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Destructive Exploitation of the South American River Turtle

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THE WORLD'S largest freshwater turtle, *Podocnemis expansa,* has long served as an important food resource for Indians and Mestizos of the Amazon and Orinoco basins (Figure 1). Although widely distributed through tropical South America, this turtle, along with its marine relatives, is now a threatened species as a consequence of overexploitation for both meat and eggs (Parsons).

Tertiary fossil records place *Podocnemis* in Eurasia, Africa, and the Americas. Today, however, perhaps due to the expansion of the ecologically more competitive cryptodire turtles, the genus survives only in isolated Madagascar (*P. madagascariensis*) and in South America (Figure 2), the latter an island continent for most of the Tertiary (Neill). Of the seven species inhabiting the Neo-tropics, *Podocnemis expansa* is the largest, its carapace reaching up to 3 feet in length. Other species such as *P. unifilis, P. dumeriliana,* and *P. cayennensis* have figured less prominently in the regional diet due to their smaller size or more restricted range.

History of Exploitation

The aboriginal population of Amazonia, recognizing the food value of these 150-pound reptiles, penned them for year-round cropping. Orellana's hunger-plagued expedition down

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Figure 1. ***Podocnemis expansa.***

the Amazon in 1542 was relieved to find a village with more than a thousand turtles in flooded enclosures and wells (Medina). A century later along the same river, Acuña reported that there was hardly a village containing fewer than a hundred corraled turtles and that the natives were thus ignorant of hunger.

Tribes of the Amazon and Orinoco made yearly pilgrimages during dry seasons to collect thousands of *Podocnemis*[1] which had finished laying on selected sandy beaches exposed by low water. Amerinds also probed the sand with sticks for nest cavities which, upon discovery, were dug up and the eggs dried over fires on wooden platforms (Gumilla). Loaded with

[1] Here and in the remainder of this paper, the generic name is used to designate the one species, *Podocnemis expansa*. This turtle in Brazil was formerly called *jurararetê or jurara-açu*, but is now known as *tartaruga*. It is also known as *charapa* in Peru and *arrau* in Venezuela.

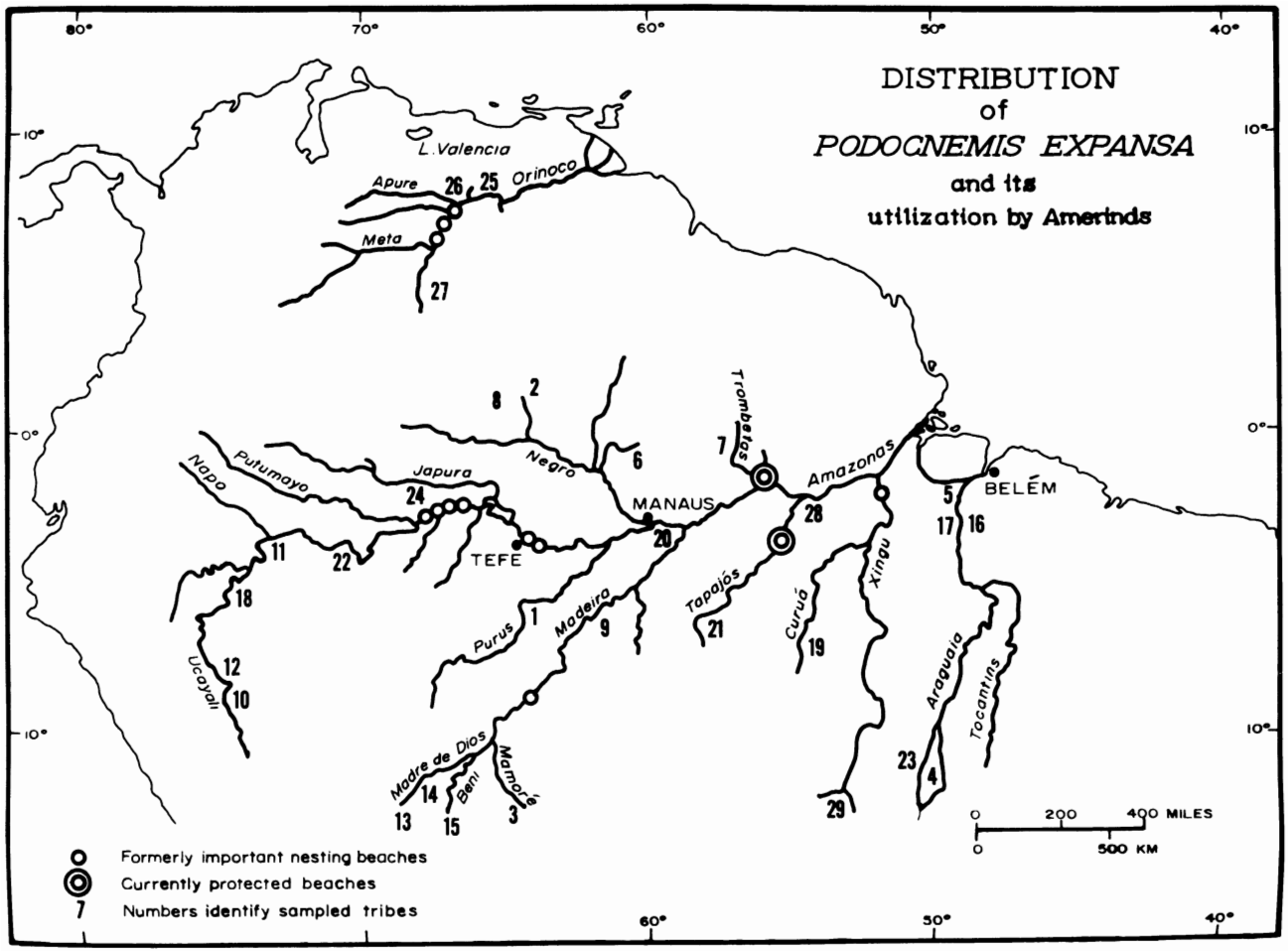

Figure 2. Rivers of South America in relation to *P. expansa*. The numbered Amerind tribes are identified in Table 1.

Table 1. Sampled Tribes Using *Podocnemis Expansa*[1]

Tribal number (Fig. 2)	Tribe	Use of *Podocnemis*	Source
1	Paumari (Aruak)	Swam down to 30 feet to catch turtles by hand	Coutinho, p. 160
2	Xiriâna (Aruak)	Collected turtles and their eggs during dry season	Costa
3	Moré (Chapacuran)	Turtle eggs an important food item in September and October	Metraux, p. 399
4	Karajá	Turtle eggs significant food item during dry season	Lipkind
5	Arara (Karib)	When the tribe first appeared on the Tocantins, turtles formed their only medium of exchange	Nimuendaju
6	Atruahí (Karib)	Descend rivers Camananaú and Curiuaú in dry season to gather turtles and their eggs	Costa
7	Kaxuiana (Karib)	Formerly collected the turtles and eggs	Frikel
8	Pakidái (Karib)	Collected turtles and their eggs during the dry season	Costa
9	Mura	Turtles a basic staple; caught by hand and harpoon.	Bates, Vol. 1, p. 328
10	Conibo (Panoan)	Ate a ragout of banana and turtle eggs; traded turtle oil with missionaries	Saint Cricq, pp. 9, 40
11	Mayoruna (Panoan)	Hunted turtles with harpoons, bows and arrows; also corraled them	Osculati
12	Shipibo (Panoan)	Ate great numbers of boiled turtlings; also traded turtle fat	Saint Cricq, pp. 60, 67
13	Yamiaca (Panoan)	Collected turtle eggs	Metraux, p. 453
14	Cavina (Tacanan)	In mythology, a huge spirit-turtle protects its species	Metraux, p. 448
15	Tumpasa (Tacanan)	In mythology, a huge spirit-turtle protects its species	Metraux, p. 448
16	Amanayé (Tupi)	Turtles abundant and kept in corrals	Nimuendaju and Metraux
17	Assuriní (Tupi)	Formerly collected turtle eggs during the dry season	Firmo

Table 1. Sampled Tribes Using *Podocnemis Expansa*[1] (Continued)

Tribal number (Fig. 2)	Tribe	Use of *Podocnemis*	Source
18	Cocama (Tupi)	Hunted turtles with harpoons, bows and arrows; also corraled them. Traded turtle oil	Metraux, p. 692
19	Kuruáya (Tupi)	Turtle a major food item	Nimuendaju
20	Mawé (Tupi)	Hunt turtles year-round	Firmo
21	Mundurukú (Tupi)	Capture turtles whenever encountered during fishing trips	Firmo
22	Omagua (Tupi)	Hunted turtles with harpoons, bows and arrows; also corraled them. Traded turtle oil	Metraux, p. 692
23	Tapirapé (Tupi)	Killed turtles in rivers and collected their eggs	Wagley and Galvão
24	Witóto	Captured turtles by flipping them over on their backs during the nesting season; also collected eggs	Whiffen
25	Guamos	Made yearly trips to the Orinoco to harvest the eggs	Humboldt, p. 184
26	Otomacs	Made yearly trips to the Orinoco to harvest the eggs	Humboldt, p. 184
27	Piaora	Formerly had to kill great numbers of crocodiles to harvest the turtle eggs safely	Roze, p. 40
28	Tapajó	Made clay lamps fashioned after the turtle	Barata
29	Tribes of the Upper Xingu	Turtle eggs furnish a basic staple during the dry season	Carvalho

[1] Corresponding to the tribal numbers shown in Figure 2. Some tribes have since moved or died out.

live turtles and dehydrated eggs, native expeditions returned to their villages to trade the eggs and to restock their corrals. These "river cattle" were especially appreciated during the long rainy season when fish were difficult to find in the flooded forest and when the use of piscicides became impractical.

Turtles were also harder to find in the wet season when they had dispersed to feed in the numerous floodplain lakes and swamps. Natives hid patiently in canoes by favorite feeding

places of *Podocnemis,* such as near the giant aroid aninga[2] or the water-loving jauari palm when their ripe fruits began falling. Cultivated fruits and manioc were also left in the water to attract the wary turtles which were then harpooned as they rose to the surface.

Some groups such as the Conibo of the Ucayali (Table 1) developed special bows and arrows for *Podocnemis.* The arrow shaft consisted of a detachable head, made initially of stone, later metal, which was tied to the shaft with fibre. Indians shot this arrow on a trajectory so that, when successful, it penetrated almost perpendicularly into the shell (Figure 3). Although it was more difficult to hit when shooting on a parabolic curve, the prey's limited lateral vision permitted no warning of the approaching missile. Wounded *Podocnemis* dived with the embedded arrowhead, but left the writhing shaft on the surface which was then hauled in to deliver the coup de grâce.

More ingenious still were the Paumari of the Purus and the Mura of the Madeira who could swim to a depth of 30 feet to grab the elusive turtles. Natives also pursued the turtles across small lakes by beating the surface and driving the quarry

Figure 3. Conibo Indians shooting turtles in the Ucayali. Source: L. Saint Cricq, *A Journey across South America* . . . (London, 1973), Vol. 2, Part 1, p. 40.

[2] The equivalent scientific names for cited flora and fauna are given in Table 3 at the conclusion of this article.

into nets. After contact, many tribes placed hooks and line baited with fruits such as those of tucumã palm at the exits of shrinking lakes when *Podocnemis* began to leave at the onset of the dry season.

This turtle made such a contribution to the regional diet that some tribes incorporated it into their ceramics. The extinct Tapajó nation once fashioned clay vases and models of the turtle, perhaps using them as lamps with turtle oil for fuel. Vanished tribes of the lower Trombetas River made elaborate models of this turtle in soapstone, possibly for religious purposes. Clay models made by the Karajá were undoubtedly toys.

Podocnemis was also embodied in tribal mythology. Among the Tumpasa of the Beni, a huge spirit-turtle is the protector of its species. Some tribes of the Orinoco believed a mystical lady watched over female turtles during the laying period and would harm anyone disturbing them at their vital work. Such cultural checks and a poorly developed market economy permitted a flourishing coexistence between turtles and aborigines.

Contact with missionaries and early Spanish and Portuguese traders soon upset this harmonious balance. Jesuits especially appreciated turtle meat during Lent, regarding it as a fish. However, traders and missionaries were more interested in the oil derived from the eggs. Oil for cooking and lighting was prepared by crushing thousands of eggs in canoes which were then flooded and left in the sun for several hours to bring the yolk fat to the surface. The oily mixture was then skimmed off with shells or gourds, boiled in copper kettles for purification and reduction, and stored in clay pots (Figure 4). A heavier oil, to be mixed with resin for caulking, was prepared by leaving the crushed eggs in the sun for several days. The finest oil came from boiling fresh fat; countless turtles were butchered for this purpose, with the meat cast aside for vultures and caimans (Ferreira, p. 37). Indians quickly learned to exchange turtle products for metal goods, especially for nails which they fashioned into arrow and harpoon heads for hunting, fishing, and turtling.

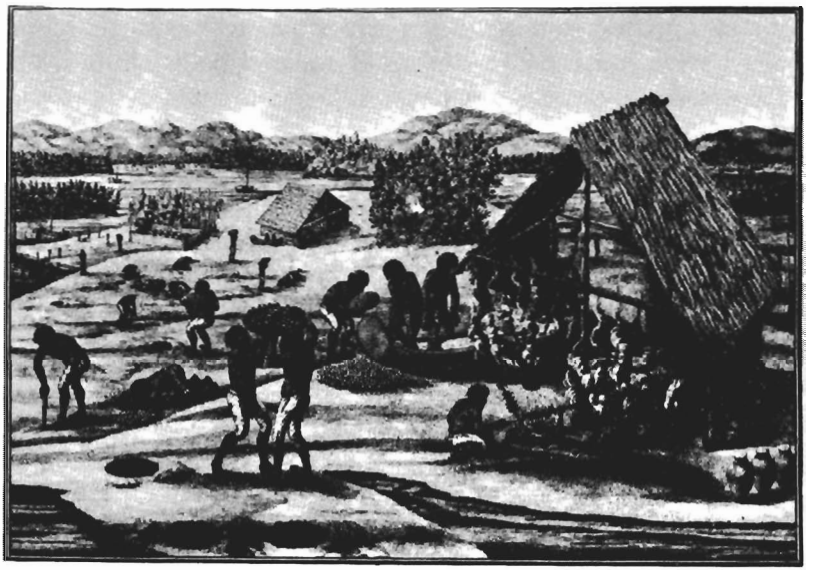

Figure 4. Manufacture of oil from turtle eggs in Amazonia circa 1786. Source: A Ferreira, *Viagem Filosófica*, Conselho Federal de Cultura, Brazil, 1972, Plate 57.

Initially the oil industry was conducted under rigorous conservation rules enforced by missionaries and state officials alike. At least a third of a nesting beach was left unmolested to provide a safety margin for the reproduction of this substantial resource. On the Orinoco, Humboldt observed that: "The Jesuits did not suffer the whole beach to be searched, they left a part untouched, from the fear of seeing the breed of arrau tortoises, if not destroyed, at least considerably diminished." (Humboldt, p. 189). In Amazonia, special permits were issued to families wishing to participate in the egg harvest on the 15 royal beaches. Production from these beaches was prolific—the Itapeua and Corasteua beaches alone provided 2,000 pots of oil annually in the eighteenth century (Table 2).

Though decreasing yearly, the rich harvest of eggs continued to be fruitful during the first half of the nineteenth century. According to Bates at least 6,000 pots were exported annually from the Upper Amazon and Madeira rivers in the

Table 2. Turtle Oil Production

Year	Location	Oil traded annually[1]	Eggs destroyed (millions)	Source
1700's	Itapeua and Corasteua beaches, Upper Amazon	2,000 pots	12	Saint Cricq, p. 495
1719	Upper Amazon	192,000 pounds	24	Coutinho, p. 166
1804	Orinoco	5,000 pots	25	Humboldt, p. 190
1830's	Ucayali	1,000 gallons	2	Smyth, p. 246
1830's	Tocantins	1,600 jars	9	Smyth, p. 279
1840's	Upper Amazon	6,000 pots	36	Herndon
1860's	Upper Amazon and Madeira	8,000 pots	48	Bates, p. 272
1870's	Madeira	2,000 pots	4	Keller
1882	Brazilian Amazon	6,028 kilos	2	Santa-Anna Nery
1885	Belém	6,855 kilos	2	Veríssimo
1886	Belém	7,934 kilos	2	Veríssimo
1887	Belém	5,070 kilos	1	Veríssimo
1888	Belém	19,174 kilos	5	Veríssimo
1889	Belém	20,260 kilos	5	Veríssimo
1890	Belém	12,975 kilos	3	Veríssimo
1891	Belém	10 256 kilos	2	Veríssimo
1892	Belém	10,730 kilos	2	Veríssimo
1893	Belém	17,922 kilos	5	Veríssimo
1894	Brazilian Amazon	14,450 kilos	4	Santa-Anna Nery
1896	Brazilian Amazon	7,781 kilos	2	Santa-Anna Nery
1897	Brazilian Amazon	11,500 kilos	3	Santa-Anna Nery
1901	Amazonas, Brazil	3,697 kilos	1	Conçalves
1902	Amazonas, Brazil	429 kilos	0.116	Conçalves
1903	Amazonas, Brazil	1,160 kilos	0.3	Conçalves

[1] Conversion scale: 1 pot = 3 gallons (Bates, p. 272); 1 pot = 6,000 eggs (Bates, p. 272), 5,000 eggs (Humboldt, p. 190), or 2,000 eggs (Keller); 24 pounds = 3,000 eggs (Le Cointe).

1860's, with an additional 2,000 pots consumed locally (Bates, p. 272). Each pot required 6,000 eggs; thus at least 48 million eggs were crushed yearly, the fruitless effort of some 400,000 females. In the 1850's, *Podocnemis* was still plentiful enough to impede river traffic on the Madeira when females were gathering near the nesting beaches, the clacking of shells being audible for "great distances" (Coutinho, p. 160). In 1875 on the same river Mathews witnessed an extraordinary sight: "For miles as far as the eye can see, which hereabouts runs straight for some 6 or 7 miles, were continuous rows of

turtle at the water's edge: the rows being eight or ten deep, many thousands must have collected together."

Not surprisingly, both the eggs and flesh of *Podocnemis* figured prominently in the diet of riverine folk. At Barcelos on the Rio Negro, a total of 53,468 turtles entered the two state corrals between 1780 and 1785, of which 17,461 are reported to have died before slaughter (Ferreira, p. 42). In Tefé on the Upper Amazon "every house has a little pond in the backyard to hold a stock of these animals through the season of dearth—the wet months." (Bates, p. 212). Writing from Manaus in 1851, Spruce states: "Here we are in the very centre of turtles and we never sit down to breakfast or supper without turtle in various forms."

In addition to cooking, the shell served other useful purposes. At Tefé in 1865, Agassiz noted: "one utensil is very characteristic; the large empty turtle shells which can be seen in every kitchen, used as basins, bowls." Carapaces also provided convenient steppingstones over slippery streets during the rainy season and when inverted served as excellent containers for carrying mud to building sites. In the absence of the preferred bark of caraipé, shells were burnt and the ashes mixed with clay for making pottery.[3] Combs were cut from the shells, while skins from the neck were dried and stitched for tobacco pouches or stretched to make tambourines (Ferreira, pp. 42-43).

Feasting on profits from turtle products, inhabitants of the Amazon and Orinoco let a valuable resource dwindle dangerously through reckless exploitation. By the end of the eighteenth century, an orgy of egg destruction was under way on most of the beaches. Explorers and travelers at that time voiced their unanimous concern: "The universal opinion of the settlers on the Upper Amazon is, that the turtle has very greatly

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[3] The ash was mixed with clay to reduce plasticity; see H. Sternberg, "Radiocarbon Dating as Applied to a Problem of Amazonian Morphology." *Comptes Rendues Du XVIII Congrès International de Geógraphie, Rio de Janeiro,* 1956, p. 417.

decreased and is still annually decreasing." (Bates, p. 272). Keller prophesized: "It is clear that with the present procedure, they must rapidly decrease, and that at no distant date they will be counted amongst things of the past." As early as 1868, Coutinho warned: "For the love of an insignificant profit, the population destroys one of the greatest resources that could assure its subsistence and well-being of its children, as well as the happiness of generations to come." (Coutinho, p. 164).

Table 2 suggests that turtle oil production had considerably diminished by the end of the last century. *Podocnemis* had lived with Indians for harmonious millennia, but 300 years of the intense pressure of civilization had driven it to the brink of extinction. Only the timely introduction of kerosene and vegetable oils in the latter half of the last century may have saved *Podocnemis* from total annihilation.

Reproduction and Mortality

Under natural conditions this turtle has enough predators to keep the population within bounds. Prior to laying, females climb the beaches daily to sun themselves, thus raising metabolism for their developing eggs. Fear of predators forces the thousands of females to wait patiently for their turn on the thin strip of beach close to the water's edge.

When time comes to lay, the females ascend the beach at night to avoid enemies and the heat of day.[4] Nevertheless, nocturnal jaguars sometimes catch a few by flipping them over on their backs, then dining at ease. Working feverishly for perhaps 90 minutes, the female turtles scoop a hole with their hind feet and deposit within some 90 eggs. The fact that this

[4] However, the Tapajós River population lays by day (P. Vanzolini, personal communication). Since gene flow seems to have stopped between some rivers, subspeciation may be under way. Although the Amazon and Orinoco watersheds are physically connected, these populations probably do not interbreed, due to the rapids in the Upper Orinoco and because the Orinoco turtle lives in a different climatic regime and breeds in March. In the Amazon, *P. expansa* breeds in October.

species lays so many eggs suggests a slim chance of survival for the offspring.

Perhaps 5 percent of the eggs never develop due to embryonic complications. An average of 25 percent of the nests are drowned due to the rising water table at the onset of the rainy season, and in some years an unusually rapid swelling of the rivers can flood 80 percent of the nests before the eggs hatch (Ojasti, 1967). Disturbance by man at favourite nesting sites has forced turtles to delay laying and to seek beaches more subject to flooding (Coutinho, p. 159).

If the nests are not flooded or disturbed, the eggs incubate at a nearly constant temperature of 90° F, 3 feet below ground, and hatch after about seven weeks (Roze, p. 39). Waiting for the cover of night, the turtlings surface and break downslope to the river. Black vultures, turkey vultures, and crested caracaras then feast on the scurrying masses, as do wood ibis and maguari and jabiru storks. These birds together are estimated to crop some 6 percent of the yearly production (Ojasti, 1971). Surviving hatchlings must then face caimans, piranhas, piraíba, and surubim.[5] Once dispersed into floodplain forests, the turtlets are comparatively safe. Although *Podocnemis* has a high reproductive potential with a life span of at least 30 years and an average yearly clutch size of 90 eggs, perhaps fewer than one in 500 survives the seven years to maturity. Once adult size is reached, this turtle is relatively free of predators other than man.

While the skin trade has considerably thinned the ranks of jaguar and caiman, man has more than compensated for the reduction of these predators. Indian pressure on the turtle was tolerable but civilization introduced a new and potent factor—the highly exploitive oil trade. Not only were most of the eggs uncovered and destroyed, but the few remaining hatchlings were increasingly consumed as a delicacy (Vieira) or flown to Rio de Janeiro for the pet trade (Pereira).

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[5] Information on aquatic predators is based on the author's interviews with turtlers.

Attempts at Conservation

In 1946, Venezuela outlawed the commercial exploitation of the turtle and declared its nesting beaches off-limits. Nevertheless, commercial turtlers continued to capture large numbers on the laying beaches and to net them for sale in the larger towns. The price of *Podocnemis* has climbed so steeply that only the middle and upper classes can afford to dine on it; the turtle no longer affords a basic staple for the "campesino." The price of an adult *Podocnemis* rises from U.S. $1 in the interior to $4 in towns, reaching $8 in the larger cities.

In Brazil, *Podocnemis* has been ascribed paper protection for decades, with disappointing results. In 1966, some 4,000 were openly transported by rail to Porto-Velho on the Madeira River (Mallinson). Turtles are taken at every opportunity and the price has soared beyond the grasp of the "caboclo." In Manaus fifty years ago, large turtles could be bought for one U.S. cent apiece (Bitencourt); now they are smuggled to market and sold readily for $30.

In 1950, Venezuela started a colony of *Podocnemis* in Lake Valencia to provide a renewable food resource for the growing population around the lake. Approximately 10,000 were flown in from the Orinoco and kept in tanks to grow beyond bite size of the lake's predator guabina fish (Ramirez). After 10 months the turtles were released but no significant nesting has taken place on the artificial beaches. *Podocnemis* apparently requires a seasonal fluctuation of the water level to coincide with its reproductive cycle, a condition that shrinking Lake Valencia may be unable to fulfill.

In 1965, "Operación Tortuguillo" began rescuing baby turtles on the Orinoco threatened by rising waters which seemed likely to flood their nests and drown them. Some 80,000 turtlings were excavated and poured into swamps and floodplain channels, bypassing predator birds and local gourmets. This rescue effort appeared timely, for the number of nests on Playa del Medio, the principal Orinoco beach, had dropped from 34,000 in 1963 to 13,800 in 1965 (Ojasti, 1967). But the

operation may have caused adverse long-term repercussions on the population; turtlings may have to break out from their nests and reach water on their own, so that the location of the beach can be imprinted for future nesting (Vanzolini). The turtle rescue program has now been dropped, the Ministry of Agriculture instead focusing its attention upon coastal fisheries.

In 1964, Brazil began protecting an important *Podocnemis* nesting beach near Oriximiná on the Trombetas River. An estimated 10,000 female turtles nested on the beach in 1969, up from 7,200 in 1966 and 5,300 in 1965. Inasmuch as the *Podocnemis* population on the Trombetas is considered the largest in the entire Amazon basin, the situation remains precarious. A second beach was set aside in 1968 opposite Monte Cristo on the Tapajós River, but only 88 *Podocnemis* used this beach in 1971, a slight gain from the 80 nesting in 1969.[6]

Potential for Domestication

There are strong economic arguments for securing the survival of the turtles. The author has visited a few of the remaining families in the Amazon who still maintain a backyard pond stocked with *Podocnemis*. The captive turtles fare well, but overcrowding and inadequate nesting provisions depress the breeding rate. Furthermore, it increasingly appears that a lowering of the water level to coincide with the seasonal climatic rhythm may be needed to stimulate reproduction.

Provided that the water level is carefully managed, *Podocnemis* shows potential for commercial production. An adult can supply 30 pounds of nutrient-rich meat, a valuable addition to the generally meager regional diet. Turtle farming could be carried out either on a large scale, as practiced by missionaries on the Ucayali in the 1860's (Raimondi), or in the backyard of urban folk—a suggestion made over a century ago by the Brazilian naturalist Coutinho (p. 166). Operating costs do not

[6] Data from Instituto Brasilero de Desenvolvimento Florestal (IBDF), Belém, Pará, Brasil.

appear excessive; one family in Belém feeds their 2,000 turtles garden weeds and kitchen middens.

When the case of the Belém family was mentioned to development planners, they replied: "But look how long it takes to reach edible size," mindful that *Podocnemis* requires eight years to attain a marketable 50 pounds. Nevertheless, an investment now seems rational in view of swelling urban populations. Furthermore, it is ecologically less destructive to farm meat protein in ponds than to convert rain forest to livestock pasture, especially when the latter requires herbicidal applications. Turtle farming could also be more productive than livestock. Cattle pastures on nutrient-poor Amazon soils can sustain a meat production of only around 50 pounds per acre per year, while a well-managed turtle pond could provide some 22,000 pounds.[7] The market for turtle meat, as a food and reputed aphrodisiac, is already assured.

Table 3. Common and Scientific Names for Flora and Fauna

Common name	Scientific name
Aninga	*Montrichardia arborescens*
Black vulture	*Coragyps atratus*
Caraipé	*Licania* spp.
Cayman	*Caiman crocodilus*
Crested caracara	*Polyborus plancus*
Guabina fish	*Hoplias malabaricus*
Jabiru stork	*Jabiru mycteria*
Jaguar	*Panthera onça*
Jauari palm	*Astrocaryum jauari*
Maguari stork	*Euxenura maguari*
Piraíba	*Brachyplatystoma filamentosum*
Piranhas	*Serrasalmus* spp.
Surubim	*Sorubim lima*
Tucumã palm	*Astrocaryum vulgare*
Turkey vulture	*Cathartes aura*
Wood ibis	*Mycteria americana*

[7] Pastures generally support only one head per five acres, slaughtering at four years, dressed carcass weight 1,000 pounds. A pond 30 by 20 by 5 feet can support 100 turtles, slaughtering at eight years, having weight (less carapace and plastron) of 25 pounds.

Conclusion

Although occupying a vast range, *Podocnemis* could slide into extinction within a few decades unless there is an immediate and sustained interest in the survival of the species by the Brazilian, Peruvian, and Venezuelan governments. Instead of pursuing peasants for catching occasional turtles, government agencies might better focus their energies by setting aside the remaining nesting beaches and strictly protecting them from commercial exploitation. With further procrastination, a valuable resource may be lost forever.

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