SCALE PATTERNS OF AMERICAN CROCODILES (*Crocodylus acutus*) FROM SEVERAL VENEZUELAN LOCALITIES*

Patrones de Escamación de Caimanes de la Costa en Varias Localidades Venezolanas

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RESUMEN

Se analizó el patrón de escamación de 686 caimanes de la costa (*Crocodylus acutus*) de Venezuela. La mayoría de los individuos (95,9%) presentaron una fila de cuatro escamas post-occipitales y 6 escamas nucales (77,6%) en el arreglo considerado típico para la especie. La frecuencia de distribución de filas dorsales transversales varía entre 13 y 18, con 15 y 16 filas como el patrón más común (37,7 y 55,9%, respectivamente). Respecto a la cresta caudal doble, la mayor parte de los individuos (99,1%) mostraron desde 16 hasta 19 filas, con un grupo de 5 crías de la misma nidada que presentó desde 20 hasta 22 de estas crestas. También se analizaron los patrones de escamación ventral. Se encontraron diferencias en las distribuciones de frecuencia de patrones de escamación entre localidades e incluso entre crías provenientes de distintas nidadas. Se consideró que la muestra de individuos mayores de 550 mm de longitud total representó una muestra no sesgada de los cocodrilos de cada población. Al considerar sólo a estos animales los porcentajes significativamente altos (85,7%) o bajos (54,5%) con el patrón nucal típico conseguidos en Pueblo Viejo y Turiamo, respectivamente, pueden interpretarse como resultados de cuellos de botella poblacionales en el pasado reciente. El patrón de escamación nucal de 117 crías descendientes de una pareja de *C. acutus* se asemejó al del macho (53,0%) y al de la hembra (26,5%).

Palabras claves: *Crocodylus acutus*, patrón de escamación, Venezuela.

ABSTRACT

The scutellation patterns of 686 American crocodiles (*Crocodylus acutus*) from Venezuela were analyzed. Most individuals have four post-occipital scales in

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one row (95.9%) and a cluster of six nuchal scales (77.6%), the pattern considered typical for the species. The frequency distribution of dorsal transverse rows ranges from 13 to 18, with 15 and 16 as the most common figures (37.7 and 55.9%, respectively). With respect to the double crested caudal whorls, most individuals (99.1%) had from 16 to 19, with a group of five siblings having between 20 and even 22 whorls. The distribution pattern of single-crested caudal whorls and transverse ventral scale rows was also analyzed. There were differences in the frequency distribution of scutellation patterns between localities and even between hatchlings from different pods. When individuals less than 550 mm in total length were removed from the analyses, the remaining crocodiles were considered to represent and unbiased subset of the population of each locality. Both the significantly high (85.7%) or low (54,5%) percentages of individuals with the typical nuchal scale pattern found in Pueblo Viejo and Turiamo, respectively, can be interpreted as resulting from a bottleneck effect. The nuchal scale pattern of 117 descendant of an American crocodile couple kept in captivity resembles that of the male (53.0%) and female (26.5%).

Key words: *Crocodylus acutus*, scutellation pattern, Venezuela.

INTRODUCCIÓN

The American crocodile (*Crocodylus acutus*) is one of the most widespread crocodilian species in the world (Brazaitis, 1973; Groombridge 1987, Thorbjarnarson 1989). Its general distribution includes the Atlantic and Pacific coast of southern Mexico, Central America and northern South America, as well as the Caribbean islands of Cuba, Jamaica, Hispaniola, and the souththern tip of Florida. Little data on its morphological characteristics are available, most are from specimens preserved in museums or from individuals kept in captivity. Although geographic variability has been recognized (Neill, 1971; Brazaitis, 1973; Ross and Mayer, 1983), it has not been adequately quantified.

The scutellation pattern of the American crocodile has been described by Brazaitis (1973), Ross and Mayer (1983) and Ross and Ross (1987), but only in the latter two papers there are detailed accounts of the origin and number of the specimens examined. Garrick (1982) analyzed the variation of the post-occipital and nuchal scale pattern of American crocodiles from several localities and habitat types but gave no figures that would permit statistical comparisons.

In this study, I analyze the scutellation pattern of the American crocodile from several Venezuelan localities. This crocodile is considered to be an endangered species in Venezuela with only a few isolated populations remaining (Seijas, 1986, 1990). The American crocodile was subjectted to severe commercial exploitation from 1929 to the 1960s (Mondolfi, 1965; Medem, 1983). During that period it was extirpated or severely depleted from most places throughout its distribution. The present populations could be the descendants of a few individuals that remained in those localities or that have been able to adapt to newly created habitats such as reservoirs. If so, the scutellation pattern of the present populations could reflect inbreeding or the bottleneck effect.

MATERIALS AND METHODS

From 1984 to 1991, the scale pattern of 567 wild American crocodiles caught at 11 localities along the Venezuelan coastal region were recorded (Fig. 1). Additional 119 records came from a couple of American crocodiles and their offspring kept in captivity at Masaguaral Ranch, in Guárico state (Table 1).

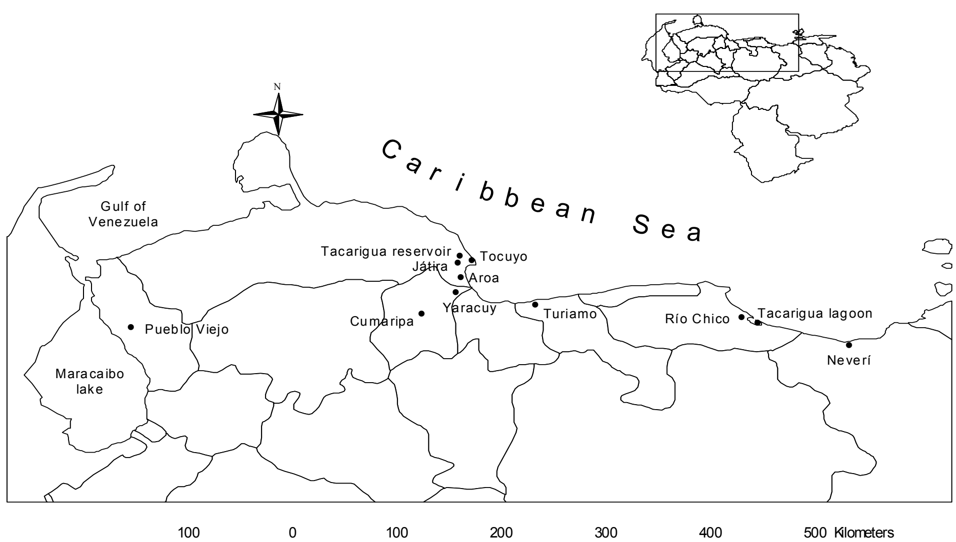

Figure 1. Localities along the Venezuelan coastal region where the American crocodiles (*Crocodylus acutus*) were captured.

Table 1. Localities and number of American crocodiles that were included in this study of scutellation pattern. Individuals less than 550 mm in total length (TL) were considered as hatchlings.

Locality	# hatchlings	# non hatchlings	Total
Aroa river	4	1	5
Cumaripa reservoir	10	1	11
Tacarigua reservoir	14	29	43
Jatira reservoir	26	38	64
Tacarigua lagoon	12	5	17
Neverí river	6	1	7
Pueblo Viejo reservoir	77	30	107
Río Chico channels	4	1	5
Tocuyo river	1	3	4
Turiamo lagoon	1	11	12
Yaracuy	214	78	292
Captives (Masaguaral)	117	2	119
Total	**489**	**197**	**686**

The localities included four rivers (Yaracuy, Tocuyo, Aroa, Neverí) four reservoirs (Cumaripa, Játira, Tacarigua, Pueblo Viejo) and three temporary brackish water lagoons or channels. All these localities have been described elsewhere (Seijas 1986, 1988).

In the remainder of this paper the word reservoir will be used only to distinguish the Tacarigua lagoon from the Tacarigua reservoir. Játira, Tacarigua reservoir and Tocuyo river are localities in close proximity, and for most analyses they were considered as conforming a single American crocodile population, hereafter called 'Tocuyo region'.

The number of scales of the post occipital (POS) and nuchal (NS) region, as well as the number of transverse rows in the dorsal (DTR), double-crest caudal whorls (DCCW), single-crest caudal whorls (SCCW), and ventral (VR) regions (Brazaitis 1973) was recorded.

To simplify data management, each scale in the POS and NS cluster was identified by a number as shown in figure 2. A crocodile with four POS in a row was identified in the data set with the #15 (1+2+4+8=15). Similarly, an individual with a cluster of 6 NS as seen in figure 2, received #63 (1+2+4+8+16+32=63). Those two patterns have been considered as "typical" for the species (Brazaitis, 1973; Garrick, 1982).

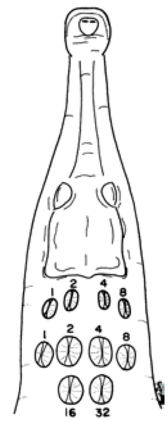

Figure 2. Drawing representing an American crocodile with typical post-occipital and nuchal scale patterns. Each scale in the typical pattern is labeled with a number. The numbers for the post-occipital pattern add to 15 (1+2+4+8=15), and the numbers for the nuchal pattern add to 63. The patterns borne by a particular crocodile is obtained subtracting from the above figures the numbers corresponding to the lacking scutes.

Animals lacking any scale in the POS or NS cluster, received the number resulting from subtracting the number of lacking scale (or scales) from the figure of the typical pattern. Crocodiles with more than 4 POS or more than 6 NS received numbers 16 and 64, respectively (Fig. 3).

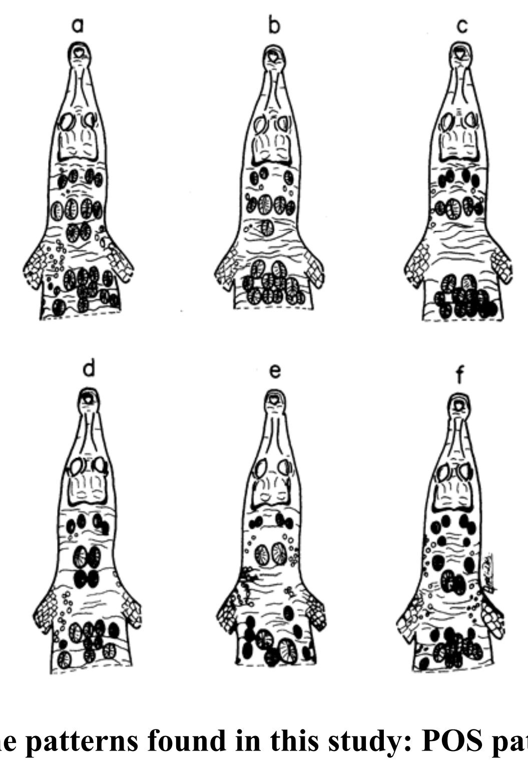

Figure 3. Some of the patterns found in this study: POS patterns #15 (a, c, d, e, f) and #11 (b). NS patterns #63 (a), #31 (c), #15 (c), #54 (d), #6 (e), and #57 (f).

In the case of the DTR, a transverse row was counted only when there was a series of scales (contiguous or not) with at least one of them crossing or reaching the middle line. This means that isolated scales at the anterior part of the dorsal region were not counted as DTR. VR were counted twice, once on the left side of the midline and once on the right, only the lower number of VR was used in the analyses.

The total length (TL) and sex (when possible) of the crocodiles were also registered. Individuals less than 550 mm in TL were considered as hatchlings; they comprised 65.1% (372 individuals) of the crocodiles captured in the wild (Table 1). Hatchlings of *C. acutus* disperse rapidly from the nest (pers. obs.) and after a year, when most of them have reached a total length (TL) of 550 mm or more, they are supposedly far away from their siblings and mixed among other crocodiles within the population. Thus, the scutellation pattern from the sample of crocodiles larger than 550 mm TL was considered to represent an unbiased subset of the scutellation pattern of the population. Data from hatchlings and non-hatchlings were analyzed separately. Chi-square tests were use to compare the frequency distribution of the scutellation patterns of the samples. When necessary, to avoid expected values of less than 5, frequency categories in the left or right extreme of the frequency distribution were grouped.

RESULTS

Post-Occipital Scales (POS). Table 2 shows the POS patterns of *C. acutus* from all localities. Most wild crocodiles (96%) have the typical four scales in a row (pattern #15), whereas 20 (3.5%) lack at least one scale and only 3 of the 567 crocodiles analyzed (0.5%) had five POS. The locality that showed the highest variability was the Yaracuy River, where 93.8% of the individuals (hatchlings + non-hatchlings) showed the typical pattern. When compared with the other localities as a whole, the deviation from the typical POS pattern at the Yaracuy River was statistically significant (X^2 = 8.47, P=0.036). Most (98.3%) of the 117 offspring born in captivity presented POS pattern #15, which was also the pattern of their parents.

Five hatchlings with POS #11 were found among three pods (77 individuals in total) captured in 1990 in a reach of river some 500 m long, which means that they could all be offspring of the same male. That suggest, as will be showed later, that the probability of finding the same scutellation pattern is greater among related crocodiles. When hatchlings were excluded from the analyses, the percentage of individuals showing the typical pattern was 97.9% and the difference between the Yaracuy River and other localities was not statistically significant.

Table 2. Post-occipital (POS) scutellation pattern of American crocodiles form several localities of Venezuela

	Post Occipital (POS) scutellation patterns							
	#7	**#9**	**#11**	**#13**	**#14**	**#15**	**#16**	**Totals**
All individuals								
Cumaripa reservoir						11		11
Tocuyo region	1					110		111
Tacarigua lagoon						17		17
Pueblo Viejo reservoir			1			104	2	107
Turiamo lagoon						12		12
Yaracuy river*	1	2	7	2	1	259	1	273
Yaracuy river pod 4			2	2		14		18
Others localities						17		17
Total wilds	2	2	10	4	1	544	3	566
Captives						117	2	119
Total all	**2**	**2**	**10**	**4**	**1**	**544**	**3**	**685**
Non-hatchling								
Cumaripa reservoir						1		1
Tocuyo region						66		66
Tacarigua lagoon						5		5
Neveri river						1		1
Pueblo Viejo reservoir			1			26	1	28
Turiamo lagoon						11		11
Yaracuy river			2			76		78
Others localities						5		5
Total non-hatchlings	0	0	3	0	0	191	1	195

* Does not include pod 4.

Nuchal Scales (NS). I found 19 different NS patterns, many of them represented by just one or two individuals (Table 3). Pattern #63 represented from 50% (in Turiamo) up to 90,7% (Pueblo Viejo) with a overall predominance of 77.9% for the wild individuals. Pattern #63 is considered the typical for the species. Contingency table analyses indicated that the differences in relative importance of non-typical patterns among localities was statistically significant (X^2 = 21.43, P<0.001). When data from Pueblo Viejo was dropped from the analysis, those differences were not statistically significant (X^2 = 5.40, P = 0.249). Even though it has a small sample size (N=12) Turiamo showed a high deviation from the typical NS pattern (50%), however, that deviation is statistically significant only when it is compared with all the other localities considered together (X^2 = 5.74; P =

0.017), or when compared with Pueblo Viejo (X^2 = 15.32; P < 0.001). The Tocuyo region and the Yaracuy River, the localities with the largest sample size, showed 69.2% of the individuals with the typical NS pattern.

Table 3. Nuchal scale (NS) patterns of American crocodiles (*Crocodylus acutus*) from different localities of Venezuela.

Localities	Total number of Patterns	Nuchal scale (NS) patterns								
		#14	#15	#31	#47	#54	#59	#63	Others	Total
All individuals										
Cumaripa reservoir	3			2				8	1	11
Tocuyo region	15	1	3	5	1	5	1	85	9	110
Tacarigua lagoon	3			1	1			14		16
Pueblo Viejo reservoir	4		2	6	2			97		107
Turiamo lagoon	5		2		1		2	6	1	12
Yaracuy river*	12	1	13	14	6	4	1	188	4	231
Yaracuy pod 3	5	1	6	5	3			14		29
Yaracuy pod 4	5	1	14	3				13	1	32
Others	2			2				15		17
Total (wilds)	18	4	40	38	14	9	4	440	16	565
Captives	7		32	16	6	1		62	2	119
Non-hatchling										
Cumaripa	1							1		1
Tocuyo region	13	1	3	2	1	5	1	49	6	68
Tacarigua lagoon	3				1			3	1	5
Pueblo Viejo	3		1	3				24		28
Turiamo	5		1		1		2	6	1	11
Yaracuy	9	1	6	9	6	1		52	3	78
Otras	2			1				2	0	3
Total non hatchlings	**18**	**2**	**11**	**15**	**9**	**6**	**3**	**137**	**11**	**194**

Does not include pods 3 and 4.

Two pods of hatchlings (29 and 32 individuals each) had 51.7% and 59.4% of the individuals with a NS pattern different from the typical (Table 3). Those deviations are statistically significant (X^2 = 4.81; P = 0.03 and X^2 = 8.82; P < 0.01, respectively) when compared with the distribution of NS pattern among non-hatchlings of that river. On the other hand, all 24 hatchlings from another pod at the same locality had the typical NS pattern which is also statistically different from the pattern of Yaracuy non-hatchlings (X^2 = 8.71; P < 0.01).

The Yaracuy river, and the Tocuyo region had the largest number of NS patterns (Table 4) and intermediate diversity indices (Shannon-Weaver

Indices, SWI= 1.193 and 1.148, respectively). The lowest diversity was showed by Pueblo Viejo population (SWI = 0.490) despite its relatively large sample size. Turiamo, on the other hand showed the highest diversity of patterns (SWI=1.295) among wild populations, although the sample size is low.

The diversity index for 116 crocodiles descendants of the same couple was also high (SWI=1.195). Of these individuals, 61 (52.3%) had the NS pattern of the male (NS pattern #63) and 32 (27.6%) had the NS pattern of the female (NS pattern #15), the remaining individuals have NS patterns intermediate between the parents'.

Table 4. Diversity of nuchal scutellation (NS) patterns of American crocodiles (*Crocodylus acutus*) from Venezuela. The upper part of the table indicates the diversity indices when all individuals are considered. The lower part shows diversity indices when hatchling are not considered.

Locality	Number of NS patterns	Sample size	Shannon-Weaver Diversity Index
All			
Turiamo lagoon	5	12	1.358
Tocuyo region	15	110	1.079
Yaracuy river	12	292	0.996
Cumaripa	3	11	0.760
Tacarigua lagoon	4	17	0.660
Pueblo Viejo	4	107	0.399
Others	2	17	0.362
Total (wilds)	19	566	0.969
Captives	6	116	1.195
Non-hatchling			
Turiamo	5	11	1.295
Yaracuy	9	78	1.193
Tocuyo region	13	69	1.148
Pueblo Viejo	3	28	0.490
Others	4	9	1.003
Total non hatchlings	**18**	**194**	**1.285**

Dorsal Transverse rows (DTR). Most crocodiles (89.1% for non-hatchlings) had 15 or 16 dorsal rows (table 5). For the subsequent analyses, the frequency category 13 was grouped with frequency category 14. Similarly, frequency categories 17 and 18 were grouped.

Pueblo Viejo showed the most skewed distribution (to the right) although the differences were only statistically significant (X^2 = 27.3 , P<0.001) when all crocodiles were considered (hatchling includes). One hatchling pod from the Yaracuy River has a frequency distribution of DTR extremely skewed to the right with most individuals (97%) with 16 or more DTR (table 5).

Table 5. Frequency distribution of American crocodiles (*Crocodylus acutus*) per number of dorsal transverse rows (DTR)

	Number of dorsal transverse rows (DTR)						
Locality	**13**	**14**	**15**	**16**	**17**	**18**	**Total**
All							
Cumaripa			7	4			11
Tocuyo region	1	8	50	47	2	1	109
Tacarigua lagoon			3	11	3		17
Pviejo	1		21	83	2		107
Turiamo			7	4			11
Yaracuy*		12	113	115	2		242
Yaracuy pod 6		1		30	2		33
Others			5	5			10
Total wilds	2	21	201	294	11	1	540
Captives		3	30	27	2		
Non-hatchling							
Cumaripa				1			1
Tocuyo region		8	33	23	2	1	67
Tacarigua lagoon			3	1	1		5
Pviejo	1		8	19			28
Turiamo			6	4			10
Yaracuy		7	34	36	1		78
Others			1	2			3
Total general	**1**	**15**	**85**	**86**	**4**	**1**	**192**

* Does not include individuals from pod 6

Double Crested Caudal Whorls (DCCW). Most American crocodiles had from 16 to had 19 rows in the double crested caudal whorls (table 6). The most frequent numbers of DCCW were 17 and 18, which together comprised more that 90% of the sample. There seem to be no differences among populations in this feature. The only 5 individuals in the entire sample with 20 or more DCCW belong to a pod from the Yaracuy river.

Table 6. Frequency distribution of American crocodiles (Crocodylus acutus) per number of double-crested caudal whorls (DCCW).

	Number of DCCW						
Region	**16**	**17**	**18**	**19**	**20**	**22**	**Total**
All individuals							
Cumaripa		1	10				11
Tocuyo region	3	58	41	8			110
Pueblo Viejo	1	58	46	2			107
Tacarigua lagoon		8	7	2			17
Turiamo		8	3				11
Yaracuy*	11	119	94	18			242
Yaracuy pod 6	1	17	10		4	1	33
Others		4	12	1			17
Total wilds	16	273	223	31	4	1	548
Captives	2	29	28	2	1		62
Non-hatchling							
Tocuyo region	2	34	28	6			70
Pueblo Viejo	1	17	12				30
Turiamo		7	3				10
Yaracuy	5	34	35	4			78
Others		3	5	1			9
Total non-hatchling	**8**	**95**	**83**	**11**			**197**

* Does not include individuals from pod 6

Single Crested Caudal Whorls (SCCW). Individuals with less than 16 were considered as probably of missing the tip of the tail and do not considered in the analyses. Number of SCCW ranged from 16 to 25, but most (81.7%) of the wild not-hatchling had 17 or 18 SCCW (table 7).

Hatchlings from Pueblo Viejo showed a high frequency (33.3%) of individuals with 19 SCCW which depart from which is expected by chance (X^2 = 15.1, P< 0.001) if compared to non-hatchlings of that locality. For non-hatchling, the localities with the larger number of individuals (Pueblo Viejo, Tocuyo region and Yaracuy) had frequency distribution statistically different, due to the unusual number of individuals with 19 or more SCCW in Yaracuy river sample ($X^2 = 22.37$, $P < 0.001$).

Table 7. Frequency distribution of American crocodiles (Crocodylus acutus) per number of single-crested caudal whorls (SCCW).

	Number of SCCW							
Region	**16**	**17**	**18**	**19**	**20**	**21**	**25**	**Total**
All individuals								
Cumaripa	1	1	9					11
Tocuyo region	10	35	46	9	2	1	1	104
Others	1	6	8	2				17
Pueblo Viejo	3	27	49	25				104
Tacarigua lagoon	2	8	6	1				17
Turiamo		6	4					10
Yaracuy	16	84	124	45	3			272
Total wilds	33	167	246	82	5	1	1	535
Captives	7	21	26	7				61
Non-hatchling								
Tocuyo region	9	27	27	3			1	67
Pueblo Viejo	1	13	15					29
Turiamo		6	3					9
Yaracuy	1	21	36	16	3			77
Others		5	3	1				9
Total non-hatchling	**11**	**72**	**84**	**20**	**3**		**1**	**191**

Transverse Ventral Scale Rows (TVSR). The number of TVSR ranged from 24 to 31 with 26 and 27 as the most common figures (63.8%) (table 8). Taking into consideration only the localities with the largest sample (Tocuyo region, Pueblo Viejo and Yaracuy), the frequency distribution of crocodiles in relation to TVSR was not homogeneous ($X^2 = 17.07$, $P = 0.009$). Pueblo Viejo reservoir, with a large number of individuals with 28 or more TVSR was responsible for this difference.

Sex and scutellation pattern.- There were no sex-related differences in the scutellation patterns, except that females show an unexpectedly high number of individuals with NS pattern #15 ($X^2 = 9.48$; $P < 0.01$). Hatchlings were excluded from this analysis. The only exception were the American crocodiles from Masaguaral Ranch for which the sex was known (ratio males/females = 1.23). However, even when the data from Masaguaral were excluded, the occurrence of NS pattern #15 between males and females deviated from the one expected by chance ($X^2 = 8.79$; $P < 0.01$).

Table 8. Frequency distribution of American crocodiles per number of transverse ventral scale rows (TVSR)

	Number of TVSR								
Region	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**Total general**
All									
Cumaripa			2	3	6				11
Tocuyo region	1	8	18	24	9	2			62
Pueblo Viejo	1	13	30	24	27	10	2		107
Tacarigua lagoon		4	8	3	2				17
Turiamo		3	4	2	1	1			11
Yaracuy	4	25	67	94	37	8	2	1	238
Others		3	5	4	3				15
Total wilds	6	256	134	154	85	21	4		461
Captives		5	16	29	11		1		62
Total	6	261	150	183	96	21	5	0	523
Non-hatchling									
Tocuyo region	1	6	14	15	7				43
Pueblo Viejo		3	4	7	10	5	1		30
Turiamo		2	4	2	1	1			10
Yaracuy	2	6	26	28	13	1	1		77
Others		1	2	4	1				8
Total	**3**	**18**	**50**	**56**	**32**	**7**	**2**		**168**

DISCUSSION

Even though the great variability in scutellation patterns of the American crocodile has been recognized previously, most of the information available in the literature cannot be used for comparative studies. To my knowledge, only the papers by Ross and Mayer (1983) and Ross and Ross (1987) gave figures that permit statistical comparisons.

The percentage of individuals with a typical POS pattern (95.9%) found in this study is much higher than the one reported by Ross and Ross (1987) for 70 *C. acutus* from Mexico and Central America (61.4%). A homogeneity test indicates that those differences are significant ($X^2 = 66.5$; $P < 0.001$). The deviation from the typical POS pattern found by Ross and Ross (1987) is even statistically significant if compared with the sample from the Yaracuy River, the locality where I found the highest deviation from the typical POS pattern ($X^2 = 54.24$; $P < 0.001$). Ross and Ross (1987) did not mention how many (if any) of the American crocodile they examined were hatchlings from the same pods. If that number was high, it could explain the discrepancies between my data and theirs because as has been shown some pods (table 2) had a relatively high percentage of individuals with a POS pattern different from the typical. My data cannot be statistically compared with those reported by Garrick (1982), where at least 75% of the American crocodiles had 4 POS (and 6 NS). Brazaitis (1973) pointed out that it is possible to find as many as 6 POS in *C. acutus*, a condition that neither Ross and Ross (1987) nor I found in the 70 and 686 individuals analyzed, respectively.

In respect to NS pattern, my data differ statistically (X^2 = 9.26; P = 0.002) from the ones reported by Ross and Ross (1987). These authors found 27 of their 70 (38.6%) American crocodiles with atypical NS patterns, whereas my figures were 125 of 565 (22.1%), respectively. When hatchlings were not considered there was no statistical difference between my data and those reported by Ross and Ross (1987) (X^2 = 2.03; P= 0.157). There is not information to determine if the high deviation from the typical NS pattern found in the sample of Ross and Ross (1987) was due to a high proportion of individuals with atypical NS patterns from the same pod, as occurs with pods 3 and 4 of table 3.

Brazaitis (1973) mentioned that some *C. acutus* have just 1 scute in the NS cluster, a condition that I never found. I consider that it is even possible to find American crocodiles without any nuchal scales. However, the probability of that event should be very low if we consider that only 3 individuals of my sample (two with pattern #6 and one with pattern #48) have two NS. That represents 0.005%. The probability of finding individuals with one or no NS should be lower than that figure.

The high proportion of individuals with NS patterns similar to the pattern of the parents found in Masaguaral pod (table 3), indicates that that characteristic is genetically and not environmentally determined as occurs with sex and other traits in most crocodilians species (Deeming and Ferguson, 1989). This possibility is also suggested by the high proportion of crocodiles with atypical patterns found in pods 3 and 4 from the Yaracuy River. All those hatchlings, which were found in a relative close proximity along the river, could be offspring of a single male. I have no explanation for the fact that a significant high number of females have the NS pattern #15.

The intermediate diversity of NS pattern of *C. acutus* from the Yaracuy River and Tocuyo region, as well as the intermediate percentage of individuals (69.2%) with the typical NS pattern, which is similar to the one reported by Garrick (1982), could be interpreted as if those populations were not extremely depleted during the commercial exploitation of the past, or that they were founded by a relatively higher number of individuals if compared to other *C. acutus* populations in the country (Pueblo Viejo or Turiamo, for example). Nowadays, Tocuyo region and the Yaracuy River contain some of the largest American crocodile populations in Venezuela (Seijas, 1988; Seijas and Chávez, 1991). In the past, the distribution of the NS and other scutellation patterns of the American crocodiles in Venezuela may have been similar to the ones found in the Yaracuy River and Tocuyo region during this study.

On the other hand, the high uniformity of NS patterns found in Pueblo Viejo, at one extreme, or the high percentage of individuals with atypical NS pattern in Turiamo, at the other extreme, could be used as evidence of the founder effect. Both Turiamo and Pueblo Viejo contain small and very isolated populations of crocodiles (Seijas 1986, 1988) with only remote possibilities of interchange with other populations. The crocodiles in Pueblo Viejo, for example, are the descendants of probably a few individuals that were trapped in that locality when the river was dammed in 1960. This hypothesis of inbreeding in very small populations (such as Pueblo Viejo and Turiamo) should be tested using the modern techniques of molecular genetics.

The frequency distribution of DTR was not as narrow as suggested by Brazaitis (1973) who indicated 16 to 17 DTR for the American crocodile, and was even wider than that reported by Ross and Mayer (1983) of 14 to 17. I do not think that the discrepancy with the latter authors (in respect to the lower range) could be due to slight differences in methodologies of data gathering procedures. The suggestion in Donoso-Barros (1966) that juveniles have a lower number of DTR (13 to 14) than adults (15) does not make any sense.

The most common figures of DCCW in my sample were 17 and 18, which is just in between the ones mentioned by Brazaitis (1973) of 16 and 17 and Ross and Mayer (1983) of 18 and 19. The frequency distribution of my data are statistically different from the one by Ross and Mayer (X^2 = 101.9, $P < 0.001$). This difference was even higher if data of pod 6 from the Yaracuy River, the one with its frequency distribution most skewed to the right, were not considered in the analysis. This discrepancy is interesting considering that the sample by Ross and Mayer included individuals from 9 countries, but did not include specimens from Venezuela.

Once again, the frequency distribution of SCCW found in my sample was quite different from the one expected according to the paper by Brazaitis (1973), with 17 and 18 SCCW as the most common figures (instead of 15 and 16). However, my results are more or less in accordance with the ones reported by Ross and Mayer

(1983). The possibility of making erroneous counts in this scutellation pattern, due to difficulties in deciding if the tip of the tail is missing or not, discourages going farther with the analysis.

The only possibility of comparison of my data on VR are with the figures by King and Brazaitis (1971). In the key to crocodilian belly skins proposed by them, the American crocodiles south of Panama are separated from the ones found north of that country, according to the number of VR. The key says that *C. acutus* north of Panama has 26 to 35 rows, whereas south of that country the American crocodile has 20 to 25 rows. As can be see in table 8, the frequency distribution of my data (24 to 31) partially overlaps with both ranges.

Variation in the scutellation pattern of the American crocodile found in this study is sometimes similar to the one reported in the literature, but in many cases that variation is higher or lower those the previously pointed out. This suggest that it is not convenient to enclose the variability between narrow margins, particularly when the number of specimens or individuals analyzed is small.

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