

DISTRIBUTION AND STATUS OF MANATEES *TRICHECHUS* SPP. NEAR THE MOUTH OF THE AMAZON RIVER, BRAZIL†

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ABSTRACT

*Interviews with hunters and collection of skulls indicate that *Trichechus inunguis* occurs throughout the region of the Amazon River estuaries from Amapá to the mainland of Pará, including Ilha de Marajó and islands on its Atlantic coast. *T. manatus* has a disjunct distribution in Brazil, apparently occurring both on the coast of Amapá north of Cabo Norte and in the Rio Mearim (Maranhão) as well as further to the southeast; it seems to have been exterminated from the Atlantic coast of Pará and is absent from the Marajó region. Continued subsistence hunting can best be controlled by destruction of illegal camboas (fence-like traps) which catch manatees at high tide. Areas deserving study are the coasts and inland lakes of eastern Amapá, the only place in the world where two sirenian species might still be found in sympatry or immediate proximity, and the lower Rio Mearim in Maranhão, which may still contain a sizable population of *T. manatus*. Ecological studies in these areas should have particular relevance to hypotheses of sirenian evolutionary interactions, and manatee reserves should be established in both areas.*

INTRODUCTION

The Order Sirenia appears to have reached its maximum diversity in the Miocene, with about a dozen known genera, but subsequently declined and is represented today by only two living genera and four species. The reduced diversity of the modern sirenian fauna is a handicap to understanding the biology of the more diverse Tertiary sirenians and the evolutionary patterns of sirenians in general. Observations of sympatric or contiguously-occurring living forms would be of great

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value to studies of sirenian evolutionary biology, but only one area in the world today provides any hope of finding two sirenian species living in sympatry.

This area is the mouth, or mouths, of the Amazon river system in Brazil. The Amazonian manatee, *Trichechus inunguis* (Natterer 1883), is distributed in fresh waters throughout the Amazon basin, including the lower reaches of the Amazon (Rio Amazonas) itself (Bertram & Ricardo Bertram, 1973). The range of the West Indian manatee *Trichechus manatus* Linnaeus 1758, apart from North and Central America and the Caribbean Islands, includes fresh and salt waters of Colombia, Venezuela, the Guianas, and the coasts of the Brazilian Northeast (that is, on both sides of the Amazon estuaries) (von Pelzeln, 1883; Bertram & Ricardo Bertram, 1973; Banks da Rocha, 1971*a,b*) as well as the lower Orinoco River (Mondolfi, 1974). Despite repeated statements in the literature, which originate from a report by von Humboldt & Wiegmann (1838), there is no good evidence that *T. inunguis* ever occurred in the Orinoco basin, nor does it appear likely (in view of the locations of rapids in both rivers) that manatees of either species exist in the vicinity of the Casiquiare Canal or other natural connections between the Amazon and Orinoco drainage systems. Thus the Amazon mouth is the only area where the two species might be sympatric.

Goeldi & Hagmann (1904) reported *T. inunguis* from Ilha de Marajó. Goeldi (in Dilg, 1909: plate 13) presented a map of manatee distribution in South America, showing *T. inunguis* in the Amazon basin and *T. manatus* on the coast of Amapá north of Cabo Norte. He believed that the manatees on the coast south of the Amazon were *T. inunguis*, but cited no specimens or other data to support this (erroneous) conclusion, which was nonetheless repeated by subsequent writers. Pereira (1944), though asserting the existence of manatees throughout the area of the present study, including the Rio Mearim, not only cited no evidence for his conclusions but considered all New World manatees referable to *T. manatus*! Finally, Cabrera (1961) suggested that the coastal manatees of the Brazilian Northeast might be *T. manatus*, in contrast to the fluvial *inunguis*. This identification has been confirmed for the present-day situation by Banks da Rocha (1971*a,b*) and for the 16th and 17th centuries by Whitehead (1977, 1978). De Carvalho & Toccheton (1969) and Pine (1973) reported a specimen of *T. inunguis* (MPEG 1518; see below) from near Belém. Apart from these, however, no published locality records of either species seem to be available from the Atlantic coasts of Pará or Amapá, the lower parts of the Rios Amazonas or Tocantins, or Ilha de Marajó, leaving in doubt whether their ranges overlap in this area. (Hybridisation is unlikely as *T. inunguis* has 56 chromosomes whereas *T. manatus* has 48; Loughman *et al.*, 1970; White *et al.*, 1976.)

The results reported below were gathered in a survey of sites on the coasts of Amapá and Pará, the lower Rio Mearim in Maranhão, and the eastern part of Ilha de Marajó; that is, the areas where the identity of any existing manatee populations seemed to be most in doubt. The main objective was to determine the present

distributions of the two species in this region and identify areas of possible sympatry. The major motivation for locating such areas was their potential value for studies aimed at testing the hypotheses of sirenian evolutionary interactions proposed by Domning (1977). Secondary aims were to determine the status of the manatee populations and the outlook for their conservation, and to collect incidental data on manatee natural history.

MATERIALS AND METHODS

From 6 May to 8 June 1978 I travelled through coastal regions of Pará, Ilha de Marajó, Amapá and Maranhão (Fig. 1) to interview fishermen and other residents and to collect bones and other data relating to manatee distribution and status. Useful information was obtained from about 28 persons, including 14 who claimed to have personally killed manatees in this region. Three captive manatees from known localities in the study area were examined out of the water, and diagnostic portions of four skulls were collected; the latter are deposited in the collection of the Departamento Peixe-Boi, Instituto Nacional de Pesquisas da Amazônia, Manaus (nos. INPA-PB 178–180, 182). Another specimen (skull, skeleton, and skin) from the study area is in the mammal collection of the Museu Paraense 'Emilio Goeldi', Belém (MPEG 1518). Three additional specimens (INPA-PB 129, 156, 185) from localities marginal to the study area are also mentioned below.

Trichechus manatus and *T. inunguis* can be easily distinguished by a variety of skeletal characters (Hartlaub, 1886; Hatt, 1934; Domning, 1978 and in prep.). These include the more complex molar pattern of *T. inunguis* and the conformation of the latter's occipital region, which allows the skull to stand upright on the occiput when placed on a flat surface, in contrast to most *T. manatus*. The latter species has 17 to 19 pairs of ribs, whereas *T. inunguis* has 14 to 16 (Goeldi & Haggmann, 1904; de Carvalho & Toccheton, 1969; Hatt, 1934). The most conspicuous and reliable external character is the presence of nails on the flipper margin in *T. manatus* and their absence in *T. inunguis*. Reports by hunters that manatees lack nails are unreliable for identification of *T. inunguis*, but unsolicited statements that manatees had nails are good indications of *T. manatus*. The presence of white or pink belly patches is usually thought to be a constant character of *T. inunguis* in contrast to other manatees, but in reality *T. inunguis* shows a range of variation from complete absence of ventral markings to elaborate series of patches extending from the throat to the tail. Moreover, hunters' perceptions of 'white marks on the belly' often include mere countershading, whereas very small patches may be readily overlooked. Therefore extreme caution must be used in identifying species from hunters' testimony unsupported by diagnostic specimens.

In general, questions asked of informants included at least the following: Do manatees occur in the area? How many kinds of manatees are recognised? Do they

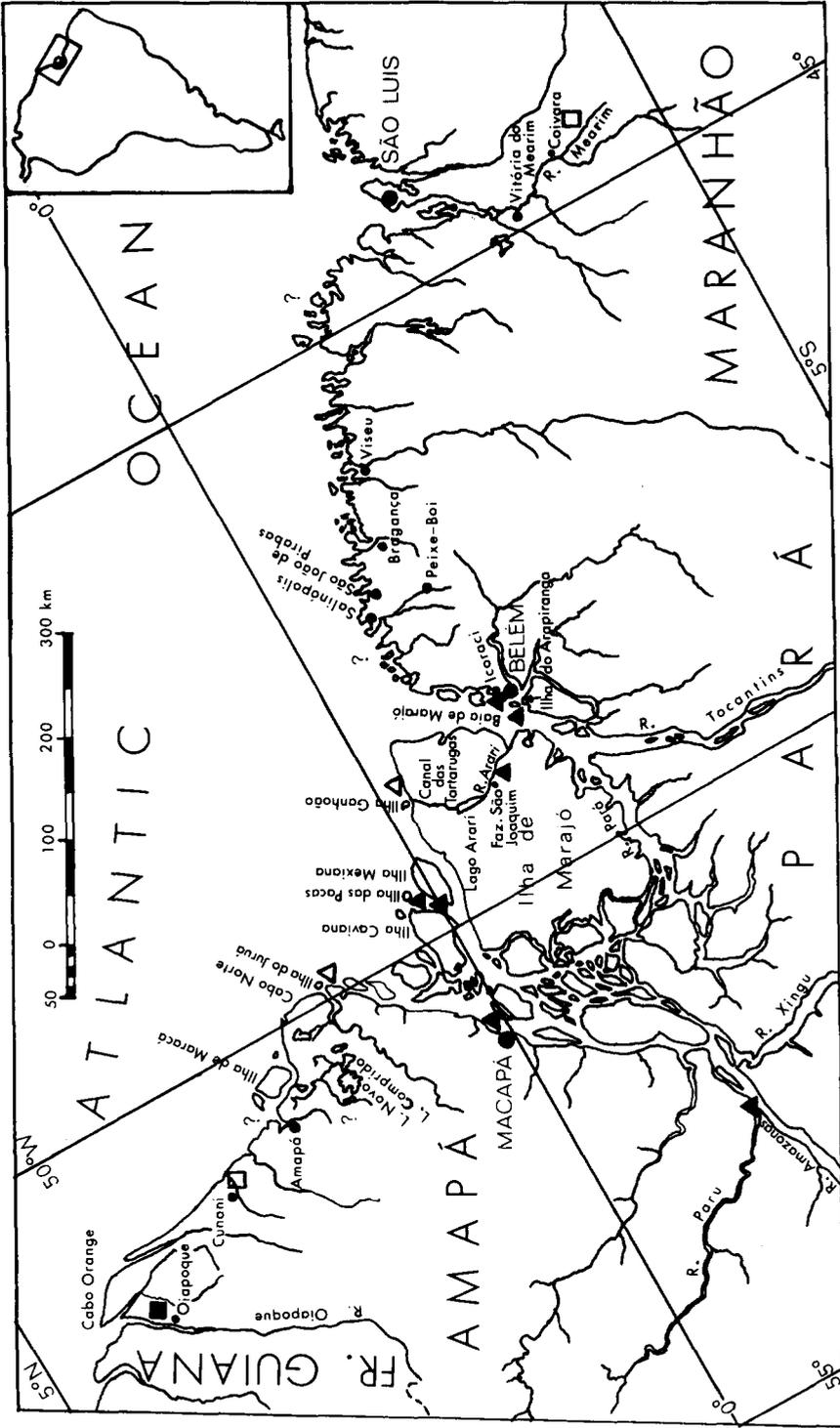


Fig. 1. Map of lower Amazon and adjacent regions of Brazil, showing localities mentioned in text. ▲, Localities of *Trichechus inunguis* confirmed by specimens; △, probable localities of *T. inunguis* unsupported by specimens; ■, locality of *T. manatus* confirmed by specimens; □, probable localities of specimens; ? , *T. manatus* unsupported by specimens; ? , areas of probable past or present occurrence of manatees, species uncertain.

have white marks or areas on the belly or nails on the flippers? To establish the first-hand nature of the information, the interviewee was always asked if he had personally killed or seen a manatee; this generally seemed to be answered honestly. Persons appearing to have more extensive knowledge were also questioned about manatee habits, food plants, hunting practices, and related topics.

DISTRIBUTION

Territory of Amapá

The fishing village of Amapá was briefly visited, with inconclusive results. Residents claimed that manatees were now seldom caught. Two hunters reported killing adult manatees in the vicinity of the Rio Amapá Grande, in 'May or June 1977' (a male) and 'about 5 years ago' (c. 1973), respectively. Two others killed several each, between 15 and 30 years ago at Ilha de Maracá off the Amapá coast, but another longtime resident of Ilha de Maracá assured me that none had been killed there in years. No diagnostic specimens could be obtained, but when I enquired about the occurrence of manatees with nails, one resident said he had seen a calf with nails that had been caught in the region of Cunani about 2 years before. On 28 July 1978, R. C. Best collected limb bones of a male manatee said to have had nails (INPA-PB 185) from Taperebo, Rio Oiapoque. The overall shape of the radius-ulna and the ratio of length of the fourth metacarpal to that of the radius (about 0.57; cf. Hatt, 1934) agree best with *T. manatus*. Manatees of undetermined species are said to occur on the coast near Cabo Norte and in lakes in eastern Amapá, especially Lago Novo and Lago Comprido. A live female *T. inunguis* 1.65 m long, which had been caught near Macapá circa 1969, was examined in the latter city; this animal had a single, very small white belly patch only ~ 10 cm long. A resident of Ilha Caviana in Pará claimed to have seen a manatee 2 m long with 'white on the belly' which was caught 'about 8 years ago' (c. 1970) at Ilha do Juruá south of Cabo Norte. It thus appears that *T. manatus* occurs north of Cabo Norte and *T. inunguis* to the south, with a possible zone of contact or sympatry near Cabo Norte and in the interior lakes.

Ilha de Marajó

I travelled up the Rio Ararí, through Lago Ararí and Canal das Tartarugas, and along the Atlantic coast to Ilha Caviana, Ilha Mexiana, and Ilha das Pacas, and interviewed residents at several localities. Canal Perigoso, separating the latter three islands, was the most active centre of manatee hunting visited in the study, and was widely recognised as such by inhabitants of the region; at least 13 manatees were killed there in 1977, and three had been caught (plus one which escaped) in 1978 as of May. The three 1977 animals whose skulls were collected (INPA-PB 178-180) were all *T. inunguis*.

A hunter on the Rio Arari caught two manatees above Cachoeira do Arari in 1977: a male calf of 14–16 kg in January or February (skull fragments and other bones collected, INPA-PB 182, *T. inunguis*); and a female on 25 September. The latter was still living in captivity and proved to be a *T. inunguis* 2.05 m long, with a very small (6.5 cm long) white belly patch.

Belém area

An adult male *T. inunguis* (MPEG 1518), having 14 pairs of ribs and no nails, was caught at Icoraci on 20 August 1958 (de Carvalho & Toccheton, 1969; Pine, 1973). Another manatee, caught in a fishing net at Ilha do Arapiranga circa March 1978, was still in captivity and proved to be a male *T. inunguis* 1.74 m long, with no belly patches. Two other captive *T. inunguis* in Belém, at the Museu Paraense 'Emilio Goeldi' and the Bosque Rodrigues Alves, have no locality data.

Atlantic coast of Pará

Elderly fishermen in São João de Pirabas and Salinópolis agreed that manatees were absent from the area. A 78-year-old man said there had been none there in his lifetime. A 63-year-old man said a couple were seen when he was about 15 (that is, c. 1930), and another said one was killed some 20 years ago. Inquiries made on my behalf by Dr W. L. Overall in Bragança and Viseu produced the same negative result. This region has been densely settled and developed for many decades, and despite the persistence of a town and a river named Peixe-Boi (manatee), the manatee population seems to have been largely exterminated. Specimens from archaeological sites could serve to identify the species which formerly occurred here; but the Museu Goeldi's large collection of faunal remains from coastal middens in Pará consists almost entirely of fish (Dr Mário Simões, pers. comm.), with no manatee bones except for one possible rib fragment.

Lower Amazon river and tributaries

These areas were not included in the interview survey. All known manatee specimens from the interior of the Amazon basin are *T. inunguis*; however, few specimens have been collected from the region below Santarém. The Museu Goeldi possesses seven skulls of *T. inunguis* from near Taperinha, just below Santarém, collected in 1910–1933 by G. Hagemann. Skull and bone fragments resembling *T. inunguis* (INPA-PB 129), from an adult male manatee killed in August 1974 and said to have had a white belly, were collected near the mouth of the Rio Paru by J. Lovisek. Manatees reportedly occur in the lower parts of the Rio Xingu and Rio Tocantins; I presume these to be *T. inunguis* though I have not been able to examine specimens from these localities.

Maranhão

Having failed to find recent evidence of manatees on the coast of Pará, I went on to Maranhão in an effort to determine how close to the south side of the Amazon

mouth they could still be found. Although manatees, evidently *T. manatus*, occurred near São Luis in the early 17th century (Walter, 1967; Whitehead, 1977), none had been reported more recently. The coastal region was not visited for lack of time, but an excursion up the lower Rio Mearim established the continued presence of the species. Only an indeterminate rib fragment (INPA-PB 156), from an animal killed circa 1975–1976, could be collected; however, a resident of the village of Coivara (= Boqueirão) stated that in about 1973 he had helped kill a male manatee in that area which had had nails. As the latter detail was volunteered before I or anyone else present had mentioned or asked about nails, I consider this reliable evidence of the presence of *T. manatus*.

FOOD PLANTS

As the hunters interviewed generally claimed to have little specialised knowledge of manatees and their habits, they could provide few ecological or behavioural data apart from names of local plants eaten by manatees. In Amapá, these were said to be principally *cai-seca*, a vinelike herb with white flowers (*Rhabdadenia biflora* (Jacq.) M. Arg., Apocynaceae), and *paraturá*, a type of 'beach grass', which I was unable to collect. At Ilha Caviana, principal food plants reported were intertidal 'beach grasses' such as *barba de bode* (*Fimbristylis capillaris* (L.) Kuntz, Cyperaceae), *junco* (*Cyperus articulatus* L. var. *nodosus*, Cyperaceae), *capim de botão* (*Cyperus luzulae* Retz), *tiririca* (*Dichromena ciliata* Vahl, Cyperaceae), and *grama da praia* (*Panicum polycomum* Trin, Gramineae), as well as fruits and leaves of *aninga* (*Montrichardia arborescens* (L.) Schott, Araceae) and fruits of *genipapo* (*Genipa americana* L., Rubiaceae). One informant, however, denied that the *Cyperus* spp. were eaten. Here, as in Maranhão and elsewhere in Amazonia, manatees are also generally acknowledged to eat *mururé*, which denotes non-gramineous floating aquatics in general but especially *Eichhornia* (Pontederiaceae).

HUNTING METHODS AND UTILISATION OF MANATEES

In most parts of Amazonia manatees are usually hunted with a harpoon, most commonly from a canoe. On the Atlantic coast of Marajó, however, hunters take advantage of the rise and fall of the tides in employing two other methods. The shores in many places are covered with 'meadows' of *Fimbristylis*, *Cyperus*, *Dichromena*, *Panicum*, and other sedges and grasses, which are submerged at the highest tides and grazed by manatees. With the first method, a three-legged wooden platform or *montar* 2–2.5 m high is erected in one of these meadows (Fig. 2). At high tide the hunter waits atop the platform until a manatee passes close enough to harpoon; no bait is used, in contrast to the otherwise similar technique used in, for example, Nigeria (Sikes, 1974). With the second method, up to several hundred

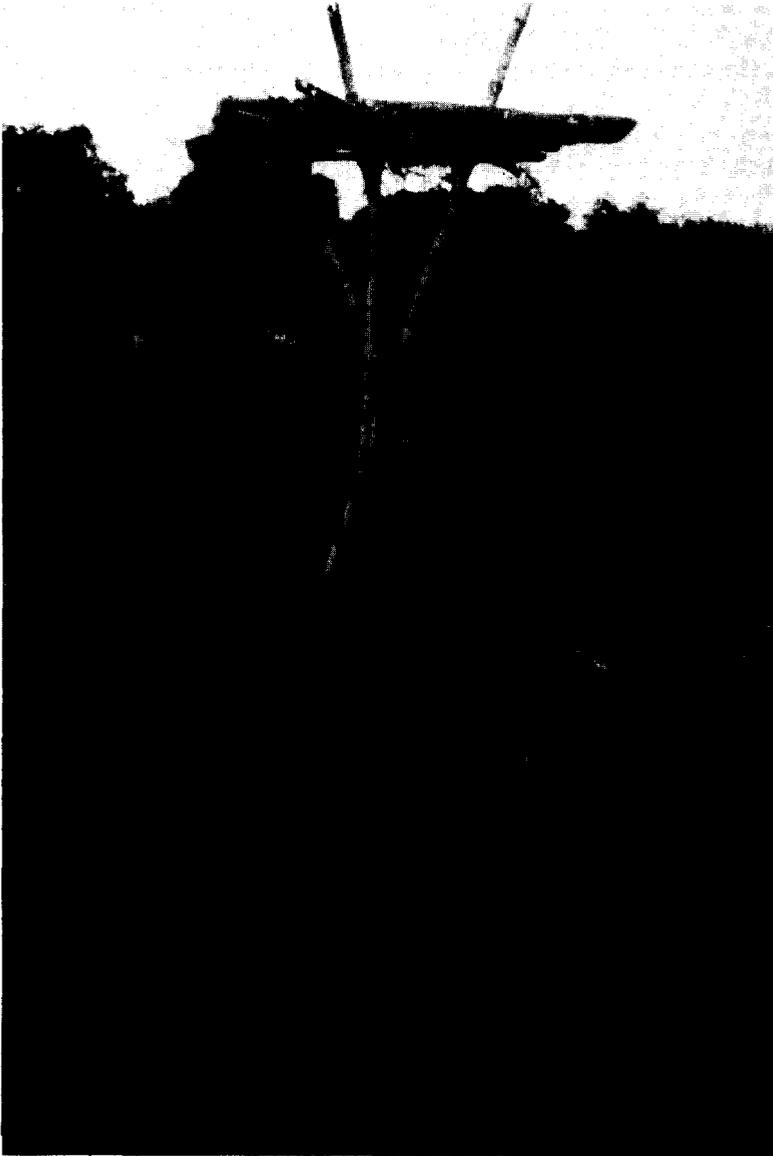


Fig. 2. Wooden platform or *montar* used for harpooning manatees on Ilha Caviana. Note meadow of *Fimbristylis*, *Cyperus*, and other sedges and grasses fed on by *Trichechus inunguis* at high tide.

metres of shoreline are enclosed by a fence of wooden stakes about 1.5 m high, called a *camboa* or *curral* (Fig. 3). At high tide the fence is completely submerged, and manatees, fish, and other aquatic animals passing over it to feed in the intertidal zone are trapped when the tide recedes. As this device works automatically and requires no skill or patience on the part of the hunter, or even his presence, it is far more destructive to the manatee population than are individual harpooners; of the 13 manatees reported killed in Canal Perigoso in 1977, 11 were caught in camboas (up to four in a single camboa during the season).



Fig. 3. Wooden fence or *camboa* enclosing part of grassy shoreline of Ilha das Pacas in Canal Perigoso. At least five *Trichechus inunguis* were caught in this camboa in 1977-78.

Fortunately, use of camboas is said to be declining, for various reasons. An informant estimated that three men could build one in about two weeks that would last up to two years; but such structures are vulnerable to storms and drifting logs and require upkeep. Some fishermen say they are too destructive to fish populations; others, that the increased availability of nylon nets allows them to go where the fish are in preference to relying on the stationary camboa. One man was said to have stopped building camboas because cattle would get in and eat the grass; another, because an aggrieved neighbour had performed black magic at the site of his camboa

to spoil his luck. Such camboas are also illegal (see below). Their use on the Amapá coast is said to have ended.

Utilisation of manatee carcasses is largely confined to the meat and fat, which are consumed locally. Sausages may be made from the intestines, and the distal parts of the flippers are sometimes used in a dish called *manhiçoba*. *Mixira*, fried meat preserved in its own fat, is sometimes made for storage or local sale. In most of Amazonia, the hide is now normally discarded; but throughout the area of this study, dried pieces are often saved. Softened into a paste by boiling, they are used as plasters for wounds, hernias, and pulled muscles. Manatee fat is said to be good for rheumatism. The bones are reputed to have medicinal value, but no one I talked to seemed to know what they were supposed to cure. One hunter on the Rio Mearim described how a section of rib with a slot cut in one end was sometimes used as 'pliers' for breaking fish bones.

Strangely, reports of kills prior to 1977 in Canal Perigoso (presently the most active centre of hunting) were few and vague, the most definite pertaining to a male manatee about 2 m long caught at Ilha Caviana 'about ten years ago' (c. 1968); the two most active hunters I interviewed denied having killed any before 1977. Although I hesitate to accept this at face value, the wife of one longtime resident of Ilha Caviana admitted being unacquainted with manatees until 1977. She said they are not killed every year because the local people are not very keen on eating manatee meat, believing that it is not healthy and that pregnant women should not eat it. One hunter sold much of the meat of the two manatees he harpooned in 1977 to the local landowner, and another who caught four in a camboa took them alive to Macapá for sale.

POPULATION STATUS AND CONSERVATION

It is impossible to estimate actual numbers of manatees still occurring in this region. Hunting pressure varies from light to fairly heavy: on the Atlantic coast of Amapá perhaps no more than two or three a year are taken; in Canal Perigoso at least 13 were caught in 1977 and three in early 1978; at Ilha Ganhoão, at least one each in 1977 and 1978; on the Rio Arari, two in 1977; in the Baía de Marajó near Belém, at least four or five in 1977-78; on the Rio Mearim, possibly one or two a year. Some of these may be underestimates, and it is safe to assume that hunting at a comparable or greater rate occurs throughout the Marajó region as it does in the rest of Amazonia.

Population trends likewise cannot be documented with available information. Some hunters at Canal Perigoso thought manatees were less abundant than formerly, but only because progressive silting-up of the coastline had caused them to feed farther from the hunters' homes.

Of a total of 19 animals of known sex reported taken in the study area, 15 were males, so there does not appear to be any disproportionately high mortality of

females. (It is noteworthy, and possibly significant, that of 15 *T. manatus* captured in Surinam by Dekker (1974), 14 were likewise males.) Only three (one male, two of unknown sex) of 22 for which hunters gave size estimates were described as calves.

Although manatees have been protected by law in Brazil since 1967, effective enforcement is impractical. In addition to this blanket protection, however, construction of camboas and similar structures by persons not officially licensed as breeders of aquatic animals is prohibited by decree of the fisheries service (Portaria SUDEPE No. 310, Article 12, 23 July 1973). As camboas, in contrast to montars, are both conspicuous and time-consuming to construct, they could easily be found and destroyed by periodic inspection patrols during the January–June high-water season when nearly all manatee hunting occurs. As camboas appear to play a minor and already-diminishing role in the local economy, such measures would place minimum strain on both enforcement agencies and local inhabitants while being of maximum benefit to the manatee population.

In addition, at least two parts of the study area should be given high priority as permanent manatee reserves. The area of eastern Amapá including Cabo Norte and the adjacent coasts and inland lakes appears to be the only remaining part of the world where two sirenian species might occur in close proximity, and it certainly deserves further study in the near future. The lower Rio Mearim in Maranhão appears to harbour a population of *T. manatus* (one resident claimed to have seen two manatees a few hours before our interview); it certainly has large areas of superb manatee habitat, with vast and undisturbed floating meadows in lakes and channels off the main river. As suitable habitat is more restricted in the coastal lagoons and rivers of the Brazilian Northeast (Piauí to Bahia), the Rio Mearim may well have the largest *T. manatus* population remaining in Brazil. The Rio Mearim appears very similar in vegetation and other features to many parts of the Amazon basin, and would be of special value for comparative studies of the two manatee species in comparable habitats.

CONCLUSIONS

1. *Trichechus inunguis* is found throughout the lower Amazon and its tributaries, including Ilha de Marajó out to its Atlantic coast and coastal islands, and from the northern (Amapá) to the southern (Pará) shore of the Amazon estuaries. This entire area is hydrologically and phytogeographically part of the Amazon basin, with little or no influence of salt water even on coasts open to the Atlantic; however, unconfirmed reports suggest that *T. inunguis* may sometimes also be found in salt water.
2. *Trichechus manatus* probably occurs on the Amapá coast somewhere north of Cabo Norte and in the Rio Mearim in Maranhão; it appears, however, to have been exterminated from the Atlantic coast of Pará, assuming that it,

and not *T. inunguis*, formerly occurred there. Its distribution on the Brazilian coast is disjunct, the Amapá population being separated from those in Maranhão and the Northeast by populations of *T. inunguis* inhabiting the mouths of the Amazon and Ilha de Marajó. The two species may coexist in eastern Amapá.

3. We may tentatively conclude that any zone of sympatry between *T. manatus* and *T. inunguis* is very restricted, if it exists at all, and that for practical purposes the species have mutually exclusive distributions. This has important implications in the context of the evolutionary hypotheses of Domning (1977), and poses several interesting theoretical questions, which will be discussed elsewhere.
4. Sizes and trends of manatee populations in the study area are unknown. Illicit subsistence hunting continues, especially in Canal Perigoso on the coast of Ilha de Marajó. This hunting can be most effectively controlled by systematic destruction of camboas, which would require minimal effort by enforcement authorities and probably cause minimal dislocation of the local economy.
5. Manatee reserves should be immediately established to include the Amapá coasts near Cabo Norte and adjacent inland lakes, as well as the lower Rio Mearim valley in Maranhão.

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REFERENCES

- BANKS DA ROCHA, N. (1971a). Memória sobre um exemplar de *Trichechus manatus* L., 1758, capturado em Goiana (Pernambuco). *Archos Mus. nac.*, Rio de J., **54**, 101-3.
- BANKS DA ROCHA, N. (1971b). Nota prévia sobre a ocorrência de sirênios no Nordeste. *Anais Inst. Ciênc. Biol. (Recife)*, **1**(1), 133.
- BERTRAM, G. C. L. & BERTRAM, C. K. RICARDO (1973). The modern Sirenia: Their distribution and status. *Biol. J. Linn. Soc.*, **5**, 297-338.
- CABRERA, A. (1961). Catalogo de los mamíferos de America del Sur. II. *Revta Mus. argent. Cienc. nat. Bernardino Rivadavia, Cienc. Zool.*, **4**, 309-732.
- DE CARVALHO, C. T. & TOCCHETON, A. J. (1969). Mamíferos do nordeste do Pará, Brasil. *Revta Biol. trop.*, **15**, 215-26.
- DEKKER, D. (1974). On the natural history of manatees (*Trichechus manatus manatus*) from Suriname for the Amsterdam Zoo. *Aquatic Mamm.*, **2**(2), 1-3.
- DILG, C. (1909). Beiträge zur Kenntnis der Morphologie und postembryonalen Entwicklung des Schädels bei *Manatus inunguis* Natt. *Morph. Jb.*, **39**, 83-145.
- DOMING, D. P. (1977). An ecological model for Late Tertiary sirenian evolution in the North Pacific Ocean. *Syst. Zool.*, **25**, 352-62.
- DOMING, D. P. (1978). The myology of the Amazonian manatee, *Trichechus inunguis* (Natterer) (Mammalia: Sirenia). *Acta Amazonica*, **8**(2), Suppl. 1, 1-80.
- GOELDI, E. A. & HAGMANN, G. (1904). Prodrómo de um catalogo crítico, commentado da collefão de mamíferos no Museu do Pará (1894-1903). *Bol. Mus. para. Emilio Goeldi Hist. nat. Ethnogr.*, **4**, 38-106, 119-22.
- HARTLAUB, C. (1886). Beiträge zur Kenntniss der *Manatus*-Arten. *Zool. Jb. 1. Abt. Syst. Geogr. Biol. Thiere*, **1**, 1-112.
- HATT, R. T. (1934). A manatee collected by the American Museum Congo Expedition, with observations on the Recent manatees. *Bull. Am. Mus. nat. Hist.*, **66**, 533-66.
- LOUGHMAN, W. D., FRYE, F. L. & HERALD, E. S. (1970). The chromosomes of a male manatee, *Trichechus inunguis*. *Int. Zoo Yb.*, **10**, 151-2.
- MONDOLFI, E. (1974). Taxonomy, distribution and status of the manatee in Venezuela. *Mems Soc. Cienc. nat. 'La Salle'*, **34**, 5-23.
- PEREIRA, M. N. (1944). O peixe-boi da Amazônia. *Bolm Minist. Agric. ind. Com. Rio de J.*, **33**(5), 21-95.
- PINE, R. H. (1973). Mammals (exclusive of bats) of Belém, Pará, Brazil. *Acta Amazonica*, **3**(2), 47-79.
- SIKES, S. (1974). How to save the mermaids. *Oryx*, **12**, 465-70.
- VON HUMBOLDT, A. & WIEGMANN, A. F. A. (1838). Ueber den Manati des Orinoko. *Wiegmann's Arch. Naturgesch.*, **4**, 1-18.
- VON PELZELN, A. (1883). Brasilische Säugethiere. Resultate von Johann Natterers Reisen in den Jahren 1817 bis 1835. *Verh. zool.-bot. Ges. Wien, Beiheft*, **33**, 1-140.
- WALTER, J. (1967). *Frei Cristóvão de Lisboa: História dos animais e árvores do Maranhão*. Lisbon, Arq. Hist. Ultramar.
- WHITE, J. R., HARKNESS, D. R., ISAACKS, R. E. & DUFFIELD, D. A. (1976). Some studies on blood of the Florida manatee, *Trichechus manatus latirostris*. *Comp. Biochem. Physiol. A*, **55**, 413-17.
- WHITEHEAD, P. J. P. (1977). The former southern distribution of New World manatees (*Trichechus* spp.). *Biol. J. Linn. Soc.*, **9**, 165-89.
- WHITEHEAD, P. J. P. (1978). Registros antigos da presença do peixe-boi do Caribe (*Trichechus manatus*) no Brazil. *Acta Amazonica*, **8**, 497-506.