^2 represent coastal and ~ 197,000 km^2 represent inland aquatic ecosystems (18% of total area, IDEAM et al. 2015). These large areas of potentially suitable crocodilian habitat and people inhabiting rural areas and depending on aquatic resources creates a relevant scenario to assess interactions between crocodilians and humans.

A few studies have tried to elucidate human-crocodilians interactions from ethno-zoological (Balaguera-Reina et al. 2010; Balaguera-Reina 2012a; Balaguera-Reina 2012b; Balaguera-Reina et al. 2017), economical (Medem 1981; Medrano-Bitar and Gomez 2008), and anthropological (Cardele de Schrimpff 2006) perspectives in Colombia. However, studies regarding how the general public interacts both positively (i.e., pro-conservation, pro-sustainable use, pro-keeping them in the ecosystem) and negatively (i.e., against share space and resources, attacks on humans or domestic animals, crocodilians killed by humans) with crocodilians in Colombia are lacking. There is also a paucity of understanding about how the media relates to these species and how available information (via TV, websites, or newspapers) impacts human-crocodilian interactions (people's attitudes and behaviors towards crocodilians). Herein, we conducted a comprehensive review of scientific and non-scientific reports of interactions between humans and crocodilians in Colombia from 1984 to 2017. The time span was defined based on the oldest document found referring to human-crocodilians interactions. Our main objectives were to define and quantify, both spatially and temporally, interactions reported between humans and crocodilians in Colombia and discuss their implications in crocodilian conservation and the search for coexistence.

Methods

We carried out a thorough search of reported cases of human-crocodilian interactions in regional (governmental) environmental agency databases (e.g., Corporaciones autónomas regionales) as digital or printed versions throughout the country, internet search engines (e.g., crocodiles + caimans + Colombia + conflict + conservation + interactions), and newspaper databases from Colombia. Only reports of interaction between humans and crocodilians (either positively or negatively) were included, excluding reports of human-human interactions related to crocodilians (e.g., conservation programs vs. use programs) and environmental-crocodilian interactions (e.g., crocodilians killed by drought; Redpath et al. 2015). This information was classified based on thematic pertinence (i.e., fatal attacks on humans, appreciation and protection, illegal trade), event description, department (= state), year, and species involved, and analyzed spatially using ArcGIS 10.4 (ESRI 2016) and graphically using R (R Development Core Team, 2012). We mapped all reported interactions by department, quantifying them and identifying areas where both positive and negative interactions were common. We also graphed the number of reports found through time to analyze trends on the period assessed, including those regarding illegal trade.

We defined nine topics that grouped all the interactions found in this study, two were counted as positive interactions (legal trade and use, and appreciation and protection-conservation) and seven as negative interactions (fatal attacks on humans, crocodilians killed by humans, illegal trade, domestic animal predation, non-fatal attacks on humans, crocodilian translocation, and people afraid of having crocodilians in their surroundings). These topics were defined using a coding text approach, in which each author of the present manuscript analyzed data collected individually, coming to a *post hoc* consensus based on the connectedness and inclusiveness of topics and the level of overlapping among them. Reports of interactions collected by non-scientific sources (e.g., newspapers, TV news, websites) were confirmed by more than one source (i.e., triangulation) to avoid the inclusion of erroneous, incomplete, or inaccurate information in the analysis. Even though the distinction between legal and illegal trade is merely a human construct, we kept these two categories separate to analyze how these two different use approaches affect human-crocodilian interactions.

Results

We found a total of 193 crocodilian report cases between 1984 and May 2017, of which 49% were reported in newspapers (hardcopy and online) and online-websites, 19% in regional (governmental) environmental agency databases (hardcopy and online), 15% in TV news, 14% in scientific documents, and 4% in the environmental ministry, national park, and universities databases (hardcopy and online). The number of reports ranged between one in 1984 and 35 in 2017 with a clear trend of increasing frequency of reports since 2011 (Fig. 1). We also found an overall increase in the number of reports regarding appreciation and protection. Illegal use was a common topic found through time in newspapers/online-websites (Fig. 2). The number of topics reported increased since 2008 including crocodilian killed by humans, crocodilian translocation, domestic animal predation, fear, and fatal attacks on humans (Fig. 2).

We found reports involving all crocodilian species inhabiting Colombia, however, American Crocodiles, Orinoco Crocodiles, and Spectacled Caimans were the most common species reported over the 33-year period (Fig. 2). We also found a small number of reports in the last few years involving Black Caimans, Cuvier's Dwarf Caimans, and Schneider's Smooth-fronted Caimans. Spectacled Caimans have the highest number of reported cases (49%) mainly related to illegal trade (i.e., animals or skins sized by police or regional environmental agencies), followed by American Crocodiles (39%), Orinoco Crocodiles (6%), Black Caimans (2%), and Cuvier's Dwarf and Schneider's Smooth-fronted caimans (1.5 % each). The remaining reports focused on crocodilians in general without reference to a particular species (Fig. 2). Illegal trade and conservation publicity (appreciation and protection) regarding particular projects were the main topics reported (28% and 23%, respectively), followed by crocodilian translocation (16%), crocodilians killed (10%), fear (8%), legal trade (5%), non-fatal attacks on humans (4%), domestic animal predation (4%), and fatal attacks on humans (2%; Fig. 2). Cases were reported in 29 out of 32 departments of Colombia covering all 5 regions (Caribbean, Andes, Pacific, Orinoco, and Amazon). The department of Magdalena had the highest proportion of reports (25%), followed by Atlántico and Bolívar (9% each), Cordoba, Cundinamarca, Meta, and La Guajira (5% each; Fig. 3).

Five fatal attacks were reported between 2011 and 2017, all of which involved either children (between 5 and 10 years old) or young men (< 30 years old); three occurred in Magdalena (involving an American Crocodile and a Spectacled Caiman), one in Norte de Santander (involving an American Crocodile), and one in Vaupes (involving a Black Caiman; Fig. 2). In contrast, eight non-fatal attacks have been reported in Magdalena (three cases), Boyacá (two cases), Córdoba, La Guajira, and Atlántico (one case each), between 2012 and 2016, all of them involving young men or adults (Fig. 2). All attacks occurred on the shore of rivers or creeks in areas where the presence of these species was common knowledge among people of the region.

Regarding illegal trade, we found a total of 13,608 skins/live animals reported as seized by the authorities between 2004 and the first five months of 2017 (number of reports = 44), with the largest shipment being seized in Bogota, Cundinamarca (2600 skins) in 2004 and in Plato, Magdalena (2624 skins and live animals) in 2015. The departments of Bolivar (20%), Magdalena, and Atlántico (14% each) had the highest number of reports of illegal trade, followed by Antioquia and Santander (9% each; Fig. 3). It is important to highlight that these numbers likely underrepresent the total number of animals used illegally, due to the lack of government records regarding this matter.

Cases of crocodilians being killed or translocated due to fear of attacks on humans or domestic animal predation were mainly reported in Magdalena, Atlántico, Bolívar, Cundinamarca, Meta, Caldas, Huila, Córdoba, Santander, Norte de Santander, Antioquia, and Valle del Cauca (Fig. 3), and primarily involved Spectacled Caimans (24 cases), American Crocodiles (21 cases), and Orinoco Crocodiles (one case; Fig. 2). Crocodilian roadkill has been reported in Magdalena (common in the Salamanca National Natural Park) and Casanare (Paz de Ariporo, Yopal, San Luis de Palenque, and Orocue cities; Rojano, pers. comm. 2017), involving American Crocodiles and Spectacled Caimans. One relevant case regarding a crocodilian being killed by people because of fear occurred on San Andres Island, where an American Crocodile appeared on a beach popular with tourists and was killed by the police, following orders from the government agency office. Interestingly, this species had never been recorded in this insular area before this incident.

We found a high number of cases of positive interactions related to crocodilian appreciation and protection (N = 55), focused mainly in the conservation programs developed in Casanare and Meta, for the Orinoco Crocodile, and in Córdoba and Norte de Santander, for the American Crocodile; these were all reported since 2008. We also found reports regarding cultural

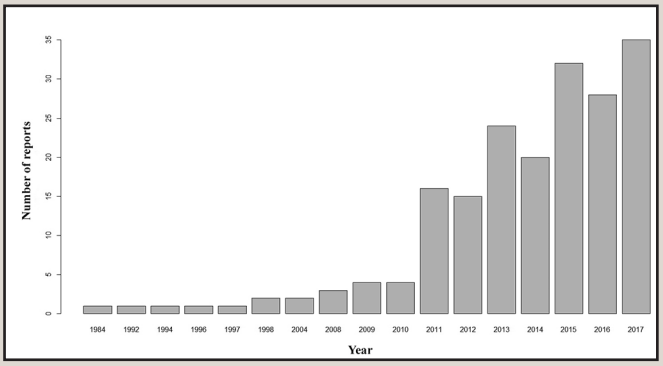

Fig. 1. Number of reports per year involving reported human-crocodilian interactions in Colombia.

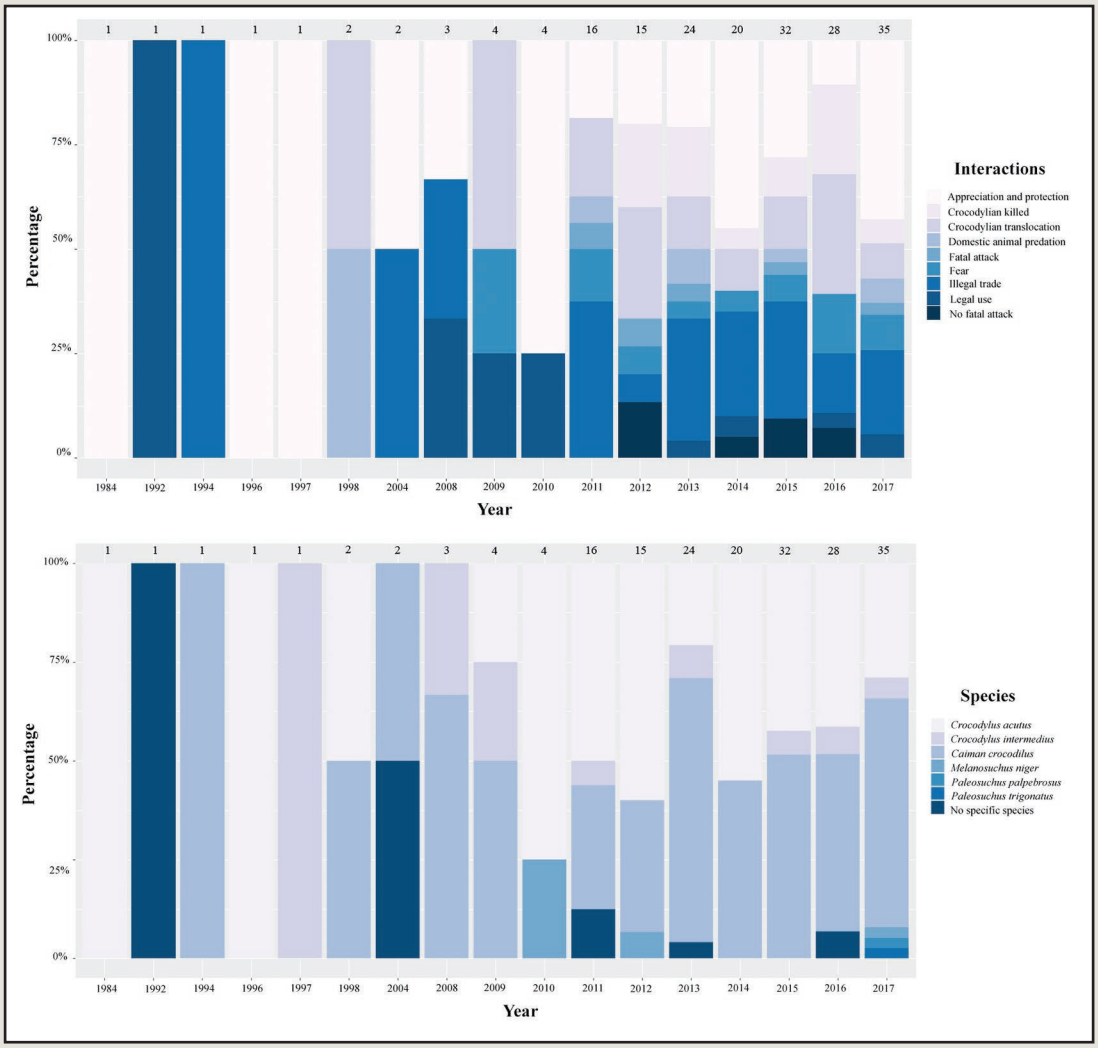

FIG. 2. Stacked bar chart depicting all interactions registered in the present study by year (top panel) and the species involved on those interactions by year (lower panel). Notice the increment of interaction topics and species during the last decade. Numbers on top of each bar represents the number of publications per year.

events honoring crocodilians such as el Hombre-Caiman Festival in Plato, Magdalena el Caiman-Cienagero Festival in Cienaga, Magdalena, and the traditional procession of floats in the Barranquilla Carnival. All of them highlighted the importance of these species (mainly American Crocodiles) for the folklore and culture of the Caribbean communities. In contrast, a low number of reports regarding this topic were found in the south of Colombia involving Black, Cuvier's Dwarf, and Schneider's Smooth-fronted caimans.

Legal trade was also reported, highlighting sustainable use taking place in the departments of Atlántico (spectacled caiman farming) and the brand new CITES-approved ranching process for American crocodiles in Cordoba. These reports also stressed the impact that Colombia has on the luxury leather market around the world and in the conservation of species such as the American crocodile.

DISCUSSION

It is noteworthy that negative human-crocodilian interactions are more frequently recorded (67%) by media, regional (governmental) environmental agencies, and scientific publications than positive interactions (33%). This might be explained by media bias towards sensationalized stories regarding attacks on humans as opposed to more mundane stories about crocodilian conservation. However, conflict, as attractive as it can be for the media, is a misleading concept that implicitly suggests both sides (humans and crocodilians) are consciously intent on interfering in the lives of the other (Fisher 2016; Pooley et al. 2017). The language used by all sources of information (scientific and non-scientific) matters in today's world, since integrative conservation planning and sustainable management are striving for coexistence (Carter and Linnell 2016). The effects that negative language can have on influencing the attitudes and behaviors of people towards the species in question merely perpetuates the problem and reduces options for solutions (Peterson et al. 2010).

We identified an increasing trend in the number of cases reported over the last decade in areas such as the Caribbean and the Andean regions, with no favorable outcomes for crocodilian populations (i.e., crocodilian killed and translocated) and with some fatal incidents involving humans. This reflects the current lack of management and planning present at local and national environmental agencies to deal with crocodilians-human interactions, having serious implications on the conservation of

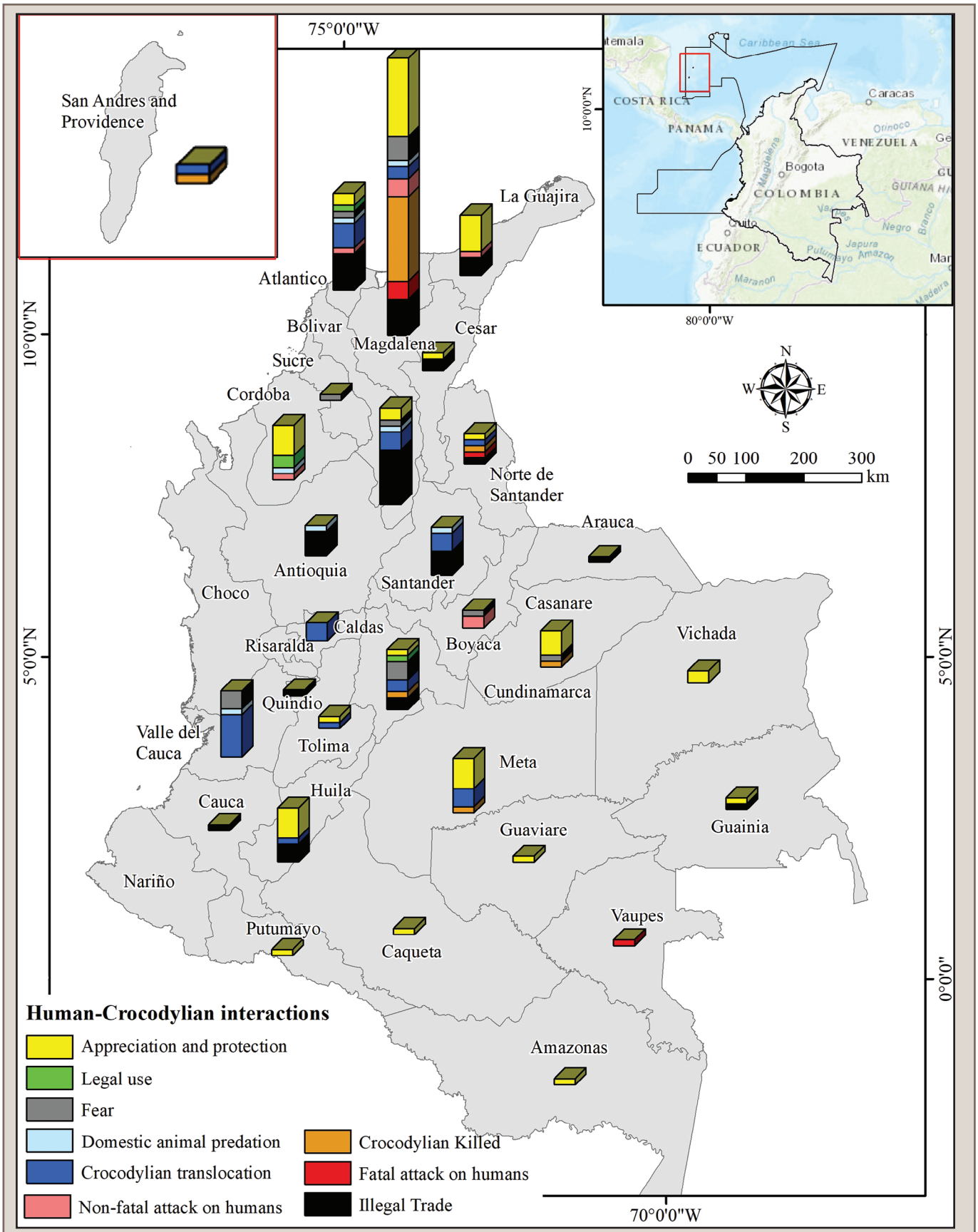

FIG. 3. Human-crocodilian interactions recorded by department in Colombia, depicting the type of interaction (stacked bar) and the number of records per department (stacked bar size). The smallest bar represents one report and the largest 35 reports, with a maximum of seven interaction topics recorded in a single department.

the species and people's attitude regarding these species. Ongoing research by authors of the present manuscript in Magdalena shows how these events have created an atmosphere of doubt in some human communities (based on interviews) with respect to the importance and relevance of having crocodilians living in the ecosystems nearby (even inside of protected areas), making it more difficult to develop strategies for coexistence. Thus, future research needs to analyze how attitudes and behaviors of people are influenced by media or other sources of information, assessing its effect in conservation planning and management. The San Andres case where the regional (governmental) environmental agency decided to kill a migrant American crocodile that showed up in a touristic beach emphasize the necessity to increase education and awareness regarding the biological relevance of crocodilians on the ecosystem not only to the general public but also in the institutions focused to protect them.

Preserving large apex predators is a challenge in conservation biology normally due to their highly conflictive relationship with humans for space and resources (Chapron et al. 2014). Currently, where habitat fragmentation is a common feature in tropical landscapes, interactions between humans and crocodilians have been increasing, bringing the challenges of co-existence into focus (Pooley et al. 2017). These challenges increase as large predator conservation programs succeed and recolonization processes push species closer to humans.

American Crocodiles had the largest number of conflicts reported with local communities in the present study, including three fatal attacks on humans. Several individuals of this species ended up translocated or killed by locals in areas such as Magdalena, Atlántico, Santander, and Norte de Santander. There is evidence of population recovery of this species in areas such as Magdalena (Tayrona National Natural Park) and Norte de Santander (Sardinata River; Ulloa-Delgado 2011; Balaguera-Reina et al. 2012; Farfan-Ardila et al. 2017). The increasing number of American Crocodiles and conflict reports in the same areas demonstrate the need to develop conservation measurements that include human-crocodilians interactions as a main topic. By understanding how locals feel about sharing space and resources with crocodilians and devising a compromise acceptable for both (crocodilian conservation and local communities), researchers could create sound and inclusive conservation that could be perpetuated through time (Pooley 2016).

Sustainable use of crocodilians has proven to be an excellent way to create incentives for people to preserve them, reducing the number of conflicts and creating "bonding" between them (Thorbjarnarson 1999; Larriera et al. 2004; Webb 2014). However, this human-crocodilian interaction is framed by legality as "discriminant," turning it into positive or negative depending on if it is legal or not. Colombia exports between 600,000 and 700,000 skins annually, bringing a revenue of 21 million USD per year to the country (Portafolio 2014). However, issues related to skins illegally obtained from wild Spectacled Caimans to augment farm production have been common since the 1990s throughout the country (Balaguera-Reina and Densmore 2014). This creates "clandestine" interactions between humans and some species of crocodilians that are difficult to assess or analyze due to the current state of illegality, making people fear repercussions at the time during surveys regarding people's attitudes and behaviors. Recently, a ranching program for the country has been proposed along with improved methods for regulating farming, with the goal of making the Colombian crocodile-skin production sustainable (Medrano-Bitar, pers. comm. 2016).

The Black Caiman as well as the Cuvier's Dwarf and Schneider's Smooth-fronted caimans have had few interactions reported, which does not necessarily mean that there is less human-crocodilian interaction. Instead it might reflect less media/scientific coverage of events due to the fact that they inhabit remote areas. Nevertheless, further scientific studies are necessary (both ecological and ethno-zoological) to assess the conservation status of these species and their relationship with humans, clearly defining how these interactions can affect/promote crocodilian conservation.

Several approaches have been used to resolve human-predator conflicts around the world, such as the separation model in the United States, Australia, and Southern Africa (keeping people and predators apart) and the coexistence model successfully applied for carnivores in Europe (allowing people and predators to live together; see Chapron et al. 2014); both have shown interesting results depending on in-situ conservation features and local idiosyncratic differences (Packer et al. 2013). In Colombia, isolating predators to remote areas was the result of the dynamic growth of settlements that the country has faced in the last two centuries, rather than the result of a thoughtful conservation development. However, because of the idiosyncrasy and culture, this segregation is not always possible due to the intrinsic sharing of living spaces and resources that people (e.g., fishermen, farmers) and some predator species (e.g., crocodilians) have. Thus, striving for a coexistence model is likely the way to face crocodilian conservation in this territory as reported in areas such as western India, Africa, and Indonesia (Pooley 2016; Lenin 2017).

Data collected in this study have shown a general lack of comprehensive view at the time human-crocodilian interaction reports were done and presented in newspapers, television shows, or technical reports, indicating the necessity of unifying the language and terms of discussion for crocodilian conservation and co-existence with humans. To do that, all parties that can directly or indirectly affect conservation (e.g., locals, decision-makers, scientists, media) should strive for common practices to prevent the release of confusing and contrasting information to the general public, which can affect the conservation/sustainable use goal. Special attention should be given to the Caribbean region of Colombia (e.g., Atlántico, Bolivar, Córdoba), where recovery of American Crocodile populations is creating a hostile environment for co-existence in departments such as Magdalena (Balaguera-Reina et al. 2017), which can end in failure of conservation processes developed in the area.

In the last decade, conservation projects in areas such as Córdoba (Cispata Bay) with the American Crocodile and Meta and Casanare with the Orinoco Crocodile, have captured the attention of the general public, receiving coverage from major outlets media (e.g., TV and newspapers) in Colombia. This could serve as a keystone strategy to bring up crocodilian conservation from the scientific community and discuss these sensitive issues with the public, creating awareness about the relevance of these species (and all predators) in their respective ecosystems, and highlighting the necessity to learn to live and share our space with them as a society (Carter and Linnell 2016).

Acknowledgments.—We thank Gustavo Majarres Pinzon and Oswaldo Madera Florez from Natural SIG Corporation and Walberto Naranjo for their help reporting human-crocodilian interactions in the department of Magdalena. We also thank the Salamanca

National Natural Park personnel for the roadkill data provided. We thank the Tayrona National Natural Park Personnel for their help resolving human-crocodilian conflicts in the area. Finally, we thank Daniel Saenz, Lou Densmore, Mark Lee, and Diana Palacios for their comments to improve the readability of this manuscript.

Literature Cited

Balaguera-Reina, S. A. 2012a. Attacks and human-crocodile conflict in local communities in Colombia. Crocodile Specialist Group Newsletter CSG 31:12–14.

———. 2012b. Ecology, population status and human interactions of *Crocodylus acutus* at Zapatosa and Costilla swamps, Cesar department, Colombia. Crocodile Specialist Group Newsletter CSG 31:7–9.

———, J. Barbosa-Cabanzo, Y. Moná-Sanabria, N. Farias-Cutidor, D. Caicedo-Herrera, R. Martínez-Palacios, and J. F. González-Maya. 2010. Population structure, distribution and threats of *Caiman crocodilus* in the lower and middle watershed, Atrato River, Chocó department, Colombia. Lat. Am. J. Conserv. 1:131–135.

———, and J. F. González-Maya. 2010. Percepciones, conocimiento y relaciones entre los Crocodylia y dos poblaciones humanas de la Vía Parque Isla de Salamanca (Caribe colombiano). Lat. Am. J. Conserv. 1:53–63.

———, S. Navarrete, F. Pescador, and K. Rodríguez. 2012. First report of Caimán aguja (*Crocodylus acutus*) population in the Tayrona National Natural Park, Colombia. Crocodile Specialist Group Newsletter CSG 31:7–10.

———, and L. Densmore, III. 2014. Legislation and conservation efforts concerning crocodiles in Colombia: a historical review. Herpetol. Rev. 45:638–642.

———, M. Venegas-Anaya, and L. Densmore, III. 2015. The biology and conservation status of the American crocodile in Colombia. J. Herpetol. 49:200–206.

———, N. Farfán-Ardila, D. Vargas-Ortega, and S. Medrano-Bitar. 2017. ¿Cómo lograr coexistencia entre cocodrilos y humanos? relaciones etno-zoológicas entre el Caimán aguja y comunidades en el Parque Nacional Natural Tayrona, Caribe colombiano. *In* M. C. Ardila-Robayo and W. Martínez-Barreto (eds.), Homenaje a Federico Medem, aportes a la Herpetología Colombiana. Biblioteca José Jerónimo Triana No. 34. Instituto de Ciencias Naturales, Universidad Nacional de Colombia. Bogotá.

Cardele de Schrimpff, M. 2006. Cazando animales en el bestiario cosmológico: el cocodrilo en el suroeste de Colombia y en regiones vecinas del Ecuador (800 A.C. a 500 D.C.). Boletín del Instituto Francés de estudios Andinos 35(3):409–431.

Carter, H. and Linnell J. D. C. 2016. Co-adaptation is key to coexisting with large carnivores. Trends Ecol. Evol. 31:575–578.

Chapron, G., P. Kaczensky, J. D. Linnell, M. von Arx, D. Huber, H. Andrén, J. V. López-Bao, et al. 2014. Recovery of large carnivores in Europe's modern human-dominated landscapes. Science 346:1517–1519.

DANE (Departamento Administrativo Nacional de Estadistica). 2016. Población de Colombia hoy. Accessed 15 Nov 2017. Available at http://www.dane.gov.co/

Elsey, R. M., and A. R. Woodward. 2010. American alligator *Alligator mississippiensis*. *In* S. C. Manolis and C. Stevenson (eds.), Crocodiles: Status Survey and Conservation Action Plan, pp. 1–4. Crocodile Specialist Group, Darwin.

ESRI. 2016. Arc GIS Version 10.4 ESRI Redlands, California.

Farfán-Ardila N., D. Vargas-Ortega, S. Medrano-Bitar, and S. A. Balaguera-Reina. 2017. Ecología poblacional del Caimán aguja (*Crocodylus acutus*, Cuvier 1807) en el Parque Nacional Natural Tayrona, Caribe colombiano. *In* M. C. Ardila-Robayo and W. Martínez-Barreto (eds.), Homenaje a Federico Medem, aportes a la Herpetología Colombiana. Biblioteca José Jerónimo Triana No. 34. Instituto de Ciencias Naturales, Universidad Nacional de Colombia. Bogotá.

Fergusson, R. A. 2010. Nile crocodile *Crocodylus niloticus*. *In* S. C. Manolis and C. Stevenson (eds.), Crocodiles: Status Survey and Conservation Action Plan, pp. 84–89. Crocodile Specialist Group, Darwin.

Fisher, M. 2016. Whose conflict is it anyway? Mobilizing research to save lives. Oryx 50:377–378.

Frank, B. 2016. Human–wildlife conflicts and the need to include tolerance and coexistence: an introductory comment. Soc. Nat. Resour. 2:738–743.

Gómez-González, J. J, J. C. Narváez-Barandica, L. Báez, E. Patiño-Flórez. 2017. Nesting ecology of *Crocodylus acutus* (Reptilia: Crocodylidae) in Bahia Portete, La Guajira, Colombia. Rev. Biol. Trop. 65:211–228.

Grigg, G., and D. Kirshner. 2015. Biology and Evolution of Crocodylians. Cornell University Press, Ithaca, New York. 649 pp.

Ideam, Minambiente, Instituto Humboldt, Instituto Sinchi, Invemar, IIAP, Parques Nacionales de Colombia, IGAC. 2015. Mapa de ecosistemas continentales, marinos y costeros de Colombia, escala 1:100.000. Accessed 2 June 2017. Available at http://www.ideam.gov.co/documents/11769/222663/Presentaci%C3%B3n+final+mapa+ecosistemas.pdf/c33bef40-e727-49db-8fb7-4201cffa37af.

Larriera, A., G. Webb, A. Velasco, M. Rodríguez, and B. Ortiz. 2004. Mission to Colombia. Final report, IUCN-SSC Crocodile Specialist Group. 59 pp.

Lenin, J. 2017. Life on the water's age. Environment section. The Hindu. Accessed 5 May 2017. Available at http://www.thehindu.com/sci-tech/energy-and-environment/life-on-the-waters-edge/article17325067.ece

Medem, F. 1981. Los Crocodylia de Sur América. Los Crocodylia de Colombia. Editorial Carrera 7 Ltda. ed., Santa Fé de Bogotá, Colombia. 199 pp.

Medrano-Bitar, S. A., and A. J. Gómez. 2008. Conservación y aprovechamiento de la baba o babilla (*Caiman crocodilus*, Linnaeus 1756) en Colombia. *In* J. Castroviejo, J. Ayarzagüena, and A. Velasco (eds.), Contribución al Conocimiento del Género Caiman de Suramérica, pp 23–69. Asociación Amigos de Doñana, Sevilla, Spain.

Organ, J. F., D. J. Decker, L. H. Carpenter, W. F. Siemer, and S. J. Riley. 2006. Thinking like a Manager: Reflections on Wildlife Management. Wildlife Management Institute, Washington, DC.

Packer, C., A. Loveridge, S. Canney, T. Caro, S. T. Garnett, M. Pfeifer, K. K. Zander, et al. 2013. Conserving large carnivores: dollars and fence. Ecol. Lett. 16:635–641.

Peterson, M. N., J. L. Birckhead, K. Leong, M. J. Peterson, and T. R. Peterson. 2010. Rearticulating the myth of human–wildlife conflict. Conserv. Lett. 3:74–78.

Platt, S. G., L. Sigler, and T. R. Rainwater. 2010. Morelet's crocodile *Crocodylus moreletii*. *In* S. C. Manolis and C. Stevenson (eds.), Crocodiles: Status Survey and Conservation Action Plan, pp. 79–83. Crocodile Specialist Group, Darwin.

Pooley S. 2016. A cultural herpetology of Nile crocodiles in Africa. Conserv. Soc. 14:391–405.

———, M. Barua, W. Beinart, A. Dickman, G. Holmes, J. Lorimer, D. Loveridge et al. 2017. An interdisciplinary review of current and future approaches to improving human–predator relations. Conserv. Biol. 31:513–523.

Portafolio. 2014. Con piel de babilla, Colombia gana mercado en China. Accessed on 20 Feb 2017. Available at: http://www.portafolio.co/negocios/empresas/piel-babilla-colombia-gana-mercado-china-57656

PNUD. 2011. Colombia rural. Razones para la esperanza. Informe Nacional de Desarrollo Humano 2011. INDH-PNUD. Bogotá, Colombia. 120 pp.

Prugh, L. R. C. J. Stoner, C. W. Epps, W. T. Bean, W. J. Ripple, A. S. Laliberte, and J. S. Brashare. 2009. The rise of the mesopredator. BioScience 59:779–791.

R Development Core Team. 2012. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna.

Redpath, S. M., S. Bhatia, and J. Young. 2015. Tilting at wildlife: reconsidering human–wildlife conflict. Oryx 49:222–225.

Thorbjarnarson, J. B. 1999. Crocodile tears and skins: international trade, economic constraints, and limits to the sustainable use of crocodilians. Conserv. Biol. 13:465–470.

———. 2010. American crocodile *Crocodylus acutus*. *In* S. C. Manolis and C. Stevenson (eds.), Crocodiles: Status Survey and Conservation Action Plan, pp. 46–53. Crocodile Specialist Group, Darwin.

Ulloa Delgado, G. A. 2011. Plan de manejo preliminar para la conservación de las poblaciones del Caimán aguja *Crocodylus acutus* (Cuvier, 1807) en los ríos Sardinata, San Miguel, Nuevo Presidente y Tibú departamento de Norte de Santander, cuenca del Catatumbo de Colombia. Ministerio de Ambiente y Desarrollo Sostenible, Corporación Autónoma Regional de la Frontera Nororiental, Empresa Colombiana de Petróleos. Tibú. 38 pp.

———, and C. L. Sierra Díaz. 2008. Toward the sustainable use of the *Crocodylus acutus* for local communities in the swamps of the Cispata bay, Caribean of Colombia. *In* Crocodiles: Proceedings of the 19th Working Meeting of the Crocodile Specialist Group, pp. 89–90. IUCN - The World Conservation Union. Gland, Switzerland and Cambridge, UK.

Ustate-Duarte, E. (ND). Diagnóstico de la cadena productiva pesquera en la República de Colombia. Estudio de prospectiva para la cadena productiva de la industria pesquera en la región de la costa del Pacífico en América del Sur. UNIDO and OPTI. Available at: http://www.innovacion.gob.sv/inventa/attachments/article/508/24117_DiagnsticoNacionaldeColombia.pdf

van der Ploeg, J., M. Cauilan-Cureg, M. Weerd, and W. T. De Groot. 2011. Assessing the effectiveness of environmental education: mobilizing public support for Philippine crocodile conservation. Conserv. Lett. 4:313–323.

Verdade, L. M., A. Larriera, and C. I. Piña. 2010. Broad-snouted caiman *Caiman latirostris*. *In* S. C. Manolis and C. Stevenson (eds.), Crocodiles: Status Survey and Conservation Action Plan, pp. 18–22. Crocodile Specialist Group, Darwin.

Webb, G. 2014. Wildlife Conservation: In the Belly of the Beast. Uniprint NT, Charles Darwin University. Australia. 342 pp.

Webb, G. J. W., S. C. Manolis, and M. L. Brien. 2010. Saltwater Crocodile *Crocodylus porosus*. *In* S. C. Manolis and C. Stevenson (eds.), Crocodiles: Status Survey and Conservation Action Plan, pp. 99–113. Crocodile Specialist Group, Darwin.