Results of the Rumphius Biohistorical Expedition to Ambon (1990)

Part 1. General Account and List of Stations

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This report gives a general account of the Rumphius Biohistorical Expedition to Ambon (Moluccas, Indonesia) held in 1990. The primary objective of the expedition was to collect marine invertebrates on the localities mentioned by Rumphius (1627-1702) in his book "D'Amboinsche Rariteitkamer" (1705). Apart from a list and descriptions of stations, a journal, the preliminary results and other expedition related matters, the present paper gives some background information on the life and works of Rumphius, and a brief survey of previous marine biological work conducted on the island of Ambon.

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Contents

Preface

In the course of time many attempts have been made to identify the marine invertebrates described and figured in Rumphius's "D'Amboinsche Rariteitkamer", and often with remarkable success. Already Linnaeus (1758) gave many of the species described by Rumphius their present specific names. In 1833 Henschel published a "Clavis Rumphiana botanica et zoologica", and in the present century the authors of the "Rumphius Gedenkboek" (1902) and the "Rumphius Memorial Volume" (1959) worked to this end. But in all these instances the authors were museum zoologists working with preserved material, and very few of them had ever visited Ambon. It is most fortunate therefore that the Rumphius Biohistorical Expedition could do fieldwork in Amboina and thereby explore the actual sites that were first zoologically explored by Rumphius, now more than 300 years ago. The members of the expedition thereby could profit from Rumphius's descriptions of the habitat and biology of the various species. It now may become possible that the comparatively few remaining problems in the identification of Rumphius's animals be solved with the help of such non-morphological data.

Apart from A.C. Bickmore's 1865 voyage to Amboina, undertaken with the object to collect and identify Rumphius's Mollusca, the present expedition, to my knowledge, is the first zoological expedition with as main object to find out the identity of Rumphius's zoological species in situ and in loco. The botanists are far ahead of the zoologists in this respect: already in 1913 Charles B. Robinson on behalf of Elmer D. Merrill went to Amboina with the special intention to collect and identify as many of the species described by Rumphius in his Herbarium Amboinense. Through Robinson's death at Amboina, he could not publish the results of his work, but this fortunately was done for him by Merrill in his "Relique Robinsonianae" (1916) and his "An interpretation of Rumphius's Herbarium Amboinense" (1917).

The natural history of Amboina, and especially that of its marine invertebrates has always had a special fame, and it is tempting to ascribe this to Rumphius's work, and in particular to his "Amboinsche Rariteitkamer". In the 17th and 18th centuries Amboina and the Moluccas counted many more "naturalists" than the capital of the East Indies, Batavia (= Jakarta). Apart from Rumphius there was Francois Valentijn (1656-1727), minister of the Dutch Reformed Church in Amboina (1685-1694, 1707-1713); Balthasar Coyett (1650-1725), governor of Banda (1691-1701) and of Amboina (1701-1706); his successor Adriaan van der Stel (abt.1665-1720), governor of Amboina (1701-1720); Isaac Lamotius (abt. 1645- abt.1720), former governor of Mauritius and prisoner at Banda (1695- abt.1701) and Samuel Fallours, curate of Valentijn (1703-1706). All these gentlemen, and probably several others, collected, illustrated and/or described marine animals of the region. As much of their material was published, be it that quality and quantity was on a much lower scale than what Rumphius did, and in no way could be compared to his scientific accuracy, they still contributed to the knowledge of the Amboinese marine fauna. Also later Amboina remained important for science. L'Honoré Naber's (1922) historical review of oceanographic research in the former Netherlands East Indies, on maps A-C showed the tracks of the best known International and Dutch oceanographic expeditions that visited the archipelago. Each of the three maps shows Amboina as a nodal point of these tracks. Also for individual travelling scientists Amboina was a must if they visited the eastern Archipelago. Amboina had evidently something special. By my own experience I

know that in the 1920's the Dutch children in the primary schools in Java were told about the beautiful "undersee gardens" of Amboina, even though, I am sure, there must have been similar, perhaps even more beautiful places elsewhere in the archipelago. Why this special fame of Amboina? Do we have to see Rumphius here as an unwitting but highly effective public relations man?

The present biohistorical expedition will, I trust, make still more clear the remarkable scientific abilities of the very modest man that Rumphius was.

L.B. Holthuis

Introduction

The Rumphius Biohistorical Expedition to Ambon (= Amboina) was a private initiative of the author that, thanks to the support of several official bodies, was successfully concluded. Between 4 November 1990 and 14 December 1990 the Dutch expedition team remained on the island, where, in co-operation with Indonesian counterparts, research was conducted on the Ambonese marine fauna.

After a study of the work of the great 17th century scientist Georg Everhard Rumpf, better known as Rumphius, and in particular his book "D'Amboinsche Rariteitkamer", in which the marine invertebrate fauna of Ambon is treated, I reached the conclusion that his work raised several questions, and that these questions could only be solved by a thorough investigation on the island itself. It is therefore that at the end of 1988 I began planning an expedition

The principal aim was to investigate and sample all the localities on Ambon mentioned in the "Amboinsche Rariteitkamer", in order to get a better insight in Rumphius's marine biological work.

A better understanding of the work of Rumphius might also elucidate some of the information in the papers of later scientists, which partly based their work on the observations and illustrations made by Rumphius. For instance 38 molluscan names (Van Benthem Jutting, 1959: 194-195) and at least 7 names of crustaceans (pers. comm. L.B. Holthuis) used by Rumphius in his Amboinsche Rariteitkamer were adopted by Linnaeus in his Systema Naturae, and several species described by Linnaeus were based on Rumphius's information.

As Rumphius was the first to make an inventory of a tropical marine fauna in a relatively small area, using exact locality data and giving habitat information for many species, new data would provide a unique opportunity to compare the present-day situation with the one described about 300 years ago.

The expedition would contribute to the knowledge of several groups of marine invertebrates (including species not mentioned by Rumphius), especially in the fields of systematics, zoogeography and ecology. Another goal was the creation of reference collections both in Indonesia and The Netherlands.

A series of reports describing the results of the expedition are planned. These are not intended to be identification guides, although publication of the results should greatly facilitate identification of the taxa treated. This will be in particular to the benefit of the Oceanographic Institute of LIPI (Lembaga Ilmu Pengetahuan Indonesia = Indonesian Institute of Sciences) and the marine biology department of Universitas Pattimura, both on Ambon.

Rumphius gave information about the practical use and the vernacular names of various marine animals by the inhabitants of Ambon. The expedition should verify to what extent these names and utilisations are still in use.

As the name "Rumphius Expedition" was already used for a series of previous expeditions to the Moluccas, I prefered to name the present expedition "Rumphius Biohistorical Expedition", especially as this emphasizes the historical importance of the enterprise.

Last but not least, the expedition is also meant to be a tribute to the man from which it derived its name: the great scientist Rumphius.

Organization

In the initial stage moral support was received from Dr. J. van der Land and Mr. J.C. den Hartog, both from the Nationaal Natuurhistorisch Museum (= National Museum of Natural History), Leiden. By coincidence an acquaintance, Dr. C.J. Hey, was leaving The Netherlands to work for several years at Universitas Pattimura in Ambon. He also was in favour of the plan and provided direct contact with the authorities on Ambon.

After I finished a concept plan, an inventory of all relevant data mentioned in the "Amboinsche Rariteitkamer" was made. Using historical and modern maps the exact topographical position of each locality mentioned in the book had to be located. In all Rumphius mentioned 20 localities, of which only one, Hukonalo, could not be traced. Strange enough even inquiries during the expedition did not reveal its location, although Rumphius (1705: 156) unequivocally spoke of "Hoeconalo in den Amboinschen Inham" (Hoeconalo in the Bay of Ambon). From each individual locality the species mentioned by Rumphius were listed. In all Rumphius gave exact locality data of about 65 species, and reported 30 additional ones with less precise data (e.g. Ambon Bay or south coast Leitimur).

Furthermore I studied the original drawings used for the "Amboinsche Rariteitkamer", which are kept in the manuscript collection of the Koninklijke Bibliotheek (Royal Library), The Hague. The study of these drawings was of importance as the published figures in this book consist of at least two intermingled sets, one made in Ambon by Rumphius's draughtsman, and one (but probably more) added in Holland. As in the set(s) of drawings made in Holland many non-Indonesian species are depicted, it was necessary to reveal the true origin of each drawing. Although these figures were studied previously by several authors (Holthuis, 1959, Van Benthem Jutting, 1959 & Engel, 1959), many important facts were apparently not recognized or understood (Strack, in preparation).

In October 1989, Miss H. Eppinga and I made a pre-expedition visit to Ambon. During this visit contacts were made with the Oceanographic Institute of LIPI and Universitas Pattimura. We were kindly housed by Dr. C.J. Hey, who also made possible to make short field trips to several localities mentioned by Rumphius. As a result I was familiar with field conditions before the expedition took place. During these trips some material (mainly molluscs) was collected.

After our return Dr. W. Backhuys and I founded the "Stichting tot Bevordering van Biohistorisch Onderzoek (SBBO)" (Foundation for the Advancement of Biohistorical Research). This resulted in an official body to work from. The next step was the defini-

tive selection of a compatible and able expedition team, a task which was completed without major difficulties.

As Dr. Van der Land put the Rumphius Biohistorical Expedition on the list of proposed scientific projects in the program "Netherlands-Indonesian Co-operation in Marine Science Development" by LIPI and SOZ (Stichting Onderzoek der Zee), and as the Nationaal Natuurhistorisch Museum also recognized the enterprise as one of their projects, the expedition gained considerable official status. In March 1990 we sent a research proposal to the Indonesian authorities, and requested a research permit.

In the initial phase the foundation was lacking finances, and all team members contributed a minimum amount of fl. 2000,00 to create a financial base. Later additional financial and material support was received from several foundations, companies and institutions (see acknowledgements). In all the expedition received about dfl. 60.000, which proved sufficient to cover the expenses.

After obtaining the necessary funds, organizing the facilities, equipment, transportation etc. took place, and everything was settled before departure, except for the permit from Jakarta. The permit came through just before I left for Jakarta to arrange official matters. On 4 November 1990, about a week after my arrival in Jakarta, the expedition team arrived at Ambon airport and marked the start of the expedition.

Expedition team

The Dutch expedition team (fig. 1) was as follows (in alfabetical order):
W. Backhuys (malacologist)
C. van Egmond (scientific assistant ichthyology)
A. Fortuin (marine biologist)
C.H.J.M. Fransen (carcinologist)
J.C. den Hartog (actinologist)
A.F. de Jong (malacologist)
W.W.C. Kolvoort (underwater photographer)
M.S.S. Lavaleye (marine biologist and malacologist)
H.L. Strack (expedition leader and malacologist)

Every team member had its own specialization and working methods. Koos van Egmond, Anne Fortuin, Charles Fransen and Willem Kolvoort did most of their fieldwork by SCUBA diving up to dephts of about 30 m, while Koos den Hartog did his fieldwork mainly by snorkeling. The intertidal zone was sampled by Willem Backhuys, Frans de Jong, Marc Lavaleye and Hermann Strack, the last two also sampled by snorkeling.

Anne Fortuin's main task was sieving the invertebrate fauna living in soft bottom substrate at depths ranging from about 4 to 20 metres (fig. 63), while Frans de Jong and Hermann Strack collected the same fauna in shallow water (around 0.5-1 m depth). Anne Fortuin also conducted a few intertidal transects at stations 4 and 14. Willem Kolvoort photographed the underwater landscape of the sampled localities and the marine fauna with emphasis on invertebrates. Marc Lavaleye did most of the laboratory photography of live specimens (fig. 46). Shell grit from numerous localities was collected by Marc Lavaleye and Anne Fortuin. Koos van Egmond acted as technician and steersman, but was also a keen collector of fishes. Willem Backhuys sampled a few non marine localities in search for land and freshwater molluscs.

John Staats, although not a team member, remained with us for the first three weeks, and returned after that period together with Willem Backhuys, who unfortunately could not stay the complete duration of the expedition.

Indonesian counterparts:
Z. Arafin, LIPI (marine biologist)
A.M. Hatta, LIPI (phytologist)
J. Manuputty, Universitas Pattimura (boatman)

Jan Manuputty (fig. 48) joined us for almost the complete duration of the expedition. Hatta and Zeinal Arafin participated in part of the field trips. During these field trips Hatta sampled a collection of algae for the Oceanographic Institute (LIPI) and, as he speaks both English and Dutch, was very helpful as intermediary for the Oceanographic Institute. Dr. Cees Hey participated in a three days visit to Pombo Island.

Indonesian staff (fig. 2):
Tin Werinussa (head household, cook)
Atha (cleaning and assistant cook)
Seli (cleaning and assistant cook)
Lorna (laundress)
Bob (chauffeur)
Jopie (maintenance equipment, boatman)

Fig. 1. The Dutch members of the expedition. Front row from left to right: W.W.C. Kolvoort, M.S.S. Lavaleye, A. Fortuin, C.H.J.M. Fransen, W. Backhuys, H.L. Strack, A.F. de Jong, J. Staats, J.C. den Hartog and C. van Egmond. Back row see Fig. 2.

Fig. 2. Indonesian staff. Front row from left to right: Bob, Jopie, Atha, Lies, Seli, Ans and Tin Werinussa. Back row see Fig. 1.

On several occasions our staff was assisted by Lies and Ans. Due to the dedication of the staff, it was possible for us to devote ourselves completely to our task, and therefore they made an important contribution to the success of the expedition. Thanks to Tin and her crew the household was always perfectly in order and meals were small feasts we always looked forward to.

Facilities and equipment

The expedition was lucky to be able to rent a spacious house situated on the edge of inner Ambon Bay (fig. 3).

Three small boats were rented for the expedition: a local wooden prahu (fig. 7), an aluminium speedboat and a polyester boat (fig. 4). All were equiped with outboard motors and moored just behind our house. The last one proved ideal for the diving team, as it was relatively spacious, stable and easy to board after diving.

The polyester boat, diving gear and a compressor were rented from the Moluccan manatee project of AID-Environment (Amsterdam). Additional diving equipment was made available by Universitas Pattimura and Dr. C. Hey. Universitas Pattimura put aquaria and stereo dissecting microscopes at our disposal. Two small dredges (gape 0.4 m) and most of the collecting gear were provided by the Nationaal Natuurhistorisch Museum (Leiden). In addition each team member brought his per-

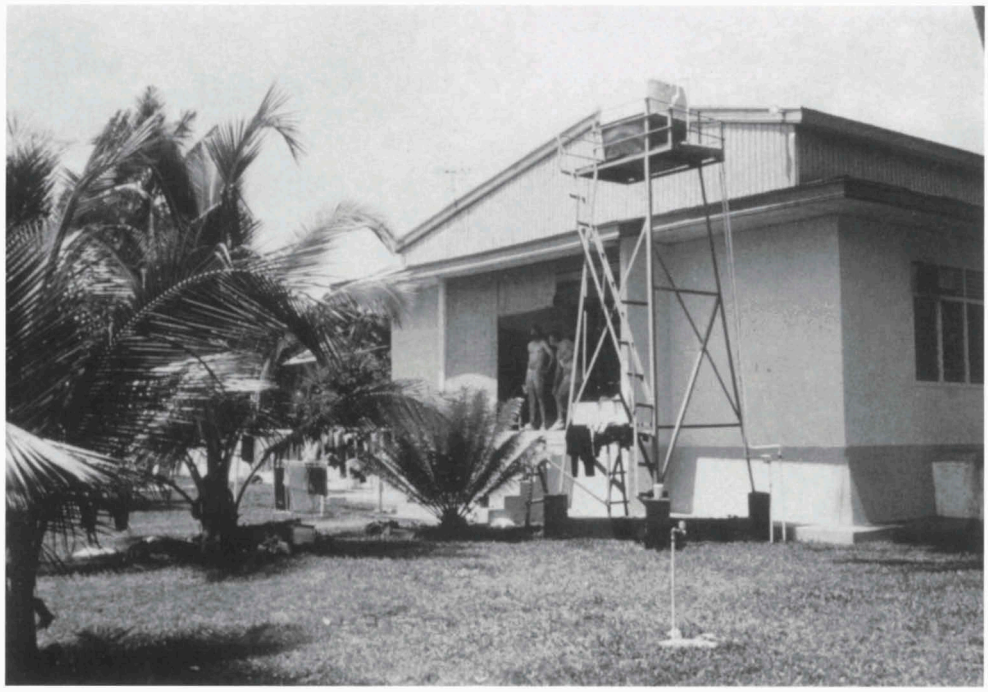


Fig. 3. The expedition's base-camp.

Fig. 4. The polyester boat in action in Ambon Bay.

sonal, more specialized, collecting equipment. Alcohol and formaldehyde were purchased in Ambon.

A small bus was rented for transportation on land. An extra jeep was rented for several days, to make possible the transportation of the complete team and their equipment to localities situated on the north coast of Hitu.

Life and works of Rumphius

As Rumphius's work was the starting-point for our expedition it is essential to present a sketch of this remarkable man's life. For more detailed information, see Sirks (1945) and De Wit (1952, 1959). A romantized life-history was written (in Dutch) by Ballintijn (1944).

Georg Eberhard Rumpf (fig. 5), who latinized his name to Georgius Everhardus Rumphius, was probably born in the neighbourhood of the German city of Hanau in the year 1627. At the age of 18 he came in the service of the Dutch West India Company and embarked on the ship "De Swarte Raef" bound for Brazil. As the ship was captured by the Portuguese it never reached Brazil but was sent to Portugal. Rumphius remained in Portugal for about three years before returning to Hanau. In Germany he was

Fig. 5. Georg Everhard Rumpf (1627-1702).

employed by count Johannes von Nassau-Idstein as construction clerk and as teacher of the count's son (Lentz, 1991). But he would not remain long in the service of this German nobleman. In 1652 (Rumphius was about 25 years old at that time) he took a decision that would dramatically determine the course of his life; he enlisted as midshipman in the Dutch East India Company. The same year, on boxing-day, he embarked the yacht "Muyden" which left the Dutch island of Texel with destination Batavia (now Jakarta). He safely reached Batavia on June 1653. Several months later he arrived at Ambon. Here he remained in military service as "vaandrig" (reserve lieutenant) and "fabryck" (engineer) and was involved in planning and constructing fortifications in the Moluccas. As military service did not satisfy him, and as his superiors were aware of his many capacities, he was soon transfered into civil service and was appointed "onderkoopman" (second merchant) at Larike (SW Ambon) in 1657. It must have been shortly afterwards that his first marriage took place. In 1662 Rumphius was promoted and became "koopman" (first merchant).

By now Rumphius had started to study the Ambonese flora and fauna. Proof of this can be found in a letter (dated 20 August 1663) he sent to the "Heren XVII", the directors of the Dutch East India Company, in which he wrote that he had started "a work, in which in latin will be described all such plants, herbs, animals etc. as I have seen, and may yet see, during my residence in the Indies". Many years followed in which Rumphius passionately dedicated himself to the study of the plants and animals occurring on Ambon and the adjacent islands. He made drawings from life and carefully noted all his observations. As many scientists in his days he was universal in his interests. He knew several languages and wrote one of the first Malay dictionaries. Furthermore he wrote on the geology, the history and the geography of Ambon.

In 1670, luck and happiness seemed to have deserted him, and the man who achieved satisfaction from life by observing nature, became blind. Despite this enormous handicap he continued with iron will the work to which he had pledged his life.

But on the ill-fated day of 17 February 1674 Rumphius was struck by another tragedy. That day Rumphius's wife and youngest daughter went to a Chinese friend to watch the Chinese new year celebrations. Suddenly a violent earthquake devastated the larger part of the town. Both women were killed under the rubble of the collapsing walls. The clerk keeping the daily record in Victoria Castle reported on the earthquake and added the following comment: "Pityful it was indeed to see this man sitting by his dead, and to hear his repeated lamentations encompassing both this new casualty and his own blindness" (Sirks, 1945: 293).

Rumphius continued his work in which he found consolation, but in January 1687 a great fire burned most of Ambon town. Rumphius's house, many manuscripts and all illustrations (and therefore all drawings made by Rumphius himself) were destroyed. Fortunately Rumphius was spared and so was the manuscript of his major work, the Herbarium Amboinense. Now new illustrations had to be made and Rumphius in this received help from the Company who put assistants at his disposal.

Late in 1690 the first six books of the Herbarium Amboinense were sent to Batavia. In 1692 they were shipped to Holland on the ship "Waterlandt". Unfortunaly this ship was sunk by the French and with the ship the manuscript went down.

However, as Henschel (1833, quoted by Sirks, 1945) wrote: "... neither the sun which blinded the writer with his rays, nor the fire that consumed his writings, nor the water that buried the manuscript beneath its waves, could deprive the world of this precious piece of work". The Governor-General in Batavia Camphuys, being an

educated man and a lover of natural history, had the manuscript copied before sending it to Holland. The first six "books" (or chapters) were copied again and in 1696 these copies, together with the three following "books", were sent to Holland and arrived there safely. The last three "books" were sent in 1697, and when several years later the supplement arrived the work was concluded.

Having finished his main work, more time was spent in finishing a manuscript on the marine fauna and geology of Ambon, the "Amboinsche Rariteitkamer". In this work, which consists of three "books", the first deals with crustaceans, echinoderms and other, mainly marine, invertebrates. The second is entirely devoted to Rumphius's favourite pastime: molluscs, and the last "book" is on geology and mineralogy.

A third manuscript in which the mammals, birds and fishes were described is considered lost. Rumphius probably never finished this manuscript and therefore it was never published, although many suspect that Francois Valentijn (1656-1727) drew from this manuscript for the chapter "Verhandelingen der dieren van Amboina" published in his compilation "Oud- en Nieuw Oost-Indiën" (1724-1727).

On the 15th of June 1702 Rumphius died in Ambon. He did not live to experience his works in published form, as the "Amboinsche Rariteitkamer" was not published until 1705, and his monumental "Herbarium Amboinense" was published between 1741 and 1750.

His work and the little we know about his life, stamp him as a great man and scientist, who deservedly became famous and is now often refered to as "the blind seer of Ambon".

Previous marine biological research

The fact that Rumphius lived and worked in Ambon and that the great majority of his observations on the marine fauna were done on that small island, makes it biohistorically one of the most important areas in the Indo-Pacific. The historical importance of the island was later emphasized by the various marine biological expeditions which called at Ambon to collect material. This was not only because Ambon was made famous by Rumphius, but also by the fact that the island offers the best natural harbour in the area. The following survey of marine biological investigations conducted on Ambon does not claim to be complete, but gives an idea of the historical importance of Ambon for marine biology.

After Rumphius's death in 1702 relatively little marine biological work was done on Ambon. None of the few 18th century expeditions set foot on the island and there was nobody living on Ambon who was able or willing to continue Rumphius's work. Shells and other "curiosities" continued to be collected for the cabinets of the European collectors, but little scientific work was done. One person certainly worth mentioning is Francois Valentijn, a Dutch clergyman who worked several years in Ambon and wrote the above-mentioned "Oud- en Nieuw Oost-Indien". In this five volume work there are also chapters on the zoology of Ambon and adjacent areas. Although Valentijn evidently missed Rumphius's genius, his work remains an important early source of information.

Between 1826 and 1829 the French vessel Astrolabe, with the two gifted scientists J.R.C.Quoy and J.P.Gaimard on board, sailed around the globe. This expedition

remained some time on Ambon. Collections were made, and noteworthy are the many observations and drawings made of living molluscs.

In 1865 the American A.C. Bickmore stayed for several months on Ambon. He set out to find all molluscs described by Rumphius, or as he wrote "It was my desire not only to obtain the same shells that Rumphius figures, but to procure them from the same points and bays, so that there could be no doubt about the identity of my specimens with his drawings" (Bickmore, 1868: 141). After leaving Ambon he boasted "Two months had now passed since I arrived at Amboina, and I not only collected all the shells figured in Rumphius's "Rariteit Kamer", which I had come to seek, but more than twice as many species beside" (Bickmore, 1868: 213). However, no scientific report was ever published about this material, and unfortunately the exact size and importance of this collection remains unknown. Mrs. N.J. Root of the American Museum of Natural History informed me (in litt., 1992) that "later correspondence shows that Bickmore deposited one ton of specimens with the museum". But except for a few shells that were identified as belonging to the Bickmore collection by Dr. W. Emerson, it is not possible to determine what the deposited specimens were. A small part of the collection is in the Delaware Museum of Natural History (Mr. A.F. Chadwick, in litt., 1992).

In 1874 the famous British Challenger Expedition remained on Ambon for about a week. During this stay some collecting was done, and among others several new crab species were dredged.

Probably one of the most important contributions to the knowledge of the Ambonese marine fauna was the Swiss expedition to Ambon Bay by M. Bedot and C. Pictet in 1890. These two men remained two months on Ambon, and rich collections of many different marine animal groups were made. They only collected in the Bay of Ambon near the city of Ambon, but a wealth of new information was gathered and published.

In 1899-1900 another famous expedition, the Dutch Siboga Expedition made several short visits to Ambon. Weber (1902: 83) reports that "trois fois au cours de notre expédition, nous avons séjourné à cette importante station de ravitaillement du charbon, que nous y avons chaque fois réuni des collections sur les reçifs et dans le port".

The Dutch Snellius I Expedition (1929-1930), although primarily a geological expedition, also collected marine biological material in the two weeks that the expedition stayed in Ambon.

In the second half of the 19th century several scientists visited the island and contributed considerably to the knowledge of the local marine fauna. Some of the most important among them are P. Bleeker, J. Brock, R.W. Semon and E. von Martens. In that period the Nationaal Natuurhistorisch Museum in Leiden received much material which E.A. Forsten and D.S. Hoedt collected in Ambon. All these men and expeditions collected material in order to do descriptive, taxonomical work. For that reason biological and ecological data were not or only rarely recorded. Exact locality data were seldomly given by 19th century collectors; therefore the majority of the specimens collected in this period only bear "Ambon" as locality indication. Strange enough also some of the 20th century expeditions did not specify the localities sampled. The result is a large amount of scattered and rather incomplete (by present standards) data on the marine biota of Ambon.

In recent times several expeditions conducted marine biological research on

Ambon. In 1970 the Mariel King Memorial Expedition operated in the northern part of the Moluccas and did some collecting in Ambonese waters. The aims of this expedition were "(1) To obtain fresh and well-preserved specimens of marine invertebrate animals, especially mollusks, from the Moluccas region, and to make these available through museum collections to specialists for taxonomic and anatomical studies; (2) in particular to re-collect as many as possible of the mollusks described and illustrated by the early Dutch naturalist Rumphius (1705) from the seas around Ambon; (3) to study and make comparisons of the invertebrate faunas, especially mollusks, of the islands in the transitional zone between the Southeast Asian and the Australian continental shelves" (Wilson, 1978: 518). The first two aims are almost identical to those of the present Rumphius Biohistorical Expedition, but as far as I could ascertain little was published on the results of this expedition.

The first of a series of expeditions initiated by the Indonesian Institute of Sciences (LIPI) was carried out in 1973 under the name Rumphius Expedition I. Subsequent expeditions under that name did no or very little research on Ambon, but the first expedition sampled several localities on Ambon, like Said, Sawahtelu and Suli. Furthermore several dredgings were carried out off the north-east and north-west coast and in Ambon Bay. In many cases the output of these expeditions was restricted to a general report with preliminary species lists.

Coral reef research (theme IV) conducted by the Indonesian Dutch Snellius-II Expedition (1984) used Ambon as a starting-point. Although not much research was done on Ambon, one of the participants (also a team member of the present expedition), J.C. den Hartog, spent about 10 days sampling Actinaria and other invertebrates in the Bay of Ambon and at a few other places on the island.

The establishment of two marine biological stations on Ambon by the Indonesian Institute of Science (LIPI) and Universitas Pattimura, forms a promising foundation for future research on the island. In fact much local work has already been done by the scientists and students working in these institutions.

Description of Ambon

Ambon is a small (ca. 1000 km^2) island, situated between 3°28'S and 3°48'S and between 127°54'E and 128°22'E, just south of the western end of the much larger island of Ceram. It is divided into two peninsulas, a large north-western one called Hitu and a smaller south-eastern one called Leitimur (fig. 6). The capital, the only town of some importance of the Moluccas, Kota Ambon (Ambon town) is situated on the north coast of Leitimur. The two peninsulas are separated by two bays, the large Ambon Bay in the west and the smaller Baguala Bay in the east. Ambon Bay itself is devided in an outer and inner bay. The outer bay is deep (ca. 700 m near the entrance). It is connected to the inner bay by a narrow (800 m wide) and only 12 m deep passage. The inner bay is rather shallow with depths not exceeding 35 m. Baguala Bay is very shallow, in most places the depth does not exceed 7 m.

Ambon is mountainous, its highest mountain being Gunung Salahatu (1059 m) in east Hitu. The western and northeastern shores of Hitu and part of the southern shore of Leitimur are rocky and quite steep. The island is partly covered by secundary forest, and small plantations. Many streams and small rivers discharge fresh water into

the sea depositing relatively large amounts of silt. This is especially evident in the inner Ambon Bay when the water becomes turbid after rainfall. The rainy season is from May to August, June being the wettest month with an average rainfall of 634 mm and almost 24 rainy days. December is the dryest month with an average rainfall of 110 mm.

Although Ambon has some reasonable roads, the villages in south-west and north-east Hitu, and part of South Leitimur are not accessible by car. Although small paths lead to these villages, the best way to reach them is by boat.

Ambon has several satellite islets. Situated near the west coast of Hitu Peninsula is a group of three called Nusa Telu or Pulau Tiga [referred by Rumphius as "De Drie Gebroeders" (The Three Brothers)]: Lain, Hatala and Ela. Ela is about 90 m high, and all are rocky with steep shores, although at least Hatala and Lain have a very small sandy beach (figs 41-42). The islets are separated from each other and the mainland of Ambon by deep channels, often with strong currents.

East of Hitu there is Pulau Pombo, which in Malayan means Dove Island. Rumphius also called this "Het Duiveneiland" (The Dove Island). Pulau Pombo is a low atoll-like formation about three km east of Hitu's east coast. It consists of an oval-shaped reef enclosing a shallow lagoon and an elongate island with raised reef deposits.

The waters surrounding Ambon can be devided in several layers. As we confined our studies to the shallow water fauna, only the surface layer is of importance. This layer is characterized by a homogeneous temperature; it varies between 30 and 100 metres seasonally. During the North-west Monsoon (January to March) diluted water from the Flores Sea entering the area causes a decrease in salinity to values of 34.00 to 32.50 ‰. At this time of the year the water temperature of the surface layer is about 28 °C. During the South-east Monsoon (May to October) water from the Halmaheira and Arafura Seas increases the salinity of the waters around Ambon to values between 34.20 and 34.50 ‰ and the water temperature drops to 27 °C or somewhat less. It is believed that upwelling occurs in the Banda Sea during this period (Birowo & Ilahude, 1971: 11). Tides are semi-diurnal and the range varies from 220 to 230 cm (Huwae, 1971: 9).

List and descriptions of Stations

(fig. 6)

Station numbers refer to localities. Therefore material from different habitats (often correlated with differences in depth) sampled at the same locality have the same number. On the definitive museum labels (but not on the field labels) different habitats in one station are marked by adding characters after the station number (e.g. St. 12a, 12b etc).

In all, 44 stations were sampled of which 8 (nos 2, 10, 12, 13, 19, 22, 24 & 25) are exclusively or mainly non marine (terrestrial or freshwater). Seven stations (nos 28, 29, 32, 33, 41, 42 & 43) were sampled by dredging. The remaining 29 stations are intertidal, snorkeling and SCUBA stations. Those mentioned by Rumphius are marked (R).

The locality descriptions are merely meant to give an impression of the sampled areas. The term "solid rock" usually refers to raised limestone. In the intertidal zone these rocks can be extremely rugged.

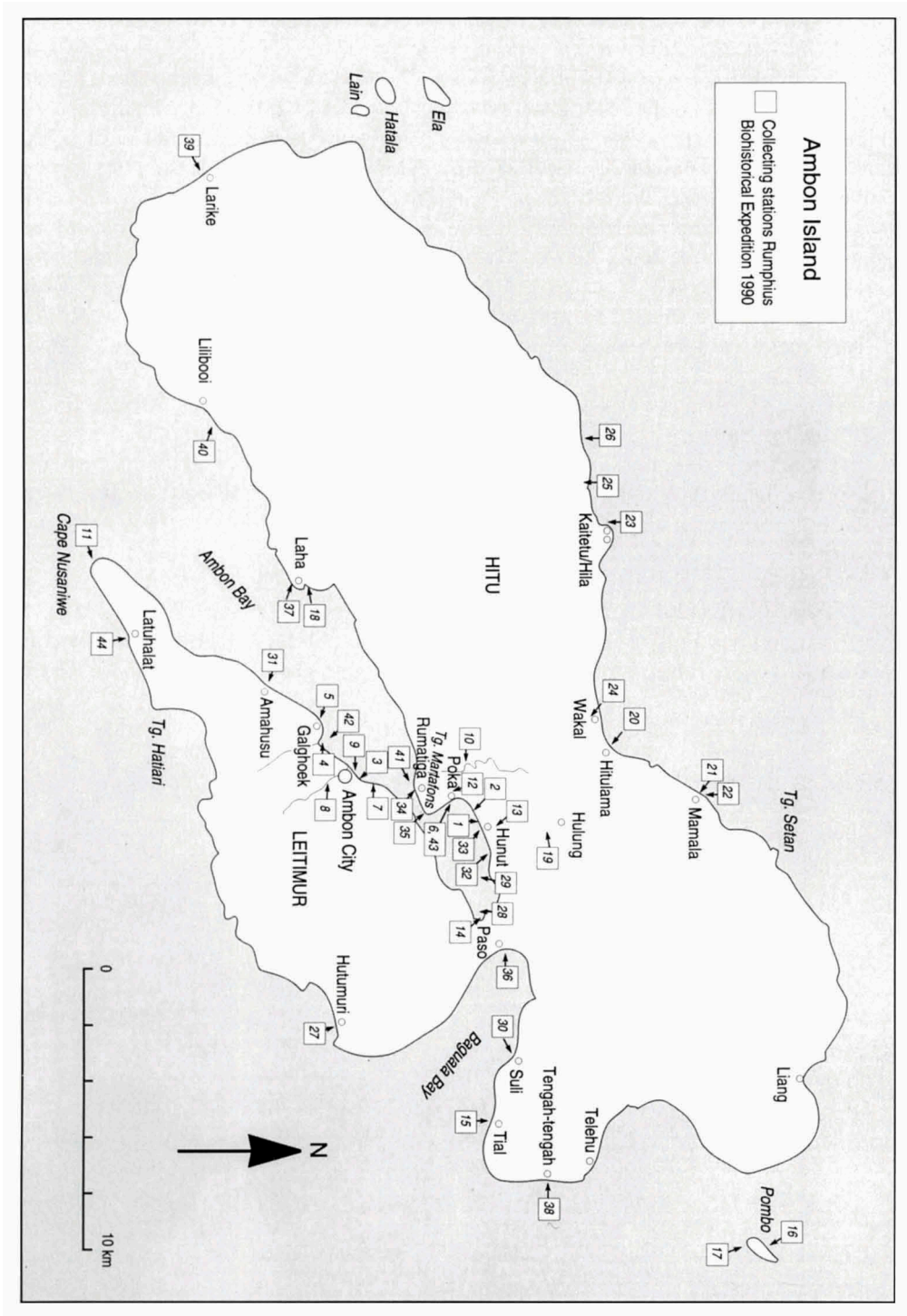


Fig. 6. Map of Ambon Island showing all sampled localities.

Station 1: Hitu, west side of Hunut (= 2 km north of Poka), in front of base camp; 4.xi-13.xii.1990 (fig. 7).

The littoral zone consists of a beach (about 25-50 m wide) of muddy sand and small pebbles with only a few scattered stones and blocks of dead coral. At high tide mark there is a narrow margin of mangroves. About 300 metres to the west of the base camp there is a wooden jetty used by fishing boats, of which the piles form a suitable substrate for invertebrates.

Sublittorally the beach in front of the base camp drops off steeply into a bare slope down to about 20-25 metres, where it becomes less steep. In the subtidal zone growth of stony corals is scarce and patchy. Near the jetty the slope is gentle and there are a few patches of seagrass. Under the jetty the bottom is littered with discarded metal, car tyres, etc.

Station 2: Hitu, river-mouth, Katekate (= 0.5 km west of base camp); 5 and 30.xi.1990 (fig. 8).

A small waterfall marks the outlet of a stream. Near the waterfall on the eastbank there is a declivity with accumulated humus and leaves on the bottom. The river-mouth is muddy; it is traversed by a concrete bridge in front of which are mangroves.

Station 3 (R): Leitimur, Batumerah (near Ambon town); 7-9.xi.1990 (figs. 9-10).

Batumerah is a village built against a steep rocky outcrop. The littoral below consists of a narrow sandy beach and several very large rocks (fig. 9). Ca. 0.5 km to the

Fig. 7. Station 1: west side of Hunut. The expedition's wooden prahu lying on the beach in front of the base camp.

Fig. 8. Station 2: a waterfall marks the mouth of a small river at Katekate.

Fig. 9. Station 3: the village of Batumerah is built against a steep rocky outcrop. The intertidal zone is characterized by large rocks.

north-east the intertidal zone consists of a broad stretch of muddy sand with pools, fringed by a low reef of dead coral (fig. 10).

Diving was done somewhat to the west of Batumerah. Here, in sublittoral shallow water, the bottom is rather muddy. Farther from the shore the bottom drops more steeply to about 12 metres. The bottom was considerably polluted by rubbish, and the water was turbid, but became gradually clearer from 3 metres downwards.

Station 4 (R): Leitimur, Wainitu (near Ambon town); 7-8.xi.1990 (fig. 11).

This area is rather polluted by rubbish (plastics and other household refuse) and excrements, especially near the river-mouth. The intertidal zone consists of a rather broad beach of muddy sand, with few scattered stones and blocks of dead coral. At high tide level there are a few small stone walls, and at the water edge at low tide level are situated several metal shipwrecks. Just below low water mark small fields of seagrass do occur.

Station 5 (R): Leitimur, Tg. Benteng (= "Galghoek"); 8-9.xi and 2.xii.1990 (fig. 12).

The intertidal zone consists of a narrow beach of rather clear, white sand, north of which lies a raised coral reef.

In shallow water (1-3 m depth) there are patches of living coral among the sand. Several dives were made just north of the raised coral reef. Here at depths of 2-3 m some places are considerably polluted by garbage such as plastics, tins, glas etc. Near the reef there is a rather steep slope with large rock boulders and coral blocks. This slope continues up to a depth of about 15 metres, where it merges into a gently sloping area of muddy sand with scattered coral formations. Further north of the raised

Fig. 10. Station 3: to the north-east the intertidal zone of Batumerah consists of a low reef of dead coral.

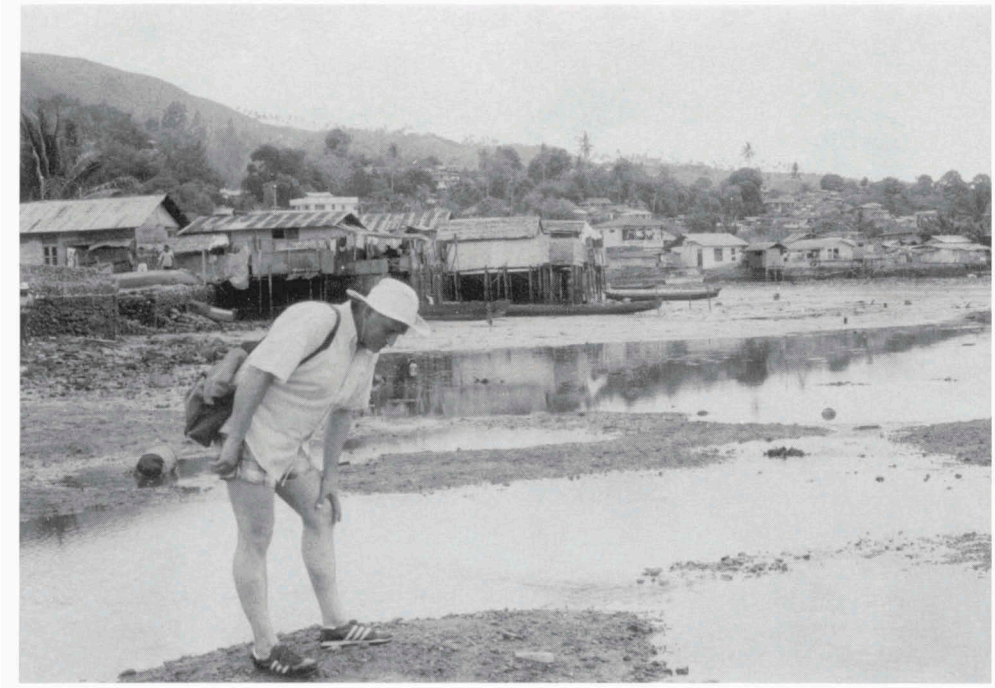


Fig. 11. Station 4: Backhuys sampling the muddy and polluted area at Wainitu.

Fig. 12. Station 5: our wooden prahu in front of Tg. Benteng.

coral reef the slope is less steep, consisting of a terrace-like landscape of muddy sand with small coral blocks separating the terraces.

Station 6: Hitu, Poka (in front of PSL building); 8 and 10.xi.1990.

This locality is situated just in front of the biological station (PSL) of the Pattimura University. It is a sandy beach becoming more muddy near the low water mark, with occasional banks of shell grit. About 100 metres north of the collecting area a small stream flows into sea.

Station 7: Leitimur, ca. 1-2 km north-east of Batumerah; 8.xi.1990 (fig. 13).

A rather wide mudflat with patches of seagrass. Part of the flat was somewhat raised and more sandy.

Station 8 (R): Leitimur, river Batugadjah (Ambon town); 10.xi. 1990 (fig. 14).

This river was sampled from the southern edge of Ambon town to a few kilometres upstream. The river is very shallow, its bottom and banks are sandy alternating with rocky and stony areas.

Station 9 (R): Leitimur, Ambon town, in front of Fort Victoria; 10.xi.1990 (fig. 15).

One of the most polluted areas, not only by the town sewers but also by spilled oil from the many ships lying in front of the city. The littoral zone consists of a stone quay-wall, with a very narrow (1-3 metres wide) sandy beach, and a few heaps of stones in front.

Fig. 13. Station 7: about 1-2 km north-east of Batumerah a large mud-flat emerges during low tide.

Fig. 14. Station 8: the river of batugadjah runs through Ambon town.

Fig. 15. Station 9: Lavaleye and the author collecting specimens from the quay-wall in front of Fort Victoria in Ambon town.

Station 10: Hitu, River Lela (near Rumahtiga); 10-11.xi.1990 (fig. 16).

This river was sampled from the road near the river-mouth up to about two km upstream. The river is shallow with sandy bottom, banks with pebbles and larger stones and a little upstream a firm clay-bed.

Station 11 (R): Leitimur, Cape Nusaniwe; 12.xi.1990 (fig. 17).

The cape consists of an exposed protruding, massive, igneous rock formation. On the eastside, adjacent to the cape, lies a white sandy beach, with rocks and pools around low water mark. Sublittorally there is a bare reef with about two metres wide rifts. At about 6 metres depth the reef is replaced by a stretch of sand, below which there is an area with stones, large rocks, coral blocks and patches of sand.

Station 12: Hitu, River Morea (near Poka); 13.xi.1990.

Upstream several little tributaries (1-2 m wide) merge into this river. Near Poka the river is rather polluted by refuse of the nearby kampong.

Station 13: Hitu, brooklet near base camp (west side Hunut); 13.xi.1990.

A small (ca. 0.5 m wide) brooklet with sandy bottom running into Ambon Bay just alongside our base camp.

Station 14 (R): Ambon Bay, mangrove forest near Paso; 13-14.xi.1990 (fig. 18).

The largest mangrove forest (ca. 5 hectares) of Ambon is situated at the Ambon Bay side of Paso. Apart from mangrove trees small palms (*Nipa fruticans*) are quite

Fig. 16. Station 10: team members at work in River Lela.

Fig. 17 Station 11: beach at Cape Nusaniwe.

Fig. 18. Station 14: intertidal party collecting in the mangove forest near Paso.

common. At low tide a large mud-flat emerges, which in some places is more sandy. The forest is indented by a few channels.

Station 15: Hitu, Baguala Bay, ca. 0.5 km west of Tial; 13-14.xi.1990 (fig. 19).

A gently sloping sandy beach. The maximal depth about 200 metres off-shore is 10 metres. Near the shore the bottom is sandy with a some coral-rubble and algae. Farther from the shore mainly coral-rubble with occasional blocks of dead coral. This merges into a zone of white coral sand and coral formations (mainly *Acropora*).

Station 16 (R): West side of Pombo Islet; 15-17.xi.1990 (fig. 20).

The base camp during our stay on Pombo was located at the west side of the islet, which consisted of a narrow, white sandy beach.

There is a wide and shallow lagoon, with locally, at about 4-6 metres depth, stretches of seagrass and coral. Just in front of our base camp the lagoon was deeper (about 20 m) and had a steep slope. The lagoon is surrounded by a fringing reef.

Station 17 (R): South-east side of Pombo Islet; 15-17.xi.1990 (figs 21-23).

A very wide reef-flat with patches of sand, coral rubble and scattered blocks of dead coral (figs 21 and 22).

Sublittorally the living coral reef gently slopes down to a depth of about 5 metres (fig. 23), followed by a steep declivity.

Station 18: Hitu, east side Laha up to and including Tawiri; 19 and 24.xi.1990 (fig. 24).

Fig. 19. Station 15: beach near Tial.

Fig. 20. Station 16: west side of the Islet of Pombo. View of the beach during low tide.

Fig. 21. Station 17: south-east side of Pombo. A very large reef-flat emerges during low tide.

Fig. 22. Station 17: south-east side of Pombo. Fringe of reef-flat.

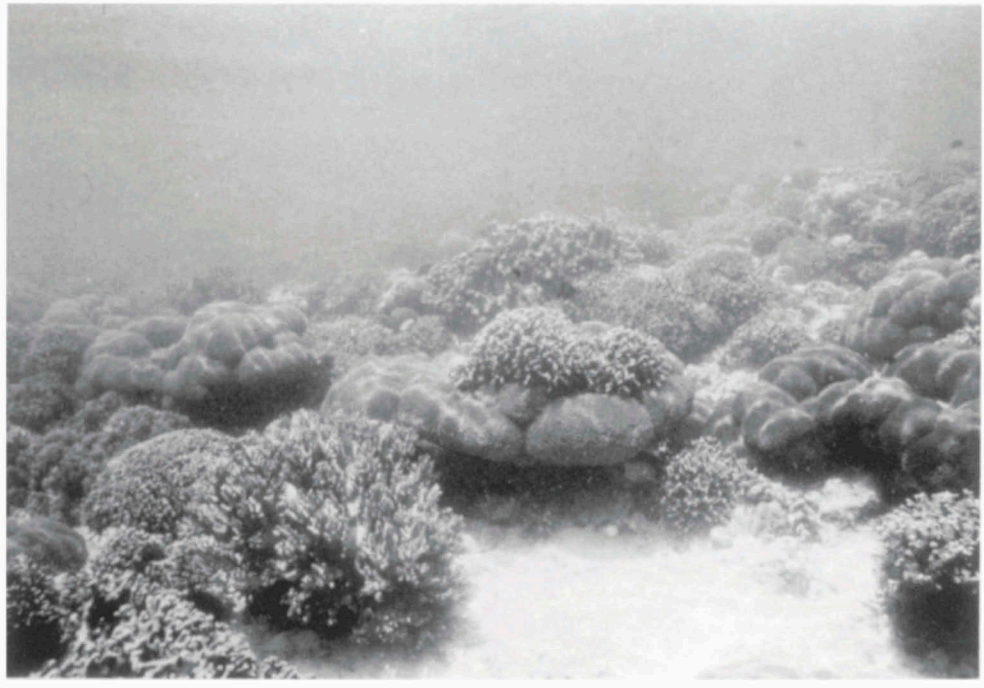


Fig. 23. Station 17: south-east side of Pombo. View of living reef at a depth of about 5 metres.

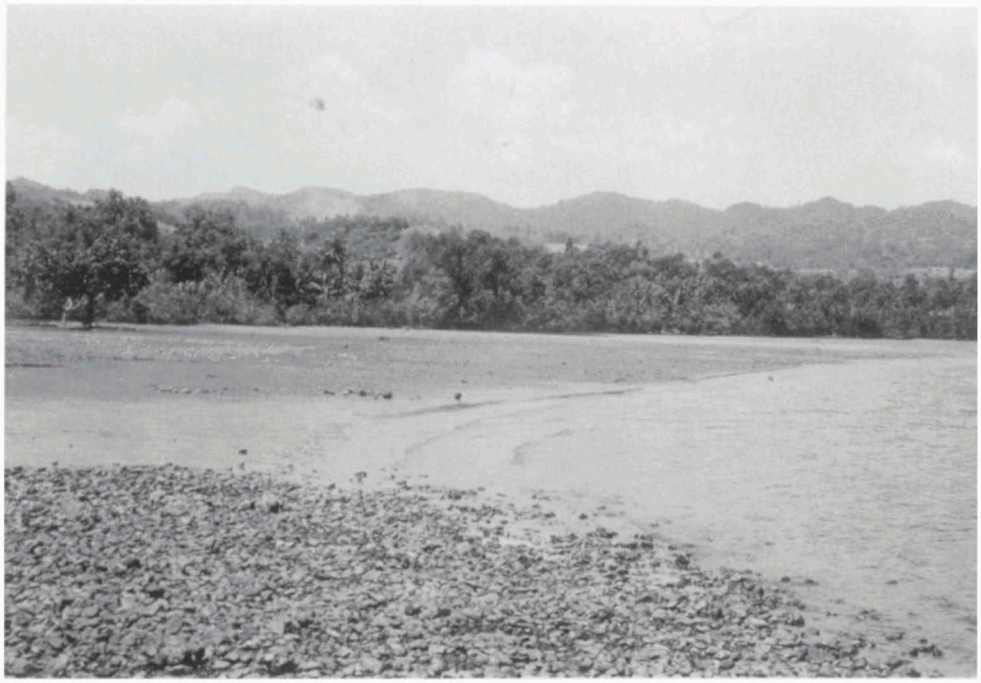


Fig. 24. Station 18: in front of the vilage of Tawiri the pebble beach is substituted by a sandy beach. On the background a small mangrove forest can be seen.

The littoral zone consists of a relatively wide pebble beach with scattered larger stones. To the north (in front of Tawiri) there is a wide sandy beach. Here a small river flows into sea and around the muddy river-mouth there is a 2.5 hectare mangrove forest.

The sublittoral zone is gradually sloping, and characterized by coral rubble, many stones and rocks covered with a thin layer of silt.

Station 19: Hitu, cascade near Hulung; 19.xi.1990 (fig. 25).

About 1 km off the road, near the village of Hulung, a beautiful small cascade can be reached climbing down a high and steep descent. Some collecting was done in the shallow rocky basins near the cascade.

Station 20 (R): Hitu, Hitulama; 20.xi.1990 (fig. 26).

The intertidal zone consists of a reef-flat with boulders of dead coral, and sandy areas with many shallow pools, several covered with seagrass. To the west there is a sandy beach.

Subtidally there is a slope covered with a 20 cm thick layer of coral rubble. Only few areas with living coral were observed.

Station 21 (R): Hitu, Mamala; 21.xi.1990 (fig. 27).

The intertidal zone is rather characteristic for all localities we visited on the North coast of Hitu, and consists of a rather wide sandy beach and reef flat with

Fig. 25. Station 19: the author sampling one of the basins of a cascade near Hulung.

Fig. 26. Station 20: the intertidal zone of Hitulama.

Fig. 27. Station 21: the intertidal zone of Mamala.

coral boulders.

The sublittoral zone is gently sloping and has a sandy bottom with scattered coral boulders and stones.

Station 22: Hitu, River-mouth Mamala; 21.xi.1990.

On Mamala beach a small river flows into sea. The bottom of the river-mouth is densely covered with pebbles and stones.

Station 23 (R): Hitu, Kaitetu (near Hila); 22-23.xi.1990 (fig. 28).

The tidal zone with many pebbles and blocks of dead coral, covered with a thin layer of silt.

Subtidal zone gently sloping, with stones and coral on sandy bottom. From about 15 m depth on mainly sand, with an occasional coral formation.

Station 24: Hitu, Wakal; 22.xi.1990.

A concrete drainage along the road, with running fresh water in it.

Station 25: Hitu, 3 km West of Kaitetu; 22.xi.1990.

Terrestrial collecting site between supralittoral zone and the road, under bed of dead leaves.

Station 26: Hitu, 4 km West of Kaitetu; 23.xi.1990 (fig. 29).

Wide beach with reef-flat with many large blocks of dead coral and stones. Just

Fig. 28. Station 23: the intertidal zone of Kaitetu.

Fig. 29. Station 26: the intertidal zone 4 km West of Kaitetu.

beneath low water mark there are patches of white sand and scattered coral blocks.

Station 27 (R): Leitimur, Hutumuri; 26-27.xi.1990 (figs 30-31).

A rather diverse locality. From west to east the area changes from a wide sandy flat with blocks of dead coral via an area covered with pebbles (fig. 30), to a coral reef-flat with pools, stones, patches of sand and seagrass, and ending at a steep rocky cliff called Tg. Hutumuri (fig. 31).

Sublittorally there is a reef with deep crevices which is merging into a flat rocky bottom with large rock formations. Below 10 m there is a steep drop-off to over 40 m depth. But in some places the descent was less steep and the bottom covered with white sand and scattered coral.

Station 28: Ambon Bay, in front of Paso; 28.xi.1990.

A few hauls were done with a small dredge at about 10 m depth on muddy bottom.

Station 29: Hitu, between base camp and Nania; 28.xi.1990.

A few hauls were executed with a small dredge at 8-12 m depth on muddy bottom.

Station 30 (R): Hitu, Suli; 29.xi.1990 (fig. 32).

Intertidally there is a long sand beach. To the west there are some scattered rock formations.

Subtidally a very gently sloping sand flat with locally some stretches with seagrass and scattered coral formations. Greatest depth about 7 metres.

Fig. 30. Station 27: pebble beach in front of Hutumuri.

Fig. 31. Station 27: rocky outcrop marking the eastern-most visited area of Hutumuri.

Fig. 32 Station 30: beach of Suli, with limestone rocks.

Station 31: Leitimur, Amahusu; 1.xii.1990.

Sublittoral zone down to 3 m depth with large rocks, merging into a sandy bottom with very few stones. Between 3 and 5 m mussel-beds do occur. The drop-off is gradual, becoming steeper at greater depth.

Station 32: Hitu, in front of Hunut; 1.xii.1990.

Several hauls were executed with a small dredge at 12-17 m depth on muddy bottom.

Station 33: Hitu, in front of base camp; 1.xii.1990.

A few hauls were executed with a small dredge at 20-23 m depth on muddy bottom.

Station 34 (R): Hitu, Rumahtiga; 3 & 5.xii.1990 (fig. 33).

The intertidal zone consists of a wide sandy beach, with stretches covered with pebbles and stones.

Subtidally there is a gently sloping sandy flat; to the west there is an area with some coral. Diving and snorkeling was done to a depth of about 6 m.

Station 35 (R): Hitu, Tg. Martafons; 4.xii.1990 (fig. 34).

Littoral zone rather diverse. To the south, near the beacon, there is a steeply sloping, narrow beach with many small stones. To the north there is a small cove where the ferry moors; here the area becomes muddier, and a few metal shipwrecks lie on

Fig. 33. Station 34: the intertidal zone of Rumahtiga.

Fig. 34. Station 35: muddy cove at Martafons.

the beach. On the other side of the cove there is a reef-flat with smooth stones and blocks of dead coral. This area is characterized by an abundant growth of sponges. About mid-littoral there is a rather large area covered with seagrass.

The sublittoral zone consists of muddy sand with stones and blocks of coral. Here too the abundance of sponges is remarkable. The beacon is densely covered with invertebrates and is situated on a steep slope, with a sandy bottom somewhat littered with rubbish.

Station 36 (R): Baguala Bay, Paso; 5.xii.1990 (fig. 35).

A very wide flat of sand and/or mud, with only few scattered stones. To the south-west there are areas with rocks and stones. This is also the area were a plywood factory is located.

Station 37: Hitu, west-side Laha; 6.xii.1990.

The intertidal zone consists of a sand beach with few smooth stones.

Up to a depth of about 3-4 metres the sandy bottom is variegated with patches of coral; a little deeper there is a rather steep, stony slope with a coral formation at 7 m depth. To the south-west the stones on the slope are replaced by mud.

Station 38: Hitu, North of Tengah-tengah; 8.xii.1990 (fig. 36).

The intertidal zone consists of a small sandy beach and a ca. 40 m broad, rather exposed area of rock-flat with tidal pools.

The sublittoral zone consists of small patches of reef and solitary coral boulders on a coarse sandy bottom, gradually sloping to a depth of ca. 15 m.

Fig. 35. Station 36: the intertidal zone of the Baguala Bay side of Paso.

Fig. 36. Station 38: the intertidal zone of Tengah-tengah.

Station 39 (R): Hitu, south-side Larike up to and including Batu Suangi; 8-9.xii.1990 (figs 37-38).

In front of the village Larike the rather exposed littoral zone consists of large smooth boulders (fig. 37), to the South these are replaced by solid rock formations. The rock Batu Suangi (fig. 38), which Rumphius described as "Het Suikerbroodje" (The Sugarloaf), is partly surrounded by a 5-10 m wide flat rocky platform.

The sublittoral zone near the village is made up by stretches of rock with wide crevices covered with large stones. The area near Batu Suangi consists of sand with isolated rock formations.

Station 40: Hitu, 1 km north-east of Lilibooi; 9 and 12.xii.1990 (fig. 39).

The intertidal zone consists of solid rock cliffs and small, narrow, pebble and coarse sand beaches.

Sublittorally the bottom is covered with rocks and coral formations, gradually sloping to about 30 metres depth.

Station 41 (R): Hitu, in front of Rumahtiga up to river Lela; 10.xii.1990.
Dredging, sandy bottom, 4-28 m depth; 6 hauls.

Station 42*: Leitimur, in front of Wainitu; 11.xii.1990.
Dredging, muddy sand bottom with many sponges, 4-20 m depth; 2 hauls.

Station 43: Hitu, in front of Poka (PSL building); 11.xii.1990.
Dredging, muddy sand bottom, 4-6 m depth, 2 hauls.

Fig. 37. Station 39: large smooth boulders characterize the intertidal zone of Larike.

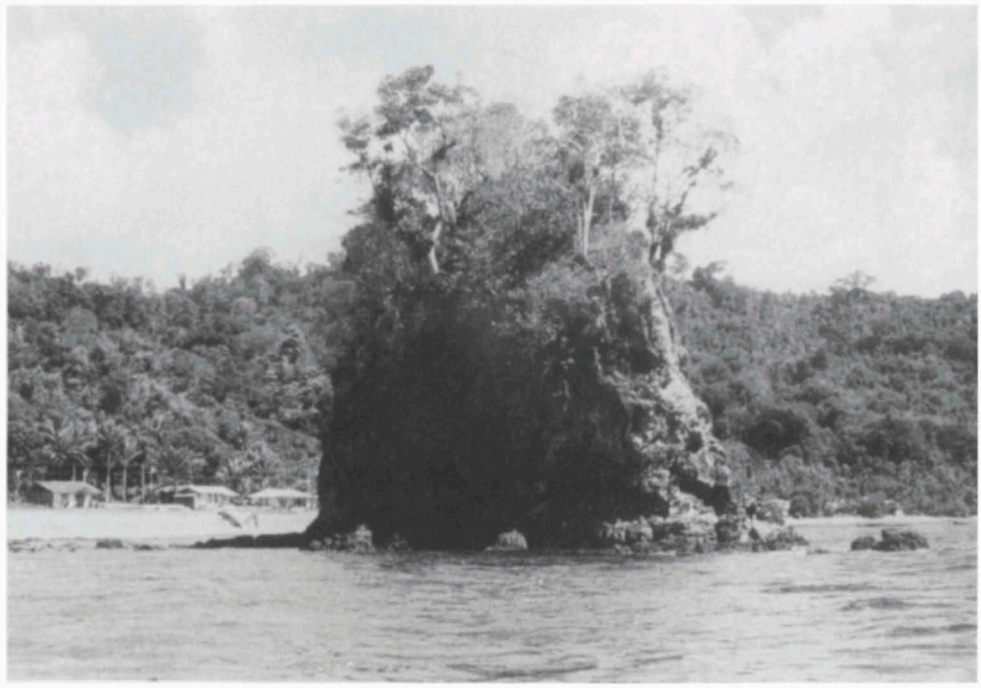


Fig. 38. Station 39: the rock Batu Suangi near Larike, which Rumphius called "het Suikerbroodje" (the Sugarloaf).

Fig. 39. Station 40: the beach 1 km north-east of Lilibooi.

Fig. 40. Station 44: intertidal rocky flat at Latuhalat.

Station 44: Leitimur, Latuhalat; 12 and 18.xii.1990 (fig. 40).

The intertidal zone consists of a rocky flat which makes a steep drop of about one metre near the low water mark. To the West there is a sand beach protected by a limestone ledge which emerges during low tide.

Subtidally there are many rock and coral formations.

As the majority of the material collected by the author during the pre-expedition working visit to Ambon in 1989, was donated to the Nationaal Natuurhistorisch Museum (Leiden), the following data could be of interest. To discriminate the following station numbers from those of the 1990 expedition, each number is preceded by the an S (= Strack). The localities marked (*) were not sampled during the official expedition. Sampling was done in the intertidal zone and by snorkeling.

Station S1 : Hitu, Rumahtiga; 2/3.x.1989.
Station S2 * : Hitu, Liang; 5.x.1989.
Station S3 : Bay of Baguala, Paso; 6.x.1989.
Station S4 : West-side Pombo Island; 8.x.1989.
Station S5 * : Leitimur, ca. 3-4 km North East of Hutumuri; 9.x.1989.
Station S6 * : Leitimur, Tg. Hatiari (East of Aerlou), 9.x.1989.
Station S7: : Leitimur, Nusaniwe, 9.x.1989.
Station S8 * : Hitu, Tg. Setan (North East of Morela); 10.x.1989.
Station S9 * : Hitu, Telehu; 12.x.1989.
Station S10 : Hitu, Poka; 16.x.1989.
Station S11* : Pulau Tiga (= Drie Gebroeders), Hatala Islet; 16.x.1989 (fig. 41).

Fig. 41. Station S11: sheltered cove of Hatala Islet.

Fig. 42. Station S12: sheltered cove of Lain Islet.

Station S12* : Pulau Tiga (= Drie Gebroeders), Lain Islet; 16.x.1989 (fig. 42).
Station S13 : Hitu, Larike (in front of Fort Rotterdam); 16.x.1989.
Station S14 : Hitu, Kaitetu (near river); 20.x.1989.
Station S15* : Hitu, ca. 2 km West of Wakal; 20.x.1989.
Station S16 : Hitu, Hitulama; 20.x.1989.
Station S17 : Leitimur, Latuhalat; 26/31.x.1989.
Station S18 : Leitimur, Wainitu; 30.x.1989.

Journal of the expedition

On 31 Oktober, having finished all official matters in Jakarta, I went to Ambon to meet Dr. C. Hey who had made many arrangements on behalf of the expedition. During the next few days the necessary additional arrangements were made. The 4th of November the Dutch expedition members were met on the airport.

The next day a marine biological seminar ("Seminar Sehari Biohistoris Rumphius") was organized by and held at Universitas Pattimura. The seminar marked the official start of the expedition and served to inform the local scientific community about our project and work. The expedition team contributed four lectures: "Life and work of

Fig. 43. Den Hartog, Staats and Van Egmond collecting in front of Batumarah.

Rumphius" (Backhuys), "Historical survey of marine biological expeditions to Ambon and the aims of the Rumphius Biohistorical Expedition" (Strack), "Taxonomy and biology of Anthozoa with emphasis on sea-anemones" (Den Hartog), and "Caridean shrimps associated with reef-organisms" (Fransen).

6 November. Necessary formalities with the local authorities were combined with a visit to the colourful old pasar (market) of Ambon town. Between the many different kinds of fruits, vegetables and fish, we did not detect any of the invertebrates described by Rumphius. In the afternoon we tested our equipment, and some first collecting attempts were made on the shore near the base camp.

Serious field-work started on 7 November. Lavaleye made a bad start as he had fallen ill and could not come with us.

It was our intention to sample the "unattractive" (often muddy and polluted) localities near Ambon town first. Although there was no formal division of the team, for practical reasons it was often split into a diving and a shore (intertidal and snorkeling) party. Today Van Egmond, Fransen, Den Hartog, Kolvoort and Staats went diving and snorkeling around Batumerah (fig. 43), while the others (Backhuys, Fortuin, Hatta, De Jong, Arafin and Strack) went sampling the intertidal zone of Wainitu. Although the water was murky, the beach muddy, and both beach and water were

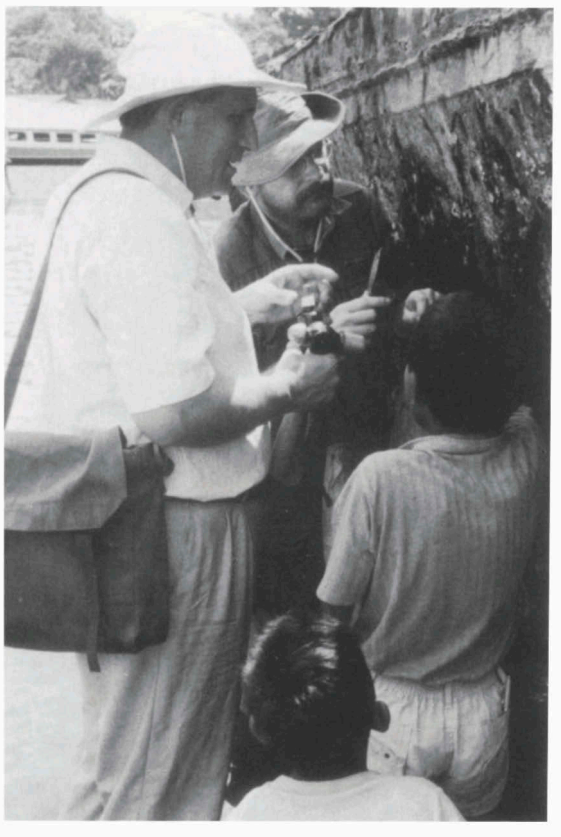


Fig. 44. Backhuys and De Jong sampling invertebrates from the hull of a shipwreck on the beach of Wainitu.

polluted by human excrements, animal life in both localities was rich beyond expectation. Shipwrecks lying on the beach of Wainitu was scrutinized (fig. 44). Everyone had a successful day, except Staats, who had a hard time keeping the badly leaking wooden prahu afloat.

8 November. Again we collected near Ambon town at Wainitu and Benteng. The divers came up with some beautiful ghost pipefishes [*Solenostomus paradoxus* Pallas, 1770)] and colourful seasquirts (Ascidiacea). These seasquirts were checked for commensals and were found to contain several small shrimps (*Pontonia katoi* Kubo, 1940), amphipods and one bivalve (*Musculus* spec.). In shallow water De Jong and I collected many living tusk shells (Dentaliidae) from clean sand at Benteng (Galghoek), and empty shells of the large, green *Dentalium elephantinum* Linnaeus, 1758 were found commonly in Wainitu. Rumphius (1705: 125-126) recorded Dentaliidae from exactly the same two localities.

After having returned to the base camp the routine of sorting, preserving and labelling the specimens, used to keep us busy for the next few hours. For this purpose a large wooden table was set in the garden (fig. 45). Photographing the many smaller invertebrates was done inside. Lavaleye who did most of the macro photography, often continued working long after all had gone to sleep (fig. 46).

9 November. As the fauna of the rather polluted stations near Ambon town had proven so rich, it was decided to visit Batumerah and Benteng again. Although the underwater visibility was bad, the abundant and large colonies of soft corals, with diameters of one meter or even more, could not be overlooked. Pipefishes [*Dunckerocampus dactyliophores* (Bleeker, 1853)], and sea-anemones with symbiontic fishes and shrimps (*Periclimenes brevicarpalis* Schenkel, 1880) were common. Den Hartog collect-

Fig. 45. Sorting, preserving and labelling specimens in the base-camp's garden.

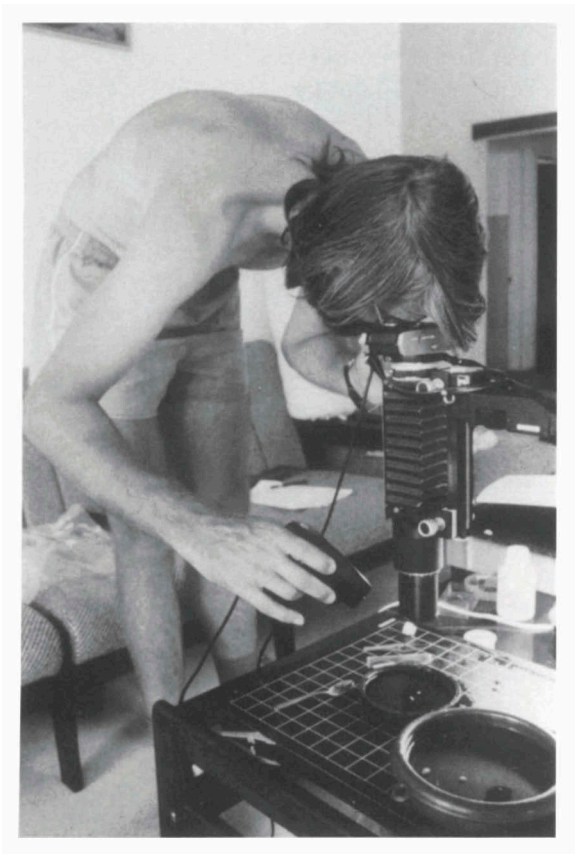


Fig. 46. Lavaleye photographing specimens from our latest catch.

ed a number of large sea anemones and already foresaw storage problems. Sailing home across the bay to the base camp we saw flocks of Red-necked Phalarope (*Phalaropus lobatus* Linnaeus, 1758) resting on the water, and we were badly surprised by the large rafts of discarded plastic in which the propeller of our outboard motor repeatedly got entwined.

10 November. The shore party went by car to the small river Batugajah near Ambon town and walked along and through the shallow water upstream. We were completely surrounded by the youth of the nearby kampong, which helped us enthusiastically catching freshwater crabs and snails. Afterwards we collected at the concrete quay in front of fort Victoria (fig. 15). Although this station is much polluted by the city sewers and oil spills of the ships in the harbour, several molluscs (*Siphonaria*, *Vermetus*, *Littorina*) were found in considerable numbers. Rumphius (1705: 38) wrote that there were flat beaches in front of fort Victoria, but nowadays only a very narrow strip of sand remains. Of all localities mentioned by Rumphius this is the one which has been most affected by recent changes. Not only its physical appearance has been altered, but the composition of the fauna also changed considerably. In the afternoon the same party visited the tidal area near Poka. In knee deep water many gastropods (*Cerithium*) and sand-dollars [probably *Arachnoides placenta* (Linnaeus, 1758)] were collected on the

sandy bottom. Higher up in the intertidal zone, among the mangrove trees, the area abounded in fiddler crabs (*Uca* spec.) and small colourful snails (Neritidae).

The diving party collected with good results at Benteng (Galghoek). The strange, inflated cushion starfishes (*Culcitta* cf. *novaeguineae* Müller & Troschel, 1842) were regularly seen here (fig. 47). Two interesting species of Corallimorpharia, *Metarhodactis* spec. and *Amplexidiscus fenestrafer* (Dunn & Hamner, 1980) were found.

11 November, Sunday. The Sundays were intended as days of rest, but due to the enthusiasm of the team and the tempting rich marine fauna this intention was seldom kept. As we also wanted to see something of the tropical forest, which covers large parts of the island, we walked along the river Lela, which flows into sea near Rumatigah. A bunch of local kidds were carrying a freshly killed, 3 metres long Python. The animal was caught while swimming downstream that morning, and was already skinned when shown to us. Upstream many freshwater molluscs were collected, among which was *Neritina pulligera* Linnaeus, 1758, with its egg hulls attached to the shells, exactly as described by Rumphius (1705: 76-77, pl. 22, fig. H). Also shrimps with very large claws (*Macrobrachium*) were caught, but the most remarkable catch that day was the shell-less freshwater snail *Acochlidium amboinense* Strubell, 1892 (pl. 4 fig. 3).

12 November. With two boats the expedition team went sampling at Cape Nusaniwe, the first "clean" and exposed locality situated at the entrance of Ambon Bay. The water here was very clear and the rather flat and bare coral reef demonstrated the exposed character of this locality. Several giant clams [*Tridacna maxima* Röding, 1798)] were collected, one of which contained 3 commensal shrimps (*Auchistus miersi* (De Man, 1888) and *A. deseani* Kemp, 1922). The most appealing find was a boxer crab [*Lybia tes-*

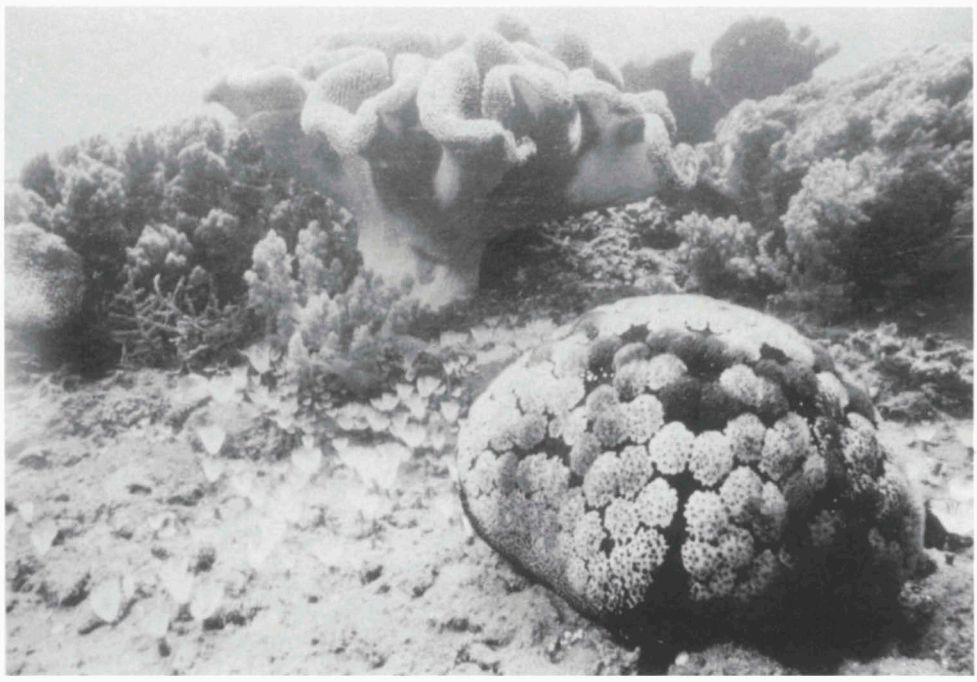


Fig. 47. Cushion starfish *Culcitta novaeguineae* Müller & Troschel were common in Benteng.

sellata (Latreille, 1812)], that had two tiny sea-anemones (presumably juvenile *Triactis producta* Klunziger, 1877) in its claws for protection.

13 November. The divers went with our bus to Tial (St. 15). This locality is situated at the shallow Baguala Bay. The beach is so gradually sloping that it took a long swim before a depth of about 4 metres could be reached. On the sandy bottom a large helmet shell [*Cassis cornuta* (Linnaeus, 1758)] was found. Although local inhabitants informed us that this species was common in Baguala Bay, we did not succeed finding other specimens during the expedition. The shore party took the wooden prahu and sailed to the largest (ca. 5 ha) mangrove forest of Ambon, which is situated at the dead end of the inner Ambon Bay. Besides many mollusc species usually found in muddy mangrove environments, large clumps of very flat, circular oysters appeared to be common. Deeper into the mangrove forest the Nipa palm (*Nipa fruticans*) with its peculiar fruit, as large as a man's head, substituted the mangrove trees. Int the upper tidal zone, under wood, Lavaleye was surprised finding a small brown shrimp [*Merguia oligodon* (De Man, 1888)], which apparently can support prolonged periods outside water. When the tide was fully out, thousands of fiddler crabs (*Uca* spec.) crept out their holes in the more sandy mud flats, and started their ritual waving with their enlarged right claws.

14 November. During a visit to the market I was fortunate enough to purchase

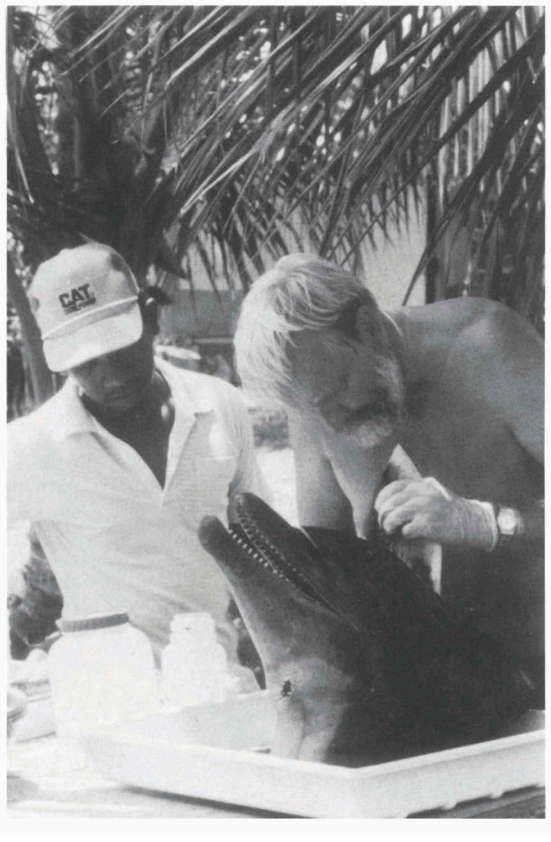


Fig. 48. Staats preparing the head of a dolphin (*Tursiops aduncus* Ehrenberg).

the head of a dolphin (*Tursiops aduncus* Ehrenberg, 1832) for 5000 rupias (about US $ 3). I was told that dolphins are occassionally caught by fishermen and that the Chinese eat them. The presence of Staats came in handy as he skilfully converted the head into a skull (fig. 48). The lower jaw disappeared mysteriously, but several days later it was returned even more mysteriously, and the following day even the last three missing teeth turned up again.

Except for Kolvoort, who went diving near Tial, the whole team again collected in the mangrove forest near Paso. In decaying wood of the Nipa palm, living specimens of the pulmonate gastropod *Ellobium aurisjudae* (Linnaeus, 1758) were collected. Crawling on the muddy bottom of small shallow channels specimens of the Opistobranch gastropod *Haminoea* spec. were found in large numbers, and burried in the mud a species of the sea-anemone family Edwardsiidae also proved to be quite common.

In the afternoon we packed for a three days stay at the islet of Pombo, and a boat full of equipment was send in advance. Our last dinner before leaving offered a real gourmet's surprise as Tin served us (amongst others) fried, fat larvae of a longicorn beetle (Cerambycidae), that live inside sago palms (fig. 49).

15 November. In two groups we went by car to Waai on the east coast, from where it is only about half an hour by boat to the Islet of Pombo. The islet recently got the status of nature reserve, and after collecting a permit and going through the necessary formalities at the police station near Waai, we headed directly towards Pombo. The narrow, elongated islet is densely grown with trees and has a beach of white sand on the west side. On this side there are a few simple wooden lodges in which we could sleep, although many preferred to sleep in the open air. Since the

Fig. 49. "Dinner is served". The larvae of a longicorn beetle living in Sago Palms.

status of nature reserve was received, it has been policy to eliminate introduced house cats, which used to form a serious hazard for the bird and reptile populations. Nevertheless we still spotted one feral cat. Everywhere on the islet were small hermitcrabs (*Coenobita* spec.), which even climbed into trees. The islet derived its name from the presence of large black and white doves (Pombo meaning dove). But other birds too seek refuge here, like the many white reef herons. After we set up camp, the west side of the islet was thoroughly sampled. Remarkable were the clumps of large honeycomb oysters [*Hyotissa hyotis* (Linnaeus, 1758)].

16 November. We woken up early by small mosquitos, which apparently were only active in the early morning. The shore party worked at the east side of the islet, were an extensive sand and coral rubble flat emerges at low tide. When breaking blocks of dead coral in the intertidal zone a rich fauna was reveiled. Near low water mark, the gastropod *Vasum turbinellum* (Linnaeus, 1758), mentioned by Rumphius from Pombo, was very common. Den Hartog found an aggregation of ca. 80 individuals of the large and extremely painfully stinging *Phyllodiscus semoni* Kwietniewski, 1898 (fig. 50), a rare species of Actiniaria described and exclusively reported from Ambon.

Tin kept cooking our diner, and every night it was driven to Waai and then

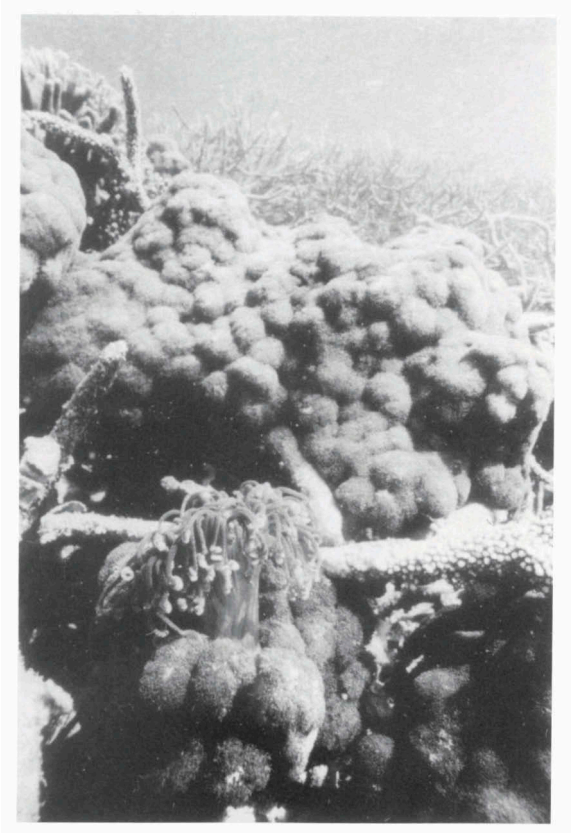


Fig. 50. Cluster of the rare sea-anemone species *Phyllodiscus semoni* Knietniewski. All specimens but one have their tentacles retracted.

shipped to Pombo. Admittedly somewhat time consuming, but we simply couldn't do without Tin's masterly dishes!

17 November. Because of its rich fauna the east side was visited again by Lavaleye, De Jong and Strack, while the divers kept mostly at the west side. I discovered a very local but rich habitat for chitons, my favorite group, and therefore completely forgot to watch my camera which was flooded by the incoming tide. A remarkable find were the egg capsules of the mollusc *Cymbiola (Aulicina) vespertillio* (Linnaeus, 1758) (fig. 51). Rumphius (1705: 104, 107, pl. 32, fig II) was the first to describe and figure the egg capsules of a member of the Volutidae. According to Rumphius the inhabitants of Boeton (= Butung, an island south-east of Sulawesi) put the shell of *C. vespertillio* under the pillows of their children and believed it prevented them having nightmares. It was therefore named Bia mimpi (dream shell). But one of the most remarkable discoveries was made by Fransen, who cut open several sea-cucumbers found in seagrass beds. In a cyst in the resperatory tree of one of the sea-cucumbers (probably *Holothuria (Metriatyla) scabra* Jaeger, 1833) he found a relative large crab [*Hapalonotus reticulatus* (De Man, 1879)] (pl. 2 fig. 1). Although at that time this association was unknown, it was recently described by Vandenspiegel et al. (1992). Our impression is that Pombo is one of the richest marine localities of Ambon.

We left Pombo in the afternoon and by one o'clock the islet regained its peace.

Fig. 51. Egg capsules of the gastropod species *Cymbiola (Aulicina) vespertillio* (Linnaeus).

Just before dark the boat with equipment, that had to sail around the peninsula of Leitimur, arrived safely at the base camp.

18 November, Sunday. Since our arrival weather conditions were excellent, but we were informed that this was rather unusual, and that normally it rained more often in the month November. The day was used to sort and store the material collected at Pombo properly. While cleaning the large *H. hyotis* oysters we found a pair of slender white fishes [*Onuxodon parvilsrachium* (Fowler, 1927)] in each oyster we opened (fig. 52). Only Backhuys found some time to collect new samples. From a humus and leave litter sample, collected near the base camp, he sieved many small landsnails. Among them was a bizarre, endemic species *Ditropis ingenua* Boettger, 1891 (figs. 53-54).

19 November. Collecting was done around Laha, near the Pattimura airport. Here, at about 2 meter depth, a large area is literally covered with mushroom corals (*Fungia* spec.) (fig. 55). These corals were searched for parasites and commensals. The undersides were checked for wentletraps (Epitoniidae), of which several were found. Between the tentacles of other mushroom corals [*Heliafungia actiniformis* (Quoy & Gaimard, 1833)] small pipefish (*Siokunichthys nigrolineatus* Dawson, 1983) were seeking shelter. In the afternoon Kolvoort, De Jong and I paid a visit to a small cascade near Hulung. In the evening Kolvoort had to consult a doctor, as for several days his ears were troublesome. Much to his dislike the doctor advised him not to dive for at least a week.

20 November. With our bus, and a supplementary Toyota landrover the whole team was transported across the Hitu peninsula to the north coast. Here the hills are quite steep, and the road is winding along the mountain ridge. On the north side the

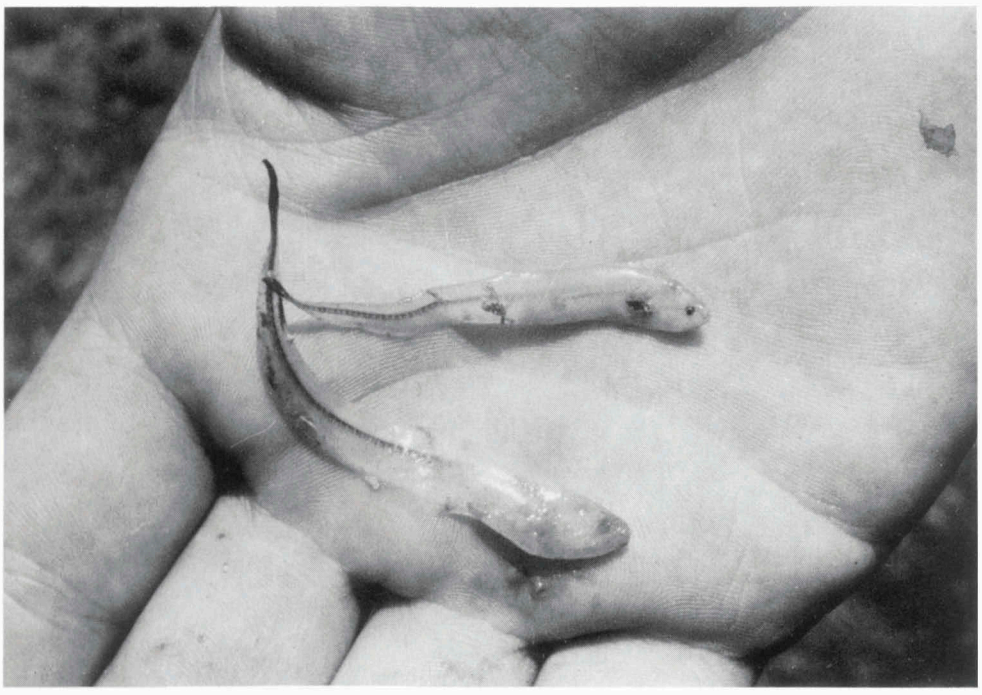
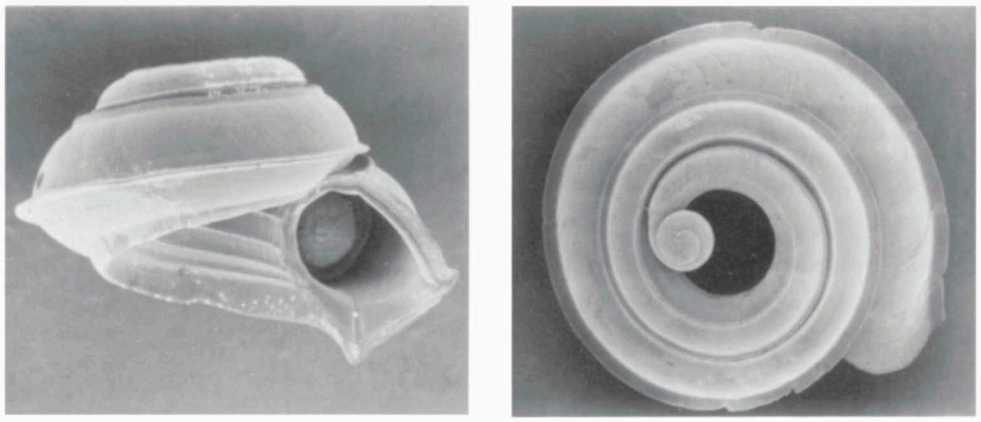


Fig. 52. *Onuxodon parvilsaachium* (Fowler) lives in the large oyster *Hyotissa hyotis* (Linnaeus).



Figs 53. & 54. The bizarre landsnail *Ditropis ingenua* Boettger. Fig. 53. lateral view, fig. 54. dorsal view.

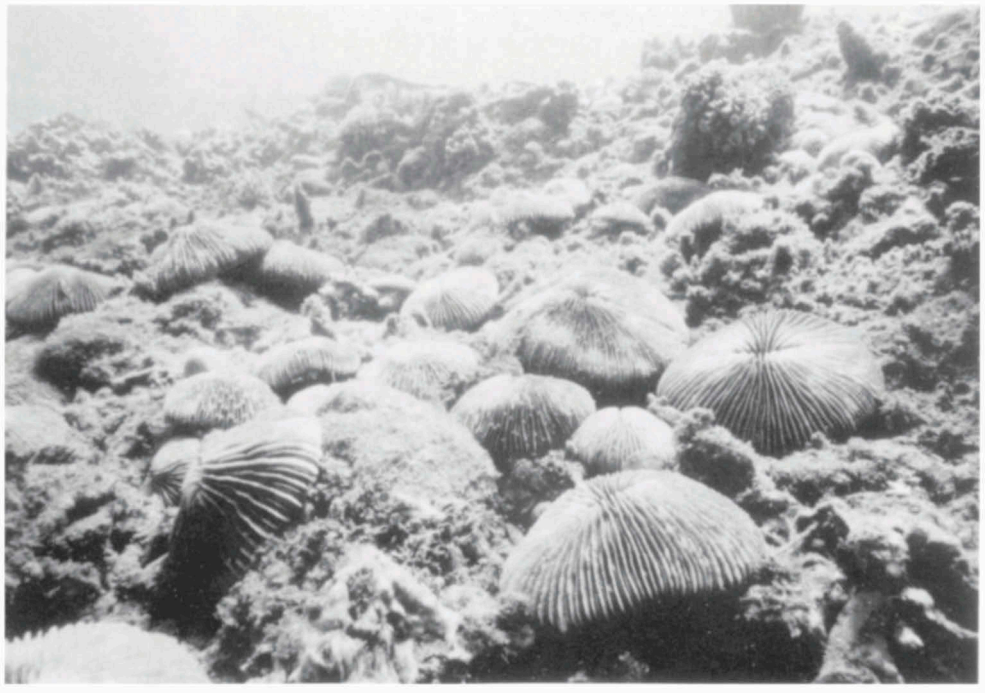


Fig. 55. At Laha the sea-bed is locally covered with mushroom corals (*Fungia* spec.).

descent was even steeper and we had a nice view over the coast in the direction of Mamala. At Hitulama the wide beach has large tidal pools where ca. 1 meter long sticky undulating seacucumbers (Synaptidae) were living. Comb stars (*Astropecten* spec.), barely covered by sand, were common and mostly infected by parasitic snails (Eulimidae). Here, as in many other places, many children helped us enthusiastically in collecting shore animals. A large sea hare (*Dolabella* spec.), probably the same

species as described and depicted by Rumphius (1705: 38, 123, pl. 10, fig. 5), was extracted from a large block of dead coral at low water-mark. A few shells of *Nautilus pompilius* Linnaeus, 1758 were purchased from fishermen. Only during my pre-expedition visit I had the good fortune to obtain a live specimen, caught on a fishing line near Liang. The divers came up with a 30 cm large specimen of *Tridacna squamosa* Lamarck, 1819 (fig. 56), and of course Fransen found that it housed a commensal shrimp (*Anchistus australis* Bruce, 1977).

21 November. Today collecting was done at Mamala, another north coast village. On our way to this village we had to drive carefully over the many nutmegs, which the local inhabitants use to dry on the middle of the road. In Mamala the tidal zone is even more extensive than at Hitulama. Many jelly fishes of the genus *Cassiopea* lay on the sandy bottoms of large tidal pools, pulsating in their characteristic upside down position. Tin had the evening off, as we and Bishop Sol were invited for dinner at Cees Hey's.

22 November. Again we visited the north coast, but this time we went westwards to Kaitetu, the sister-village of Hitu. Before reaching Kaitetu we made a short stop to see the production of the sago flower, which is still done in the traditional way (fig. 57). Kolvoort could not refrain from diving again and headed for the water, loaded with

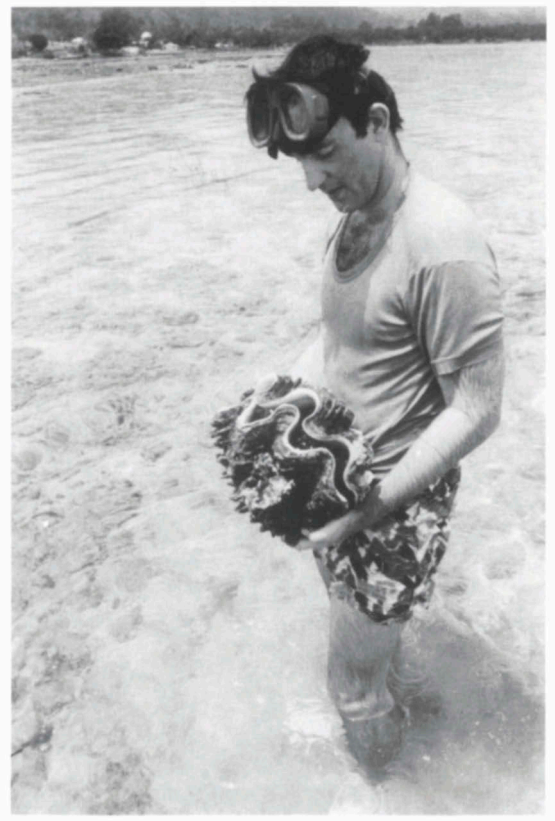
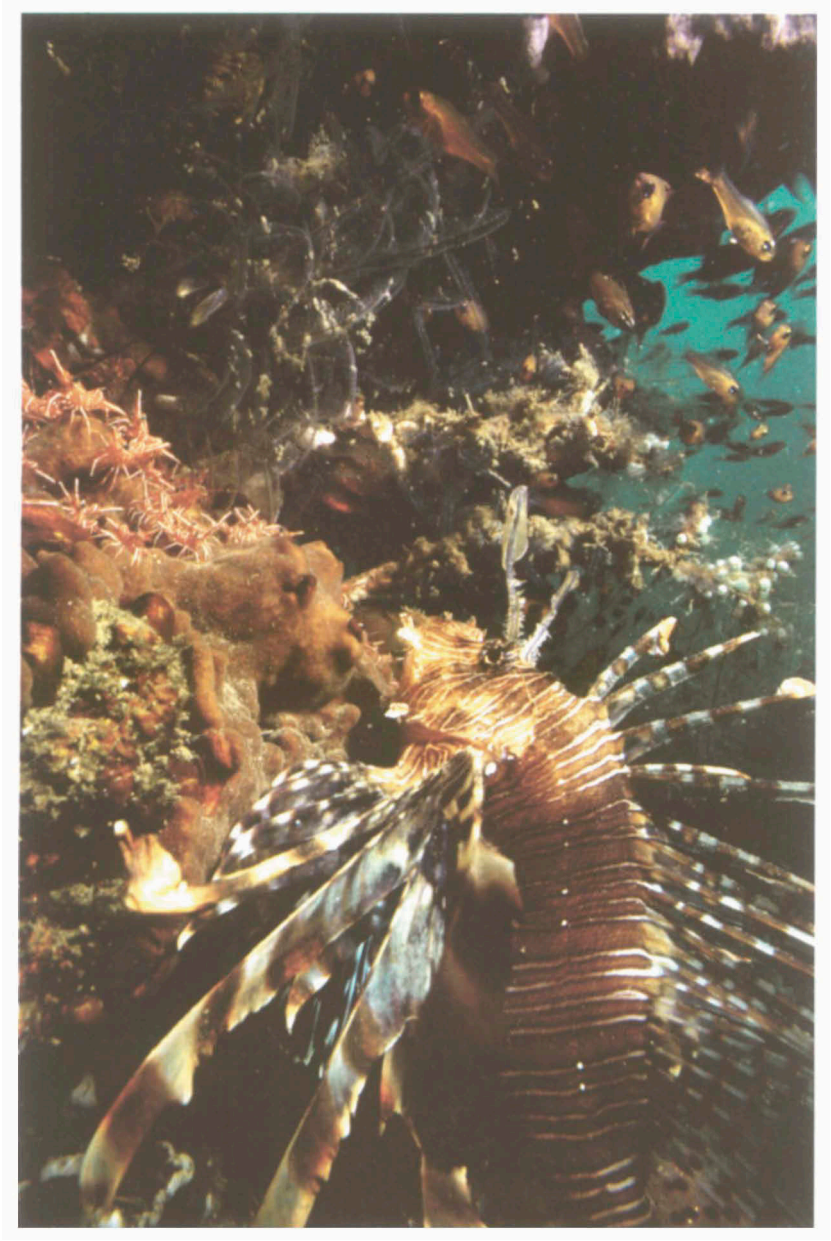


Fig. 56. The author landing a large specimen of *Tridacna squamosa* Lamarck collected by Fransen in Hitulama.



Pl. 1. Lion fish *Pterois* spec. and shrimps *Rhynchocinetes uritai* Kubo, 1942.

cameras (fig. 58). In Kaitetu the divers found a rock with numerous cleaner shrimps (*Lysmata amboinensis* (De Man, 1888), *L. debelius* Bruce, 1983 and *Rhynchocinetes uritai* Kubo, 1942), and large fish patiently undergoing treatment (pl. 1). Sea pens (Pennatularia), which Rumphius described from this site, proved still abundant. A spider crab (*Cyclocoeloma tuberculata* Miers, 1880) was collected which had its carapace covered with

Pl. 2. Fig. 1. The crab *Hapalonotus reticulatus* (De Man, 1879) was found living in a sea-cucumber (probably *Holothuria (Metriatyla) scabra* Jaeger, 1833). Fig. 2. The crab *Dorippe quadridens* (Fabricius, 1793) carrying a sea-urchin for protection. An unexpected association.

corallimorpharian sea-anemones (*Discosoma* spec.) (fig. 59) (see Den Hartog, 1990). A large orange-red nudibranch, called spanish dancer [*Hexabranchus sanguineus* Rueppel & Leuckart, 1831)], had two very well camouflaged commensal shrimps (*Periclimenes imperator* Bruce, 1967) near its gills (pl. 3 fig. 1). In the evening Backhuys, Lavaleye and I paid a visit to bishop Sol, who showed us his famous library specialised on the Moluccas, including original copies of the books by Rumphius and Valentijn.

23 November. Today both Backhuys and Staats had to return to the Netherlands. The remaining team members revisited Kaitetu. About 4 km west of Kaitetu De Jong

Fig. 57. Sago flower production is still done in the traditional way.

Fig. 58. Kolvoort on his way to take more underwater photographs.

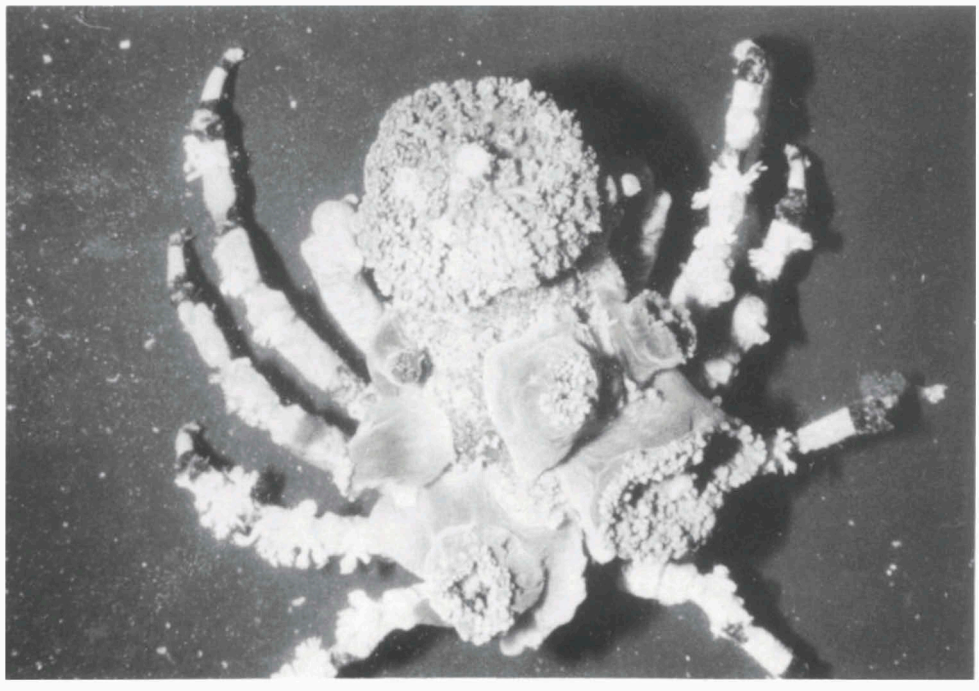


Fig. 59. The spider crab *Cyclocoeloma tuberculata* (Miers) had its carapace covered with corallimorpharian sea-anemones *Discosoma* spec.

and I collected about a dozen species of the gastropod genus *Terebra*, in very shallow water (about 1 m depth) by probing the sand between coral boulders with our hands. An exceptional find by Fransen was a basket star at only two metres depth. We were no longer surprized to find commensal shrimps (*Periclimenes lanipes* Kemp, 1922) living between the tangle of arms. On our way back we visited the oldest church of Ambon (1780), and the ruins of the ancient Portuguese/Dutch fort "Amsterdam" in the village of Hitu. The fort was of special interest to us, as Rumphius was stationed in Hitu when he was promoted first merchant. Undoubtedly he must have visited the fort frequently.

24 November. We went to Laha with two of the boats. The relatively short trip took us more than one hour and a half, because of the many floating plastic bags, which constantly got entangled in the outboard motor propellers. When collecting at Laha a local boy asked if we were interested in "Bia kodok", a name I knew Rumphius had used for a large bivalve of the genus *Polymesoda*, which lives in rather muddy areas. I was surprised to hear that the name was still in use here. The Malayan name means frog shell, because the animal makes a croaking noise when suddenly opening or closing its shell (Rumphius, 1705: 138-139 and Von Martens, 1902: 125). Our first and only (small) shark (*Atelomycterus marmoratus* Bennett, 1830) was caught here by Van Egmond. He managed to seize it with his bare hands while diving.

25 November, Sunday. This resting day was mainly used to tidy up our collecting gear and to range already collected material. Some of us visited the Siwalima Museum, which has an interesting collection of objects relating to Ambonese history and culture.

26 November. Via a bad road and a ramshackle bridge we reached the village of Hutumuri on the southeast coast of Leitimur. A concrete wall protects the village from the sea, which was very calm during our visit. Here the common cowry, *Cypraea annulus* Linnaeus, 1758, proved really abundant. In crevices of some pieces of dead coral as many as ten or more specimens were found. Having returned to the base camp we found Cees Hey waiting for us. He and Mr. C. Moeliker had just returned from the island of Buano, where they had searched for a rare species of fly catcher. Although the bird was not found, they brought along a coconut crab (*Birgus latro* Linnaeus, 1758). This large and spectacular land crab, which is highly praised for its meat, is now probably eradicated in Ambon, but perhaps small populations still survive in Ambon's satellite islets, Pulau Tiga.

27 November. Hutumuri was visited for a second time. On the rather flat coral reef, at 2 meters depth, Lavaleye found large *Trochus niloticus* Linnaeus, 1767 and many worm-snails (Vermetidae). The worm-snails were easy to spot, as they spin an extensive mucous web with which they catch their food. The night before we had heard a car break, and the howling of a wounded dog. Little did we think of it then, but when today dinner was served, Tin, our cook, surprised us indeed; the dog was hers and as she knew that we were eager to try all local dishes, she proudly served it to us in a spicy sauce.

28 November. Our dredge was tried for the first time in the inner bay (fig. 60). We caught many molluscs and 1.5 meter long, orange seacucumbers (Synaptidae). Between the many brown leaves, we spotted a peculiar, well camouflaged crab [*Trigonoplax unguiformis* (De Haan, 1839)], with a strangely flattened carapace and of the same colour as the leaves. The divers found two large *Pinna* shells in front of the base camp, and a shrimp [*Anchistus custos* (Forskål, 1775)] as well as a pea crab (Pinnotheridae) were found inside. Rumphius (1705: 25-26, 153) does mention this particular case of commensalism. He called the shrimps "Pinna guards" as he believed (and Plinius before him), that they pinched the *Pinna* to warn it against danger. They also would pinch the *Pinna* when a fish entered the shell, so that, once the valves had closed, it could be consumed by the *Pinna* and the shrimp. According to both Plinius and Rumphius this proved that emotions like friendship or love were possible between different sea animals.

29 November. Suli, a village situated on the north side of the Baguala Bay, has a gradually sloping beach like the nearby locality Tial. We found one specimen of the bivalve *Meretrix meretrix* (Linnaeus, 1758), a species mentioned by Rumphius from this locality. In seagrass fields the starfish *Protoreaster nodosus* (Linnaeus,) was found in large numbers (fig. 61). On the westside of Suli there are some scattered limestone rocks. Here chitons [*Acanthopleura spinosa* (Bruguière, 1792)] were hiding in deep crevices in the rock. Hammer and chisel were needed to collect a few specimens.

30 November. We snorkeled and dived near the base camp. Two enormous (25 cm) winged oysters [*Pteria penguin* (Röding, 1798)], containing shrimps (*Paranchistus serenei* Bruce, 1983), and several cylinder roses (Cerianthiidae) were species we had not collected before.

1 December. The divers, in search for a new, as yet unsampled type of habitat, had chosen a steep rocky coast at Amahusu in the outer bay. Unfortunately the drop off did not continue as deep as was hoped, but soon ended and was substituted by a

Fig. 60. Lavaleye dredging in inner Ambon Bay.

gradually sloping sandy bottom. In the afternoon we dredged again near the base camp at about 15 meters depth.

2 December, Sunday. It had not rained for a long time, but this night it looked as if the weather wanted to catch up. I was feverish and stayed all day in bed. In the morning the rest of the team did some collecting in Benteng, near Ambon town. The afternoon was used to do some sightseeing, and the trail to Soya di Atas, a small mountain behind Ambon city, was followed. Here one has a splendid view over Ambon Bay, and in the far distance our base camp was visible. In the mountains many flowers including orchids, and huge tree-ferns are growing. Large and brilliantly coloured butterflies were plentyful, but birds were less common as was hoped for.

3 December. De Jong, a little careless while collecting at Benteng the day before, woke up with huge blisters on his shoulders and arms. This did not prevent him from collecting in Rumahtiga, where we went using two of our boats. In this locality the shore consists mostly of bare sand and we did not expect to find much here. To our surprise we were quite mistaken. Crawling on the sand in very shallow water we found large quantities of olive shells (Olividae), a specimen of *Harpa major* Röding, 1798 with its enormous foot (fig. 62), and two large sand-dollars (*Echinodiscus auritus* Leske,) mentioned by Rumphius (1705: 37, pl. 14, fig. F). Furthermore box crabs

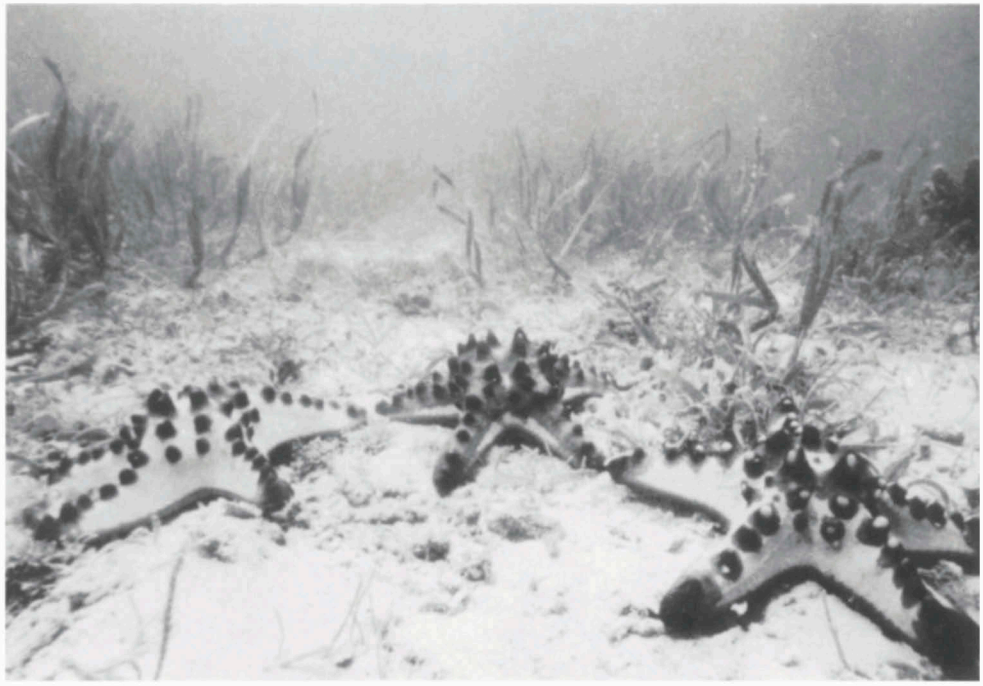


Fig. 61. Specimens of *Protoreaster nodosus* (Linnaeus) were very common in the sea-grass fields in Suli.

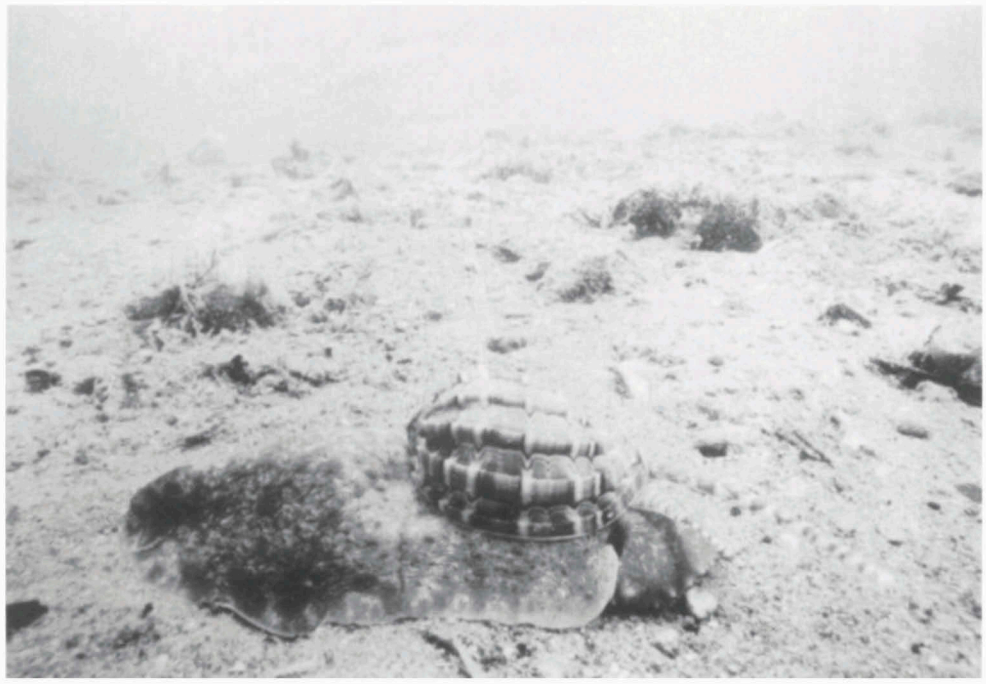
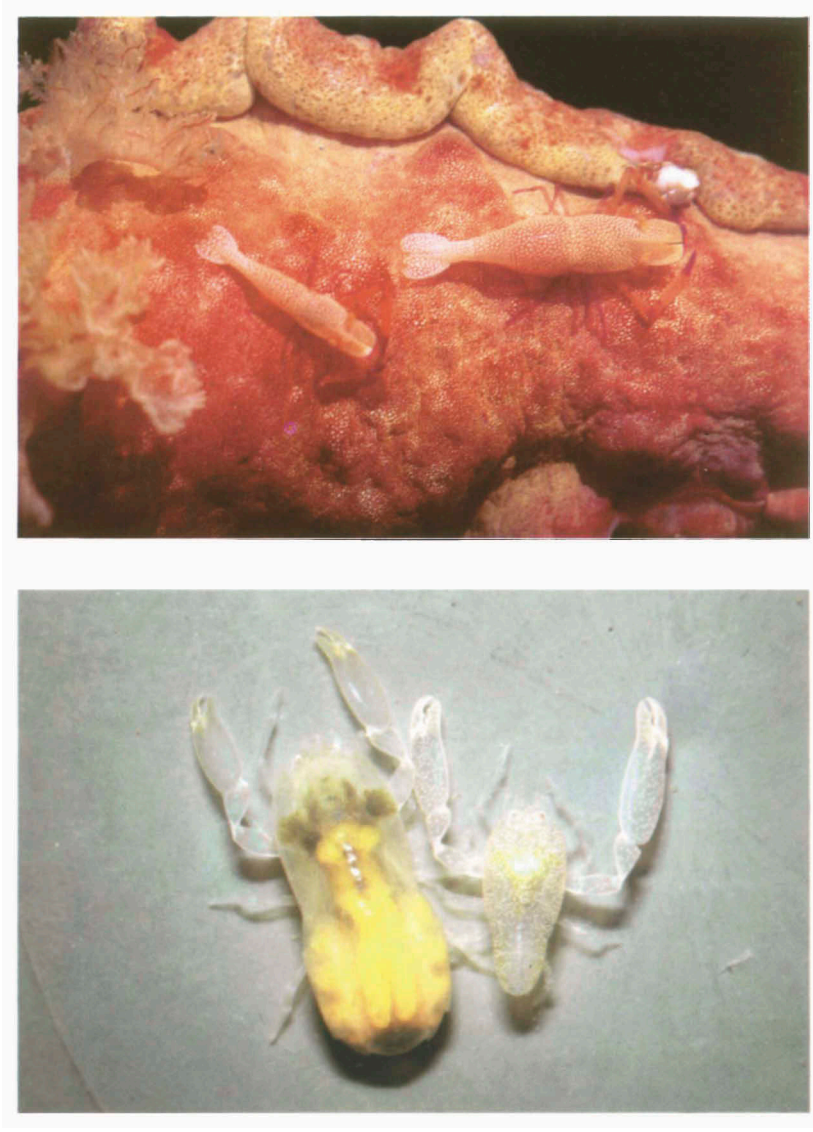


Fig. 62. *Harpa major* Röding crawling on its remarkably large foot.

(Calappidae) were quite common but difficult to catch. A little to the west, where a fresh water stream runs into sea, a large mussel bank felled dry, and several women were observed taking baskets full of them. Rumphius (1705: 151) called these "duck mussels" as people in Rumphius's days did not eat them, but gave them to the ducks or pigs; probably they are still in use as forage. The divers too had a successful day and were surprised by fast running sea urchins. A better look reveiled that crabs [*Dorippe quadridens* (Fabricius, 1793)], were running around with long-spined sea urchins, firmly held on their back with their specialised hind legs (pl. 2 fig. 2). They provided a very effective protection against predators, especially as the sea urchin's spines had a nasty sting (as I found out myself). This association is here recorded for the first time. In their revision of the Dorippinae, Holthuis & Manning (1990: 33) were still uncertain about the species or group associated with *D. quadridens*. One of the sea urchins that was dragged around by the *Dorippe* crab, also housed two species of shrimps (*Periclimenes hirsutus* Bruce, 1971, and *Tulearíocaris zanzibarica* Bruce, 1967), one species of swimming crab (*Lissocarcinus arkati* Kemp, 1923), and a parasitic gastropod species (Eulimidae)! Evidently associations can be very complex in tropical waters. A few large, strange looking, purple brown sea-anemones (*Actinostephanus haeckeli* Kwietniewski, 1898) with tentacles like an octopus were collected. Sofar, this species was exclusively known from the two types, which were also collected in Ambon. Three empty shells (unfortunately no living specimens) of *Phalium glaucum* (Linnaeus, 1758), a large species Rumphius only mentioned from this locality, were brought up. No other sampled station yielded a single specimen of this species; an indication that apparently this locality did not change much during the last 300 years.

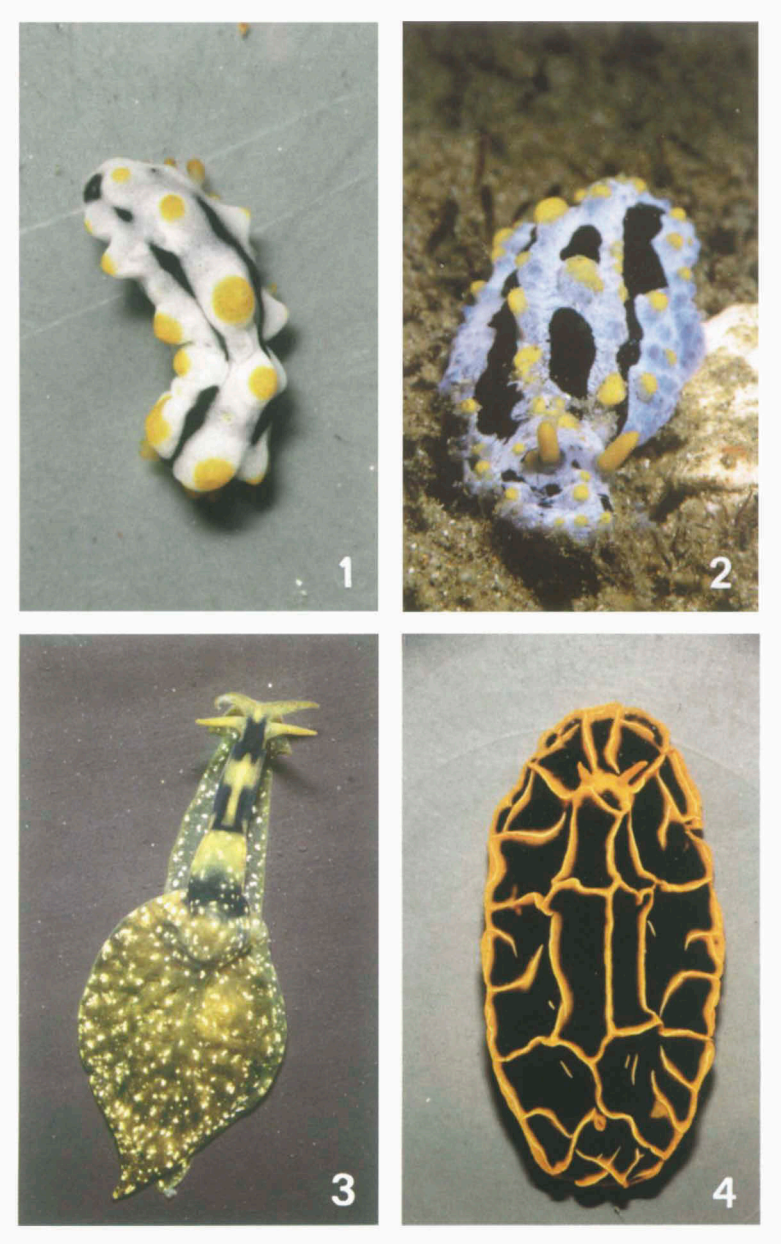
4 December. We visited Tg. Marta Fons, situated at the north side of the bottle neck between the inner and outer bay. Here many large prahus bring people across the bay, and the official ferry works from here as well. On the narrow and steep beach near the beacon many sea urchins (several species) and hermit crabs with parasitic anemones (*Calliactis* spec. and *Carcinactis* spec.) on their shell were observed. A little further towards the inner bay a flat area emerges during low tide, the bottom of which is strewn with stones that are often held together by yellow sponges. Under a large stone covered with sponges I found a beautiful red coloured crab [*Carpilius convexus* (Forskål, 1775)], this species was described and figured by Rumphius (1705: 18, pl. 11, fig. 4). Remarkable were also the large numbers of file clams (*Limaria* spec.) living under sponge covered stones, and the hundreds of the bivalve *Vulsella vulsella* (Linnaeus, 1758) found in hughe clumps of sponges. Apparently sponges are an important environmental factor in this locality. In a small, rather muddy bay, partly submerged ship wrecks provided an excellent habitat for an abundant growth of fouling organisms. Especially the parts near the low water mark and out of the sun were much favoured. Here the hull was thickly grown with thorny oysters (*Spondylus* spec.), *Chama lazarus* Linnaeus, 1758 and oysters (Ostreidae). Also finding shelter here were several species of cowry (Cypraeaidae) and large numbers of the gastropod *Cymatium pileare* (Linnaeus, 1758).

5 December. The shore party drove to the Baguala Bay side of Paso, and came along the now unused and dry canal that was build by the Dutch to connect Baguala Bay with Ambon Bay. The beach here is very wide, and several hours were spent sampling the sand and mud. Although the area looked promising, we were not very



Pl. 3. Fig. 1. The shrimp *Periclimenes imperator* Bruce, 1967 is associated with the large nudibranch *Hexabranchus sanguineus* Rueppel & Leuckart, 1831). Fig. 2. The shrimp *Chernocaris placunae* Johnson, 1967 lives in the bivalve *Placuna ephippium* (Retzius, 1788).

successful. Mainly the bivalve *Meretrix meretrix* (Linnaeus, 1758) and several specimens of *Oliva* spec. were found. We did not snorkel here because of the very shallow water and the bad visibility. Fortuin picked up the only specimen of the paper nautilus (*Argonauta hians* Lightfoot, 1786) found during the expedition. The divers revisited the landing-stage and came up with some tube anemones (Cerianthiidae) with tubes that also harboured phoronids and small white bivalves. In the evening we prepared for a three days trip to Pulau Tiga (the three islets on the far west side of Ambon) planned for the following day.



Pl. 4. Fig. 1. An as yet unidentified Holothurian probably mimics the poisonous nudibranchs of the genus *Phyllidia* (see fig. 2.). Fig. 2. The nudibranchs of the genus *Phyllidia* exhibit warning coloration to potential predators. Fig. 3. The shell-less freshwater snail *Acochlidium amboinense* Strubell, 1892. Fig. 4. The recently described Nudibranch *Reticulidia halgerda* Brunckhorst & Burn, 1990 was found in Latuhalat.

6 December. We woke up early and left the camp before 8 o'clock with two heavily loaded boats. The sky was clouded and when we reached the outer bay, we noticed some swell. The more we advanced to the west the rougher the sea became, and when we were near Laha and saw even larger waves ahead of us, we had to cancel our voyage, as our boats were too small for such a rough sea. Although our destination could not be reached we tried to make the best of it, and decided to sample the area west of Laha. Just before we went on shore here, the team members in one of the boats saw a leather-back seaturtle (*Dermochelys coriacea* Linnaeus). Unfortunately it swam away before any pictures could be taken. West Laha was rich in cream-coloured soft corals, that fell dry during low tide and were collected by a local inhabitant (possibly for food). For the layman the large black frogfish [*Antennarius commersoni* (Latreille, 1804)], caught by Den Hartog, was certainly the most attractive find. Less spectacular but scientifically more interesting was the sieving of subtidal sediment which Fortuin had done in many localities (fig. 63), and which here yielded large quantities of micro-molluscs of which several taken alive. Having returned at our house, a car stopped in front of it and to our surprise St. Nicholas and his traditional black assistants (in Dutch called "Zwarte Pieten") were the passengers. It showed that some Dutch cultural influence still remains.

7 December. This day was used to change the alcohol and formaline of the col-

Fig. 63. Fortuin sieving the sediment in search of invertebrates living in subtidal soft-substratum.

lected specimens, and to pack the material in plastic drums for final transport. This took most of the day, and therefore little additional collecting was done. Only Fransen went out to catch shrimps (*Alpheus* spec.), that live associated with gobies (Gobiidae). The burrows in which they live were common in front of our base camp, but although several methods were tried his efforts were in vain. And Kolvoort, having no collections to pack, was as usual shooting film after film underwater.

8 December. With one boat and without much equipment the shore party tried to reach Larike on the west coast of Hitu. The sea was much calmer today and we had no trouble reaching the village. From a distance we already sighted the singular, high rock just in front of the village (fig. 38) which Rumphius described as the "Suikerbroodje" (sugar loaf). In turning large stones on the shore (fig. 37) we discovered many, about 5 cm long chitons (*Chiton densiliratus* Carpenter in Pilsbry, 1893) (fig. 64). These were only found in this locality, proving again the unique character of many localities. It also proves that large numbers of localities have to be sampled to get a good impression of the marine biota of a certain area, even when that area is relatively small, like in the case of Ambon. A large crab [*Daldorfia horrida* (Linnaeus, 1758)], described by Rumphius (1705: 15-16), was added to the collection, and the peculiar stalked barnacle (*Mitella mitella* Linnaeus, 1758), of which Rumphius (1705: 158) wrote that it was common on the "Suikebroodje", proved indeed very common above low water level on this rock. Walking through the streets of Larike we, at first, did not notice the ruin of the old dutch fort "Rotterdam". It is almost completely surrounded by the village houses, and even within the only three remaining, ca. 4 m high walls, a house was build.

9 December, Sunday. As yesterday's trip to Larike proved rather easy, we made a

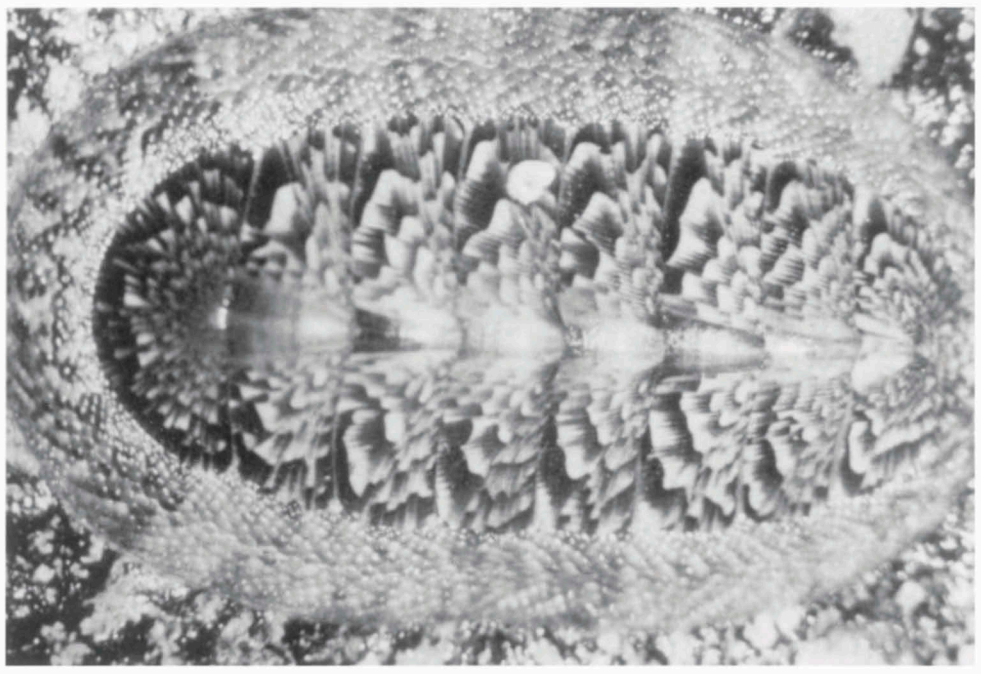


Fig. 64. *Chiton densiliratus* Carpenter was only found in Larike.

second attempt to reach Pulau Tiga with two boats. On our way there one boat party did some collecting in Lilibooi as they had to wait for the other boat, that had stayed behind to photograph the many dolphins which regularly frequent the outer bay. When we arrived at Larike the swell made it again impossible to go further and reach Pulau Tiga. So we decided to stay in Larike. The divers were enthusiastic about the underwater scenery at the "Suikerbroodje", but little was collected. Shore collecting was easy as all we had to do was to thank the many children who brought specimens in large quantities.

10 December. In the morning we continued packing the bulk of the collected material (fig. 65). The smell of formalin and alcohol was all around the camp. In the afternoon we did some dredging near Rumahtiga at a depth of about 12 meters. One haul contained several of the above mentioned crab (*D. quadridens*) and several sea urchins. When put together in our aquarium, the crabs immediately grabbed an urchin and held it on their back, again proving the association between crab and urchin. The divers had found a specimen of the saddle oyster [*Placuna ephippium* (Retzius, 1788)]. This bivalve has very flat valves, but surprisingly it contained two, in proportion large commensal shrimps (*Chernocaris placunae* Johnson, 1967) (pl. 3 fig. 2).

11 December. Today we finished packing the material. The weather was too rough to go out far with the boats. In this time of the year the wind is blowing most-

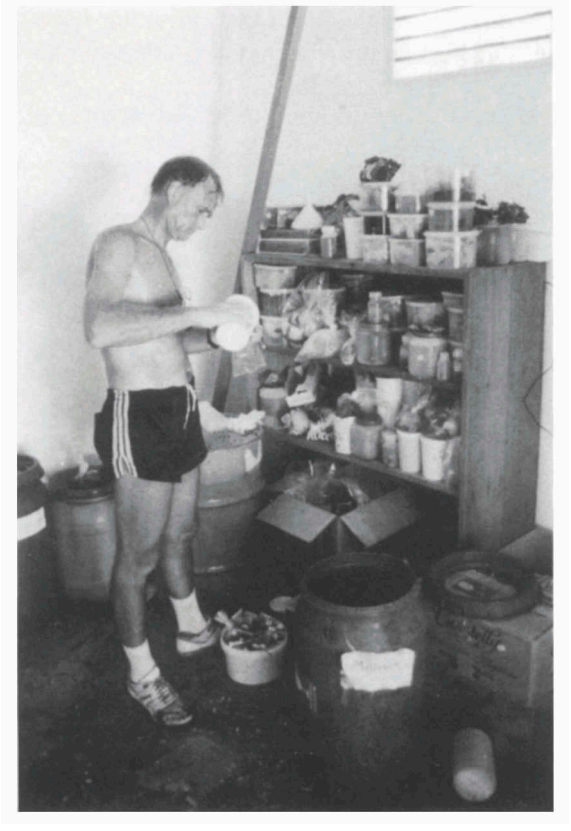


Fig. 65. Den Hartog making his collection of sea-anemones ready for transport to The Netherlands.

ly from a north-western direction. Only Kolvoort ventured to go, and took photographs near Lilibooi. Later on he and the other divers dived in front of the base camp. Van Egmond saw one of his wishes fulfilled as at last he discovered two specimens of the notorious, deadly poisonous stone fish [*Synanceja horrida* (Linnaeus, 1766)] in front of our house. Dredging around Wainitu produced large quantities of sponges; their spicules still irritated our hands long after we returned to the base camp.

12 December. The divers went to Latuhalat on the south side of Leitimur. Here a small, but remarkable Holothurian was collected (pl. 4 fig. 1). This, as yet unidentified species, seems to mimic the poisonous nudibranchs of the genus *Phyllidia* (pl. 4 fig. 2). During the expedition many nudibranch species were colected, but the striking black and yellow species, *Reticulidia halgerda* Brunckhorst & Burn, 1990, (pl. 4 fig. 4) found in Latuhalat was not collected before.

In the evening we gave a farewell diner for the Dutch scientific community and our Indonesian counterparts.

13 December. Today we paid a visit to the town hall, where the plan to erect a new monument for Rumphius was discussed. Afterwards we took some time to buy souvenirs and presents for the household staff. The accumulated collections (ca. 2 cubic metres) were brought to Dr. B. Ellenbroek, who offered to take care of the shipment to the Netherlands. We organized a small party for the household staff, and gifts were exchanged.

14 December. At 8 o'clock the expedition team left for the airport heavily laden with luggage, which included some of the most important finds. Thanks to the goodwill of the flight company Garuda there was no extra payment for overweight. At 10.30 a.m. the participants left Ambon and reached The Netherlands via Sulawesi, Jakarta, Singapore, Abudabi and Cairo.

I stayed somewhat longer to arrange the paperwork for the shipment of material, and to supervise the construction of a large wooden case in which it had to be transported. In between I managed to undertake two short fieldtrips. One to Laha together with Jopie and one to Latuhalat. The latter trip proved quite rewarding as I discovered that the chiton species *Cryptoplax planus* Ang, 1968 was actually a boring organism. This species was hitherto only known from the type material from the Philippines, and was found abundant during the expedition and the working visit the year before. It actively burrows in limestone rock, and not just dwells in existing caveties like the other members of the genus; a behaviour not known from any other chiton species. I left Ambon on Thursday December 20.

Preliminary results

The Rumphius Biohistorical Expedition knew no major set-backs. Apart from a few team members suffering from mild, short-termed affections, the work of the expedition was not hindered by disease or accidents.

Our primary objective to investigate and sample all localities on Ambon mentioned by Rumphius was largely achieved. We were able to study all localities, except for Pulau Tiga ("De Drie Gebroeders"). Although two attempts were made, these small islands on the West coast of Ambon, could not be reached by our small

boats due to bad weather. This was rather disappointing as the expedition wanted to ascertain if the coconut crab *Birgus latro* Linnaeus, 1758 still occurs on these islets as recorded by Rumphius and as confirmed by Kopstein (without date [1928?]: 71-75) who observed specimens on the islet Hatala. Furthermore we were not able to relocate Hukunalo mentioned by Rumphius. This locality could not be traced on any available map, both old and new. Inquiries made in Ambon during the expedition failed also to localize this site.

Altogether thousands of lots were sampled. The collection is particularly rich in the following groups: molluscs (extensive collections of Polyplacophora, Scaphopoda, Nudibranchia, Nassariidae, Mitridae, Costellariidae, Terebridae, Pyramidellidae, Arcidae, Cardiidae, Veneridae, Tellinidae etc.), crustaceans (extensive collection of commensal shrimps Pontoniinae), echinoderms, cnidarians (mainly Actiniaria, Ceriantharia, Corallimorpharia and to a lesser extent Octocorallia) and fishes [mainly Scorpaenidae, Syngnathidae and Pomacentiidae (genera *Amphiprion* and *Premnas*)]. A preliminary survey of part of the material revealed new taxa, and range extensions for many species.

The bulk of the material was shipped in a wooden case (2 × 1 × 1 m). The shipment was made possible by the invaluable help of Dr. B. Ellenbroek. In April 1991 the case arrived safely in Leiden. Not all the material was shipped in this case; several important partial collections of small-sized animal groups were taken back to the Netherlands with us by airplane. This was the case for molluscan groups like; Nudibranchia, Polyplacophora, Scaphopoda and terrestrial gastropods and for the commensal shrimps. Directly after the case arrived, sorting of the material started. Although much of the material was sorted within a few months, sorting the large collection of molluscs took more than a year. At present about 30 specialists, both Dutch and foreign, have agreed to study part of the collected material. Their papers will in due time be published in: Zoologische Mededelingen and Zoologische Verhandelingen.

Once the material has been studied it will remain in the Nationaal Natuurhistorisch Museum in Leiden, and in the reference collections of the oceanographic institute of LIPI at Ambon, and the marine biology department of Universitas Pattimura Ambon.

During the expedition about 6000 colour slides were taken, half of which under water. Of the other half, the larger part are photographs of small invertebrates made at the base camp. The collection of slides is kept and administered by the present author in his capacity as secretary of the Foundation for the Advancement of Biohistorical Research (Rotterdam, The Netherlands).

Comparing our preliminary results with information given by Rumphius, the most striking outcome is the great accuracy and reliability of Rumphius's work. For instance Rumphius recorded the mollusc species *Phalium glaucum* (Linnaeus, 1758) from Rumahtiga. We found that species in exactly the same locality, and although it is a large and easily recognizable species it was not found in any of the other 36 marine stations sampled. The tusk shell *Dentalium elephantinum* (Linnaeus, 1758) proved to be common in Wainitu as stated by Rumphius. In one or two other localities only a single, worn specimen of this species was found. According to Rumphius the stalked barnacle *Mitella mitella* Linnaeus, 1758 occurred commonly on the rock "Het Suikerbroodje" near Larike. Not only we were able to relocate this rock (fig. 38), but indeed the above barnacles were found commonly attached to it. The expedition succeeded in finding the

majority of species described by Rumphius in the "Amboinsche Rariteitkamer", but as far as we can ascertain at this moment at least 40 species could not be found.

Although we did not have enough time to make a thorough study of the vernacular names used by the Ambonese for the island's marine fauna, we were able to reach the conclusion that many of these names did not change since Rumphius's time. Of all vernacular names recorded by the expedition, about one third appeared to be identical to those recorded by Rumphius, viz.: *Lysiosquilla maculata* (Fabricius, 1793) (pl. 3, fig. E) = Loë; *Charybdis feriata* (Linnaeus, 1758) (Pl. 6, fig. P) = Cattam Ayam; *Ranina ranina* (Linnaeus, 1758) (Pl. 7, figs T & V) = Cattam Kodok; *Diadema setulosum* (Leske,) (Pl. 13, fig. 5) = Duri Babi & Makaruweng; *Turbo marmoratus* Linnaeus, 1758 (Pl. 19, fig. B) = Bia Mata Bulan; *Trochus niloticus* Linnaeus, 1767 (Pl. 21, fig. A) = Bia kukusan; Neritiidae (Pl. 22, figs K, L, I, N & H) = Bia Cuncil; *Murex tribulus* Linnaeus, 1758 (Pl. 26, fig. G) = Bia Duri; Cypraeidae (Pl. 38 & 39) = Bia Huri; *Tridacna spec.* (Pl. 42, figs A & B) = Bia Meka; *Polymesoda spec.* (Pl. 42, fig. H) = Bia Kodok; *Tapes litteratus* (Linnaeus, 1758) (Pl. 43, fig. B) = Bia Lepper; *Trachycardium spec.* (Pl. 44, fig. E) = Bia kakurang; *Anadara spec.* (Pl. 44, fig. I) = Bia Anadara; *Gari spec.* (Pl. 45, fig. D) = Bia Bokasang and Pinnidae (Pl. 46, figs I, K, L, M & N) = Bia Mencadu. Not much was recorded on the local use of marine animals as utensils, but we learned that small species of the gastropod genus *Cypraea*, like *Cypraea annulus* Linnaeus, 1758, are still used in games as reported by Rumphius (1705: 117). Furthermore a large variety of molluscan and crustacean species are collected by the local inhabitants and used as food. The above information was gathered during inquiries I made in the following villages: Suli, Paso, Tawiri and Hutumuri, and supplemented by Mr. R. de Groot, who made inquiries in Amahusu and Tial.

Apparently the marine environments of the shallow water coastal areas on Ambon, especially those situated on the circumference of the island, have changed very little during the past 300 years. Recent increase of the population did not yet dramatically affect the marine fauna, although some changes were observed that justify close monitoring the situation in the years to come. Changes were most apparent in Ambon Bay where rafts of discarded plastics float on the surface. Oil spills from the many boats lying in front of Ambon town have a degrading effect on the marine environment of the Ambon town area, and these effects could become more wide ranging as there are plans to increase the importance of Ambon Bay as a harbour. Continuing population increase, especially in and around Ambon town, will certainly result in a larger degree of pollution in Ambon Bay, especially as sewage processing is non-existent at the moment. Thoughtless deforestation or other improper land management causes erosion, and large quantities of silt are caried to sea, which alter the marine fauna composition. In Wainitu (near Ambon town) we were informed by a resident that in the past the beaches were much more sandy, and that they have become muddier during recent years. There are as yet very few large scale industries on Ambon, the most important is the plywood factory near Paso at Baguala Bay.

Some time was spent to ascertain the possibilities of erecting a new monument for Rumphius in Ambon town. Contacts were made with Bishop Sol, who is very interested in the history of the Moluccas, and who lives practically on the place where the old monument once stood. Inquiries with some officials of Ambon town made clear that the authorities were willing to co-operate, but that they preferred a new design and a different location for the monument. Funds to build the monu-

ment would have to be raised in Europe.

Although, as mentioned above, there were no major set-backs during the course of the expedition, the following is worth mentioning.

A few collecting methods were not tried, such as sampling by night, sampling and washing of sea weeds and coral blocks in fresh water or diluted formalin, and the use of bait traps. Also we had schemed to dredge in deeper water using LIPI's research vessel. Unfortunately their new dredge was not operational during our stay, and we were forced to cancel this plan. In the case the present expedition should have a follow-up, the use of these methods could reveal valuable, new information.

Shortage of time prevented a maximal realization of our aims. Several localities could only be visited once, which is not enough for adequate sampling rich and complex environments like those encountered in Ambon. The diversity of marine habitats is remarkably great for a small island like Ambon. This became evident as during the last weeks of the expedition each new locality studied continued to yield many species which were not collected previously.

Regarding the diversity of the marine fauna Wilson (1978: 521) made the following remarks: "Shore collecting was less successful among these northern and central Moluccas islands. Most of the reefs and sand flats were very narrow with little habitat diversity. Species diversity seemed correspondingly low compared to that of other islands in the Indo-Malay area which are surrounded by broader areas of shallows". It is remarkable that the conclusions of the Rumphius Biohistorical Expedition are quite the opposite. One of many examples of the rich species diversity encountered during the expedition is given by the preliminary result of the study of the families Mitridae and Costellariidae (Mollusca, Gastropoda) by Dr. H. Turner. His comments (in litt.) on the material are selfexplanatory ".... your dry and alcohol material comprises in total 92 mitriform species: a remarkably rich output of your expedition".

Rumphius also recorded exact locality data of animals occurring on islands adjacent to Ambon. Many of the localities he referred to were located on Ceram, and should a follow-up be planned it would be advisable to conduct fieldwork on this island as well.

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References

Ballintijn, G., 1944. Rumphius. De blinde ziener van Ambon: 1-192, figs.— Utrecht.

Benthem Jutting, W.S.S. van, 1959. Rumphius and Malacology. In: H.C.D. de Wit (ed.), Rumphius Memorial Volume: 181-207, 6 pls.— Baarn.

Bickmore, A.S., 1868. Travels in the East-Indian Archipelago: 1-553, 36 figs.— London.

Birowo, S. & A.G. Ilahude, 1971. General Hydrological Conditions Around Ambon Island. In: Preliminary Report on Ambon Survey 1970: 11-14.— Jakarta (?).

Engel, H., 1959. The Echinoderms of Rumphius. In: H.C.D. de Wit (ed.), Rumphius Memorial Volume: 209-223, 4 pls.— Baarn.

Henschel, A.W.E.Th., 1833. Vita G.E. Rumphii, Plinii Indici. Accedunt specimen materiae Rumphianae medicae clavisque Herbarii et Thesauri Amboinensis: i-xvi, 1-216, 1 pl.— Breslau.

Hartog, J.C., 1990. Associated occurerence of *Cyclocoeloma tuberculata* Miers, 1880 (Decapoda; Majidae) and species of Discosomatidae (Anthozoa; Corallimorpharia).— Zool. Med. Leiden 64 (12): 161-168, figs 1-7.

Holthuis, L.B., 1959. Notes on Pre-Linnean Carcinology (Including the Study of Xiphosura) of the Malay Archipelago. In: H.C.D. de Wit (ed.), Rumphius Memorial Volume: 63-125, 5 pls.— Baarn.

Holthuis, L.B. & R.B. Manning, 1990. Crabs of the Subfamily Dorippinae MacLeay, 1838, from the Indo-West Pacific Region (Crustacea: Decapoda: Dorippidae).— Researches on Crustacea, Special number 3: 1-151, figs 1-58.

Honoré Naber, S.P., 1922. Historisch overzicht van het onderzoek. In: De zeeën van Nederlandsch Oost-Indië: 1-53, 3 pls.— Leiden.

Huwae, A., 1971. A Brief Description of Ambon. In: Preliminary Report on Ambon Survey 1970: 3-10, 1 map.— Jakarta (?).

Lentz, C., 1991. Ueber die Idsteiner Vergangenheit des Naturforschers Georgius Everhardus Rumphius. Heimatjahrbuch des Rheingau-Taunus-Kreises 42: 76-82.

Kopstein, F., n.d. [1928?]. Een zoölogische reis door de tropen: 1-160, 172 figs.— Batavia.

Rumphius, G.E., 1705. D'Amboinsche Rariteitkamer, Behelzende eene Beschryvinge van allerhande zoo weeke als harde Schaalvischen, te weeten raare Krabben, Kreeften, en diergelyke Zeedieren, als mede allerhande Hoorntjes en Schulpen, die men in d'Amboinsche Zee vindt: Daar beneven zommige Mineraalen, Gesteenten, en soorten van Aarde, die in d'Amboinsche, en zommige omleggende Eilanden gevonden worden: 28, 1-340, 43, 60 pls.— Amsterdam.

Sirks, M.J., 1945. Rumphius, the Blind Seer of Amboina. In: P. Honig & F. Verdoorn (eds), Science and Scientists in the Netherlands Indies: 295-308, figs 76-78.— New York.

Vandenspiegel, D., A. Oveare & Cl. Massin, 1992. On the association between the crab *Hapalonotus reticulatus* (Crustacea, Brachyura, Eumedonidae) and the sea cucumber *Holothuria (Metriatyla) scabra* (Echinodermata, Holothuridae).— Bull. Inst. r. Sci. nat. Belg., Biologie 62: 167-177, figs 1-6.

Von Martens, E., 1902. Die Mollusken (Conchylien) und die übrigen wirbellosen Thiere in Rumpf's Rariteitkamer. In: M. Greshoff (ed.), Rumphius Gedenkboek: 109-136.

Wilson, B.R., 1978. A Malacological Expedition to the Moluccas.— National Geographic Society Research Reports, 1969 Projects: 515-523, figs 1-2.

Weber, M., 1902. Siboga Expeditie. Introduction et description de l'expedition: 1-159.

Wit, H.C.D. de, 1952. In memory of G.E. Rumphius (1702-1952).— Taxon 1: 101-110.

Wit, H.C.D. de, 1959. Georgius Everhardus Rumphius. In: H.C.D. de Wit (ed.), Rumphius Memorial Volume: 1-26, figs 1-2.

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