Herpetological Conservation and Biology 7(3):376–382.
Submitted: 12 January 2012; Accepted: 5 November 2012; Published: 31 December 2012.

JUVENILE RECRUITMENT, EARLY GROWTH, AND MORPHOLOGICAL VARIATION IN THE ENDANGERED SANTA CATALINA ISLAND RATTLESNAKE, *CROTALUS CATALINENSIS*

MARCIO MARTINS[1], GUSTAVO ARNAUD[2], AND HECTOR ÁVILA-VILLEGAS[3]

[1]*Departamento de Ecologia, Instituto de Biociências, Universidade de São Paulo, 05508-090 São Paulo, São Paulo, Brazil, e-mail: martinsmrc@usp.br*
[2]*Centro de Investigaciones Biológicas del Noroeste, Mar Bermejo no. 195, Col. Playa Palo de Santa Rita, C. P. 23090, La Paz, Baja California Sur, Mexico, e-mail: garnaud04@cibnor.mx*
[3]*Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO), Liga Periférico Insurgentes Sur No. 4903, 2do piso, Col. Parques del Pedregal, Del. Tlalpan, C. P. 14010, México City, D.F., Mexico, e-mail: havila@conabio.gob.mx*

***Abstract*.—Life-history information constitutes the raw data for building population models used in species conservation. We provide life-history data for the endangered Santa Catalina Island Rattlesnake, *Crotalus catalinensis*. We use data from 277 observations of *C. catalinensis* made between 2002 and 2011 on the island. Mean snout-vent length (SVL) of adult *C. catalinensis* was 643 mm for males and 631 mm for females; the difference was not significant. The degree of sexual size dimorphism (SSD; using SVL) was -0.02. However, sexes were dimorphic in total length (SVL + tail length), relative tail length, and stoutness. Juvenile recruitment occurs during late-summer. In their first year of life, juveniles seem to grow at a rate of about 1.7 cm/mo. Females seem to become mature around 570 mm SVL, probably in the year when they become 2 y old. Scattered literature data corroborates the time of juvenile recruitment described herein. Growth in *C. catalinensis* seems to be slower than that of *C. ruber*, its sister taxa, but similar to other rattlesnakes.**

Key Words.—conservation; juvenile recruitment; Mexico; population; reproduction; snake

INTRODUCTION

Life-history data such as time of juvenile recruitment, early growth, sexual dimorphism, and age at first reproduction constitute raw data for building the population models used in extinction risk assessments and management programs of endangered species (IUCN 2001; Lindenmayer and Burgman 2005). The endangered, rattleless Santa Catalina Island Rattlesnake, *Crotalus catalinensis* (SEMARNAT 2010; IUCN. 2011. The IUCN Red List of Threatened Species. Available from http://www.iucnredlist.org [Assessed 11 December 2011]), is endemic to the Santa Catalina Island in the Gulf of California, Mexico (Fig. 1). It is a slender, moderate-sized species (e.g., Beaman and Wong 2001; Grismer 2002; Arnaud et al. 2008). It occurs in the desert habitats that cover the Santa Catalina Island (rocky and barren with sparse brush and cacti; see Arnaud et al. 2008; Martins et al. 2008), is primarily terrestrial and occasionally arboreal, and its diet is composed of lizards and mice (Grismer 2002; Ávila-Villegas et al. 2007; Arnaud et al. 2008; Martins et al. 2008). Molecular evidence (Murphy and Crabtree 1985; Murphy and Aguirre-León 2002; Murphy et al. 2002; Castoe and Parkinson 2006) indicates that *C. catalinensis* originated from the isolation of a population of the Red Diamond Rattlesnake, *Crotalus ruber*, in the Santa Catalina Island during the Pleistocene. *Crotalus catalinensis* differs from *C. ruber* by the lack of a rattle and by its smaller size, which attains 0.85 m in the former and at least 1.8 m in the latter (e.g., Grismer 2002; Beaman and Dugan 2006; this study). The apparent dwarfism in *C. catalinensis* was hypothesized to be a consequence of the small size of the main prey, adult Catalina Deer Mice (*Peromyscus slevini*, Cricetidae; Boback 2003; Ávila-Villegas et al. 2007). However, there is very little published information on the reproductive biology of *C. catalinensis* in nature (see Recchio and Lazcano 2010). Armstrong and Murphy (1979) and Grismer (2002) provided a few observations on gravid females in mid-summer and newborns in August and September. More recently, Arnaud et al. (2008) presented preliminary results on the reproduction of *C. catalinensis* using some data from this study; they

FIGURE 1. The rattleless Santa Catalina Island Rattlesnake, *Crotalus catalinensis*. (Photographed by Marcio Martins).

provided data indicating that births occur in late summer and early fall.

Here we provide data on the time of juvenile recruitment, an estimate of early growth, and compare basic morphological data of juveniles and adults, sexes, and color morphs of *C. catalinensis*. The data provided herein can be used in extinction risk assessment and management programs of *C. catalinensis* in the future. The questions we explore are: (1) Do sexes differ in their gross morphology (body length, tail length, and stoutness)? (2) Does morphology change during ontogeny? (3) Is juvenile recruitment seasonal? (4) How much do juveniles grow in their first years?

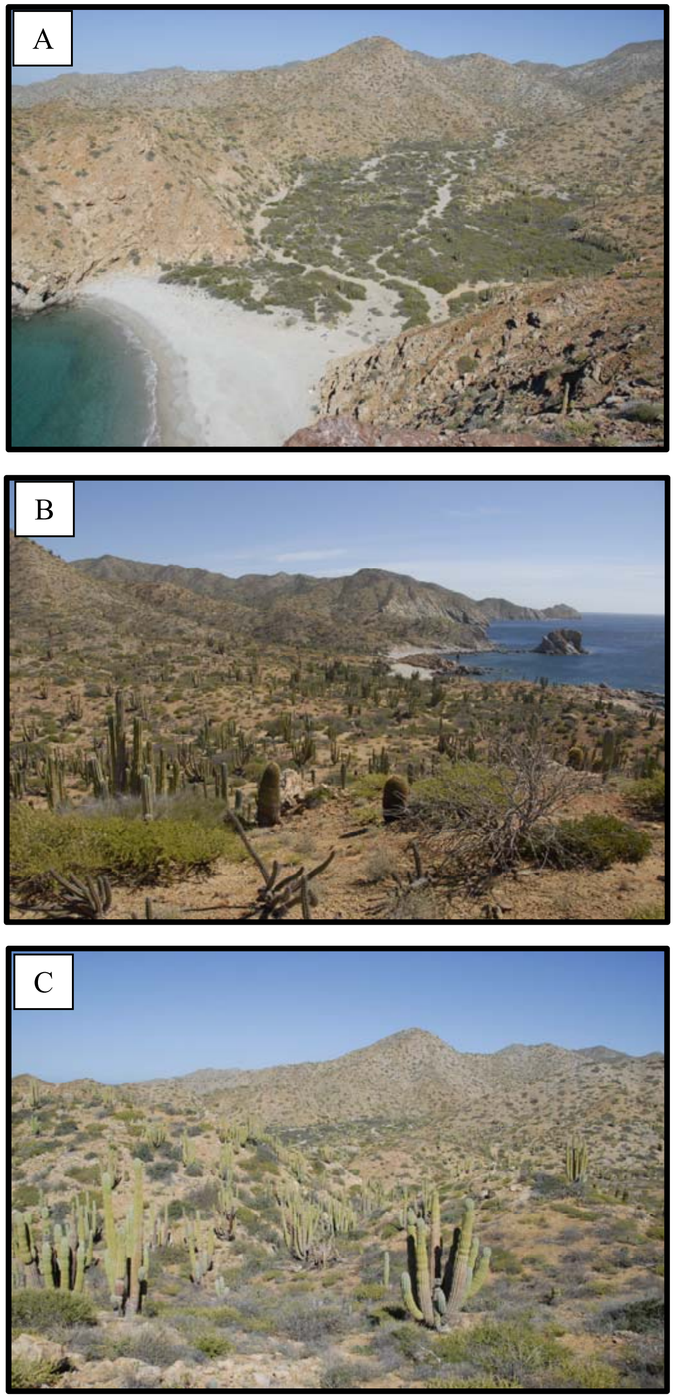

FIGURE 2. (A) View of one of the southernmost valleys of Santa Catalina Island, showing a streambed and a beach. (B) and (C) Two views of the typical desert vegetation inhabited by *Crotalus catalinensis*. (Photographed by Marcio Martins).

MATERIALS AND METHODS

Santa Catalina (25°39'N, 110°49'W) is a 41 km^2 granitic island (Murphy et al. 2002) characterized by rocky hillsides separated by sandy streambeds (Fig. 2A), bearing the typical vegetation of the Sonoran Desert (Fig. 2B and 2C; see Wiggins 1980; Martins et al. 2008). The island is located in the Parque Nacional Bahía de Loreto, off the coast of Loreto, in Baja California Sur, Mexico. The climate of this region can be divided into three seasons (Fig. 3): the dry season (March-June), characterized by the virtual absence of rainfall; the summer rainy season (July-October), with a substantial increase in precipitation caused by the cyclonic activity of the tropical Pacific; and the winter rainy season (November-February), with a reduction of rainfall from previous months (Garcia 1973; Salinas-Zavala et al. 1990).

We use data from 277 observations of *C. catalinensis* made during 20 visits to the Santa Catalina Island from 2002 to 2011. In each field trip (4–7 d), we searched for snakes on the surface of arroyos and adjacent hillsides at different times of the day, but mainly in late afternoon and at night (1900 to 2400), most of the time sampling a different locality each day. For each snake found, we recorded its snout-vent length (SVL ± 1 mm), tail length (TL ± 1 mm), sex (by cloacal probing or by everting hemipenes), and mass (in g). We palpated females for detection of embryos or enlarged follicles and marked almost all individuals by clipping ventral scales (*cf.* Fitch 1987). Snakes were released immediately after data gathering.

We tested differences between juveniles and adults, and males and females in snout-vent length and total length (TTL) with Student *t*-tests, after testing variables for normality with Kolmogorov-Smirnov tests. We tested differences in relative tail length and stoutness with analyses of covariance, with TL and mass as dependent variables, and SVL and TTL as covariates, respectively. All variables were log transformed. In all these analyses, we considered an individual an adult when its SVL was > 550 mm (based on our own data on minimum size of gravid females). We present snake sizes as SVL or as SVL + TL. We performed all statistical analyses in Statistical (StatSoft Inc., Tulsa, Oklahoma, USA) and considered significant statistical results with $P \leq 0.05$. The degree of sexual size dimorphism in SVL was calculated following Gibbons and Lovich (1990) and Shine (1994). We estimated growth rate from recaptures of animals separated by at least 2 mo and visually on a graph depicting the distribution of individual sizes throughout the year, in which monthly data of all years were combined (e.g., Klauber 1956; Sayler 1966; Quinn 1979; Webb et al. 2002).

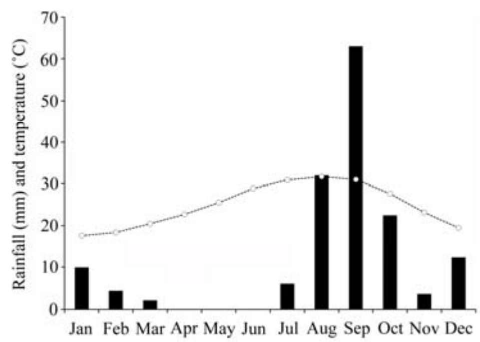

FIGURE 3. Variation in monthly amount of rainfall (mm; bars) and mean temperature (° C; dotted line with circles), for Loreto, Baja California Sur, Mexico, located about 65 km northwest of Santa Catalina Island. Data from Garcia (1973) for 1920–1962.

RESULTS

There was no significant difference between the SVL of adult males and females of *C. catalinensis* (Table 1; $t = 1.48$, df = 184, $P = 0.139$), whereas adult males had significantly larger TTL ($t = 2.45$, df = 184, $P = 0.015$) than adult females. The degree of sexual size dimorphism in SVL was -0.02. Adult females showed significantly shorter tails ($F_{1,183} = 93.52$, $P < 0.001$) and were significantly stouter ($F_{1,104} = 10.91$, $P = 0.001$) than adult males. Juvenile males had significantly shorter tails than adult males ($F_{1,128} = 7.22$, $P = 0.008$), whereas in females the tail of juveniles was not significantly different from those of adults ($F_{1,111} = 0.12$, $P = 0.730$). Juvenile males did not differ from adult males in stoutness ($F_{1,83} = 2.99$, $P = 0.088$), and the same result was found for females ($F_{1,61} = 1.77$, $P = 0.188$).

TABLE 1. Means, standard deviations (SD), and sample sizes (n) for morphological characters of newborns (young born in September), juveniles (those individuals older than newborns and younger than adults), and adults of *Crotalus catalinensis*. Abbreviations are: SVL = snout-vent length (in mm), RTL = relative tail length (as a percentage of SVL), TTL = total length (SVL + TL [tail length]; in mm), and stoutness (mass in g divided by TTL, both variables were log transformed).

	SVL			RTL			TTL			Stoutness		
	mean ± SD	range	n	mean ± SD	range (%)	n	mean ± SD	range	n	mean ± SD	range	n
Newborns	288.1 ± 37.3	193–380	12	7.9 ± 1.0	6.5–9.8	12	310.8 ± 39.5	212–359	12	0.82 ± 0.08	0.72–0.98	8
Juvenile males	463.2 ± 69.0	261–545	32	8.0 ± 0.8	6.1–9.8	32	499.9 ± 73.6	283–585	32	0.98 ± 0.11	0.66–1.17	24
Juvenile females	469.2 ± 56.3	372–545	27	6.9 ± 1.1	4.7–8.8	27	501.5 ± 59.0	395–580	27	1.03 ± 0.09	0.88–1.17	19
Adult males	643.4 ± 60.1	554–784	99	8.4 ± 0.8	6.3–10.5	99	697.6 ± 65.0	598–847	99	1.20 ± 0.05	1.04–1.29	62
Adult females	631.5 ± 47.2	552–757	87	7.0 ± 1.2	5.0–9.7	87	676.0 ± 53.4	589–820	87	1.21 ± 0.05	1.06–1.29	45

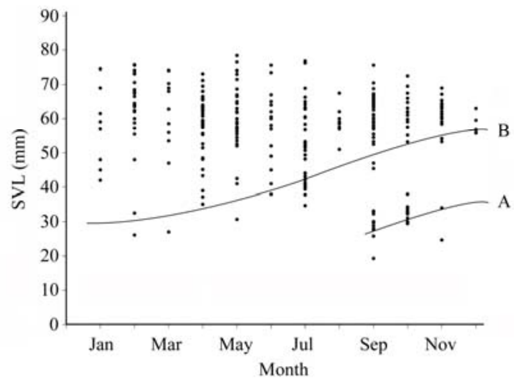

FIGURE 4. Distribution of individual sizes (SVL, in mm) of *Crotalus catalinensis* caught monthly during the study with monthly data of all years combined. All points are for individuals captured in the field on Santa Catalina Island, Baja California Sur, México. Approximate growth curves are shown for the first year (the year when juveniles were born; curve A) and the second year (when juveniles become 1 y old; curve B).

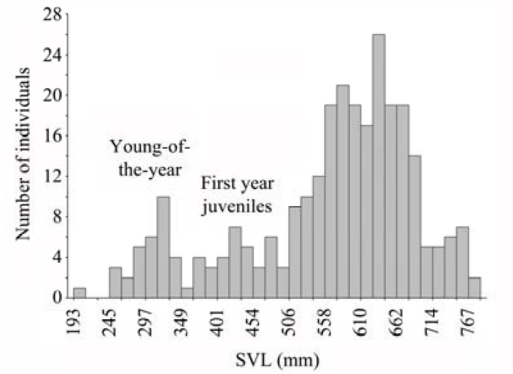

FIGURE 5. Distribution of SVL (mm) of all *Crotalus catalinensis* caught in the field on Santa Catalina Island, Baja California Sur, México.

We found pregnant females of *C. catalinensis* with detectable embryos in mid-July (n = 4; 603–650 mm SVL), late August (n = 2; 575–585 mm SVL), and early September (n = 1; 645 mm SVL). In July, all four adult females found (SVL > 550 mm) were pregnant. In August, we found two of four adult females pregnant, and in September, one of 29 females was pregnant.

The distribution of individual sizes throughout the year (Fig. 4) shows that active individuals of *C. catalinensis* were found in the field in all months. This distribution also shows a concentration of newborns (20–30 mm SVL) in late summer (September). The distribution of individual sizes throughout the year (Fig. 4) and the distribution of size classes in our sample (Fig. 5) also indicate that in their first year, juveniles grow from a mean SVL of about 250 mm to a mean SVL of about 450 mm, an increase of about 200 mm (a mean growth rate of about 1.7 cm/mo). The distribution of size classes in our sample (Fig. 5) also indicates that the young-of-the-year (newborns to 4 mo-old juveniles) are concentrated in the approximate range of 250–350 mm SVL and that first year juveniles (those in the year following the year they were born) are more variable in size (300–500 mm SVL). The gap that appears above the young-of-the-year in September and October (Fig. 4) is also evident as the first valley of the histogram of sample distributions (Fig. 5) at approximately 350–365 mm SVL). We recaptured four individuals > 2 mo after being marked. Total length varied from 469 to 795 mm and the estimated growth rate was 0.12–1.86 cm/mo (Table 2).

DISCUSSION

With very few exceptions (e.g., *Crotalus pricei*; Prival et al. 2002), rattlesnakes are sexually dimorphic in SVL (e.g., Klauber 1956; Shine 1978, 1994), including *C. ruber*, the sister species of *C. catalinensis* (Klauber 1956). In most cases, males show a larger SVL than those of females (Klauber 1956). Our analyses showed that *C. catalinensis* is not sexually dimorphic in relation to SVL and this lack of dimorphism in SVL may not be related to the small size of *C. catalinensis* because other similar-sized or even smaller rattlesnakes are sexually dimorphic in SVL (e.g., *C. cerastes*, *C. enyo*, *C. lepidus*; Shine 1978, 1994; Beaupre 1995; Goldberg and Beaman 2003). The degree of sexual dimorphism in SVL of *C. catalinensis* is in the lower portion of the range described in the literature for other rattlesnakes (-0.01 to -0.29; Shine 1994; Almeida-Santos 2005).

Based on the distribution of individual sizes in our study, *C. catalinensis* is active throughout the year, as previously suggested by Ávila-Villegas (2006). This distribution also indicates that juvenile recruitment occurs during late summer, especially in September, and the finding of gravid females in July, August, and September corroborates this result. Grismer (2002)

TABLE 2. Mark and recapture data (SVL = snout-vent length, TL = tail length), including estimated growth rate, for four individuals of *Crotalus catalinensis* on Santa Catalina Island, Baja California Sur, México.

Individual	Date marked	SVL + TL (mm)	Mass (g)	Date recaptured	SVL + TL (mm)	Mass (g)	Growth rate
Female 1	28 Sept. 2003	575 + 37	137	20 April 2004	583 + 37	159	0.12 cm/mo
Female 2	1 Nov. 2003	629 + 38	213	16 July 2004	650 + 40	202	0.27 cm/mo
Female 3	18 April 2004	433 + 36	55	14 July 2004	482 + 41	61	1.86 cm/mo
Male 1	19 April 2004	731 + 64	211	16 July 2004	762 + 66	--	1.10 cm/mo

found gravid females from mid-July to early August. Newborns were found in mid-August by Grismer (2002), who also reported a female collected in August that gave birth in captivity. Armstrong and Murphy (1979) reported a female that gave birth in September. Thus, all the available data obtained in nature indicate that time of juvenile recruitment in *C. catalinensis* is concentrated from mid- to late summer as in many other rattlesnakes (e.g., Klauber 1956). This relatively short time of juvenile recruitment is similar to those of most rattlesnakes, a character that seems to be very conservative in rattlesnakes in general (e.g., Klauber 1956; Diller and Wallace 1984; Taylor and DeNardo 2005).

Our distribution of individual sizes also indicates that in their first year of life, juvenile *C. catalinensis* grows at a mean rate of about 1.7 cm/mo, although it may vary throughout the year depending on climatic conditions, and therefore, prey availability and foraging opportunities (possibly faster from late summer to early autumn and late winter to early spring and possibly slower from mid-autumn to mid-winter). Our recapture data on a single juvenile (a female which grew from 469 to 523 mm of total length in 87 d, growth rate of 1.86 cm/mo) indicates that in their second year, growth rates are still high. Klauber (1956) presented data indicating that juveniles of *C. ruber* from San Diego County, California, USA grow faster than those of *C. catalinensis*, from a mean about 300 mm TTL as neonates to a mean about 650 mm when they complete 1 y (a growth rate of about 2.9 cm/mo). Other rattlesnakes grow about 1–2 cm/mo in their first months of activity (e.g., Gibbons 1972; Beaupre et al. 1998; Diller and Wallace 2002). Based on the SVL of gravid females (575–689 mm), it seems possible that females could mate when they are around 2 y old (SVL approximately 600–650 mm) and give birth in the following year. Thus, first reproduction may occur when they become at least 3 y old, as in most rattlesnakes (e.g., Klauber 1956; Gibbons 1972; Brown 1991).

In conclusion, our study provides evidence for several life-history traits of *C. catalinensis*, most of which are demonstrated for the first time: (1) there is no difference in the SVL of males and females (with a degree of sexual dimorphism in SVL of -0.02); (2) sexes are dimorphic in total length (larger in males), relative tail length (longer in males) and stoutness (higher in females); (3) juvenile recruitment occurs during late-summer, especially in September; (4) in their first 12 mo of life, juveniles seem to grow at a rate about 1.7 cm/mo; and (5) females seem to become sexually mature with an SVL around 570 mm, probably in the year they become 2 y old. Although being locally abundant and occurring on a relatively large island that is part of a National Park, *C. catalinensis* inhabits an ecosystem that is relatively fragile and susceptible to human induced perturbations and stochastic events (Arnaud et al., 2008). For instance, domestic cats (*Felis catus*) were only recently eradicated from the island, and cat scat analyses from the island showed that they frequently fed on *C. catalinensis* before eradication (Arnaud et al., 2008; G. Arnaud, pers. obs.). Although an education program targeting local fishermen is underway, the possibility of new cat introductions cannot be discounted (Arnaud et al., 2008). Another concern is the strong dependence of *C. catalinensis* on its main prey, the mouse *Peromyscus slevini*, an endemic to the island (Ávila-Villegas et al., 2008). Any decline on this mouse population (e.g., with a new introduction of domestic cats) would also have negative effects on the rattlesnake population (Ávila-Villegas et al., 2008). In this context, a long term monitoring program of *C. catalinensis* should be implemented to detect possible declines in the future. The life-history data provided herein could be used to optimize the use of time and funds in such a monitoring program. For instance, data on size of sexual maturation in females could be used to determine the target individuals for censusing of the potential reproductive female population and the time when newborns occur in the population could be used to monitor juvenile recruitment.

Acknowledgments.—We thank Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO), Secretaría del Medio Ambiente y Recursos Naturales (SEMARNAT) and Consejo Nacional de Ciencia y Tecnología (CONACyT) for providing funds (FB1484/HK051; SEMARNAT-CONACyT-2002-C01-0584); the Centro de Investigaciones Biológicas del Noroeste (CIBNOR) for providing institutional support; the staff of Parque Nacional Bahía de Loreto for logistic support and transportation to the island; Iván Hernández, Rosalva Murillo-Quero, Elí García, Oscar Cruz, Miguel Angel Leal, Israel Guerrero, and José Luis Burguete for help with fieldwork; and Otavio A.V. Marques, two anonymous reviewers, Robert Lovich, and David Germano for providing useful comments on earlier drafts of the manuscript. Marcio Martins thanks Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP; 2010/50146-3) for funding his work in Mexico. Permits were provided by Instituto Nacional de Ecología (INE; SGPA/DGVS/03943/10 and AGPA/DGVS/04526/11).

LITERATURE CITED

Almeida-Santos, S.M. 2005. Modelos reprodutivos em serpentes: estocagem de esperma e placentação em *Crotalus durissus* e *Bothrops jararaca* (Serpentes: Viperidae). M.Sc. Thesis, Universidade de São Paulo, São Paulo, Brazil. 204 p.

Armstrong, B.L., and J.B. Murphy. 1979. The natural history of Mexican rattlesnakes. University of Kansas Museum of Natural History Publications 5:1–88.

Arnaud, G., M. Martins, L. Burguete–Trujillo, I. Hernández-Rodríguez, H. Avila-Villegas, R. Murillo-Quero, and A. Quijada-Mascareñas. 2008. Historia natural de la serpiente de cascabel *Crotalus catalinensis*, endémica de la isla Santa Catalina, Golfo de California. Pp. 93–100 *In* Estudios de las Islas del Golfo de California. Flores-Campaña, L.M. (Ed.). Universidad Autónoma de Sinaloa, Culiacán, México.

Avila-Villegas, H. 2006. *Crotalus catalinensis* (Santa Catalina Island Rattlesnake). Winter activity. Herpetological Review 37:476.

Avila-Villegas, H., M. Martins, and G. Arnaud. 2007. Feeding ecology of the endemic Rattleless Rattlesnake, *Crotalus catalinensis*, of Isla Santa Catalina, Gulf of California, Mexico. Copeia 2007:80–84.

Beaman K.R., and E.A. Dugan. 2006. *Crotalus ruber* (Red Diamond Rattlesnake). Catalogue of American Amphibians and Reptiles 840:1–17.

Beaman, K.R., and N. Wong. 2001. *Crotalus catalinensis*. Catalogue of American Amphibians and Reptiles 733:1–4.

Beaupre, S.J. 1995. Comparative ecology of the Mottled Rock Rattlesnake, *Crotalus lepidus*, in Big Bend National Park. Herpetologica 51:45–56.

Beaupre, S.J., D. Duvall, and J. O'Leile. 1998. Ontogenetic variation in growth and sexual size dimorphism in a Central Arizona population of the Western Diamondback Rattlesnake (*Crotalus atrox*). Copeia 1998:40–47.

Boback, S.M. 2003. Body size evolution in snakes: evidence from island populations. Copeia 2003:81–94.

Brown, W.S. 1991. Female reproductive ecology in a northern population of the Timber Rattlesnake, *Crotalus horridus*. Herpetologica 47:101–115.

Castoe, T.A., and C.L. Parkinson. 2006. Bayesian mixed models and the phylogeny of pitvipers (Viperidae: Serpentes). Molecular Phylogenetics and Evolution 39:91–110.

Diller, L.V., and R.L. Wallace. 2002. Growth, reproduction, and survival in a population of *Crotalus viridis oreganus* in north central Idaho. Herpetological Monographs 16:26–45.

Fitch, H.S. 1987. Collecting and Life-history Techniques. Pp. 143–164 *In* Snakes: Ecology and Evolutionary Biology. Seigel, R.A., J.T. Collins, and S.S. Novak, (Eds.). MacMillan Publishing Company, New York, New York, USA.

Garcia, E. 1973. Modificaciones al Sistema de Clasificación Climática de Koppen, para Adaptarlo a las Condiciones de la República Mexicana. Instituto de Geografía, Universidad Nacional Autónoma de México, México City, D.F., Mexico.

Gibbons, J.W. 1972. Reproduction, growth, and sexual dimorphism in the Canebrake Rattlesnake (*Crotalus horridus atricaudatus*). Copeia 1972:222–226.

Gibbons, J.W., and R. Lovich. 1990. Sexual dimorphism in turtles with emphasis on the Slider Turtle (*Trachemys scripta*). Herpetological Monographs 4:1–29.

Goldberg, S.R., and K.R. Beaman. 2003. *Crotalus catalinensis* (Santa Catalina Rattleless Rattlesnake). Reproduction. Herpetological Review 34:249–250.

Grismer, L. 2002. Amphibians and Reptiles of Baja California, Including its Pacific Islands and the Islands in the Sea of Cortés. University of California Press, Berkeley, California, USA.

IUCN (International Union for Conservation of Nature). 2001. IUCN Red List categories and criteria: Version 3.1. IUCN Species Survival Commission Gland, Switzerland, and Cambridge, UK.

Klauber, L.M. 1956. Rattlesnakes: Their Habits, Life Histories, and Influence on Mankind. 2nd Edition. University of California Press, Berkeley, California, USA.

Lindenmayer, D., and M. Burgman. 2005. Practical Conservation Biology. CSIRO Publishing, Melbourne, Victoria, Australia.

Martins, M., G. Arnaud, and R. Murillo-Quero. 2008. Exploring hypotheses about the loss of the rattle in rattlesnakes: How arboreal is the Santa Catalina Rattleless Rattlesnake, *Crotalus catalinensis*? South American Journal of Herpetology 3:162–167.

Murphy, R.W., and B. Crabtree. 1985. Genetic relationships of the Santa Catalina Island Rattleless Rattlesnake, *Crotalus catalinensis* (Serpentes: Viperidae). Acta Zoológica Mexicana 9:1–16.

Murphy, R.W., and G. Aguirre-León. 2002. Non avian reptiles: origins and evolution. Pp. 181–220 *In* A New Island Biogeography in the Sea of Cortés. Case, T.J., M.L. Cody, and E. Ezcurra (Eds.). Oxford University Press, New York, New York, USA.

Murphy, R.W., J. Fu, A. Lathrop, J.V. Feltham, and V. Kovac. 2002. Phylogeny of the rattlesnakes (*Crotalus* and *Sistrurus*) inferred from sequences of five mitochondrial DNA genes. Pp. 71–92 *In* Biology of Vipers. Schuett, G.W., M. Höggren, M.E. Douglas, and H.W. Greene (Eds.). Eagle Mountain Publishing, Eagle Mountain, Utah, USA.

Prival, D.B., M.J. Goode, D.E. Swann, C.R. Schwalbe, and M.J. Schroff. 2002. Natural history of a northern population of Twin-spotted Rattlesnakes, *Crotalus pricei*. Journal of Herpetology 36:598–607.

Quinn, H.R. 1979. Reproduction and growth of the Texas Coral Snake (*Micrurus fulvius tenere*). Copeia 1979:453–463.

Recchio, I.M., and D. Lazcano. 2010. *Crotalus catalinensis* (Santa Catalina Island Rattlesnake). Reproduction. Herpetological Review 41:500–501.

Salinas-Zavala, C.A., A. Leyva-Contreras, D. Lluch-Belda, and E. Díaz-Rivera. 1990. Distribución geográfica y variabilidad climática de los regímenes pluviométricos en Baja California Sur, México. Atmósfera 3:217–237.

Sayler, A. 1966. The reproductive ecology of the Red-backed Salamander, *Plethodon cinereus*, in Maryland. Copeia 1966:183–193.

SEMARNAT (Secretaria de Medio Ambiente y Recursos Naturales, México). 2010. Norma Oficial Mexicana NOM-059-SEMARNAT-2010, Protección ambiental. Especies nativas de México de flora y fauna silvestres. Categorías de riesgo y especificaciones para su inclusión, exclusión o cambio. Lista de especies en riesgo. México City, D.F., Mexico.

Shine, R. 1978. Sexual size dimorphism and male combat in snakes. Oecologia 33:269–277.

Shine, R. 1994. Sexual size dimorphism in snakes revisited. Copeia 1994:326–346.

Taylor, E.N., and D.F. DeNardo. 2005. Reproductive ecology of Western Diamond-Backed Rattlesnakes (*Crotalus atrox*) in the Sonoran Desert. Copeia 2005:152–158.

Webb, J.K., K.A. Christian, and P. Fisher. 2002. Fast growth and early maturation in a viviparous sit-and-wait predator, the Northern Death Adder (*Acanthophis praelongus*), from tropical Australia. Journal of Herpetology 36:505–509.

Wiggins, I.L. 1980. Flora of Baja California. Stanford University Press, Stanford, California, USA.

MARCIO MARTINS is a Full Professor at the Department of Ecology, University of São Paulo, Brazil. During the last decades he's been working on frogs and snakes in many different regions of Brazil and, more recently, in northwestern Mexico. His studies focused mainly on natural history, community ecology, ecomorphology, and conservation. He has been involved with extinction risk assessments of herps at international, national, and regional levels. He is also a member of the Frog and Viper specialist groups of IUCN. Presently, he is the president of the Brazilian Society of Herpetology and the Receiving Editor of the society's journal, South American Journal of Herpetology. (Photographed by Gustavo Arnaud)

GUSTAVO ARNAUD is a Researcher at Centro de Investigaciones Biológicas del Noroeste (CIBNOR), working under the Environmental Planning and Conservation Program, and participating in the institutional strategic effort for the conservation of Mexican Biodiversity. During the last decades, he has been working with the natural history and conservation of small mammals and reptiles in the islands of the Gulf of California. He is also the coordinator of the State Web of Environmental Educators of Baja California Sur. Presently he is carrying on a research project on the rattlesnakes of northwest Mexico, emphasizing micro endemic species. (Photographed by Marcio Martins).

HÉCTOR ÁVILA-VILLEGAS is a Biologist established in Aguascalientes, Mexico. He was a collator in the Conservation project of the Islands of the Gulf of California and obtained his Master degree working on the natural history of the Santa Catalina Island Rattlesnake, *Crotalus catalinensis*. He has worked for environmental, governmental agencies and is employed by the National Commission for Biodiversity (CONABIO). (Photographed by Flor Torres).