UNIVERSIDAD NACIONAL DE COLOMBIA
SEDE BOGOTÁ
FACULTAD DE CIENCIAS
DEPARTAMENTO DE BIOLOGÍA

ACTA BIOLÓGICA COLOMBIANA
ARTÍCULO DE INVESTIGACIÓN

SUBSISTENCE HUNTING FOR TURTLES IN NORTHWESTERN ECUADOR

Aprovechamiento de subsistencia de la fauna de tortugas en el noroccidente de Ecuador

JOHN L. CARR[1], Ph.D.; ANA ALMENDÁRIZ[2], M.Sc.; JOHN E. SIMMONS[3], M.Sc.; MARK T. NIELSEN[4], M.Sc.

[1] University of Louisiana at Monroe, Department of Biology and Museum of Natural History, Monroe, Louisiana 71209-0520, USA and Universidad del Valle, Facultad de Ciencias Naturales y Exactas, Departamento de Biología, Sección de Zoología, Grupo de Investigación en Ecología Animal. Cali, Colombia.

[2] Escuela Politécnica Nacional, Instituto de Ciencias Biológicas, Museo de Historia Natural Dr. Gustavo Orces V., Quito, Ecuador. ana.almendariz@epn.edu.ec

[3] Museologica, Bellefonte, Pennsylvania, USA. simmons.johne@gmail.com

[4] University of Utah, Department of Biology, Salt Lake City, Utah 84112 USA. marknielsen@bioscience.utah.edu

Author for correspondence: John L. Carr, carr@ulm.edu

Received April 1st 2014, first decision May 5th 2014, accepted May 28th 2014.

Citation / Citar este artículo como: CARR JL, ALMENDÁRIZ A, SIMMONS JE, NIELSEN MT. Subsistence hunting for turtles in northwestern Ecuador. Acta biol. Colomb. 2014;19(3):401-413.

ABSTRACT

We describe the subsistence exploitation of an entire turtle fauna in Esmeraldas Province, Ecuador. We collected first-hand accounts and witnessed a number of capture techniques used by rural Afroecuadorian and Chachi inhabitants of the Cayapas-Santiago river basin. The diversity of techniques indicated a practical knowledge of the ecology of the species. *Chelydra acutirostris*, *Kinosternon leucostomum*, *Rhinoclemmys annulata, melanosterna*, and *R. nasuta* were captured and eaten. *Poziando* involved cleaning pools in a stream bed during the relatively dry season by removing live plants, organic detritus, and then seining with baskets; we observed *R. melanosterna* and *K. leucostomum* captured in this way. Pitfall traps baited with fruit were used to catch *R. melanosterna* during forays on land. Basket traps ("*canasto tortuguero*") with a wooden slat funnel across the opening are floated with balsa lashed to the sides. Banana or *Xanthosoma* leaf bait in the basket traps caught *R. melanosterna*, *R. nasuta*, and *K. leucostomum*. Marshy areas were probed for *R. melanosterna* and *K. leucostomum*. Direct capture by hand was also common. Turtles were relished as food items; all turtles captured were consumed, usually in soup or stew. Use of turtles for food in the region was pervasive, perhaps because fish and game populations were depleted.

Keywords: Afro-descendant, Afroecuadorian, Chachi, *Chelydra acutirostris*, ethnozoology, *Kinosternon leucostomum*, *Rhinoclemmys annulata*, *Rhinoclemmys melanosterna*, *Rhinoclemmys nasuta*.

RESUMEN

Describimos la cacería de subsistencia de la fauna de tortugas en la provincia de Esmeraldas, Ecuador. Hemos recogido testimonios de primera mano y fuimos testigos de una serie de técnicas de captura utilizadas por los habitantes rurales afroecuatorianos y chachis de la cuenca de los ríos Cayapas–Santiago. La diversidad de técnicas indica un conocimiento práctico de la ecología de las especies. *Chelydra acutirostris*, *Kinosternon leucostomum*, *Rhinoclemmys annulata*, *R. melanosterna* y *R. nasuta* fueron capturadas y utilizadas como alimento. El método de "pozeo" consiste en limpiar las pozas o quebradas durante la estación de menos lluvia; en el proceso se remueven las plantas vivas y detritus orgánicos y las tortugas se cazan con la ayuda de canastas, y observamos que *R. melanosterna* y *K. leucostomum* fueron capturadas de esta manera. Las trampas de caída,

cebadas con frutas, se utilizaron para capturar *R. melanosterna* durante incursiones a tierra firme. El "canasto tortuguero" es un cesto de fibra vegetal que tiene la parte interna en forma de embudo, construido con listones de madera (generalmente chonta) y en su exterior se atan dos trozos de madera de balsa para darle flotabilidad. Los canastos fueron cebados con plátanos u hojas de malanga (*Xanthosoma)* para atrapar especies de *Rhinoclemmys* y *K. leucostomum*. En las zonas pantanosas, se usó la técnica de tanteo o pisoteo para colectar *R. melanosterna* y *K. leucostomum*. La captura directa o a mano también es un método común de caza. Las tortugas fueron preparadas como alimento principalmente en sopas o guisos. El uso de las tortugas en la alimentación se ha generalizado en la región, posiblemente porque ha disminuido la cacería de animales grandes.

Palabras clave: afrodescendiente, afroecuatoriano, chachi, *Chelydra acutirostris*, etnozoología, *Kinosternon leucostomum*, *Rhinoclemmys annulata*, *Rhinoclemmys melanosterna*, *Rhinoclemmys nasuta*.

INTRODUCTION

The "bushmeat crisis" is the result of recognizing that hunting of wildlife resources in tropical forests is largely unsustainable (Schaller, 2000; Bennett and Robinson, 2000a; Bennett and Robinson, 2000b; Robinson and Bennett, 2000; Robinson and Bennett, 2004). This crisis has attracted the attention of the Secretariat of the Convention on Biological Diversity (CBD) as a concern (Nasi *et al.*, 2008), and has lead to the formation of the CBD Liaison Group on Bushmeat (LGB) to make recommendations to further the goals of the Convention with respect to increasing the sustainability of bushmeat extraction from tropical forests (LGB, 2009). Among the distinctions made with respect to the bushmeat crisis, hunting has been defined as the extraction of any vertebrate wildlife (other than fish) from the wild (Nasi *et al.*, 2008), no matter the technique used. Although many exploited reptiles are largely aquatic and their extraction might equally well be considered as "fishing" from an ecological perspective (Bennett and Robinson, 2000a), the blanket use of the term "hunting" for all reptiles is well accepted (Nasi *et al.*, 2008). Bennett and Robinson (2000a) further distinguish between active and passive hunting, a distinction of possible sociological significance.

Bushmeat has received considerable attention in the anthropological and conservation literature (Robinson and Redford, 1991; Redford and Padoch, 1992; Robinson and Bennett, 2000; Silvius *et al.,* 2004; Restrepo Calle, 2012). Turtles and tortoises are hunted as sources of protein and for other uses by rural inhabitants of many tropical ecosystems all over the world (Mittermeier *et al.*, 1992; Klemens and Thorbjarnarson, 1995). In South America, human use of turtles and tortoises is well documented for Amazonia and Orinoquia. Among the most frequently hunted species are the widely distributed tortoises *Chelonoidis carbonaria* and *C. denticulata* (Werner, 1984; Ojasti *et al.*, 1986; Peres, 2000), and the large river turtles *Podocnemis expansa,* and *P. unifilis* (Gilmore, 1948; Smith, 1974; Mittermeier, 1975; Castro Casal *et al.*, 2013). However, many smaller species have also been reported as food or for other uses, such as species of *Rhinoclemmys* (Pritchard and Trebbau, 1984; Corredor–Londoño *et al.*, 2007), *Kinosternon,* and *Trachemys* (Castaño–Mora, 1997). The conservation status of these valuable natural resources has also been addressed (Smith, 1979; Alho, 1985).

Bennett and Robinson (2000a) emphasized the significance of reporting socioeconomic information for case studies of bushmeat exploitation. In South American studies of wild animal consumption, human populations often have been characterized as "traditional," as opposed to recent immigrants (*colonos*) to forested areas (Redford and Padoch, 1992). The traditional populations have usually been indigenous, tribal Amerindians, or their de-tribalized descendants, *caboclos* or *ribereños* in the case of Amazonia (Schmink *et al.*, 1992). Another group seldom studied, but logically considered a traditional group would be Afroecuadorians, descendants of slaves brought by the early European colonists (West, 1957; Whitten, 1974; Price, 1996). Such a group has cultural practices and Traditional Ecological Knowledge (TEK) of resource use developed over generations as adaptations to their forested environment. This said, such traditional societies are still subject to adoption of new methods and technologies (Kaplan and Kopischke, 1992; Schmink *et al.*, 1992), as well as learning from their indigenous neighbors (Orejuela, 1992; Turner *et al.*, 2003).

In the course of fieldwork on turtles in northwestern Ecuador, we made observations of the extensive use of the entire turtle fauna as a food source. Although our data were collected over two decades ago, we feel the observations are still relevant for at least three reasons: 1) We observed techniques that are undocumented; 2) the primary ethnic group involved has been little studied, particularly with respect to reptile utilization; and 3) our descriptions may serve as a baseline for additional study. These observations contribute to prior ethnozoological studies concerning turtle use in South America. Turtles are of significant conservation concern throughout the world with nearly 50% categorized in some degree of threat by the IUCN (Rhodin *et al.*, 2011), and human exploitation has been identified as one of the major threats (Mittermeier *et al.*, 1992; Thorbjarnarson *et al.*, 2000). Our purpose is to describe the techniques for capturing turtles and the ways in which they were utilized by two ethnic groups. The turtle fauna of this trans-Andean locality is entirely cryptodiran and taxonomically distinct from the Amazonian pleurodires and tortoises that have frequently been described in other studies of South American turtle use (e.g., Johns, 1987; Fachín–Terán *et al.*, 2004; Pezzuti *et al.*, 2010; Castro Casal *et al.*, 2013). Also, the primary inhabitants of northwestern Ecuador are Afroecuadorians, a

population with little published concerning their interactions with wildlife (West, 1957; Whitten, 1974).

MATERIALS AND METHODS

Study Area

The Cayapas-Santiago basin is located in the extreme northwestern region of Ecuador near Colombia (Fig. 1). The lower portions of the rivers occupy the northeast corner of Esmeraldas Province along the Pacific coast. We visited several small communities in July and August of 1986 in rural parroquias of the cantons of Eloy Alfaro (Borbón, La Tola, Maldonado, and Timbiré), and San Lorenzo (Carondelet, Concepción, and Tululbí). Along the Santiago River, we visited Concepción and San José de Tagua, plus Nueva Esperanza and La Boca on the Bogotá River, an affluent of the Santiago River. Ricaurte is at the juncture of the Palabí River and Tululbí River, which is an affluent of the Bogotá River. We visited one village on the Cayapas River, Playa Grande. The two senior authors traveled to the region again in January of 1991 specifically to visit Hacienda La Molinita near the mouth of the Cayapas River, a locality we heard about during the prior trip. The area is covered with humid tropical forest that is mostly secondary, or at least has undergone selective harvesting of the valuable timber trees. In 1986, we visited during the relatively dry time of year in late July and early August. As graphed by Naranjo (1981), this is just at the onset of the less rainy time of year that extends into December (*época de transición*); annual precipitation in the region of Borbón and San Lorenzo is between 2.000-2.500 mm per annum. The climate of the area is classified as Af (tropical rainforest climate, fully humid) in which there is no month of the year with less than 60 mm of rainfall (Kottek *et al.*, 2006), so there is no true dry season. With the lower rainfall amounts, relatively low water conditions were in evidence and many creeks that connect with the main rivers were not flowing, but consisted of a series of discrete pools. The tidal influence extends for a considerable distance up the Santiago and Cayapas rivers. Above the tidal area, the rivers in the Santiago drainage are swiftly flowing, shallow streams with stony substrates. At the mouth of the Cayapas River, there is an extensive region of mangrove forest extending east and northeast to the Colombian border (Reserva Ecológica Manglares Cayapas Mataje). West of the mouth is an area of freshwater marsh, several thousand hectares in extent, which includes Hacienda La Molinita. Farther upstream in the Santiago River and Cayapas River basins, the Reserva Ecológica Cotacachi Cayapas covers an area extending from about 300 m up to the volcanic peaks of the Andes.

The rural inhabitants outside the larger population centers (i.e., Borbón, San Lorenzo, and La Tola) consisted almost exclusively of either of two ethnic groups, Afroecuadorians or Amerindians. Regardless of ethnic identity, nearly all inhabitants appear to lead a primarily subsistence existence (Carrasco, 1988; Ferdon, 1950). The literacy rate is very low; unemployment

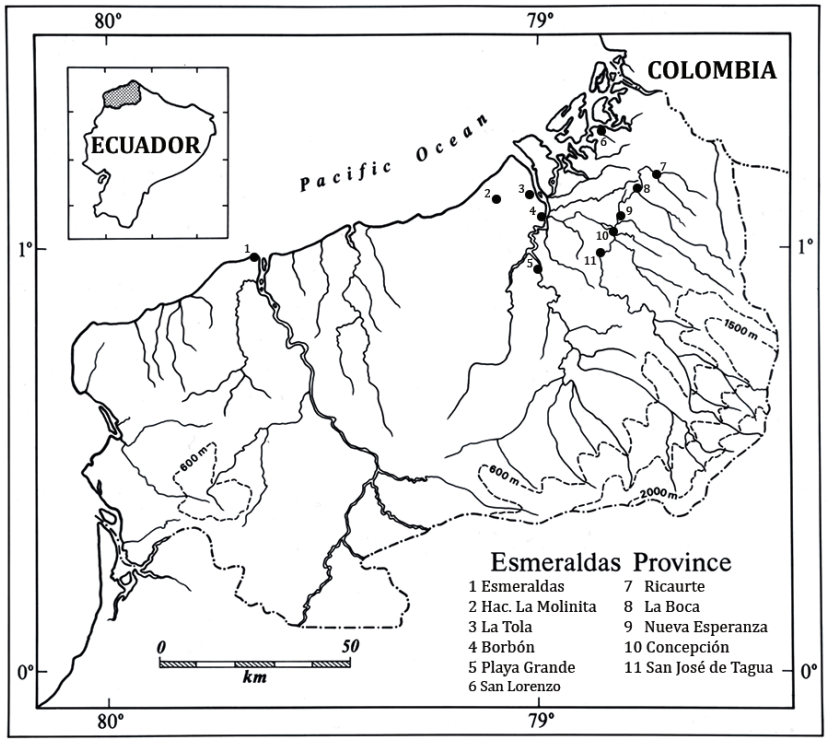

Figure 1. Map of Esmeraldas Province indicating the location of the places mentioned in the text.

and underemployment are pervasive (Jaramillo, 1980). Most of our observations were made within or on the margin of the Comuna Río Santiago-Cayapas, an Afroecuadorian commune dating to 1885 (Speiser, 1989), in which as of 1990 the average monthly income per family was reported as less than $80 USD, the annual population growth rate was approximately 3.7%, and the area experienced high child mortality and an elevated incidence of tropical diseases (Calero–Hidalgo, 1992). There are localized concentrations of Amerindians (Chachi) along the Cayapas River. The Chachis are indigenous to the area, while the black Afroecuadorian population has inhabited the region for more than 450 years, initially having escaped from the servitude of the Spanish colonists as early as 1553 (Barrett, 1925; West, 1957; Whitten, 1974).

Interviews

In each community visited, we interviewed several people to learn about their knowledge of the local turtle fauna; in particular, we focused on the ability of the person to describe the physical characteristics of each kind of turtle with which he or she was familiar in order to assess their firsthand knowledge of local turtles, of which five species are known from Esmeraldas (Carr and Almendáriz, 1990; Rueda–Almonacid *et al.*, 2007). By this means, we sought more knowledgeable people in order to obtain the most valuable information in the shortest time (Davis and Wagner, 2003). Along with this discussion, we also asked questions about where and how to find turtles. Based on our experience with the turtle species in the area, we could easily distinguish between persons with actual first-hand knowledge versus those who were only vaguely acquainted with physical characteristics of the species. We also asked people to demonstrate capture techniques, from which we were able to describe the capture methods supplemented with details provided by the practitioners of the techniques. Our methodology is known as "participant observation fieldwork" with semi-structured and unstructured interviews, plus key informants (Bernard, 1994).

RESULTS

In every rural location visited, we found evidence of the use of turtles and local inhabitants who were knowledgeable about freshwater and terrestrial turtles. We recorded all five turtle species previously known from the region, including *Chelydra acutirostris*, *Kinosternon leucostomum*, *Rhinoclemmys annulata, R. melanosterna*, and *R. nasuta* (voucher specimens are listed in Appendix 1).

Folk Taxonomy

Mittermeier *et al.,* (1980) published an extensive list of vernacular names used by various groups for turtles in different regions of South America. We found a well-developed system of names in use by the rural Afroecuadorian population in Esmeraldas, including some regional variation between localities (Table 1). Several of the names were reported by Mittermeier *et al.,* (1980), indicating their use along the Pacific coastal lowlands into Colombia; however, we also found several previously unreported names used for the *Rhinoclemmys* species. Although we have previously listed these vernacular names, there was no indication of the sociological context that we have presented here (Carr and Almendáriz, 1990).

The Chachi turtle vocabulary was not as well developed, there being primarily a single term applied to several species, written two ways by Barrett (1925), pītcī´lī and pī´tcī´lī, and spelled "pichilli" by Mitlewski (1987). However, our interviews with Chachis were few and most of the names in Table 1 were provided by a single informant living in a small Chachi settlement across the Cayapas River from Borbón. Their use of at least one turtle name follows the widespread use of the Afroecuadorian term "*tapaculo*" for *Kinosternon leucostomum*.

Turtle Capture Methods

Turtles were eaten in every place we visited in Esmeraldas and they were captured by a wide variety of methods (Table 2). Descriptions and illustrations (Figs. 2–4) of the five techniques that follow are based on our first-hand observations of the methods in action, with some details

Table 1. Scientific names and the corresponding common names for the five turtle species found in northwestern Ecuador.

	COMMON NAME	
SPECIES	AFROECUADORIANS	CHACHIS
Chelydra acutirostris	*Tortugaña*	*Abello*
Kinosternon leucostomum	*Tapaculo*	*Tapaculo*
Rhinoclemmys annulata	*Bambera* (Santiago River)	*Pichili*
	Tortuga (Cayapas River)	
R. melanosterna	*Pintadilla* (Santiago River)	*Pichili*
	Orito (Cayapas River)	
	Patiamarilla (La Tola)	
R. nasuta	*Sabaleta*	*Pichili*

Table 2. Sites visited, turtle capture techniques reported or used, and uses recorded other than as food. The species involved are indicated as follows: *Chelydra acutirostris* = C, *Kinosternon leucostomum* = L, *Rhinoclemmys annulata* = A, *R. melanosterna* = M, *R. nasuta* = N.

	Collection Techniques					Uses	
Site	Poziando	Pitfalls	Canasto	Probing	Hand	Utensil	Toy
Concepción	L, M, C, N	M, N, L			M		
Nueva Esperanza			A, M, N, L		N		
San José de Tagua	L, M				A		
Playa Grande				L, M	M	C	
La Boca					M, N	C	
Ricaurte					A		
Hacienda La Molinita				L, M			L, M

based on our informants' narratives of how they work. All of these methods were employed by Afroecuadorian inhabitants of the basin. Our observations of the Chachis were far fewer, with only one technique observed.

Pool Cleaning (*poziando*)

Pool cleaning, locally called *poziando*, is a community activity in which a group of people work together to glean edible biomass from pools that remain as the water level in a stream falls during the relatively dry period of the year. The Spanish verb used for this activity was "*poziar*, which appears to be an invention related to the fact that work takes place in a *poza* (a poza or pozo generally refers to a water-filled pool). We were invited to observe *poziando* at a finca near San José de Tagua (Fig. 2). All our observations concerning this technique were made on that occasion when a team cleaned three pools in a stream bed that would have been connected with the Santiago River during high water.

Any water flow between pools was blocked to prevent escape of the animals during the cleaning process. The first task was to chop all the vegetation down that was covering the banks and overhanging the pool. This was primarily done by young men using machetes. The brush, sticks, and branches that were cut were removed and thrown out of the pool. In addition, detritus in the pool (sticks, leaves, branches) was removed and discarded. Some of the women walked through the pool kicking up and stirring the decomposing vegetation from the bottom. This was collected and removed from the pool (Fig. 2A).

The next step was the capture phase. The entire pool was seined with baskets (Figs. 2B-2C). Each participant took a basket and worked along the bottom of the pool up towards the bank, carefully groping the bank area. Any additional debris caught in the baskets was also removed. The workers scooped and directed material toward the mouth of their baskets with their hands. The baskets had nearly square bottoms with more rounded openings about 35 cm across (Figs. 2A and 2C).

The entire process took about one hour with 12 people in the pool at the height of the cleaning and basket seining. Participants included adult women, children, and young men (teenage–early twenties). Adult men were not observed to participate. All turtles, fish, freshwater shrimp, and other invertebrates that were caught were kept, no matter their size. Small captured animals were put in spherical gourds with holes cut in them (Fig. 2D). These gourds were left floating upright in the water as the participants worked.

As it was explained to us, *poziando* is an annual event performed during the relatively dry season. Any of the aquatic turtle species could potentially be captured using this technique. The day of our observations, three specimens of *K. leucostomum* and four of *R. melanosterna* were captured in the large pool nearest the river (approximately 40-50 m long, 4-5 m wide).

We were told of other techniques that could be used to collect food items from pools, but we did not observe these methods. A technique related to *poziando* we were told about was *achicar* (bailing). Two people use *bateas* (wooden bowls) to empty a *poza* of water in order to catch all of the edible aquatic organisms; rerouting part of the flow (if any) may also be used to reduce the volume to be bailed. A third method is to use a fish poison called *barbasco* that is made from a plant similar to *caucho* (rubber plant). The *barbasco* extract is prepared and put in the water. It will reportedly kill or stun everything, allowing for easy collection of fish and turtles as they float to the surface.

Pitfall Traps

We were told about the use of pitfall traps by an informant in Concepción, and we arranged for a firsthand demonstration. Pitfalls were reportedly used primarily for catching the pintadilla (*R. melanosterna*). A hole is dug about 30-50 cm deep, with roughly the same diameter. The hole need not be circular, but can be square or rectangular. Our informant dug holes fairly close to the shoreline of a body of water, and we saw older holes from prior uses of the technique in the same vicinity (Fig. 3B). In the demonstration we witnessed,

Figure 2. A. After the edges and overhanging vegetation have been cut back, debris is removed from the bottom during *poziando* near San José de Tagua. Photo: JE Simmons. B. Young people and children in the water "seining" with baskets. Photo: JE Simmons. C. Woman and young man with baskets and gourds for holding the catch. Photo: JE Simmons. D. Woman and boy examining the turtle they caught, *Kinosternon leucostomum*. Photo: JE Simmons. E. Young boy with a specimen of *Rhinoclemmys melanosterna* lashed by palm leaves to a stick for the trip home. Photo: JE Simmons. F. Diagrammatic view of a pitfall trap with a turtle.

holes were dug within 1-2 m of the shoreline of a section of oxbow with a grassy margin (the oxbow pool measured approximately 10 m x 80 m). Average dimensions of five pitfall holes were 394 mm (± 56 mm) in diameter and 396 mm (± 55 mm) deep.

A stick was placed in the middle of the hole, extending up to the level of the surrounding substrate, with a banana impaled on the stick as bait (Figs. 2F and 3A). As explained to us, when the turtles come out of the water at night to feed, they smell and approach the bait, falling into the hole. The turtles cannot crawl out of the hole and therefore remain contained until they are collected. Our informant indicated that it is also possible to catch *R. nasuta* and *Kinosternon leucostomum* in this manner. We tended the pitfall traps over a period of several days and captured one specimen of *R. melanosterna*.

Turtle Basket (*canasto tortuguero*)

At the small village of Nueva Esperanza on the Bogotá River, we were shown a basket trap used specifically for turtles (called *canasto tortuguero*), although the Spanish word for basket is considered feminine, i.e. *canasta*). The basket proper is a typical sort of woven basket; however, the open end was closed off with a wooden-slat (palm or bamboo) funnel

across it (Figs. 4A-4B). The basket had sticks of balsa lashed to opposite sides, which would float the basket with about half of it out of the water; the size was ~35 cm diameter x 70 cm long. The traps are baited with material that is simply thrown inside the trap. Our informants reported using either *guineo* (banana; *Musaceae*: *Musa acuminata*) or *malanga* leaves (*Araceae*: *Xanthosoma* sp.) for bait.

Two men caught turtles for us using these traps, but we were not able to see them deployed. However, we confirmed that the turtles had been captured using the baits mentioned above by examining their stomach contents. Our informants reported that they could catch *Rhinoclemmys nasuta*, *R. melanosterna* and *Kinosternon leucostomum*. The informants indicated that *R. melanosterna* was the most commonly caught turtle species, but the majority of turtles caught for us were *R. nasuta* (Fig. 3D). The four species caught for us were all three *Rhinoclemmys* species and *K. leucostomum*.

Probing

At Playa Grande, on the Cayapas River, we learned of another active turtle capture technique. This particular village has both Afroecuadorian and Chachi inhabitants and we were instructed jointly in the technique by both ethnic groups. We were taken to a marshy area not far from the river. During the relatively dry season, the marsh had no standing water; however the substrate was wet and spongy and the entire

Figure 3. A. A turtle pitfall trap set with a banana. Photo: JE Simmons. B. Our informant is demonstrating construction of a pitfall trap using a small shovel. Photo: JE Simmons. C. A view of people searching the marshy area near Playa Grande. Photo: JE Simmons. D. Containers of turtles caught for us using *canastos tortugueros*. Photo: JE Simmons. E. Young woman probing for turtles in the marshy area with a machete. Photo: JE Simmons. F. One specimen each of *Kinosternon leucostomum* and *Rhinoclemmys melanosterna* sitting on the surface near the spot where they were located by probing—notice the mud on their shells. Photo: JE Simmons.

area was covered with knee-high grasses (Fig. 3C). Our informants told us that they found turtles by probing in the substrate with a rigid stick, rod, or machete blade. In less than an hour at midday, our informants located specimens of both *Rhinoclemmys melanosterna* and *Kinosternon leucostomum* that were partly to mostly buried in the substrate at the base of plants (Figs. 3E and 3F). The turtles apparently spent the low water period in this manner, estivating through the relatively dry time of year. The only other place that we encountered the same type of habitat was at Hacienda La Molinita, an extensive area of freshwater marshes used for ranching. Ranch workers reported the same two species of turtles on the ranch. They also reported catching turtles that were estivating, and that turtles were occasionally killed when pastures were burned, apparently because the turtles do not dig deeply into the substrate (Fig. 3F).

Direct Hand Capture

Several individuals in different locations reported the opportunistic capture of turtles by hand. The terrestrial species in the area, *Rhinoclemmys annulata*, is apparently caught and eaten whenever it is encountered by Afroecuadorians. Other species were reported to make forays on land and were similarly caught by hand, including *R. melanosterna* and *R. nasuta*. Turtles that were apparently basking on a river bank were captured as reported by a group of young boys in Concepción who brought us small specimens of *R. melanosterna* and *K. leucostomum*. Turtles were also captured while wading in shallow streams for other reasons, such as the report by a young woman of *R. nasuta* captured at night while hunting for freshwater shrimp.

Restraining the Catch

Several different means of restraining live turtles were observed. Hollow gourds with an opening on the upper surface were used to hold small turtles, fish, and freshwater shrimp during the course of *poziando* activities. We also witnessed gourds being used in and around homes to hold turtles until they were eaten (e.g., *Kinosternon leucostomum*). Larger turtles were kept in a basket in Nueva Esperanza, perhaps with something over the top to discourage climbing. We only saw the baskets when they were brought out to show us turtles (Fig. 3D).

One of the *Rhinoclemmys melanosterna* specimens caught while *poziando* at San José de Tagua was tied to a stick for the trip home (Fig. 2E). A stick was placed perpendicular to the turtle's long axis across the anterior shell opening with the turtle's head and legs withdrawn. The turtle was then lashed to the stick with palm leaves running down across the posterior shell opening with the legs withdrawn there as well. Tied in such a manner the turtle was completely immobilized and provisioned with a handle in the form of the projecting ends of the stick (Fig. 2E). This is very similar to a photo in Lehr (2000) of tortoises being restrained in Peru.

Turtle Consumption and Subsequent Use

Our informants reported that turtles were always used to make soup or stew. All five species were used in this manner, with some people expressing a preference for *Chelydra acutirostris*. We examined numerous specimens from trash middens and those that people showed us when we asked about turtles. What remained after consumption of the turtle was a carapace with irregular cuts across the bridge made with a machete (apparently). All of the shell contents were gone, although in a couple of freshly prepared specimens there were a few small scraps of tissue adhering to the carapace. In a few cases the entire shell was intact, but usually all that was left was the carapace. We never found a separate plastron, either intact or disarticulated; only as part of an entire shell.

We observed a couple of different uses for turtle shells (or parts) subsequent to consumption of the soft parts; however, based on our observations, most shells were discarded (Table 2). In a couple of villages, we saw the carapaces of large *C. acutirostris* specimens being used as cooking containers, apparently to roast other things over an open fire. At Hacienda La Molinita we found the child of a ranch worker with a couple of turtle shells painted in bright colors used as toys (Fig. 4C).

Turtle Commerce

There did not appear to be any commercial trade in turtles at the localities we visited, with one exception. Based on our observations, turtles were eaten by the Afroecuadorian household that captured them. Turtles were but one of their subsistence sources of protein (Redford and Robinson, 1991).

We were informed that there was commercial traffic in turtles at La Tola. Although our informants reported that there were no terrestrial or freshwater turtles in the immediate vicinity of La Tola, at some times during the year they said that turtles were sold there for food. Turtles brought into the area as a food source came from Hacienda La Molinita (to the west and south along the road), where it was reported that there were large lagoons with turtles and caimans (*Caiman crocodylus*). Two of the fincas where the turtles were said to come from were named El Oriente and La Sabana. The turtles that were imported to La Tola were called *tapaculo* and *patiamarilla*, corresponding with *Kinosternon leucostomum* and *Rhinoclemmys melanosterna,* respectively. The Afroecuadorian inhabitants of La Tola had also heard of *tortugaña* (*Chelydra acutirostris*). They did not mention any other freshwater or terrestrial turtles. When we visited Hacienda La Molinita, we found that Afroecuadorian ranch workers caught and used turtles as food, and they apparently sold extra specimens in La Tola; ranch workers reported the same two common species, and mentioned that *tortugaña* could occasionally be found in the farthest areas from the coast closer to forested areas.

DISCUSSION

The diversity and ingenuity of techniques used by inhabitants of the Cayapas-Santiago basin in capturing turtles is indicative of their substantial traditional ecological knowledge (TEK) of the species they use as a food resource. Examples of this include the use of marsh habitats and estivation by *Kinosternon leucostomum* and *Rhinoclemmys melanosterna*, which are then located by probing during the low-water period of the year, or exploiting knowledge of nocturnal terrestrial activity by aquatic turtles such as *R. melanosterna* in order to trap them in pitfalls. We found that all species of turtles native to the region were eaten and thereby formed a part of the largely subsistence household economy (Redford and Robinson, 1991). There was only one locality where we found a local commerce in turtles running over a distance of less than 15 km between Hacienda La Molinita and a coastal town, La Tola.

The lowland Cayapas-Santiago basin of Esmeraldas represented an area of active interchange between two peoples, the Afroecuadorians and Chachis (West, 1957; Whitten, 1974; Ramírez de Morejón, 1984; Carrasco, 1988). This sort of "edge" in both ecological and sociological terms has been identified as a place of synergism between ethnic groups where they meet and overlap (Turner *et al.*, 2003), and may account for the rich diversity of exploitation techniques we observed. While we primarily observed Afroecuadorians and their interactions with turtles, it is difficult to discern the cultural origin of some observations. For example, some common names for turtle species were being adopted by Chachis (this study), but the origin of the baskets used by Afroecuadorians has been attributed to the Chachis and other lowland Amerindian groups (Barrett, 1925; West, 1957; Orejuela, 1992).

We only observed one turtle capture technique used by both groups, probing; all the others were practiced by the Afroecuadorians. Earlier accounts mention other techniques for acquiring turtles by the Chachis such as spearing with harpoons and hand capture (Barrett, 1925; Mitlewski, 1987). Harpoon fishing techniques have been adopted by Afroecuadorians (Ramírez de Morejón, 1984; Speiser, 1989), but we made no observations of this method of capture. The *canasto tortuguero* appears to be a slightly modified version of the *catanga*, widely used for trapping freshwater shrimp and small fish (West, 1957; Mitlewski, 1987; Orejuela, 1992), usually described as a cylinder of palm slats, which would be rigid. West (1957:158) mentions the turtle version is larger, called a *tortuguera*, but makes no mention of it differing in construction material. The *canasto tortuguero* we observed was essentially a flexible basket with the rigid, funnel entrance made of palm slats or bamboo; the same type of turtle trap reported from the Pacific coast of Valle del Cauca in Colombia (called *catanga tortuguera*, Corredor-Londoño *et al.*, 2007).

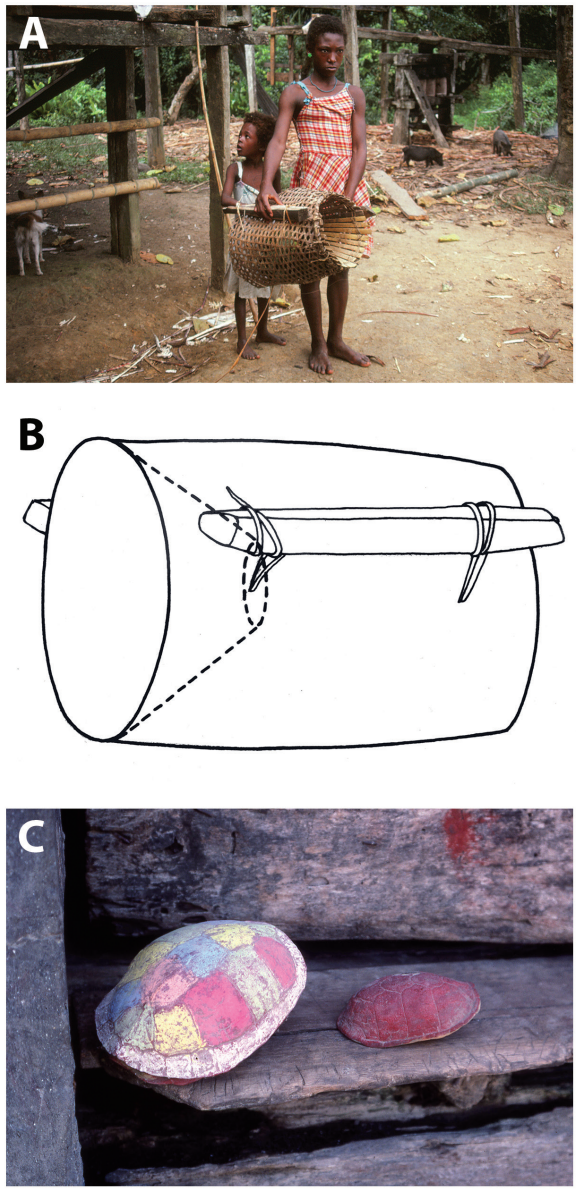

Figure 4. A. Young woman holding a *canasto tortuguero* used by her family to catch turtles. Photo: JE Simmons. B. Diagrammatic view of a *canasto tortuguero* showing the single funnel entrance and balsa wood floats lashed to the side. C. Two painted turtle shells used as toys by children at Hacienda La Molinita. The shell on the left is that of *Rhinoclemmys melanosterna*, that on the right is *Kinosternon leucostomum*. Photo: JL Carr.

Pool cleaning (*poziando*) and the use of pitfall traps appear to be unreported techniques for the capture of turtles by traditional people in South America. These are techniques customized for the local conditions, in particular the lower water levels during part of the year, an important aspect of seasonal change in tropical environments that have often been part of the pattern in the exploitation of turtle

populations (e.g., Johns, 1987; Fachín–Terán *et al.*, 2004; Pezutti *et al.*, 2010). Pool cleaning is not a turtle-specific capture technique; all of the aquatic animals of interest are captured including fishes, turtles, and freshwater shrimps. Perhaps it developed out of the Chachi fishing technique described by Barrett (1925:121-124) for trapping and then catching shad in the side streams when the water levels fell. In the case of *poziando*, it is an Afroecuadorian technique that simply takes advantage of small streams that naturally become disconnected from the main river by falling water levels, which are then seined by a team of people using baskets, rather than nets as described by Barrett (1925). Using pitfall traps specifically for capturing aquatic turtles was a simple, passive trapping technique used to take advantage of turtle-specific behaviors in their natural environment, i.e., nocturnal activity on land by *R. melanosterna* and possibly other turtles.

In a recent review of ethnozoological studies in Colombia (Restrepo Calle, 2012), reptiles contributed 11% of the total species composition hunted, the majority of which were turtles. In terms of biomass consumed, turtles accounted for 55% of the reptile contribution, which was second only to mammals. In a similar review of 14 Amerindian study sites in Amazonian Ecuador (De la Montaña, 2013), reptiles constituted a smaller proportion of the total numerical composition and turtles contributed less to the reptile biomass consumed. These patterns are generally similar to those reported by Redford and Robinson (1987) in terms of the number of individuals hunted (mean of 11.5% reptiles per study). With the exception of Mitlewski (1987), general studies pertaining to the Chachis or Afroecuadorians have made little mention of turtles among the game animals hunted in the region (Barrett, 1925; West, 1957; Ramírez de Morejón, 1984; Carrasco, 1988; Speiser, 1989). We found the use of turtles as a food source to be pervasive in Esmeraldas, particularly so among the Afroecuadorian population, also found to be the case among Afro-descendant and indigenous populations in Valle del Cauca (Corredor–Londoño *et al.*, 2007) and the Negro River basin in Brazil (Pezzuti *et al.*, 2010), respectively.

Other than using the turtles as food, which is a global occurrence (Klemens and Thorbjarnarson, 1995; Thorbjarnarson *et al.*, 2000), we observed only two other uses for turtles. Both uses were simple household uses in Afroecuadorian households. We found the carapace of the largest species, *Chelydra acutirostris*, used as a cooking implement in two locations, and entire turtle shells painted and used as a child's toys. Use of shells as decorations has been reported in Colombia (Corredor–Londoño *et al.*, 2007), but when painted it has usually been for decorative purposes or to sell as handicrafts, *artesanías* (Mittermeier *et al.*, 1992; Castro Casal *et al.,* 2013). One literature reference mentioned using a turtle shell to make a whistle, or call, for hunting agoutis (*Dasyprocta* sp., Ramírez de Morejón, 1984).

According to the draft Red List status assessments of the Tortoise and Freshwater Turtle Specialist Group, *R. annulata* is Data Deficient (DD), *K. leucostomum* and *R. melanosterna* are of Least Concern (LC), and *C. acutirostris* and *R. nasuta* are Near Threatened (NT) (TTWG, 2011). In the Ecuadorian Red Data book (Carrillo *et al.*, 2005), all five turtle species are listed with a greater degree of threat: *Chelydra acutirostris* as Vulnerable (VU), and the other four species as Endangered (EN). Human use has been identified as a primary or secondary factor in the Red List status of half or more of listed turtle species (Klemens and Thorbjarnarson, 1995; Thorbjarnarson *et al.*, 2000). This includes subsistence uses of turtles.

As it has frequently been demonstrated, faunal populations become depleted over time and this is reflected in patterns such as the negative relationship between faunal abundance and distance to human settlement, human population density and per capita biomass hunted, as well as settlement age and per capita biomass hunted (e.g., Peres and Nascimento, 2006; De la Montaña, 2013). Several studies in Esmeraldas have mentioned the depletion of larger mammals in the forest (West, 1957; Albuja V and Mena–Valenzuela, 1987; Carrasco, 1988; Suárez *et al.*, 1995), as well as the fish in the rivers (Mitlewski, 1987; Carrasco, 1988; Barriga, 1990). It may be that turtles have become a more important resource over time; switching species upon decline of a food resource has been a recurrent pattern observed in faunal use studies, including with turtles (Mittermeier, 1975; Lamar and Medem, 1982; Johns, 1987; Fachín–Terán *et al.*, 2004; De la Ossa and Vogt, 2010). Mitlewski (1987) specifically referred to overexploitation due to the introduction of outboard motors, dynamite fishing, and a growing human population as diminishing the aquatic food resources the Chachis relied upon for subsistence. Sierra (1999) was able to relate the degree of deforestation in Esmeraldas between 1983 and 1992 to the human population density, as well as the ethnic system of production. Sierra and Stallings (1998) reported a 30% increase in population from 1982 to 1990 for the region under study. Subsequently, the population of the rural *parroquias* we visited in the cantons of Eloy Alfaro and San Lorenzo experienced 56% and 83% growth in population, respectively, between 1990 and the 2010 census (INEC, 2010).

CONCLUSIONS

Given the social and economic factors that have influenced both Chachi and Afroecuadorian populations in Esmeraldas in the two decades plus since our study, and the projected population growth to 2020 in the rural *parroquias* (3-4%) (INEC, 2010), it would be worth visiting the region once again to see how well turtle populations have persisted and whether or not traditional practices of turtle exploitation have changed. The general pattern (as observed in previously mentioned studies) has been that, with increased access

to markets by expanding human populations, along with acculturation and modernization, subsistence hunting practices change or are lost. Regardless of cultural practices, populations of wild animals, including turtles, seem destined to decline, if only from the inevitable loss of habitat rather than direct human exploitation.

ACKNOWLEDGMENTS

We thank Anne Musser and Karen Schmitt for preparing illustrations and Julianne Snider for help formatting the plates. Tara Haid helped organize raw data, and Silvia Almendáriz tabulated the demographic data for the study sites. Luis Albuja assisted in organizing the trips and made a vehicle available for our use. Ramiro Barriga and Berta Ludeña assisted in the field. Patricio Herrera made facilities available for us at the Ministerio de Agricultura y Ganadería Campamento Forestal Borbón. We are deeply indebted to our river pilot, Jorge Villareal, for skillfully navigating our river journeys and assisting us with meeting local turtle hunters. We thank Editmar Bolaños for assistance with collecting and Calderón Lemos for arranging for us to observe poziando at San José de Tagua. We thank the Ministerio de Agricultura y Ganadería for granting permits for our work. Field work in 1986 was financed with a Doctoral Dissertation Improvement Grant (BSR-8601094) from the National Science Foundation (JLC) and the trip in 1991 was facilitated by the Rapid Assessment Program of Conservation International.

REFERENCES

Albuja-V L, Mena–Valenzuela P. Distribución y notas ecológicas de *Proechimys semispinosus* (Rodentia: Echimyidae), en el noroccidente ecuatoriano. Politécnica.1987;12(4):145-162.

Alho CJR. Conservation and management strategies for commonly exploited Amazonian turtles. Biol Conserv. 1985;32:291-298.

Barrett SA. The Cayapa Indians of Ecuador. Indian Notes Mg. 1925; No. 40: pt. 1, xvi + 182 pp.; pt. 2, viii + pp. 183-476.

Barriga R. Peces de la Reserva Etnica y Forestal Awa, Ecuador noroccidental. Politécnica. 1990;14(3):7-55.

Bennett EL, Robinson JG. Hunting for the Snark. In: Bennett EL, Robinson JG, editors. Hunting for Sustainability in Tropical Forests. New York, NY: Columbia University Press; 2000a. p. 1-9.

Bennett EL, Robinson JG. Hunting of wildlife in tropical forests: implications for biodiversity and forest peoples. Washington, DC: International Bank for Reconstruction/ The World Bank, Environment Department Papers No. 76; 2000b. 42 p.

Bernard HR. Research Methods in Anthropology: Qualitative and Quantitative Approaches. 2 ed. Thousand Oaks, CA: Sage Publications; 1994. 584 p.

Calero–Hidalgo R. The Tagua Initiative in Ecuador: a community approach to tropical rain forest conservation and development. In: Plotkin M, Famolare L, editors. Sustainable Harvest and Marketing of Rain Forest Products. Washington, DC: Island Press; 1992. p. 263-273.

Carr JL, Almendáriz A. Contribución al conocimiento de la distribución geográfica de los quelonios del Ecuador occidental. Politécnica. 1990;14(3):75-103.

Carrasco E. El Pueblo Chachi: El Jeengume Avanza. 2 ed. Quito, Ecuador: Ediciones Abya-Yala Colección Ethnos; 1988. 219 p.

Carrillo E, Aldás S, Altamirano M, Ayala F, Cisneros D, Endara A, *et al.* Lista Roja de los reptiles del Ecuador. Quito, Ecuador: Fundación Novum Milenium, UICN-Comité Ecuatoriano, Ministerio de Educación y Cultura. Serie Proyecto PEEPE; 2005. 46 p.

Castro Casal A, Merchán Fornelino M, Garcés-Restrepo MF, Cárdenas Torres MA, Gómez Velasco F. Uso histórico y actual de las tortugas charapa (*Podocnemis expansa*) y terecay (*Podocnemis unifilis*) en la Orinoquia y la Amazonia. Biota Colomb. 2013;14(1):45-64.

Castaño–Mora OV. Status of the tortoises and freshwater turtles of Colombia. In: Van Abbema J, editor. Proceedings: Conservation, Restoration and Management of Tortoises and Turtles–An International Conference. New York, NY: New York Turtle and Tortoise Society; 1997. p. 302-306.

Corredor–Londoño G, Kattan G, Galvis–Rizo CA, Amorocho D. Tortugas del Valle del Cauca. Santiago de Cali, Colombia: Corporación Autónoma Regional del Valle del Cauca; 2007. 74 p.

Davis A, Wagner JR. Who knows? On the importance of identifying "experts" when researching local ecological knowledge. Hum Ecol. 2003;31(3):463-489.

De la Montaña E. Cacería de subsistencia de distintos grupos indígenas de la Amazonía ecuatoriana. Rev Ecosist. 2013:22(2):84-96.

De la Ossa–Velásquez J, Vogt RC. Efecto de sustitución: una expresión del agotamiento poblacional de quelonios en Barcelos, Amazonas, Brasil. Rev Asoc Colomb Cienc Biol. 2010;22:61-67.

Fachín–Terán A, Vogt RC, Thorbjarnarson JB. Patterns of use and hunting of turtles in the Mamirauá Sustainable Development Reserve, Amazonas, Brazil. In: Silvius KM, Bodmer RE, Fragoso JMV, editors. People in Nature: Wildlife Conservation in South and Central America. New York, NY: Columbia University Press; 2004. p. 362-377.

Ferdon EN, Jr. Studies in Ecuadorian geography. Monog Sch Amer Res. 1950;15:1-86.

Gilmore RM. Fauna and ethnozoology of South America. In: Steward JH, editor. Handbook of South American Indians, Vol. VI, Physical Anthropology, Linguistics and Cultural Geography of South American Indians. Washington, DC: Smithsonian Institution; 1948. p. 345-464.

INEC (Instituto Nacional de Estadística y Censos). Censo de Población y Vivienda (CPV-2010). [consulted 25 May 2014]. Available at: URL: http://www.ecuadorencifras.gob.ec/censo-de-poblacion-y-vivienda/.

Jaramillo M. Diagnóstico Socio-Económico de la Provincia de Esmeraldas. Otavalo, Ecuador: Instituto Otavaleño de Antropología, Colección Pendoneros; 1980. 300 p.

Johns AD. Continuing problems for Amazon river turtles. Oryx. 1987;21(1):25-28.

Kaplan H, Kopischke K. Resource use, traditional technology, and change among native peoples of lowland South America. In: Redford KH, Padoch C, editors. Conservation of Neotropical Forests: Working from Traditional Resource Use. New York, NY: Columbia University Press; 1992. p. 83-107.

Klemens MW, Thorbjarnarson JB. Reptiles as a food resource. Biodivers Conserv. 1995;4(3):281-298.

Kottek M, Grieser J, Beck C, Rudolf B, Rubel F. World map of the Köppen-Geiger climate classification updated. Meteorol Z. 2006;15(3):259-263.

Lamar WW, Medem F. Notes on the chelid turtle *Phrynops rufipes* in Colombia (Reptilia: Testudines: Chelidae). Salamandra. 1982;18(3-4):305-321.

Lehr E. Zur Nutzung einiger Amphibien- und Reptilienarten in Peru. Reptilia. 2000;24:40-46.

LGB (Liaison Group on Bushmeat). Report of the Liaison Group meeting on bushmeat. Montreal, Canada: Secretariat, Convention on Biological Diversity; 2009; UNEP/CBD/LG-Bushmeat/1/2:1-18. Available at: URL: HTTP://www.cbd.int/doc/meetings/for/lgb-01/official/lgb-01-02-en.pdf.

Mitlewski B. Pesca cayapa. In: CEPLAES, editor. La Pesca Artesanal en el Ecuador. Quito, Ecuador: ESPOL, CEPLAES and ILDIS; 1987. p. 155-174.

Mittermeier RA. A turtle in every pot: a valuable South American resource going to waste. Anim King. 1975;78(2):9-14.

Mittermeier RA, Carr JL, Swingland IR, Werner TB, Mast RB. Conservation of amphibians and reptiles. In: Adler K, editor. Herpetology: Contemporary Research on the Biology of Amphibians and Reptiles. Oxford, OH: Society for the Study of Amphibians and Reptiles; 1992. p. 59-80.

Mittermeier RA, Medem F, Rhodin AGJ. Vernacular Names of South American Turtles. SSAR Herpetol Circ. 1980;10:1-44.

Naranjo P. El Clima del Ecuador. Quito, Ecuador: Editorial Casa de la Cultura Ecuatoriana; 1981. 125 p.

Nasi R, Brown DE, Wilkie D, Bennett E, Tutin C, Van Tol G, *et al*. Conservation and Use of Wildlife-based Resources: the Bushmeat Crisis. Montreal, Canada: Secretariat of the Convention on Biological Diversity, CBD Technical Series No. 33; 2008. 50 p.

Ojasti J, Febres-Fajardo G, Cova-OM. Consumo de fauna por una comunidad indígena en el Estado Bolívar, Venezuela. Symposio Conservación y Manejo Fauna Silvestre Neotropical (IX CLAZ Perú); 1986. p. 45-50.

Orejuela JE. Traditional productive systems of the Awa (Cuaiquer) Indians of southwestern Colombia and neighboring Ecuador. In: Redford KH, Padoch C, editors. Conservation of Neotropical Forests: Working from Traditional Resource Use. New York, NY: Columbia University Press; 1992. p. 58-82.

Peres CA. Evaluating the impact and sustainability of subsistence hunting at multiple Amazonian forest sites. In: Bennett EL, Robinson JG, editors. Hunting for Sustainability in Tropical Forests. New York, NY: Columbia University Press; 2000. p. 31-56.

Peres CA, Nascimento HS. Impact of game hunting by the Kayapo of south-eastern Amazonia: implications for wildlife conservation in tropical forest indigenous reserves. Biodivers Conserv. 2006;15(8):2627-2653.

Pezzuti JC, Lima JP, Da Silva DF, Begossi A. Uses and taboos of turtles and tortoises along Rio Negro, Amazon Basin. J Ethnobiol. 2010;30(1):153-168.

Price R. Maroon Societies: Rebel Slave Communities in the Americas. 3 ed. Baltimore, MD: John Hopkins University Press; 1996. 480 p.

Pritchard PCH, Trebbau P. The Turtles of Venezuela. Oxford, OH: Society for the Study of Amphibians and Reptiles; 1984. 403 p.

Ramírez de Morejón M. Folklore de la Zona Norte Esmeraldeña. Esmeraldas, Ecuador: Banco Central del Ecuador; 1984. 396 p.

Redford KH, Padoch C, editors. Conservation of Neotropical Forests: Working from Traditional Resource Use. New York, NY: Columbia University Press; 1992. 475 p.

Redford KH, Robinson JG. The game of choice: patterns of Indian and colonist hunting in the Neotropics. Am Anthropol. 1987;89(3):650-667.

Redford KH, Robinson JG. Subsistence and commercial uses of wildlife in Latin America. In: Robinson JG, Redford KH, editors. Neotropical Wildlife Use and Conservation. Chicago, IL: University of Chicago Press; 1991. p. 6-23.

Restrepo Calle S, editor. Carne de Monte y Seguridad Alimentaria: Bases Técnicas para una Gestión Integral en Colombia. Bogotá, Colombia: Instituto de Investigación de Recursos Biológicos Alexander von Humboldt; 2012. 108 p.

Rhodin AGJ, Walde AD, Horne BD, Van Dijk PP, Blanck T, Hudson R, editors. Turtles in Trouble: The World's 25+ Most Endangered Tortoises and Freshwater Turtles—2011. Lunenburg, MA: Turtle Conservation Coalition [IUCN/SSC Tortoise and Freshwater Turtle Specialist Group, Turtle Conservation Fund, Turtle Survival Alliance, Turtle Conservancy, Chelonian Research Foundation, Conservation International, Wildlife Conservation Society, and San Diego Zoo Global]; 2011. 54 p.

Robinson JG, Bennett EL, editors. Hunting for Sustainability in Tropical Forests. New York, NY: Columbia University Press; 2000. 582 p.

Robinson JG, Bennett EL. Having your wildlife and eating it too: an analysis of hunting sustainability across tropical ecosystems. Anim Conserv. 2004;7(4):397-408.

Robinson JG, Redford KH, editors. Neotropical Wildlife Use and Conservation. Chicago, IL: University of Chicago Press; 1991. 520 p.

Rueda–Almonacid JV, Carr JL, Mittermeier RA, Rodríguez–Mahecha JV, Mast RB, Vogt RC, *et al.* Las Tortugas y los Cocodrilianos de los Países Andinos del Trópico. Bogotá, Colombia: Conservación Internacional; 2007. 538 p.

Schaller GB. Foreword. In: Bennett EL, Robinson JG, editors. Hunting for Sustainability in Tropical Forests. New York, NY: Columbia University Press; 2000. p. xv-xviii.

Schmink M, Redford KH, Padoch C. Traditional peoples and the biosphere: framing the issues and defining terms. In: Redford KH, Padoch C, editors. Conservation of Neotropical Forests: Working from Traditional Resource Use. New York, NY: Columbia University Press; 1992. p. 3-13.

Sierra R. Traditional resource-use systems and tropical deforestation in a multi-ethnic region in North-west Ecuador. Environ Conserv. 1999;26(2):136-145.

Sierra R, Stallings J. The dynamics and social organization of tropical deforestation in northwest Ecuador, 1983-1995. Hum Ecol. 1998;26(1):135-161.

Silvius KM, Bodmer RE, Fragoso JMV, editors. People in Nature: Wildlife Conservation in South and Central America. New York, NY: Columbia University Press; 2004. 463 p.

Smith NJH. Destructive exploitation of the South American river turtle. Yearb Asso Pac Coast Geog. 1974;36:85-102.

Smith NJH. Aquatic turtles of Amazonia: an endangered resource. Biol Conserv. 1979;16(3):165-176.

Speiser S. Tradiciones Afro-esmeraldeñas. 3 ed. Quito, Ecuador: Ediciones Abya-Yala; 1989. 57 p.

Suárez E, Stallings JR, Suárez L. Small-mammal hunting by two ethnic groups in north-western Ecuador. Oryx. 1995;29(1):35-42.

Thorbjarnarson JB, Lagueux CJ, Bolze D, Klemens MW, Meylan AB. Human use of turtles: a worldwide perspective. In: Klemens MW, editor. Turtle Conservation. Washington, DC: Smithsonian Institution Press; 2000. p. 33-84.

TTWG (Turtle Taxonomy Working Group). Turtles of the world, 2011 update: annotated checklist of taxonomy, synonymy, distribution, and conservation status. In: Rhodin AGJ, Pritchard PCH, van Dijk PP, Saumure RA, Buhlmann KA, Iverson JB, Mittermeier RA, editors. Conservation Biology of Freshwater Turtles and Tortoises: A Compilation Project of the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group. Chelon Res Monogr. 2011; No. 5:000.165-000.242.

Turner NJ, Davidson-Hunt IJ, O'flaherty M. Living on the edge: ecological and cultural edges as sources of diversity for social—ecological resilience. Hum Ecol. 2003;31(3):439-461.

Werner D. Amazon Journey: An Anthropoligist's Year among Brazil's Mekranoti Indians. New York, NY: Simon and Schuster; 1984. 296 p.

West RC. The Pacific Lowlands of Colombia. Louisiana State Univ Stud, Social Science Series; 1957; 278 p.

Whitten NE, Jr. Black Frontiersmen: A South American Case. Boston, MA: Schenkman Publ. Co.; 1974. 221 p.

Appendix 1. Voucher specimens of the turtle species found during this study were deposited in the National Museum of Natural History (USNM) of the Smithsonian Institution, Washington, DC, or the museum of the Escuela Politécnica Nacional (MEPN), Quito, Ecuador.

Chelydra acutirostris: MEPN 86; USNM 281875.
Kinosternon leucostomum: MEPN 53–55, 104–105; USNM 281876–281877.
Rhinoclemmys annulata: MEPN 90; USNM 281878–281879, 281892.
R. melanosterna: MEPN 91; USNM 281882–281886.
R. nasuta: MEPN 35; USNM 281887, 281891.