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Mating leatherbacks observed in waters of Costa Rica. See pages 11-12. Photograph: J J. Kiszka

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Recent Publications

First Records of Hawksbill Sea Turtle (*Eretmochelys imbricata*) Connectivity Between the Galápagos Islands and Continental Ecuador

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Ecuador hosts the southernmost nesting sites for hawksbill sea turtles (*Eretmochelys imbricata*) in the Eastern Pacific Ocean (EPO). Hawksbills are a highly threatened species whose populations are particularly vulnerable in the EPO (Gaos et al. 2010, 2018; Rguez-Barón et al. 2019). Ecuador consists of both mainland (herein referred to as Continental Ecuador) and insular land masses, with the latter including the Galápagos Islands, an archipelago of volcanic islands covering approximately 8,000 km² and located approximately 900 km west of Continental Ecuador (Mestanza-Ramón, et al. 2019; Fig. 1).

Consistent hawksbill nesting in Ecuador has been documented in two areas along Continental Ecuador (Gaos et al. 2010, 2017a), and although a single hawksbill hatchling was encountered on the Galápagos Islands in 2015 (Gaos et al. 2018; J.P. Muñoz pers. obs.), no confirmed records of nesting by the species exist for the archipelago. In contrast, foraging by juveniles, and to a lesser extent adults, has been documented in several areas along both Continental Ecuador and the Galápagos Islands (Zárate et al. 2015; Alarcón et al. 2016; Gaos et al. 2018).

Post-nesting hawksbills equipped with satellite telemetry tags by Equilibrio Azul (EA) at Machalilla National Park (MNP) on Continental Ecuador have been recorded undertaking limited migrations (<300km) to foraging grounds located along the country's southern coast, including to mangrove estuaries in the Gulf of Guayaquil and Jambeli Archipelago (Gaos et al. 2012a, 2012b). Records of migrations for juvenile hawksbills are rare in Ecuador and other parts of the EPO, with turtles in this life stage typically remaining within geographically restricted home ranges for extended periods (Carrión-Cortez et al. 2013; Miranda et al. 2019). There is no information available for the movement of adult male hawksbills in Ecuador, but preliminary information from Pacific Nicaragua suggests reproductively mature males do not migrate (A.R. Gaos pers. obs.; FFI-Nicaragua unpublished data).

Genetic studies indicate that nesting hawksbills in Ecuador represent a distinct management unit that is demographically isolated from populations in other parts of the EPO (Gaos et al. 2016). Genetic studies also suggest that EPO hawksbills use feeding grounds in the vicinity of their natal beaches (Gaos et al. 2017b).

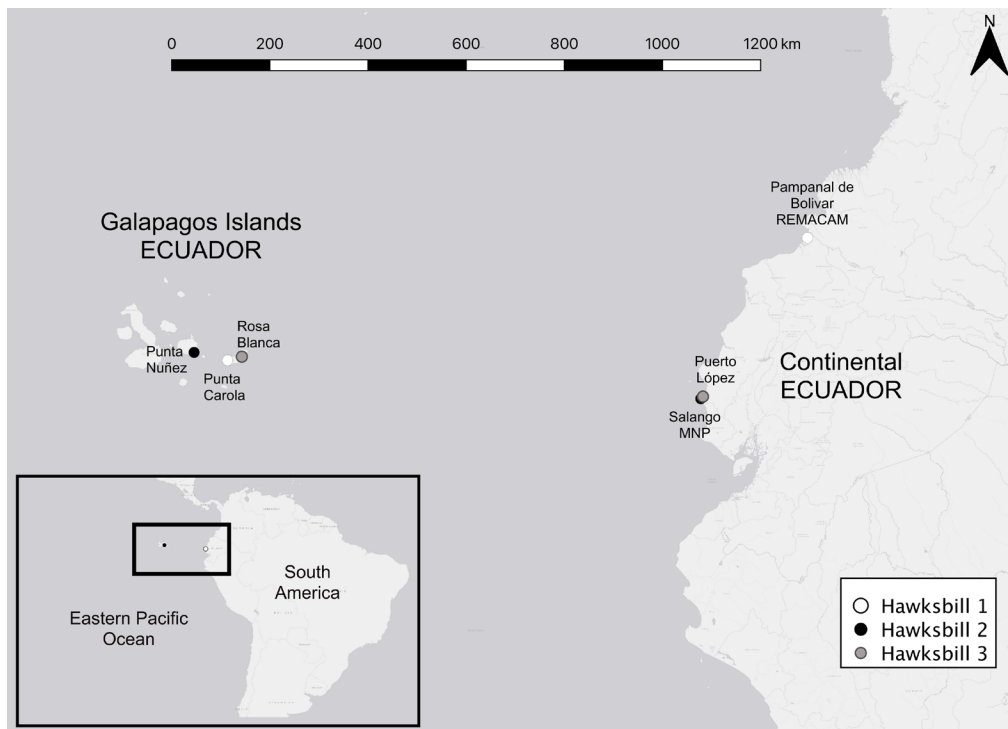


Figure 1. Map of locations where Hawksbill 1 (white dot), Hawksbill 2 (black dot) and Hawksbill 3 (grey dot) were captured and recaptured. Hawksbill 1 was tagged at Punta Carola (San Cristobal Island) in Galápagos and recaptured in Pampanal de Bolívar (REMACAM: Reserva Ecológica Manglares Cayapas Mantaje) in Continental Ecuador. Hawksbill 2 was tagged at Punta Nuñez (Santa Cruz Island) in Galápagos and recaptured in Salango (MNP: Machalilla National Park) in Continental Ecuador. Hawksbill 3 was tagged at Rosa Blanca (San Cristobal Island) in Galápagos and recaptured in Puerto López in Continental Ecuador.

Hawksbill number	Tags	Date		Elapsed time (yrs)	Sex	Curved carapace length (cm)			Weight (kg)			Location		Distance travelled (km)
		Capture	Recapture			Capture	Recapture	Change	Capture	Recapture	Change	Capture	Recapture	
1	JC268; JC269	24-Jun-14	14-Ago-2015	1,3	Female	70.0	70.0	0.0	38	-	-	Punta Carola, Galapagos Islands	Pampanal de Bolivar (REMACAM), Continental Ecuador	1224.1
2	BA624; ME35; ME36	18-Jun-04	3-Feb-17	12,6	Male	38.1	83.4	45.3	12	60	48	Punta Nuñez, Galapagos Islands	Salango (MNP), Continental Ecuador	1046.9
3	EA020; EA021	22-Jan-20	27-Aug-23	3,5	Not identified	60	62.1	2.1	35	-	-	Rosa Blanca, Galapagos Islands	La Poza, Puerto López, Continental Ecuador	953.76

Table 1. Capture and recapture data on the three hawksbills included in this study, including size (CCL: Curved Carapace Length), weight (kg), location, growth, distanced travelled (straight line measurement). Dash indicates no data available. MNP: Machalilla National Park. REMACAM: Manglares Cayapas-Mataje Ecological Reserve.

Combined results from satellite telemetry and genetic studies suggest the species rarely, if ever, undertake long-distance migrations in the EPO (Gaos *et al.* 2018; Gaos *et al.* 2017b; Gaos *et al.* 2016). Despite nearly a decade of flipper tagging efforts of adult and juvenile hawksbill turtles at multiple locations in Continental Ecuador and the Galápagos Islands, a flipper tag from Ecuador has never been registered in another country of the EPO, and vice versa. Similarly, flipper tag returns have not been previously documented between disparate nesting and foraging grounds in Ecuador.

This report discusses the first capture-recapture events of three hawksbill turtles, including one male, one female and one juvenile, all of which were originally tagged in the Galápagos Islands and subsequently encountered in Continental Ecuador. The hawksbill records were obtained from three different sources: ongoing and prior in-water monitoring efforts in Continental Ecuador and the Galápagos Islands, reports from local fishers and environmental authorities in Continental Ecuador and reports from the EA citizen-science photo-identification project, Foto-ID.

Along Continental Ecuador, monthly in-water censuses of hawksbill turtles are carried out by EA in collaboration with the

Eastern Pacific Hawksbill Initiative (ICAPO), with a focus on surveying nearshore habitats of MNP and surrounding areas. The surveys are conducted by at least three observers, snorkeling in defined transects, and in an attempt to observe and capture hawksbills using free-diving techniques. Similar in-water surveys are conducted by an ongoing project in the Galápagos Islands led by the group Proyecto Tortuga Negra - Galápagos Science Center (PTN-GSC). PTN-GSC surveys primarily occur on the island of San Cristobal but are undertaken opportunistically in other parts of the archipelago. Additionally, although focused on green turtles (*Chelonia mydas*), a past project in the Galápagos Islands led by the Charles Darwin Foundation (CDF) included in-water monitoring using tangle-nets around Santa Cruz Island, during which hawksbill turtles were occasionally captured (Zárate *et al.* 2015). Finally, the EA Foto-ID project consists of a citizen-science program where people get involved in sea turtle research by reporting any encounters with turtles with photographs, videos and the location and date of the encounter. The objective is to identify individuals using the information in the images through photo-identification using recognition of scales or other visual means such as flipper tags.



Figure 2. Photographs of Hawksbill 1 when first captured by PTN-GSC at Punta Carola, Galápagos Islands (a), and when recaptured by a local fisherman at Pampanal de Bolivar, Continental Ecuador (b). Photos by Juan Pablo Muñoz/PTN-GSC (a), and MAATE (b).

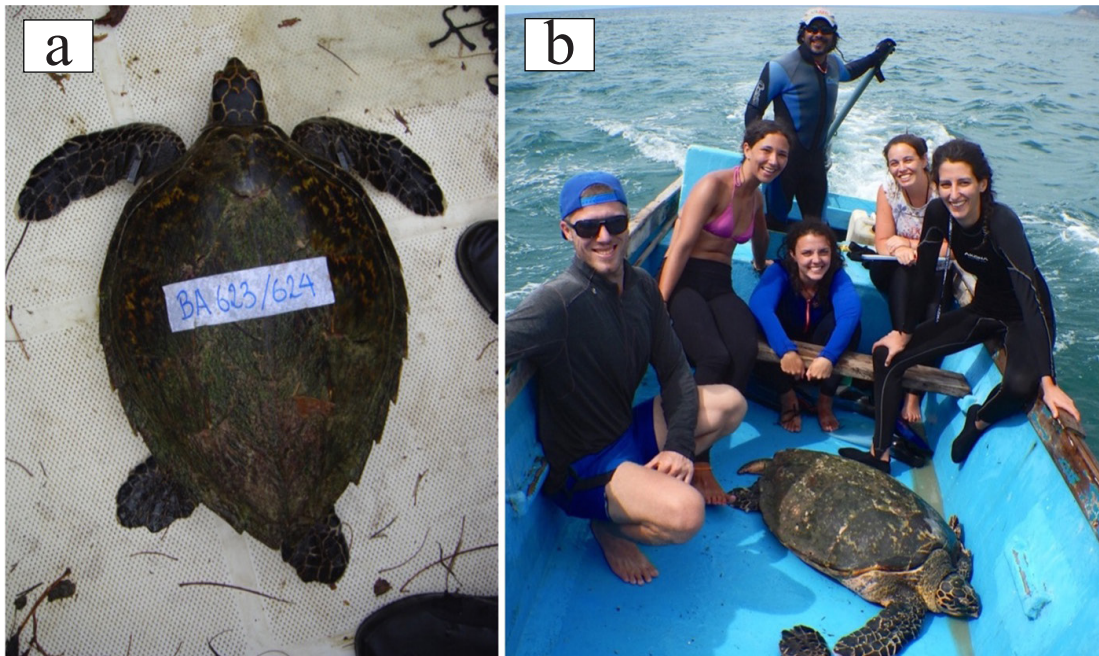


Figure 3. Photographs of Hawksbill 2 when captured as a juvenile by CDF in the Galápagos Islands (a), and when captured by EA as an adult (b) in Continental Ecuador. Photos by Patricia Zárate/CDF (a) and Felipe Vallejo/Equilibrio Azul (b).

During the initial capture events of all hawksbills, morphometric measurements were taken and Inconel (Style 681, National Band & Tag, Newport, KY, USA) flipper tags were applied to the trailing edge of both front flippers. Curved carapace length (CCL) was measured for all captured turtles using a flexible measuring tape, and, when feasible, weight was calculated using a portable scale.

The first record of connectivity came from a turtle (herein referred to as Hawksbill 1) originally tagged by GSC on 24 June 2014 in Punta Carola, San Cristobal Island, Galápagos Islands (Fig. 2a). The turtle measured 70 cm CCL and weighed 38 kg. Based on the turtle's size and lack of an elongated tail, it was determined to

be a putative female (Table 1). Hawksbill 1 was recaptured on 14 August 2015 when it became incidentally entangled in a gillnet of a fisher in the Manglares Cayapas Mantaje Ecological Reserve (REMACAM) in Continental Ecuador (Fig. 2b). Observing the tag on the flipper, the fisher held the turtle and provided it to members of Ecuador's Ministry of Environment, Water and Ecological Transition (MAATE). The turtle had no CCL change at recapture and no weight information was collected. MAATE personnel reported the turtle and relevant data to EA. The time between capture events was approximately 1.3 years, and the straight-line distance between the two capture sites was 1,224.1 km.



Figure 4. Photographs of Hawksbill 3 when captured in Galapagos in 2020 (a) and when recaptured through the Equilibrio Azules Photo-ID project in Puerto López, Continental Ecuador in 2023 (b). Photos by Juan Pablo Muñoz from Galapagos Science Center (a) and Sebastián Hernández during a session with his freediving school in Puerto López, Continental Ecuador (b). Highlighted in red is one of the tags when the turtle was encountered by the citizen-science project.

The second record of connectivity came from a turtle (herein referred to as Hawksbill 2) originally tagged by CDF on 18 June 2004 in Punta Nuñez, Santa Cruz Island, Galápagos Islands (Fig. 3a). The turtle measured 38.1 cm CCL and weighed 12 kg. Hawksbill 2 was recaptured on 3 February 2017 during a monthly survey carried out by EA at Salango Island (MNP) in Continental Ecuador (Fig. 3b). The time between capture events was approximately 12.6 years, and the straight-line distance between the two capture sites was 1,046.9 km. The turtle measured 83.4 cm CCL at the time of recapture and 60 kg, increasing by 45.3 cm and 48 kg between capture events. The turtle was confirmed as a male during the recapture as a result of its elongated tail and increased size (Fig.3b).

The third record of connectivity came from a turtle (herein referred to as Hawksbill 3) originally tagged by GSC on 22 January 2020, in Rosa Blanca, San Cristobal Island, Galápagos Islands (Fig 4a). This turtle was observed on 27 August 2023 by a free-diving instructor in Puerto López who registered the turtle using photos, videos and the number of one flipper tag to the Foto-ID project. One month later, on 29 September 2023 the turtle was recaptured during EA's monthly surveys in the same place in Puerto López where it was reported to Foto-ID. The time between capture events was 3.5 years, and the straight-line distance between the two sites was 953.76 km. The turtle was a juvenile when first captured, measuring 60 cm CCL, and when recaptured measured 62.1 cm CCL, representing an increase in size of 2.1cm. The location of recapture is one of EA's monthly monitoring sites adjacent to the main index nesting beach of the area within MNP, and this turtle had not been observed prior to this event, suggesting a recent recruitment to the reef.

These results provide the first records of hawksbill turtle connectivity between the Galápagos Islands and Continental Ecuador, as well as the first records of tag returns from different monitoring programs within the country as a result of a citizen-science project. To our knowledge, these findings also represent the longest migrations for hawksbill turtles documented in the EPO to date (Gaos *et al.* 2012a), as well as the longest recapture timeframe of an individual hawksbill in this ocean region. In the case of Hawksbill 2 and 3, considering the turtles were juveniles when first captured, the migration registered represents a developmental migration and for Hawksbill 1, an actual migration.

Given hawksbill turtles have never been documented nesting in the Galápagos Islands, despite monitoring at nesting beaches around the archipelago (Zárate *et al.* 2013), it is likely that these turtles originated from nesting beaches on Continental Ecuador, dispersing to the Galápagos Islands as post-hatchlings, where they settled to forage and grow. The movements to Continental Ecuador could be the first leg of a round-trip migration to nest, demonstrated by Hawksbill 1, and to copulate for developmental migration, demonstrated by Hawksbill 2. Alternatively, one or both turtles could have made permanent shifts to habitats in Continental Ecuador at some point prior to recapture. Of note is that REMACAM is a mangrove estuary, coinciding with habitat preferences for adult hawksbills in several countries of the EPO (Gaos *et al.* 2012a,b; 2018) and MNP, including the adjacent Puerto López is a reef and the main nesting area in the country.

Acknowledgements. The results obtained in this study are thanks to the collaboration of different researchers and NGOs working together to learn about Eastern Pacific hawksbills and support their conservation. The data obtained are part of ongoing

hawksbill studies undertaken by EA and the ICAPO network (Research Permit from the Ministry of Environment of Ecuador, Contrato Marco: MAE-DNB-CM-2016-0053) since 2016, with the aim of quantifying hawksbill juvenile recruitment to reefs to measure the success of more than ten years of nest protection efforts. Additionally, the data are supported by the ongoing sea turtle research undertaken by the Proyecto Tortuga Negra - GSC (Galápagos Science Center -Universidad San Francisco de Quito) in the Galápagos. These results are also thanks to prior tagging efforts by Patricia Zárate, the CDF and colleagues and to the collaboration and sharing of tagging information and data by all the involved. The collaboration with the MAATE, Machalilla National Park and park rangers from the REMACAM has been essential in this work and for the conservation of this species, and we thank them all. Finally, these results highlight the importance of research through citizen science programs such as the EA Foto-ID project, where important information can be obtained and the public can be directly involved in research and conservation. We especially thank Sebastián Hernández from the "Vamos al Agua" Freediving School for this important report and for continually collaborating with the project. We also thank and highlight the financial support given by the National Fish and Wildlife Foundation, NFWF, to Equilibrio Azul and ICAPO's ongoing projects and the help provided by WildAid to the Foto-ID project

Alarcón-Ruales, D., J.P. Muñoz-Pérez, M. Hirschfeld, A. Gaos, J. Denking, L. Vaca-Pita, J.A. Cháves, J. Valdes, J.G. Castañeda, J.C. García, C. Quintero, G. Lewbart, & K. Lohmann. 2016. Hawksbill population in the Galápagos. Proceedings of the Annual Symposium on Sea Turtle Biology and Conservation, Lima, Perú. Tech Memo NMFS-SEFSC 734. p. 216.

Carrión-Cortez, J., C. Canales-Cerro, R. Arauz & R. Riosmena-Rodríguez. 2013. Habitat use and diet of juvenile Eastern Pacific hawksbill turtles (*Eretmochelys imbricata*) in the North Pacific coast of Costa Rica. *Chelonian Conservation & Biology* 12: 235-245.

Gaos, A.R., F.A. Abreu-Grobois, J. Alfaro-Shigueto, D. Amorocho, R. Arauz, A. Baquero, R. Briseño, D. Chacón, C. Dueñas, C. Hasbún, M. Liles, G. Mariona, C. Muccio, J.P. Muñoz, W.J. Nichols, M. Peña, J.A. Seminoff, M. Vásquez, J. Urteaga, B. Wallace, I. Yañez, & P. Zárate. 2010. Signs of hope in the eastern Pacific: international collaboration reveals encouraging status for the severely depleted populations of hawksbill turtle *Eretmochelys imbricata*. *Oryx* 44: 1-7.

Gaos, A.R., M.J. Liles, V. Gadea, A. Peña de Niz, F. Vallejo, C. Miranda, J.J. Darquea, A. Heriquez, E. Altamirano, A. Rivera, S. Chavarria, D. Melero, J. Urteaga, C.M. Pacheco, D. Chacón, C. LeMarie, J. Alfaro-Shigueto, J.C. Mangel, I. Yañez & J.A. Seminoff. 2017a. Living on the edge: hawksbill turtle nesting and conservation along the Eastern Pacific Rim. *Latin American Journal of Aquatic Resources* 45: 572-584.

Gaos, A.R., R.L. Lewison, M.P. Jensen, M.J. Liles, A. Heriquez, S. Chavarria, C.M. Pacheco, M. Valle, D. Melero, V. Gadea, E. Altamirano, P. Torres, F. Vallejo, C. Miranda, C. LeMarie, J. Lucero, K. Ocegüera, D. Chacón, L. Fonseca, M. Abrego, J.A. Seminoff, E.E. Flores, I. Llamas, R. Donadi, B. Pena, J.P. Munoz, D.A. Ruales, J.A. Chaves, S. Otterstrom, A. Zavala, C.E. Hart, R. Brittain, J. Alfaro-Shigueto, J. Mangel, I.L. Yanez & P.H. Dutton.

- 2017b. Natal foraging philopatry in Eastern Pacific hawksbill turtles. *Royal Society Open Science* 4: 170153.
- Gaos, A.R., R.L. Lewison, M.P. Jensen, M.J. Liles, A. Heriquez, S. Chavarria, C.M. Pacheco, M. Valle, D. Melero, V. Gadea, E. Altamirano, P. Torres, F. Vallejo, C. Miranda, C. LeMarie, J. Lucero, K. Ocegüera, D. Chacón, L. Fonseca, M. Abrego, J.A. Seminoff, E. Flores, I. Llamas, B. Peña, J. Muñoz, D. Alarcón-Ruales, J. Chaves, S. Otterstrom, A. Zavala, C. Hart, R. Brittain, J. Alfaro-Shigueto, J.C. Mangel, I. Yañez & P.H. Dutton. 2018. Rookery contributions, movements and conservation needs of hawksbill turtles at foraging grounds in the eastern Pacific Ocean. *Marine Ecology Progress Series* 586: 203-216.
- Gaos, A.R., R.L. Lewison, M.J. Liles, V. Gadea, E. Altamirano, A.V. Henríquez, P. Torres, J. Urteaga, F. Vallejo, A. Baquero, C. LeMarie, J.P. Muñoz, J.A. Chaves, C.E. Hart, A. Peña de Niz, D. Chacón, L. Fonseca, S. Otterstrom, I.L. Yañez, E.L. LaCasella, A. Frey, M.P. Jensen & P. Dutton. 2016. Hawksbill turtle terra incognita: conservation genetics of eastern Pacific rookeries. *Ecology and Evolution* 6: 1251-1264.
- Gaos, A.R., R.L. Lewison, M. Liles, W.J. Nichols, A. Baquero, C.R. Hasbún, M. Vasquez, J. Urteaga & J.A. Seminoff. 2012b. Shifting the life-history paradigm: discovery of novel habitat use by hawksbill turtles. *Biology Letters*: 1-4.
- Gaos, A.R., R.L. Lewison, B.P. Wallace, I.L. Yañez, M.J. Liles, W.J. Nichols, A. Baquero, C.R. Hasbún, M. Vasquez, J. Urteaga & J.A. Seminoff. 2012a Spatial ecology of critically endangered hawksbill turtles *Eretmochelys imbricata*: implications for management and conservation. *Marine Ecology Progress Series* 450: 181-194.
- Mestanza-Ramón, C., M. Sanchez Capa, H. Figueroa Saavedra, & J. Rojas Paredes. 2019. Integrated coastal zone management in continental Ecuador and Galapagos islands: challenges and opportunities in a changing tourism and economic context. *Sustainability* 11: 6386.
- Miranda, C. 2019. Ecuador. In: Rguez-Barón, J.M., S. Kelez, M. Liles, A. Zavala-Norzagaray, O.L. Torres-Suárez, D. Amorocho & A. Gaos. (Eds). *Sea Turtles in the East Pacific Region: MTSG Annual Regional Report 2019*. IUCN-SSC Marine Turtle Specialist Group. pp. 274-330.
- Rguez-Barón, J.M., S. Kelez, M. Liles, A. Zavala-Norzagaray, O.L. Torres-Suárez, D. Amorocho & A. Gaos. (Eds). (2019) *Sea Turtles in the East Pacific Region: MTSG Annual Regional Report 2019*. IUCN-SSC Marine Turtle Specialist Group. 419pp.
- Zárate, P.M., K.A. Bjorndal, M. Parra, P.H. Dutton, J.A. Seminoff & A.B. Bolten. 2013. Hatching and emergence success in green turtle *Chelonia mydas* nests in the Galápagos Islands. *Aquatic Biology* 19: 217-229.
- Zárate, P.M., K.A. Bjorndal, J.A. Seminoff, P.H. Dutton & A.B. Bolten. 2015. Somatic growth rates of green turtles (*Chelonia mydas*) and hawksbills (*Eretmochelys imbricata*) in the Galápagos Islands. *Journal of Herpetology* 49: 641-648.