

INTRODUCTION

The knowledge of the fauna of Suriname is of essential importance in the study of the neotropical Mammalia. The first publications containing information on mammals of Suriname appeared very early in the history of European exploration of South America. Such publications were relatively numerous in the 17th and 18th centuries, when the Republic of the Seven United Netherlands was at the peak of its power, and Suriname was one of its richest colonies. At that time many animals, alive or preserved, were sent from Suriname to the Netherlands. The living specimens were kept in Dutch menageries, while skins and alcohol specimens found their way to private natural history collections ("cabinets of rarities") of which at that time there was an impressively great number in Holland (see Engel, 1947); several foreign collections received material via the Netherlands. In many instances the Dutch collections formed the basis for, or contributed considerably to, important zoological publications, like those by Albertus Seba (1665-1736), Petrus Artedi (1705-1735), Carolus Linnaeus (1707-1778) and Peter Simon Pallas (1741-1811). Linnaeus (1758), in his fundamental 10th edition of *Systema Naturae*, based many of his descriptions on Suriname material, either by directly studying this (when in Holland, 1735-1738, Linnaeus must have seen much Suriname material in Dutch collections, while Swedish naturalists like C. G. Dahlberg (1721-1781) and D. Rolander (1725-1793) sent Suriname specimens to Swedish collections), or by referring to previous publications like that by A. Seba. Thomas (1911: 124), when dealing with the type localities of the mammals described by Linnaeus in the 10th edition of his *Systema Naturae*, stated: "with regard to species named from the figures in Seba's 'Thesaurus', it would not be unjustifiable to suggest that in the case of all tropical South American animals, Surinam — the great source of all Dutch collections — should be accepted as the type locality . . .". No less than 24% of all species of mammals known from Suriname have Suriname as the type locality. It goes without saying that for a better understanding of the relation between the various species, and that between the various subspecies of a single species, it is essential to know the characters of the population of the type locality and of its variability. Therefore, in the present work I have tried to give of every species a description based exclusively on the Suriname material examined by myself (of course with the exception of discoloured, mutilated or abnormal specimens) and also to provide as many illustrations as feasible of such material. I hope, by giving this information, to enable students of the faunae of other parts of South America to obtain a better idea of the status of the Suriname populations.

The second object of the present book is to provide a reliable guide for the identification of the species of Suriname mammals, not only to professional zoologists, but also to agriculturists, ecologists and others who in their work in Suriname have

to deal with mammals, be it for their control or their protection; furthermore it is intended for anyone (e.g., hunters and naturalists) who just wants to know more about the fascinating creatures that inhabit this beautiful and interesting country. Therefore keys are provided to all the species. In most cases there are two sets of keys, one based exclusively on external characters, the other only on characters provided by the skull. The keys to the skulls are added because skulls and skull fragments of animals hunted or used as food are often found as offal in or near settlements in the interior or as signs of good luck fastened to the roofs of Amerindian and Bushnegro dwellings. In the keys I have tried to employ such characters as are normally still noticeable in the fragments that one usually finds. Another use for the keys to the skulls is to identify skull fragments of small mammals (especially Marsupialia and Rodentia) found in owl pellets or in stomach contents. In some groups the species are very difficult to distinguish on external characters alone, and then the skull characters may be decisive for a certain identification, this being especially true for some groups of Marsupialia, Chiroptera, Cricetidae and Muridae. Illustrations are added as a help with the keys. In using the keys one has to keep in mind (1) that they are based on characters of adult animals in which all molars are functional, and therefore not necessarily will give good results for juveniles, (2) that notwithstanding the long period in which the Suriname mammals have received the attention of zoologists, the Suriname mammal fauna still is far from well known (especially from the interior), and that there undoubtedly are several species which so far have not yet been reported from the country. Therefore a careful comparison with the description and illustrations is most advisable.

With few exceptions the order of the taxa treated in the present work, is the same as that adopted in the fundamental check-list of South American mammals by A. Cabrera (1958-1961).

Of all orders diagnoses are provided. Of the species the following information is given: (a) the scientific name; (b) a reference to the original publication of the name; (c) the type locality, and if this is restricted, how and by whom it has been restricted; (d) synonymies, viz., references to authors providing a good synonymy of the species or subspecies; (e) vernacular names in English (E), Dutch (N), and Sranan-tongo (S), the latter being the official Suriname language; here only the better known vernacular names are listed, a more complete account of them can be found in a paper by Staffeleu (1975); (f) distribution, giving the general distribution of the species, and, if pertinent, of the subspecies; (g) occurrence in Suriname, giving a general statement of the known ecological and geographical range of the species within Suriname, with a complete list of the examined Suriname material, and, if available, references to previous Suriname records of the species¹; (h) description,

¹ Many of the records of Suriname mammals published in the literature, and especially in popular literature, narratives, etc., are rather vague and it often is impossible to ascertain which species actually is meant, even when a scientific name is given. Also in many instances references are very general and do not give any new information. For these reasons I have refrained from

giving the description of the external characters of the Suriname specimens examined and a short account of the skull characters; (i) remarks, a paragraph containing miscellaneous information, e.g., whether or not the species is harmful or otherwise of direct interest to the economy or health, an account of what is known about the biology of the species, based mainly on Suriname sources, problems of nomenclature of the species, and scientific names under which it has been reported from Suriname.

Due to reasons explained in the preface the treatment of the Chiroptera is somewhat different from that of the rest of the Mammalia. Practically all descriptions of the Chiroptera are the same as those published by me in 1962, and often not exclusively based on Suriname material. Because the bats were extensively dealt with in my 1962 "The bats of Suriname", fewer details of taxonomic, nomenclatural and other aspects are given; for these, reference is given to my 1962 paper. All information on the Suriname Chiroptera obtained by me after 1962 is included in the present publication.

The preparation of the present paper showed time and again how incomplete our knowledge of the Suriname mammals still is. Of many species extremely few specimens are present in Museum collections, not only of the rarer species or those that are difficult to catch, but also many common species, and even well known game species. The preparation of scientific specimens of larger animals is cumbersome, while most hunters prefer to keep trophies themselves. It cannot be emphasized enough that material of most species is badly needed for study collections in order to permit scientists to obtain a good idea of the variation of the various characters of a species within a certain area, of its range within the country, and of its habitats. The fauna of large areas in Suriname is still completely unknown. A very good example of the situation is the case of *Sylvilagus brasiliensis*, which an expedition reported as having been used as food, and which in collections is only represented from Suriname by a very young specimen and some droppings.

The neighbouring countries do not fare much better. Of neither French Guyane nor of Guyana a comprehensive account of the Mammalia has been published, although considerable information is scattered over numerous scientific publications. The papers by Tate (1939) and Roth (1941) are of great value in this respect.

ILLUSTRATIONS

Of practically all species dealt with here illustrations are provided, if possible based on adult Suriname specimens. These illustrations are of various origin.

All the non-photographic illustrations were made by the staff-artists of the Rijksmuseum van Natuurlijke Historie. The coloured plates (A-I and frontispiece)

trying to list under each species all previous Suriname records known to me and only discussed the more important ones. Newspapers like "De West", "De Surinamer", etc., although they may contain interesting records of Suriname mammals, have only incidentally been cited, simply because these publications could not be consulted by me and the items that I do record are based on clippings and collections of clippings that I received from other people.

are by the hand of Mr. R. van Assen, who also made pls. 1-7, 43, 44, 46-50, 55, 58-60, 73, 74, 79, 90, 92, 104-113, 125, 126, 128, 129, 133-135, 137, 138, 142 and 143. Mr. J. J. A. M. Wessendorp is responsible for pls. 56, 68-71, and 75, which are based on published figures and actual material. Mr. Wessendorp also made the text-figures 1, 2, 6, 7, 38, 39, 41a, b, 44, 45, 48, and 49c, d. Mr. W. C. G. Gertenaar made text-figures 3, 4, 5, 10, 11, 15, 16, 21, 23, 25, 30, 33, 34, 37, 40, 41c, d, 42, 43, 46, 47, 49a, b, and 51. Mr. H. Heyn made text-figures 13, 17, 18, 22, 24, 29, 31 and 36, and also the reproductions of figs. 12, 14, 26, 28, and 35.

For the photographs I am much indebted to the following persons: Dr. D. C. Geijskes (pls. 57, 78, 93, 141, 144-149), Mr. J. Lindblad (pls. 45, 72, 80, 97), Mr. A. Reyne (pl. 150), Mr. P. Staffeleu (pl. 76), Mr. P. A. Teunissen (pl. 74A), Dr. P. Wagenaar Hummelinck (pl. 98).

The other photographs were made by the staff-photographers of the Leiden Museum. Mr. H. F. Roman is responsible for pls. 14-42, and for the photographic reproduction on pl. 13. The remaining photographs are by the late Mr. C. Hoorn (pls. 8-12, 51-54, 61-67, 77, 81-89, 91, 94, 95, 99-103, 114-124, 127, 131, 132, 136, 139, 140 and 151), the photographic reproductions of text-fig. 50 and pls. 96 and 130 were also made by him.

NOMENCLATURE

During the preparation of this work several nomenclatural problems were encountered, which are discussed under the species involved. There are, however, a few problems of more general interest, which may be discussed here.

In the present publication I have accepted the new names published in Etienne Geoffroy-Saint-Hilaire's (1803) "Catalogue des mammifères du Muséum National d'Histoire naturelle" as available names. The validity of this work is the subject of strong controversy among zoologists. An attempt to place this work on the "Official Index of Rejected and Invalid Works in Zoology", undertaken on the advice by J. R. Ellerman and T. C. S. Morrison-Scott (1954: 130-131; 1962: 287-288), and by W. E. China (1962: 289), was later abandoned by China (1963: 243), but the Commission has not yet expressed a definite opinion on whether or not this work is available. The arguments brought forward by L. B. Holthuis (1963: 242) to show that Geoffroy's Catalogue must be considered published, are fully shared by me, and I see no reason to reject Geoffroy's names, which are widely accepted in zoological literature; quite a number of authors (P. Hershkovitz, 1955c: 187-189; H. W. Setzer, 1952: 343; E. R. Hall, 1963: 245; J. Dorst, 1963: 245) do accept Geoffroy's Catalogue as available.

Although the full name is Etienne Geoffroy-Saint-Hilaire, I have followed the usage by French mammologists to cite that author's name as E. Geoffroy. Similarly, the name Isidore Geoffroy-Saint-Hilaire is cited by me as I. Geoffroy.

As P. Fermin (1765; 1769) did not consistently use binominal nomenclature in his books, his latin names cannot be used.

MATERIAL

Under the heading "Occurrence in Suriname" all the material examined by me is listed with the registered numbers of the specimens. A number given without other indications stands for a registered number of the Rijksmuseum van Natuurlijke Historie in Leiden (RMNH). The registered number of material from other institutions is preceded by the following abbreviations:

AMNH	American Museum of Natural History, New York, U.S.A.
BMNH	British Museum (Natural History), London, England.
CNHM	Field Museum (Natural History), Chicago, Illinois, U.S.A.
MNHN	Muséum National d'Histoire Naturelle, Paris, France.
SMN	Staatliches Museum für Naturkunde, Stuttgart, Federal Republic of Germany.
ZMA	Zoölogisch Museum (= Instituut voor Taxonomische Zoölogie), Amsterdam, Netherlands.
ZMB	Zoologisches Museum, Berlin, German Democratic Republic.
ZMH	Zoologisches Museum, Hamburg, Federal Republic of Germany.

In the enumeration of the material the samples are arranged more or less geographically; first by districts, roughly from west to east, in the order Nickerie, Coronie, Saramacca, Suriname, Para, Brokopondo, Commewijne and Marowijne Districts. Within the districts the arrangement as a rule is from north to south. If more than two samples originate from the same district, the name of the district as a rule is given with the first and the last sample only. Most of the localities mentioned can be found on maps 1-3; an index to the geographic names on the maps is given on pp. 551-553.

MEASUREMENTS

In most groups external and skull measurements are provided of all or of at least a representative part of the examined Suriname specimens. In some instances, however, the measurements of only a single adult male and a single adult female are given; such specimens are selected at random, being generally the most complete or the best preserved of the lot; in these cases the measurements given are neither minimum, maximum or average measurements, while differences between male and female measurements do not necessarily indicate a sexual dimorphism. The measurements are taken with vernier callipers to the nearest tenth of a millimetre. The measurements are given in millimetres (mm) unless indicated otherwise; the body weight in grams (gr) or kilograms (kg). Text-figures 1, 5-7, show the way in which the measurements used in this book were taken, and at the same time explain the terms used.

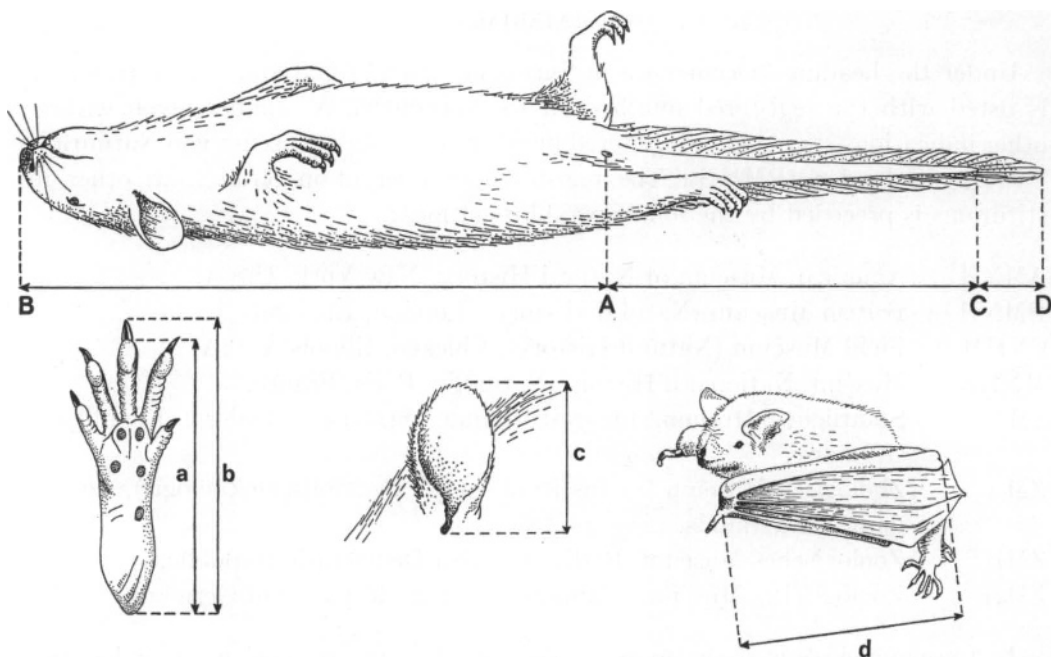
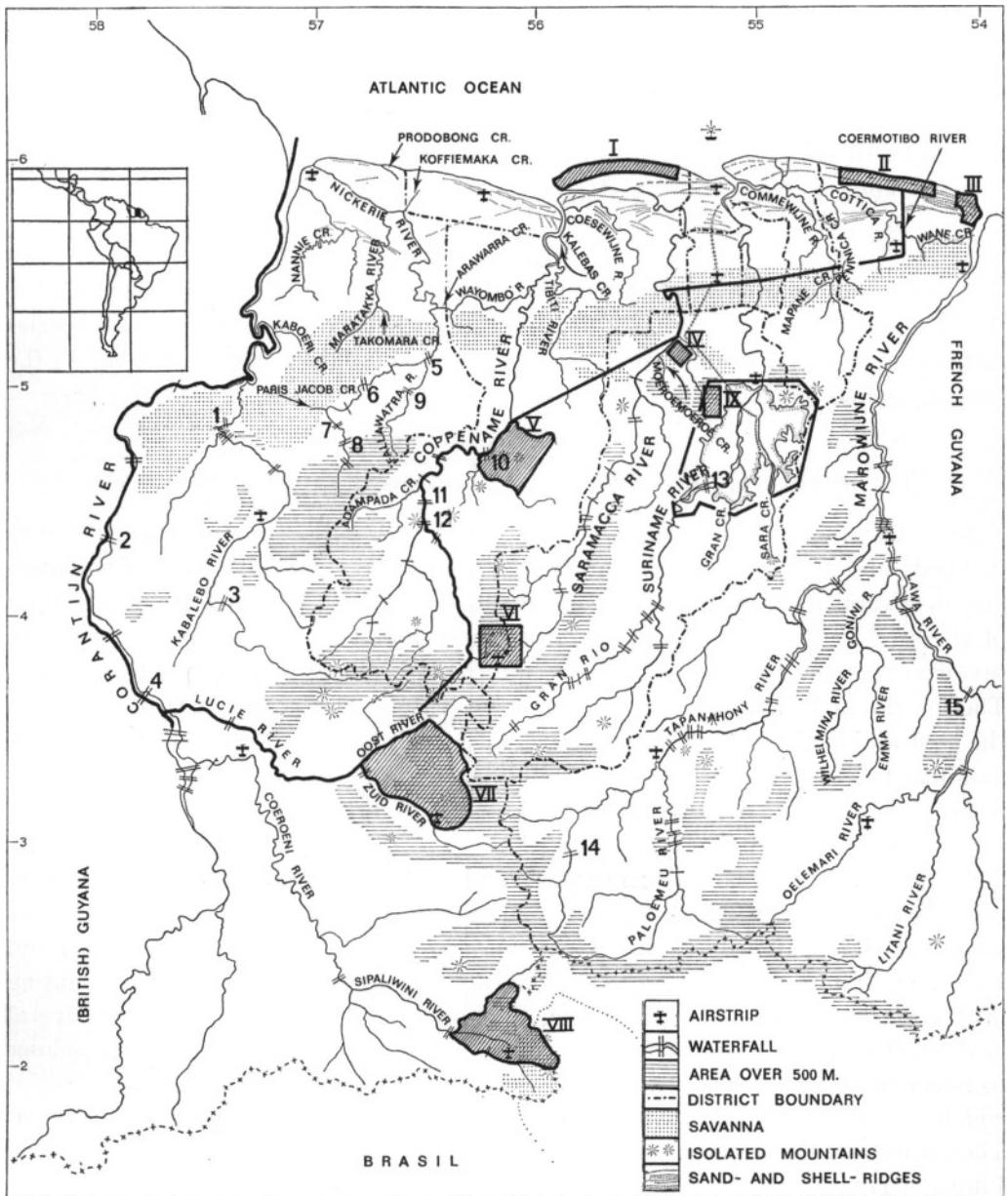


Fig. 1. Indication of the external measurements used in this publication. A, anus; B, tip of the snout; C, end of the tail; D, end of the tuft of the tail; A-B, head and body; A-C, tail without tuft; A-D, tail with tuft; a, hind foot without nails; b, hind foot with nails; c, ear; d, forearm (only used in Chiroptera).

ZOOGEOGRAPHY

Suriname, situated on the north coast of South America roughly between 2° and 6° N, and 54° and 58° W, belongs to the neotropical faunal province. Its mammal fauna is rich and varied, but, although from the earliest time the Suriname mammal fauna received the attention of travellers and naturalists, it is still quite insufficiently known. The fauna is typical for the northern part of the South American mainland, and most species known from Suriname are also found in Venezuela, Trinidad, the two other Guianas and the lower Amazon basin.

The country has a flat muddy coast with a few sandy beaches. Behind the coast are mangroves and swampy areas traversed in an east-west direction by elevated sand or shell ridges. Still farther inland are lowland savannas and gallery forests. South of these follow the foot hills and finally the higher mountains (with upland plateaus and highland savannas), which extend south to the border with Brazil; this border is formed by the watershed of the Amazon basin. The country is traversed in a roughly south-north direction by seven main rivers, which are from west to east: the Corantijn River (which forms the border with (formerly British) Guyana), the Nickerie River, the Coppename River, the Saramacca River, the Suriname River, the Commewijne River and the Marowijne River (which forms the border with



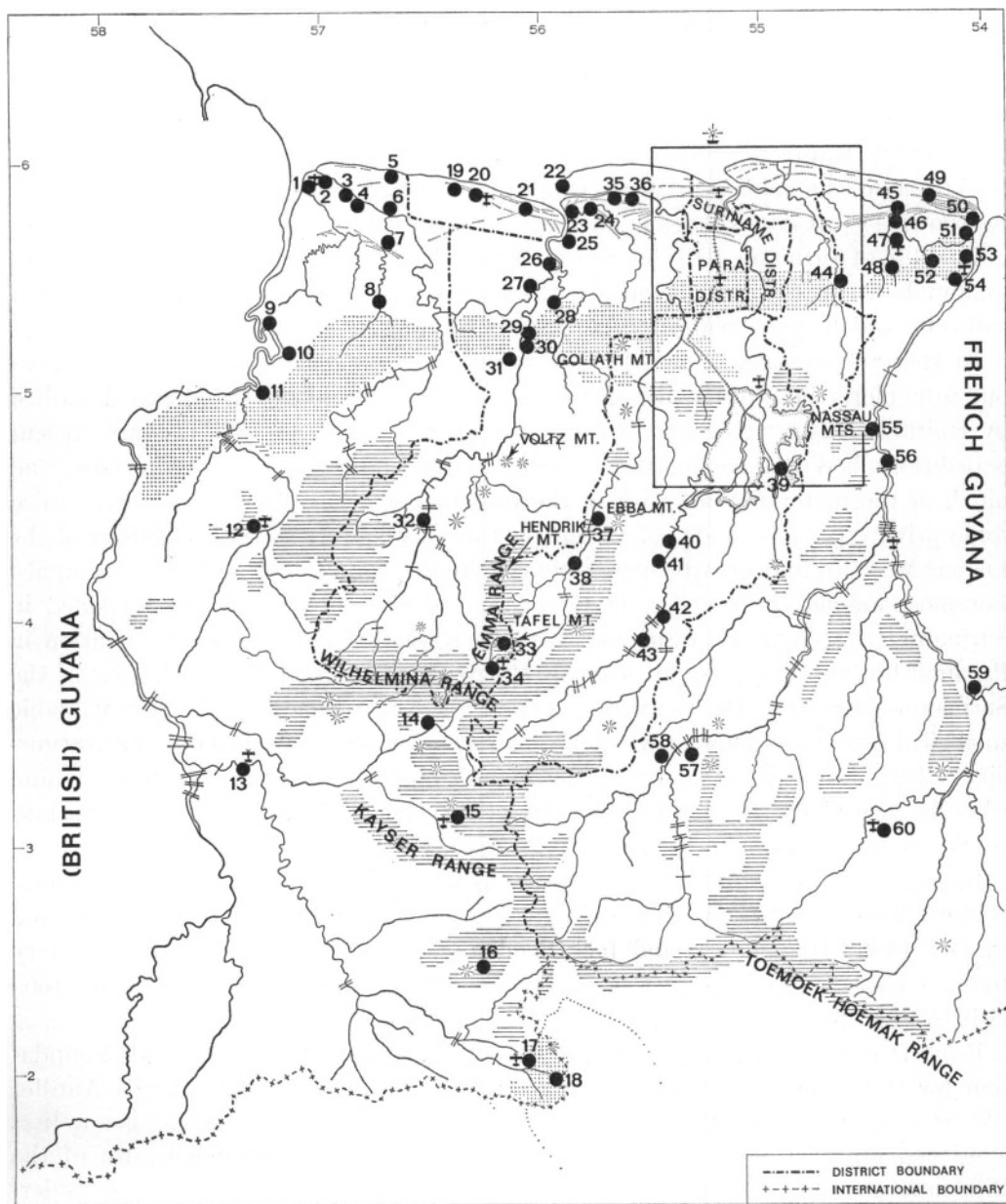
Map 1. Map of Surinam showing the rivers and creeks mentioned in the text, as well as the rapids and falls: 1, Avanavero Falls; 2, Wonotobo Falls; 3, Doublesteps Falls; 4, Frederik Willem IV Falls; 5, Stondansi Falls; 6, Lombok Falls; 7, Graniet Falls; 8, Blanche Marie Falls; 9, Cremer Falls; 10, Raleigh Falls; 11, Sidonkroetoe Falls; 12, Tonckens Falls; 13, Mamadam Falls; 14, Lada Falls; 15, Maripasoela. The shaded areas are nature reserves; I, Coppename-monding; II, Wia-Wia; III, Galibi; IV, Brinckheuvel; V, Raleighval-Voltzberg; VI, Tafelberg; VII, Eilerts de Haan Gebergte; VIII, Sipaliwini; IX, Brownsberg. The heavy line borders the north-western area covered by the Game Ordinance.

French Guyane); the first six rivers form three pairs (Corantijn-Nickerie, Coppename-Saramacca, Suriname-Commewijne), the second river of each pair joining the first just before it reaches the sea, the first of each pair being the more important. The rivers are navigable for about the lower 100 km, the falls line being at about 5° N. The northern lowland region (roughly between 5° and 6° N), although faunistically the best known area, is still relatively poorly explored, while collecting in the interior dates from the present century, having been quite intensive during the last 30 years. Therefore it is still too early to draw conclusions as to the distribution of the species within Suriname itself. The fact that a species has not yet been found in the interior does not mean that it does not occur there; on the other hand a species collected in the interior but not in the lowland area is likely to be restricted to the mountains and foothills.

THE HISTORY OF THE STUDY OF THE MAMMALIAN FAUNA OF SURINAME

After the discovery in 1499 of the mainland coast of South America by Alonso de Ojeda and Juan de la Cosa, numerous ships visited the "Wild coast of Guyana" and in several narratives remarks are made about the interesting fauna and flora of the area, which was so different from those found in Europe. It is difficult to say who was the first author to give information on the mammals of Suriname. There is no doubt that De Laet (1625), Keye (1659) and Warren (1667) were among the first authors to contribute, although very superficially, to the knowledge of the mammal fauna of the country; they mentioned the more obvious species, such as marsupials, monkeys, sloths, anteaters, armadillos, large bats, "hares and rabbits", jaguars, ocelots, pumas, otters, coatis, raccoons, "deer and roes", peccaries, tapirs and manatees. In the 18th century several general accounts of Suriname were published in which the mammalia were more or less extensively treated, e.g. the works by Herlein (1718), Bellin (1763), Fermin (1765, 1769), Bancroft (1769), and Hartsinck (1770). In 1705 Maria Sybilla Merian published her exquisite painting of *Marmosa murina* (L.) with young, a figure that was copied later by several authors. The well known book by Stedman (1796) on his experiences as a soldier in Suriname contains also much valuable information on the mammals, several of which are well illustrated by him. As already mentioned above, Seba's (1734) Thesaurus contains numerous superb illustrations of Suriname mammals on which Linnaeus (1758) based many of his species.

In the 19th century several publications of greater or lesser importance dealing with Suriname mammals were published: a complete list of the then known species was the one by Lammens (1844); this list, although it contains a fair number of inaccuracies, is still of considerable importance. Temminck (1824-1841) dealt with some Suriname mammals, and so did Jentink (1887, 1888) in his catalogues of the mammal collections in the Leiden Museum; in a number of other scientific papers of that time (e.g. by W. Peters) information on Suriname mammals can be found.



Map 2. Map of Surinam. Localities: — (NICKERIE DISTRICT): 1, Stalweide; 2, Nieuw Nickerie; 3, Prins Bernhard Polder; 4, Groot-Henar Polder; 5, Hertenrits; 6, Wageningen (Samiha Creek); 7, Cupido; 8, Awarra savanna; 9, Wakay; 10, Washabo; 11, Matapi; 12, Kabalebo airstrip; 13, Coeroeni Island; 14, Lucie-kamp; 15, Kayserberg airstrip; 16, Alalapadoe; 17, Sipaliwini airstrip; 18, Vier Gebroeders (mountain); — (CORONIE DISTRICT): 19, Burnside; 20, Totness; 21, Coronieweg; — (SARAMACCA DISTRICT): 22, Coppename Punt; 23, Boskamp; 24, Karel François; 25, Kalebaskreek; 26, Goede Hoop; 27, Wayombo; 28, Sabana; 29, Heidoti; 30, Bitagron; 31, Kaaimanston; 32, Hebiweri; 33, Anton van Aerde cave (Tafel Mt.); 34, Rudi Kappel airstrip; 35, Calcutta; 36, Tijgerkreek; — (BROKOPONDO DISTRICT): 37, Posogroenoe; 38, Mambabasoe; 39, Dam; 40, Aurora; 41, Botopasi; 42, Djoemoe; 43, Ligolio; — (COMMEWIJNE DISTRICT): 44, Nengrekondre-pepre; — (MAROWIJNE DISTRICT): 45, Jerusalem; 46, Tamarin; 47, Moengo; 48, Patamacca; 49, Wiawia; 50, Galibi; 51, Langamankondre; 52, Moengotapoe; 53, Pierrekondre; 54, Albina; 55, Nason; 56, Lokelokatabbetje; 57, Magneetrots; 58, Vincent Fajks airstrip; 59, Maripasoela; 60, Oelemari airstrip. For localities in the Suriname- and Para District, and adjacent areas, see map 3 (on p. xxvii).

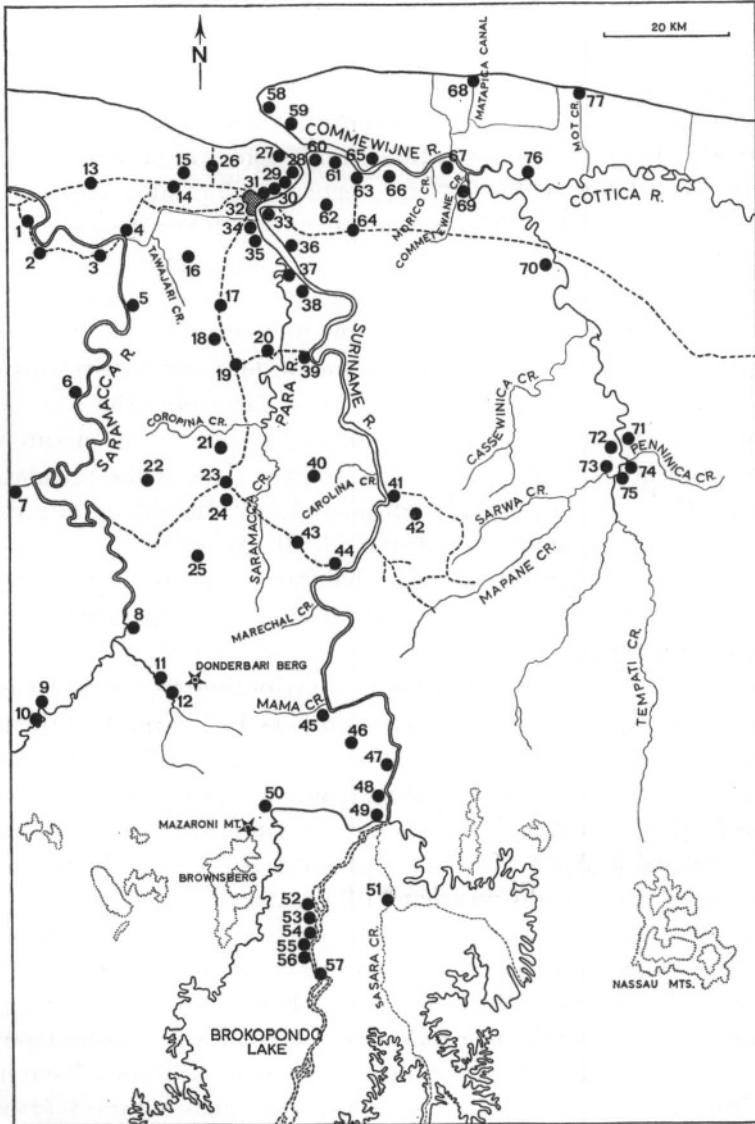
Also popular accounts were published (e.g., Von Sack, 1810; Teenstra, 1835), but by far the most important contributions are those published by A. Kappler (1881, 1885, 1887). Kappler, whose biography is published by Haverschmidt (1973), came to Suriname as a soldier (1836-1841), and later (1842-1879) lived there as a trader. As shown by his books, he was an excellent observer and greatly interested in the animal life of Suriname. His descriptions of the biology and ecology of the Suriname mammals at present still belong to the main sources of our knowledge on these subjects, and Kappler will often be cited in the present book.

In the 20th century a considerable number of scientific expeditions were sent out to explore the interior of Suriname; these expeditions are listed and described by Holthuis (1959: 34-41) and Hoogmoed (1973: 19-26). Especially the more recent expeditions had the possibilities to acquire important zoological collections, and much of the material dealt with in the present book was obtained by them. Also some private persons made collections, in this way adding to the collections of the Leiden Museum and greatly increasing our knowledge of the Suriname mammals. Foremost among these is Dr. D. C. Geijskes, who from 1938 to 1965 resided in Suriname (1938-1952 as entomologist of the Agricultural Experimental Station in Paramaribo, 1952-1954 as Government Biologist, and 1954-1965 as Director of the Surinaams Museum). Dr. Geijskes travelled all over Suriname and made valuable zoological collections most of which are now kept by the Rijksmuseum van Natuurlijke Historie at Leiden. Many of the mammals dealt with here we owe to him, while he also placed his great knowledge of the biology and ecology of the various species at my disposal.

Important material of Suriname mammals was collected for the Chicago Natural History Museum by H. A. Beatty (from 20 August 1960 to 10 February 1962) and by Drs. Philip Hershkovitz and Jack Fooden (from 15 November 1961 to February 1962). I had the privilege to examine these important collections during my 1963 visit to Chicago.

From December 1962 to July 1963, thanks to a grant of the Netherlands Foundation for the Advancement of Research in Surinam and the Netherlands Antilles (WOSUNA), it was made possible for me to visit Suriname and to get a first hand acquaintance with the living mammal fauna. Mr. P. Staffeleu, also of the Rijksmuseum van Natuurlijke Historie, accompanied me and contributed considerably to the success of our Suriname stay. Important collections were brought together and we received much most interesting and useful information concerning Suriname mammals. Later (1 November to 10 December 1972; after having also taken part in the 1971 N.W. Suriname Expedition) Mr. Staffeleu returned to Suriname in an effort to obtain material of species, that were still poorly represented in the available Suriname collections (even some common species were represented by a few mediocre specimens only). This more directed collecting proved to be most rewarding and successful.

Of many of the zoologists who collected in Suriname, biographical data and data



Map 3. Map of the lower Suriname River and adjacent regions. Localities: 1, Groningen; 2, Dirkshoop; 3, Kampongbaroe; 4, Uitkijk; 5, Santigron; 6, Tottiekamp (Toti-kampoe); 7, Bigi Poika; 8, Kwakoe Gron; 9, Loksiehatti; 10, Finisanti; 11, Goudplacér; 12, Gros; 13, Garnizoenspad; 14, Pomona; 15, Kwatta; 16, Santo Boma; 17, Lelydorp; 18, Copieweg; 19, Onverwacht; 20, Onoribo; 21, Republiek; 22, Matta; 23, Zanderij; 24, Berlijn; 25, Sectie O; 26, Weg naar Zee; 27, Purmerend; 28, Leonsberg; 29, Clevia; 30, Morgenstond; 31, Ma Retraite; 32, Paramaribo; 33, Meerzorg; 34, Dijkveld; 35, Kasabaholo Creek; 36, Peperpot; 37, Houttuin; 38, Domburg; 39, Paranam; 40, Powakka; 41, Jodensavanne; 42, Blakkawatra; 43, Kraka; 44, Phedra; 45, Berg en Dal; 46, Baboenhol; 47, Brokopondo; 48, Brokobaka; 49, Afobaka; 50, Brownsweg; 51, Abontjima; 52, Kabel; 53, Njoenkondre; 54, Lombé; 55, Ganiakondre; 56, Gansee; 57, Bedoti; 58, Braamspunt; 59, Pomona; 60, Nieuw Amsterdam; 61, Marienburg; 62, Lust en Rust; 63, Alkmaar; 64, Tamanredjo; 65, Kroonenburg; 66, Wederzorg; 67, Alliance; 68, Matapica; 69, Slootwijk; 70, Potribo; 71, Nengrekondre-pepre (Ningriprekondre); 72, Sapende; 73, Gododrai; 74, Peninika internaat; 75, Mooimankondre; 76, Charlottenburg; 77, Bigisanti.

concerning their itineraries and collecting activities can be found in the above cited papers by Holthuis (1959) and Hoogmoed (1973).

In several scientific papers of this period (e.g., Tate, 1939; Sanborn, 1941; Sanderson, 1949) Suriname mammals are mentioned, while also a number of popular accounts provided interesting information. Sanderson's (1939) narrative of his 1938 visit to Suriname belongs in the latter category as does also Walsh & Gannon's (1967) account of the so-called "Operation Gwamba". "Operation Gwamba", which will be frequently referred to in the present work, was a project set up to save the animals inhabiting the area of about 1500 square km which became submerged after the completion in 1964 of the Afobaka Dam in the Suriname River. About ten thousand animals mostly found crowded on small islands or in tree tops were taken from the area and brought to uninhabited higher places near the lake. The authors provide a list of all animals taken and in this way an interesting picture is obtained of the composition of the fauna of the area and the sizes of the populations of the various species. Many species, usually considered rare, turned up in great numbers and proved to be quite common, but they evidently are of such secretive behaviour or living in such unusual or inaccessible habitats that usually they have been overlooked. Wherever in the text reference is made to "Operation Gwamba" the above publication is meant.

A very important, but too little known contribution to the knowledge of the Mammalia of Suriname was given by the brothers F. P. and A. P. Penard, and I want to end this chapter on the history of the research on Suriname mammals by giving special attention and paying a special tribute to these two remarkable pioneers in the present field. Frederik Paul Penard (26 January 1876 - 4 September 1909) and Arthur Philip Penard (6 April 1880 - 12 September 1932) were the sons of Frederik Paul Penard Sr., a well to do merchant of Paramaribo, and his wife Philippina Salomons. In 1889, when Frederik Jr. was 13 years old and Arthur 9, both showed symptoms of lepra and had to leave school. From then the two boys lived in isolation at their home in Paramaribo. Without outside help the older boy taught himself and his younger brother, while their mother encouraged the boys and assisted them to her best ability, kept the outside contacts for them and must have had a most stimulating influence. Their two other brothers Thomas Edward (7 May 1878 - 27 October 1936) and William A. Penard were not affected by the disease and both went at an early age to the United States. Thomas Edward arrived there in 1891, when he was 13, and got his education there; he became a prominent engineer, and was also well known as an amateur ornithologist (for a biography see Peters, 1937: 232-234). Both Frederik and Arthur developed a great interest in natural history and ethnology and around 1896 they started a natural history collection, mostly of birds and birds eggs. Since they could not leave home, all their material was obtained from hunters and fishermen, mostly Amerindians. In 1899 the two brothers decided to write a book on the ornithology of the Guianas. The actual writing of it was mainly, or exclusively, done by Frederik; Arthur maintained the

contact with the hunters and fishermen and for this purpose learned the languages of the Indians that brought them their specimens. In this way Arthur obtained much field information of the species, which information was used in their book. Arthur also supervised the preparation of the bird skins, and made the necessary notes on them to be used by Frederik in his text. By selling their collection of bird skins (to the Rothschild collection) they obtained the necessary funds to publish the first volume of their "De Vogels van Guyana" (in April 1908). Through the untiring efforts of Dr. F. A. Jentink, director of the Rijksmuseum van Natuurlijke Historie at Leiden, and his curator of birds Dr. E. D. van Oort, and with the financial aid of numerous Dutch amateur ornithologists, the second volume was published in 1910. The two brothers were also much interested in ethnology and Arthur's knowledge of the Indian languages made it possible for them to obtain very important information, which they published in a number of books and articles.

It was little known that the boys had also done their share in mammological research, and even planned the publication of a book on the "Mammals of Suriname". The history of this book, which unfortunately never was published as such, is the following. In 1905 and 1906 "De Surinamer" a "nieuws- en advertentieblad" (newspaper and advertiser), which was issued twice a week in Paramaribo, published a series of articles under the title "Grepn uit de Natuurkunde van Suriname. Bijeengebracht uit talrijke wetenschappelijke werken en lokaal-beschrijvingen van Jagers, Visschers enz. door X" (Some aspects of the natural history of Suriname. Brought together from numerous scientific publications and local descriptions by hunters, fishermen, etc. by X). The pseudonym X proved to stand for the brothers F. P and A. P. Penard. The articles are numbered 1 to 91 and the first 57 deal with Mammalia; in the remaining articles the reptiles are treated, but the reptile text is interrupted by a general description of the ecology of the country and of the influence of the seasons (articles 79 to 86). The series extended from 1 January 1905 to 9 December 1906, and appeared in vols. 12 and 13 of "De Surinamer". A complete collation with indication of the dates of publication of the various articles is given in the bibliography at the end of this book.

In a letter dated 5 November 1909 Mrs. Penard, who was widowed by then, approached Dr. E. D. van Oort, curator of birds of the Leiden Museum, asking whether there would be any possibility to have the "Grepn uit de Natuurkunde" published in book-form as 'it can be considered to be the most complete account so far written about Suriname zoology'¹ (the word "zoology" probably stands here for "mammalogy"). At that time Frederik had just died, and Van Oort and Jentink had succeeded to get the second volume of "De Vogels van Guyana" accepted for publication. Evidently Van Oort's answer to Mrs. Penard was positive as she wrote him (28 December 1909): 'It is with pleasure that I see from your letter of 1 December, that you will try to find a publisher for the zoological work

¹ This quotation is translated from the Dutch; here, and in the rest of the text, these translated quotations are placed in single quotation marks, straight quotations in double marks.

of my sons. Copies of "De Surinamer", the newspaper in which this work appeared in serial form, cannot be obtained anymore. However, the cuttings of these articles, which have been brought up to date and are now in shape to be published as a book, at present are in the possession of my son Thos. E. Penard, 32 Irvingstreet, Everett, Mass., U.S.A.; they will soon be sent to you. In case the work cannot be published, would you then be so kind to return the manuscript, as I do not have a duplicate'. The next item is a letter (in English) sent to Dr. van Oort by Thomas E. Penard and dated Everett, Feb. 15, 1910; its contents is as follows:

"Dear Sir. I am sending to you, registred under separate cover, the manuscript of 'De Zoogdieren van Guyana' [The mammals of Guyana], concerning which my brother [error for: mother] has already written you and for which you believe you may be able to find a publisher providing the material should warrant it.

In your letter of Dec. 1, 1909 addressed to my mother, you ask for the original papers in which portions of the subject have already appeared. These, however, have been used in the preparation of the manuscript and it is now impossible to obtain duplicates of them. We have no other copies in the family. I would ask you, therefore, to return the original manuscript to me in case you decide not to publish it. I would ask you, also, to return the manuscript to me in case you do publish it, if this request be not entirely unreasonable. My intense interest in my brothers' work leads me to make the above request; I should like to keep the original manuscript as a personal souvenir.

I have delayed in sending the manuscript to you directly upon receiving instructions to do so, because I wished to copy certain portions which appeared to me most valuable, to guard against possible loss through the mails. The manuscript has been carefully disinfected.

Kindly inform me what course you adopt, and let me know if I can render any further assistance. Yours respectfully, Thomas E. Penard"

Thereupon Drs. Jentink and Van Oort got in touch with at least two Dutch publishers: Martinus Nijhoff in The Hague (who had already published the bird book of the Penards), and W. Versluys in Amsterdam, a well known publisher of popular natural history literature of high quality. Nijhoff on 30 June 1910 wrote Dr. Jentink, informing him that as soon as the bird book of the Penards was published he would consider the possibility to publish the volume on mammals as a sequel to it, while Mrs. Penard in a letter to Dr. van Oort, dated 12 November 1910, wrote: 'Mr. Nijhoff informed me that he considers the publication of the manuscript concerning the mammals, in case the sale of the bird books is favourable'. Among the records of the Leiden Museum is a letter from the publishers W. Versluys to Dr. van Oort, dated Amsterdam 20 April 1910, stating that they would like to see the manuscript of the mammal book before giving any opinion as to the possibility of publishing it. However, as the subject of the book was of such a restricted interest, they were afraid that not much could be paid for it; perhaps a serial publication in their journal "De Levende Natuur" could be considered, after which the full text perhaps could be issued in book-form. No further correspondence on the subject can be found, but it seems likely that both publishers finally turned the manuscript down, as the book was never published. The manuscript was probably returned to either Thomas Edward or to Mrs. Penard; the latter died in Paramaribo on 24 December 1926, 76 years old. The manuscript was said to be kept by Arthur Penard and after

his death in 1932 went to the youngest of the four Penard brothers, William. This manuscript, which consists of a number of school exercise books, in which the cuttings are pasted in, was finally donated by William Penard to Frater Abbenhuis, a roman catholic priest, who deposited it in the library of the home of the roman catholic friars in Paramaribo. It was used by the teachers of the roman catholic schools in Paramaribo for their biology courses. When I was in Paramaribo in 1963, I consulted this manuscript and made two photocopies of it, both of which are now in the Rijksmuseum van Natuurlijke Historie, Leiden. There is also a bound photocopy in the Library of the Surinaams Museum, thanks to the good offices of Mr. F. Haverschmidt. A complete set of "De Surinamer" in the roman catholic episcopal archives in the Bisschopshuis, Gravenstraat, Paramaribo, made it possible for me to obtain all the bibliographic information of the various articles, given here in the bibliography (pp. 542, 543).

The articles by the brothers Penard are of varying quality and the information contained in them must be treated with some reserve, but much is very valuable, although often in need of verification. It is amazing that two young men in these extremely difficult circumstances, isolated from the rest of the world, with a sick body and no hope for a better future, still had the energy, interest, and strength of mind to undertake these extremely difficult projects and to succeed so well. Some of the casual remarks in the letters of Mrs. Penard show, better than an extensive description, the terrible and heart-rending situation in which they lived, e.g., in her letter of 12 November 1910 answering Dr. van Oort's request for material of bird skins. She wrote then: 'To my great regret I have to inform you that my son [i.e., Arthur; Frederik had died about a year ago] who should have to supervise the preparation of the skins requested by you, cannot do so anymore because of the loss of his eyesight'. Mrs. Penard, who did all the correspondence for her sons, must have been an exceptional woman, to whom, very deservedly, the two brothers dedicated their bird book.

In the present work I have rather freely cited from the Penards' articles referring to each with the date of publication. In order to make these citations less cumbersome, I have only given their free English translation (in single quotation marks) and refrained from citing the original Dutch text.

A biography of the brothers Penard was published by Haverschmidt (1949).

NATURE PROTECTION, HUNTING AND PEST CONTROL IN SURINAME

Until 1954 no official measures were taken in Suriname to protect its fauna. In that year an ordinance was published (*Gouvernementsblad van Suriname*, 1954 no. 25) regulating the protection, hunting and selling of animals and animal products. This ordinance is still in force at present. Article 1 indicates that in Suriname all feral mammals, birds and turtles are fully protected with the exception of two categories, viz., the 'game animals' and the 'predominantly harmful animals'.

Article 6 rules that the species belonging to these two categories will be indicated by decree. The first such decree was published in 1955 and it has been revised several times since. The latest decree, which is still in force today, is the one of 1 October 1970, published in the *Gouvernementsblad van Suriname*, 1970 no. 104. In Article 2 sub 1a it lists the following animals as 'game animals' in the meaning of Art. 1 of the Ordinance:

'Boshert or pranasai-dia or prasara-dia (*Mazama americana*);
 Haas or Hé (*Agouti paca*);
 Jaguar (*Panthera onca*);
 Kapasi or lontoetere or gordeldier (*Dasypus novemcinctus* and *Dasypus kappleri*);
 Kesi-kesi (*Cebus apella apella*);
 Klein boshert or koeriakoe or boesikrabita (*Mazama gouazoubira*);
 Konijn or koni-koni or agoeti (*Dasyprocta cayanus*);
 Pakira (*Tayassu tajacu*);
 Pingo (*Tayassu pecari*);
 Tapir or buffel (*Tapirus terrestris*);
 Waterhaas or kapoewa (*Hydrochaeris hydrochaeris*);
 Zeehert or savanna-hert (*Odocoileus virginianus*)'.

Article 2 sub 2a lists the following mammals as 'predominantly harmful species':

'Aira (*Eira barbara*);
 Awari or grote buidelrat (*Didelphis marsupialis*);
 Bloedzuigende vleermuisen (*Desmodus rotundus*);
 Huismuis or moismoisi (*Mus musculus*);
 Huisrat (*Rattus rattus*);
 Mongoes or fret (*Herpestes auropunctatus*);
 Rioolrat (*Rattus norvegicus*);
 Stadsrat (*Rattus alexandrinus*)'.

The same decree indicates that hunting is permitted from 1 May to 31 December on all mammals of the category 'game animals', with the exception of the Jaguar (*Panthera onca*), which may be hunted throughout the year. Hunting for game animals and killing predominantly harmful animals is only allowed with a special government permit.

Article 5 of the decree of 1970 states that the Game Ordinance 1954 is in force only for the area in the northern part of Suriname shown on map 2. In the southern part of the country hunting is free.

Schultz (1971) extensively dealt with the Suriname nature reserves and nature parks.

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I am most indebted to the directors and curators of the museums listed on p. xxi for allowing me to study mammal specimens, mainly from Suriname, present in the collections under their care. The study of this material not only contributed to a better understanding of the occurrence of various species in Suriname, but also made it possible to solve some problems in the fields of taxonomy and nomenclature. During my visit to the Field Museum at Chicago in 1963, I discussed several problems

with Dr. P. Hershkovitz, Research Curator of Mammals, who allowed me also to study the extensive material of Suriname mammals collected by him in 1961 and 1962 (Hershkovitz, 1962). Dr. P. J. H. van Bree, Curator of Mammals of the Zoological Museum in Amsterdam, kindly placed at my disposal the collections of Suriname mammals obtained by that museum in recent years, and was most helpful also in other respects.

Dr. D. C. Geijskes, formerly Director of the Surinaams Museum, provided the greater part of the material used in the present study. He was the one who stimulated my work on the Suriname mammals and without his insistence I would never even have begun the present project. Throughout my work he has given me advice and information, and urged me on.

Very important Suriname material was placed at my disposal by the following of my colleagues, who collected in Suriname during longer or shorter periods (indicated in parentheses behind their names); in many instances they provided me with most valuable specimens, several belonging to species not before reported from Suriname: Dr. M. Boeseman (13 November 1963 - 4 October 1964, 19 January - 26 April 1971), Dr. P. H. van Doesburg (April 1957 - April 1963, November - December 1968), Dr. M. S. Hoogmoed (24 April - 20 November 1968, 10 January - 18 February 1970, 26 September 1974 - 27 November 1975), Dr. G. F. Mees (8 March 1965 - 13 April 1966, 15 November 1971 - 15 November 1972). The important collections obtained by Mr. P. Staffeleu have already been mentioned on p. xxvi. Dr. F. Lukoschus of the University of Nijmegen, between July and October 1971 collected mammals in Suriname for his parasitological researches; his collection contained many interesting specimens, especially among the Chiroptera, his specimens are now in the Leiden Museum.

Mr. J. Schouten, chief of the technical staff of the Mammal Division of the Rijksmuseum van Natuurlijke Historie, is mainly responsible for the efficient and excellent way in which the collected material was made available for study; he helped me also in many other respects for which I am most grateful. I am likewise much indebted to Mr. D. G. Reeder, who not only, during his stay in Suriname, collected several of the specimens treated here, but also, after he joined the technical staff of the Mammal Division, took care of the preparation and administration of part of the Suriname material.

During my stay (1962-1963) in Suriname, which was made financially possible by a generous grant from the Netherlands Foundation for the Advancement of Research in Surinam and the Netherlands Antilles (WOSUNA) (later named Netherlands Foundation for the Advancement of Tropical Research, WOTRO), many people greatly facilitated my work there. Among these persons I should like to mention Ir. P. G. de Boer, Director of the "Stichting voor de Ontwikkeling van Machinale Landbouw in Suriname" (the so-called Wageningen rice-project); Mr. P. J. Bolwerk, Head of the Archeological Service, Surinaams Museum; the late Father A. Donicie, C.S.S.R., Director of the Peninika Boardingschool in the upper

Commewijne area; Mr. Jimmy Douglas, at the time District Commissioner of the Commewijne District; Dr. H. Kuil and Dr. E. Hooghiemstra, Directors of the Veterinary Service; Prof. Dr. E. van der Kuyp, Director of the Bureau for Public Health (B.O.G.); Ir. H. E. Lionarons, Director of the Fishery Service; Ir. J. Samson, formerly Director of the Agricultural Experimental Station, Paramaribo; Ir. G. P. Tiggelman, Director of Agriculture; Ir. P. J. D. Versteegh, Director of the Forestry Service; and the Direction of the Suriname Airlines Company (S.L.M.). It is impossible to mention all the others, who helped me in some way or other and made my stay in Suriname such a pleasant and successful one.

With utmost gratitude I mention here the stimulating collaboration generously and profusely rendered by my colleague, Prof. Dr. L. B. Holthuis, during the many years of preparing this publication. His patience and expert advice (especially though not exclusively on nomenclatorial matters), as well as his willingness to condense my 1962 thesis into the present chapter on Chiroptera, were crucial for the publication of this work in its present form.

I should like to end this chapter with expressing my deep gratitude to the late Prof. Dr. H. Boschma, to whom this book is dedicated, for his advice, moral support and guidance throughout this study and for critically reading the manuscript. Without his always freely given and stimulating help this book would never have been realized.