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Sponges

of the New Caledonian Lagoon

ORSTOM éditions

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Photographs and diving research
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ORSTOM
L'Institut
français
de recherche
scientifique
pour le
développement
en coopération

Book jacket design : Michelle Saint-Léger
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Éditions de l'Orstom
INSTITUT FRANÇAIS DE RECHERCHE SCIENTIFIQUE
POUR LE DÉVELOPPEMENT EN COOPÉRATION

Collection Faune et flore tropicales n° XXXIII

Paris, 1998

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et fabrication
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ISSN : en cours
ISBN : 2-7099-1354-2

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Avant-propos

Cet ouvrage est le résultat d'une longue étude réalisée en collaboration entre spécialistes de la taxonomie, de la chimie et de la biologie des Spongiaires, appartenant à plusieurs laboratoires de Nouvelle-Zélande (Professeur Patricia Bergquist, Michelle Kelly-Borges, Chris Battershill), d'Australie (John Hooper, Jane Fromont, Clive Wilkinson), du Brésil (Radovan Borojevic) et de France (Claude Lévi, Jean Vacelet, Cécile Debitus).

Lorsqu'en 1976, le programme d'étude de substances naturelles d'origine marine (Snom) fut décidé et financé conjointement par l'Orstom et le CNRS en partenariat avec la compagnie Rhône-Poulenc, il apparut rapidement nécessaire de procéder à une large exploration des lagons et des récifs de la Nouvelle-Calédonie, notamment autour du centre Orstom de Nouméa. La composition des principaux groupes zoologiques de la faune marine de cette région était, dans le meilleur des cas, mal connue ou même presque totalement inconnue. Après une prospection de plus de quinze ans, l'équipe des plongeurs à laquelle fut confié le soin de procéder aux collectes d'animaux, composée de Pierre Laboute, Jean-Louis Menou, Georges Bargibant, a permis le recensement de la grande majorité des espèces présentes dans cette région, aujourd'hui une des mieux connues du monde tropical. L'identification des espèces, due aux meilleurs spécialistes, a déjà permis à l'Orstom de publier deux ouvrages de la série "Faunes tropicales", consacrés aux Échinodermes et aux Ascidies. D'autres sont en préparation. Ces livres sont illustrés par des photographies en couleur prises sur place par les membres de l'équipe de plongée scientifique.

Le présent ouvrage est consacré aux Spongiaires ou Éponges. Ces animaux se sont révélés de très intéressants producteurs de molécules originales, dont certaines ont montré diverses et parfois puissantes activités pharmacologiques. C'est la raison pour laquelle un effort tout particulier de récolte et d'étude a été fait dans cette région du Pacifique sud-ouest où la diversité des espèces est très grande.

Ce type de livre illustré a plus ou moins un caractère hybride. Il ne s'agit pas d'un guide de terrain où l'image prime largement sur le texte, ni d'une monographie scientifique. Il permet de faire connaître, avec toute la rigueur scientifique nécessaire, les espèces les plus caractéristiques des milieux récifaux de Nouvelle-Calédonie.

On a longtemps pensé que la plupart des espèces marines de la faune tropicale de la mer Rouge, de l'océan Indien, des mers de l'archipel indo-malais et de l'océan Pacifique étaient largement distribuées dans cet immense domaine maritime. On sait aujourd'hui qu'il n'en est rien et que la composition spécifique de la faune varie considérablement suivant les régions. Cependant, si les espèces varient, les genres dominants sont à peu près les mêmes; c'est un panorama de ces genres, les plus fréquemment rencontrés dans les milieux coralliens, que nous présentons au lecteur.

Nous lui apportons en outre une introduction très documentée sur la structure et le fonctionnement des Spongiaires, indispensable à la connaissance de ce groupe d'animaux, dont la variété des formes et la riche diversité des couleurs attirent le regard de tout explorateur de la faune récifale.

In memoriam

Pierrette Lévi
(1924-1987)
by her strong
personality,
her knowledge
of sponges and
marine fauna and
her human qualities
has greatly
contributed to
the development of
a long collective
work which
began in 1976
in New Caledonia,
a work which
this book beautifully
illustrates.

Foreword

This work is the result of a long study conducted in collaboration with specialists in taxonomy, chemistry and biology of Porifera from New Zealand (Professor Patricia Bergquist, Michelle Kelly-Borges, Chris Battershill), Australia (John Hooper, Jane Fromont, Clive Wilkinson), Brazil (Radovan Borojevic) and France (Claude Lévi, Jean Vacelet, Cécile Debitus).

When in 1976, the research programme about the marine natural products (Snom) was launched and financed jointly by Orstom and CNRS in partnership with the Rhône-Poulenc company, it seemed necessary to explore on a large scale the lagoons and reefs of New Caledonia, mainly round the Orstom centre in Noumea. The composition of the main zoological groups of the marine fauna in this area was, in the best cases, badly known or even nearly unknown. After a prospecting of more than fifteen years, the team of divers which was entrusted with collecting animals and was composed of Pierre Laboute, Jean-Louis Menou and Georges Bargibant allowed to record the great majority of the species present in this area, which is nowadays one of the best known in the tropical world. The species which were identified by the best specialists already allowed Orstom to publish two works belonging to the series "Faunes tropicales" and devoted to the Echinoderms and the Ascidians. These books are illustrated with colour photographs taken in situ by the members of the team of divers.

The present book is devoted to Porifera or Sponges. These animals proved to be very interesting producers of original molecules, some of which showed various and sometimes powerful pharmacological activities. Therefore, a very special effort was made to collect and study these animals in this area of southwest Pacific where the species diversity is very great.

This type of illustrated book is more or less hybrid. It is neither a field guide where the picture prevails largely over the text, nor a scientific monograph. It allows to bring to light the most characteristic species of the New Caledonian reefs with all the scientific rigor necessary. For a long time it was thought that most of the marine species of the tropical fauna from the Red Sea, the Indian Ocean, the seas of the Indo-Malaysian archipelago and the Pacific Ocean were largely distributed in this vast maritime area. Nowadays, it is known that such is not the case and that the specific composition of the fauna varies considerably with the areas. However, although species vary, the prevailing genera are nearly the same; the reader is given a general outline of these genera which are the most frequently found in the coral reefs.

Moreover, a well documented introduction gives information on the structure and function of Porifera which is necessary to know this group of animals whose various shapes and rich colour diversity draw the attention of any explorer of the reef fauna.

Acknowledgements

We gladly acknowledge the support and encouragement of Orstom without whom this project would not have been possible, especially successive Directors of the Noumea Orstom Centre, the crews from the "Dawa", "Vauban" and "Alis" ships. We thank the Australian government Department of Ditard and the French Embassies in Canberra and Wellington, through their scientific and cultural attachés, who provided us with funds for a series of workshops on the taxonomy of sponges in New Caledonia.

We thank our institutions for supporting our respective participation in this project: Australian Institute of Marine Science, Townsville; University of Auckland, Auckland; Queensland Museum, Brisbane; Sir George Fisher Centre at James Cook University, Townsville; Muséum national d'histoire naturelle, Paris; Centre d'Océanologie de Marseille; Centre national de la recherche scientifique, Paris; National Institute of Water and Atmospheric Research-Oceanographic, Wellington.

Author profiles

Chris Battershill is a marine biologist with the New Zealand Oceanographic Institute (NIWA), now specialising on chemical ecology, aquaculture and population biology of sponges which produce pharmacologically interesting compounds. Over the past decade he has worked extensively throughout New Zealand, the South Pacific, Australia, the Subantarctic and Antarctic waters looking at aspects of the ecology of sponges, particularly recruitment patterns and responses to anthropogenic disturbance, and is particularly interested in rocky reef communities, both marine animals and plants, that elicit anti-tumour and anti-viral active chemicals.

Patricia Bergquist is Professor of Marine Zoology at the University of Auckland, Auckland. Her research interest has been directed towards sponges since 1958, having published over 100 papers, monographs and books on different aspects of sponge biology ranging from taxonomy to molecular biology. Her particular interest lies in using multidisciplinary approaches to study the problems of sponge systematics and phylogeny, in particular corroborating traditional morphologically-based taxonomic decisions with informative molecular and ecological data obtained from a diversity of techniques.

Radovan Borojevic, Professor of Cell Biology at the Institute of Chemistry, Federal University of Rio de Janeiro, Brasil works on cell differentiation and evolution of multicellular systems. Principal interests in systematics are Calcareous Sponges.

Cécile Debitus, is a research officer at the Orstom Center in Noumea (New Caledonia). The main subject of research programs led in Orstom's laboratory are the bioactive compounds isolated from marine Invertebrates, with a special interest on Sponges from the New Caledonian lagoon and the surrounding seamounts.

Jane Fromont is a Research Scientist and Curator at the Department of Aquatic Zoology, Western Australia Museum, Perth, Australia. She has been working on sponges in Australia and New Zealand since 1981, with her principal interests being the taxonomy and systematics of sponges, their reproductive biology, ecology and distribution. Jane's most recent project has been to document haplosclerid and petrosid species occurring in tropical Australian waters, in particular the Great Barrier Reef region, and to investigate the role of reproductive mode (ovipar-ity/viviparity) as a mechanism of niche separation amongst sympatric sibling species.

John Hooper is Senior Curator of the Queensland Museum, Brisbane. He commenced studies on sponges in 1981, working firstly in the northwestern Australian region, subsequently in various parts of southeast Asia, Micronesia, southwest Pacific islands and more recently along the length of the east coast of Australia. He is currently attempting to comprehensively document the northeastern Australian tropical and subtropical sponge faunas in collaboration with commercial pharmaceutical interests, and in orchestrating a publication project to make sponge taxonomy available to the non-specialist community. His main research interests concern the exploration of (prospecting for) sponge biodiversity, particularly the coral reef and inter-reef faunas; documenting the heterogeneity in sponge distribution patterns throughout tropical Australasia; tinkering with ideas about the biogeography of sponges throughout the Indo-west Pacific; and publishing on the systematics of the orders Poecilosclerida, Axinellida and Halichondrida in particular.

Michelle Kelly-Borges is a Senior Scientist at UNITEC Institute of Technology, Auckland, New Zealand, and is also currently a consultant to the Coral Reef Research Foundation in Micronesia. Her main research interests lie in the reproductive and benthic ecology of common reef sponges, the molecular, morphological and biochemical systematics of tetractinomorph sponges, especially the desma-bearing "lithistid" families, and sponge genome structure and characterisation. She has extensive field experience in sponge populations from both the Caribbean and northwest and southwest Pacific island regions, and is presently involved in the establishment of a commercial bath-sponge aquaculture industry in Micronesia.

Claude Lévi is a membre correspondant of the French Academy of Sciences. He was Director of the Laboratory of Biology of Marine Invertebrates, Muséum national d'histoire naturelle, Paris, France. He has mainly studied development, metamorphosis, normal and experimental morphogenesis and taxonomy of tropical and bathyal sponges.

Jean Vacelet is Director of Research CNRS at the Centre of Oceanology of Marseille (Station Marine d'Endoume), University of the Mediterranean, Marseille. He has studied the taxonomy, biology and ecology of sponges in the Mediterranean and various tropical seas, including extensive field observations, since 1956. His main interests are in sponge reproduction, cytology, skeletogenesis, symbiosis with micro-organisms, the fauna of submarine caves, and exploitation of commercial sponges (including pathology and culture), and in particular studying recent hypercalcified sponges ('sclerosponges'), relicts of the once widespread main Mesozoic and Palaeozoic reef builders (sphinctozoans, stromatoporoids, chaetetids).

Clive Wilkinson is Principal Research Scientist at the Australian Institute of Marine Science, Townsville. His research has focused on the ecology and physiology of coral reef sponges on the Great Barrier Reef and how populations compare with other coral reef regions. Specific themes are on determining the role of symbiotic algae that occur within many coral reef sponges and how reefs are affected by pollution. Clive's current interests include reef disturbance patterns and processes.

Introduction

Only the upper levels of the world's seas, the first fifty metres or so, are yet considered to be relatively well studied by marine biologists. In fact, our knowledge of Earth's marine fauna largely derives from life in these zones. Even so, only relatively small sections of the vast tracts of all coastlines have been investigated by curious naturalists and scientists, and these usually include only the more potentially interesting areas for our scientific explorations. Areas selected were based on many and varied criteria, largely dependent upon particular objectives of each study, but usually concerning such factors as the regions' physical and chemical properties, turbulence of coastal waters, tidal amplitude, geographic location, and origin of circulating currents.

The first recorded explorations of the marine environment were conducted on the Mediterranean coasts. For a long time these studies were considered to be 'typical' marine environments and used as references or baselines to the studies of marine life in other localities. But, very soon, attention was captured by the coral-rich reefs in the tropical oceans with their mega-diverse faunas, firstly in the Caribbean and then later in the Indo-west Pacific. The intrepid naturalists of the 18th and 19th centuries often reported dramatic encounters with reefs. They often illustrated their discoveries with hand-prepared colourful illustrations, revealing a variety of shapes and pastel colours. These early reports were of great importance to the development of scientific knowledge concerning the sea, notably including the pioneering insights of Charles Darwin from the “Beagle” voyage concerning the formation and evolution of coral reefs.

In the early years, animals were mainly collected by walking along the beach, on open reefs during low tides, free diving with the help of the talented indigenous populations, or using remote instruments such as light dredges towed behind small boats. These methods were in use for about two centuries, essentially providing a random sample of marine life and slowly contributing to the growing scientific knowledge of coral reefs. The main area investigated was the rich reef belt contained within the tropical seas, including the Red Sea, Maldives, Seychelles, Indonesia and Caribbean. Only much later did we acquire information on the vast tracts of reefs scattered across the Pacific, following in the paths of the navigators. With the advent of scuba diving and underwater photography this new world finally became more accessible, and our knowledge of these shallow seas has since increased dramatically.

Today there is a vast library of specialised publications concerning the biology, physics and chemistry of the sea, but unfortunately many of these documents are unintelligible or at best difficult to comprehend for the non-specialist audience. There are also many popular, more general books on coral reefs, but these are often too simple, too general, and usually only display the more obvious or spectacular reef species, concentrating in particular on mobile animals. Reef fishes were the first to attract public interest, with their beautiful colours, shapes and behaviours, and there are now many popular books on these animals. Corals, the reef builders, were considered only as background scenery to these mobile animals, and most of this "scenery" remained relatively poorly known to all but specialists. Visitors to aquariums rarely stop to contemplate a fish-free pool, even if this pool contained a rich assemblage of corals and other sedentary fauna - it is probable that we are first attracted by motion and not immediately by beautiful colours or curiosity as to "what are those"?

Gradually, divers became more interested in the "scenery", and started studying the sedentary fauna which they had at first ignored. Subsequent developments in underwater macrophotography and more structured collection protocols eventually produced a superb documentation of many species within these faunas. We are slowly but surely discovering further aspects of their biology, their preferred places to live, their roles and interactions within ecological systems, and other characteristics not previously possible before the advent of scuba. Without doubt, for this "scenery" of corals and other shallow water sedentary fauna, the use of scuba has contributed more than any other technique to our scientific knowledge.

But the submarine world is not only a showcase! As in the aerial world it contains a number of distinct ecosystems. In these ecosystems, such as coral reefs, the living animals, plants and microbial organisms interact with each other. These interactions are varied and complex. Coral reefs are large ecological systems but we now recognise that they are composed of innumerable smaller, distinct parts or subsystems, each with their own particular faunas (*e.g.* soft bottom habitats on the lagoon floor, deep canals or spur-and-grooves on outer reefs with their many small caves). Nevertheless, each discrete part contributes to the entire reef system. Similarly, relationships between coral reefs and other external systems are also of major interest, particularly areas that are now subject to increasing human impact and threat of destruction. Coral reefs exchange products with the seas and oceans, and in turn the oceans ultimately determine the climatic and hydrological conditions that are essential to the reefs' continued wellbeing. Understanding the global behaviour of such reef systems, which for example produces enormous amounts of carbonates, is now recognised as being essential to a greater understanding of the major world processes such as weather patterns, sea level changes and global warming. To fully comprehend these systems we need to analyse the individual components - the organisms - that comprise the system, as well as determining the cycles of primary production, energetic balances and carbon flux associated with their interactions. This is the role of the large scientific institutions.

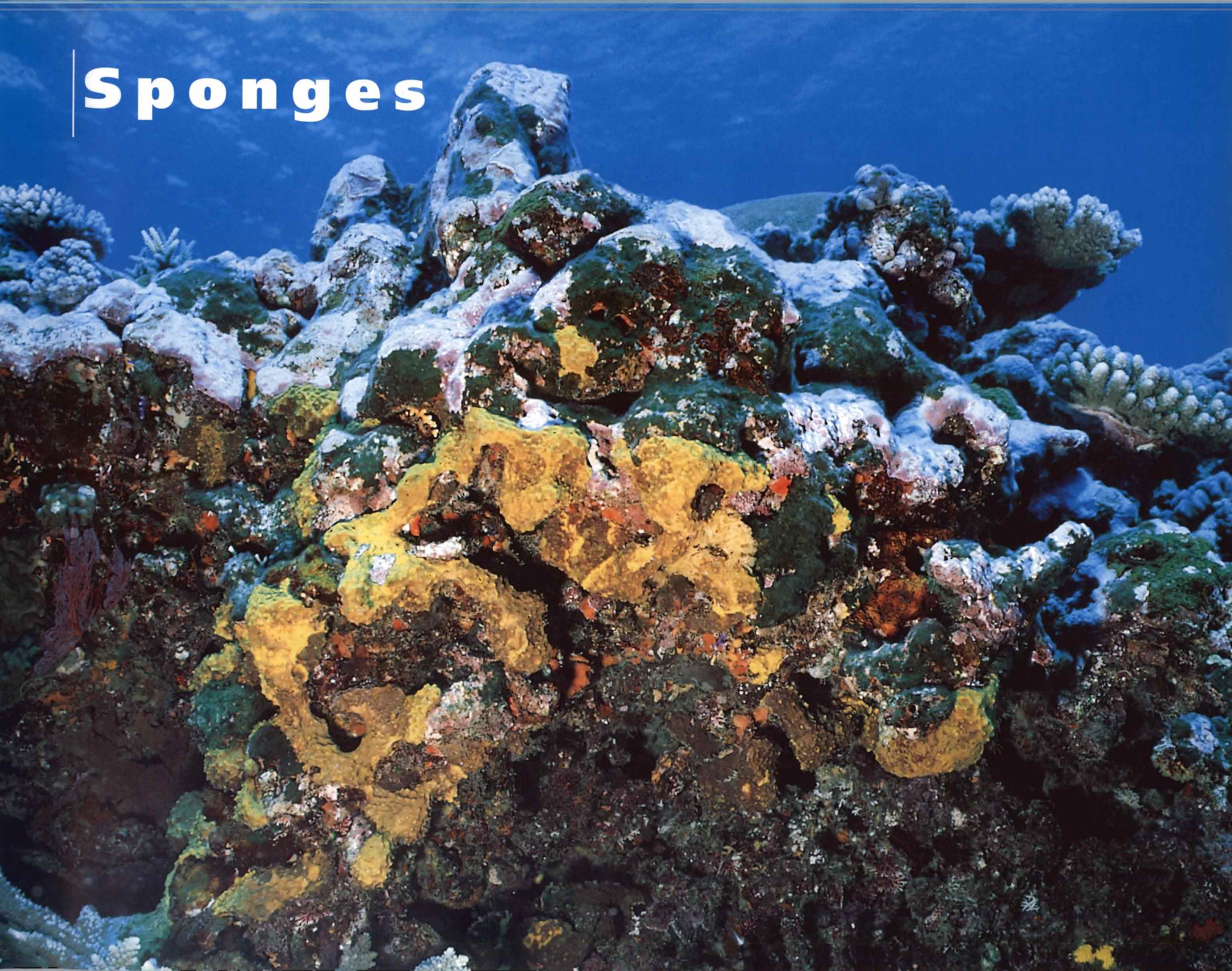
Prior to the early observations of Dr Catala the marine fauna of the Noumea lagoon and the coral reefs of New Caledonia were almost completely unknown, apart from commercial species such as shells and edible fishes. René Catala's greatest wish was to present the "marvels of the sea" to the public in an aquarium. To achieve this he required specialists to identify the most common species of the lagoon and the most hardy species that could survive in the aquarium. His passion for this exceptional fauna inspired many of us.

A decision was taken in 1976 by the Director General of Orstom, Professor Georges Camus, to develop in conjunction with CNRS a research program on marine natural products in the Noumea region. This led to an intensive exploration of these coral reefs and careful documentation of the marine fauna using contemporary methods, including underwater photography. These collections of marine animals have rapidly accumulated over the years, reflecting the exceptional diversity of marine species now known to live here. Many scientific monographs and other publications that describe this fauna demonstrate this incredible diversity. That this knowledge now exists is a direct consequence of the decision to establish Orstom in Noumea. Undoubtedly the marine fauna of New Caledonia will soon be one of the best known faunas of the tropical world.

A group of specialists from Australia, France, New Zealand and other countries have all contributed to these taxonomic studies, and this book is a culmination of their efforts. Similar books on fishes, echinoderms and ascidians have already been published for the New Caledonia region, and studies on gorgonians and nudibranchs are currently in preparation. The present book on sponges, or phylum Porifera, is based on a selection of approximately one hundred species from the many hundreds of species found in the coral reefs and associated habitats of New Caledonia. As demonstrated in this book, most of these sponges are unique to

New Caledonia, not found anywhere else on this planet like so many others of its marine animals. Books like the present one are so important in educating the world community about the unique biodiversity contained within isolated island ecosystems, and we hope that they contribute in some way to careful management and preservation of these unique environments.

Sponges

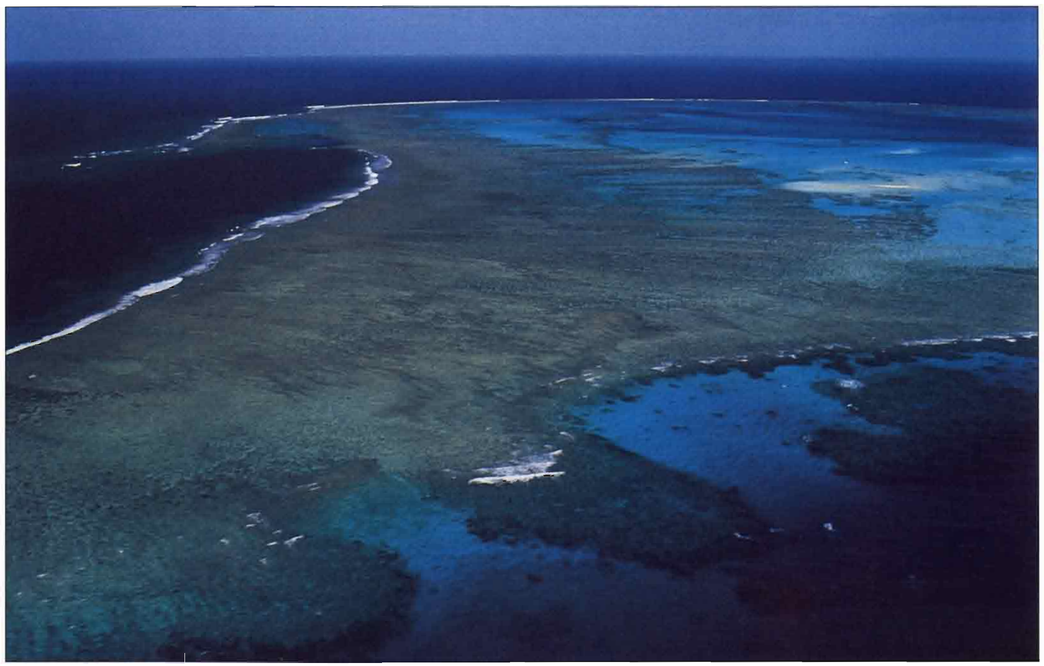


Most divers and reef explorers have undoubtedly seen these amazing, apparently very simple animals. They are particularly prevalent in the upper levels of New Caledonian reefs, providing a spectacular mosaic of diverse shapes and vibrant colours. But perhaps few people actually knew what they were looking at. Sponges remain poorly known even today, although people are familiar with commercial "bath" sponges mainly from the eastern Mediterranean and Gulf of Mexico. Yet even in these commercial species only the skeleton is used and consequently few people are aware of the structure, function and diversity of the living sponge animals.

Ilôt Canard in front of Nouméa peninsula
(photo P. Laboute)

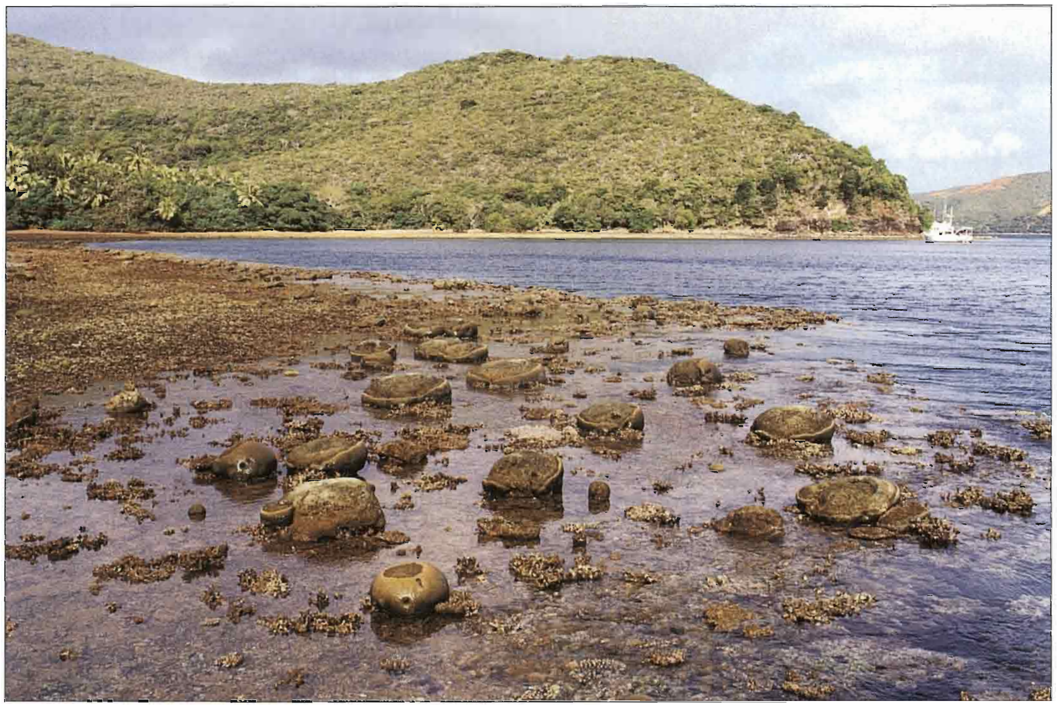
N.W. Lagoon, Île des Pins
(photo C. Lévi)

Sponges are fascinating. Each sponge is composed of millions of cells and has a unique cellular and skeletal organisation. They appear very early in the fossil record of the history of life, and studies of both fossil species and those living today allow us to better understand how the first multicellular animals may have functioned. Living sponges play a vital role in filtering seawater, essential to the equilibrium of marine ecosystems. They are generally unable to move, living more or less firmly attached to the seabed, and consequently they have developed a variety of defensive systems against various predators and parasites, including bacteria and fungi. This is why many studies searching for pharmacologically active substances, such as antibiotics, have targeted sponges in particular. Teams of chemists and biologists all over the world are currently studying many active compounds extracted from these animals and the diverse tropical faunas have provided a rich source of these compounds, some of which have already provided commercial products.



Grand récif, Passe de Mato
(photo P. Laboute)

This book does not attempt to provide a complete description of the sponge fauna of New Caledonia, which is certainly five or six times more numerous than presented here, with a large number of species collected and yet to be described. In particular, there are many small species, often no more than thin crusts, cryptic in coral reefs and other habitats, rarely seen during our relatively brief incursions into the lagoon. The species described in this book represent the most common or eye-catching examples from the various biotopes within the New Caledonia reef system. Throughout the world's tropical oceans one may find similar species of sponges in similar habitats, many of which are relatives of those living here, but the isolated reefs of New Caledonia contain many unique species.



Canal Woodin. Baie Nord
(photo P. Laboute)

Outer reef slope, 6 m
(photo P. Laboute)

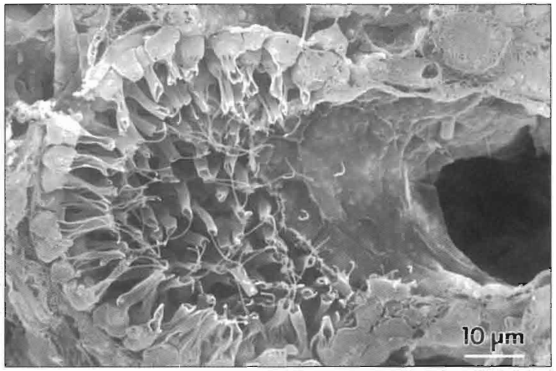
Identification of sponges is very difficult, requiring long experience, and this is particularly true for areas like New Caledonia and other faunas in the southwest Pacific Ocean which are still relatively poorly known.

It is with great pleasure that we thank those who accepted the challenge to participate in the arduous task of making this book a reality. We gratefully acknowledge the tremendous contributions made by Georges Bargibant, Pierre Laboute and Jean-Louis Menou, who have explored the reefs of New Caledonia and Loyalty Islands for so long. Photographs in this book are testimony to their competence and talent.

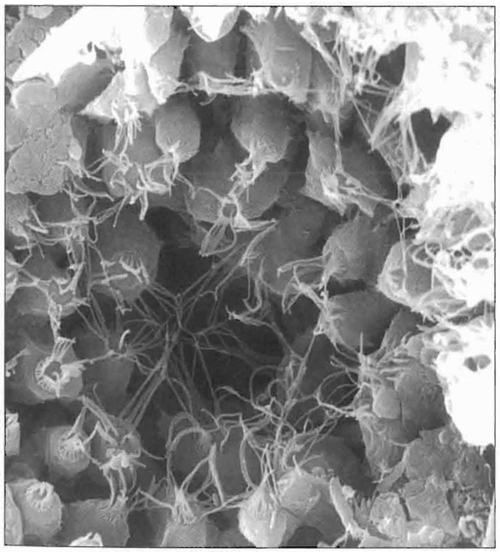
Baie des Tortues. New-Caledonia
(photo P. Laboute)

What is a sponge ?

A sponge is a multicellular, filter-feeding animal, without organised tissue or organ systems, with a peculiar layer of collared cells or **choanocytes**.



Choanocytes *in situ*
(photo De Vos *et al.*)



Choanocytes *in situ*
(photo P. R. Bergquist)

Sponges are part of the benthos or benthic fauna. They live in all areas of the marine world, from the shallow coastal seas to the deepest oceanic trenches. About 5500 species have so far been described by scientists, but perhaps there are three times as many more species awaiting to be discovered. They are particularly diverse in warmer seas and there is a special fauna associated with coral reefs, where a remarkable range of colours and shapes can be found. Generally there is a lower overall diversity of species in cooler waters, although populations of individual species may be locally abundant, but we are discovering that local distributions may be extremely patchy - abundant in one area and scarse in another - and this is particularly true for the coral reef associated sponges.

The phylum Porifera is perhaps best known to the lay person from commercial "bath" sponges. These useful sponges, including the genera *Spongia* and *Hippospongia*, have been harvested by mankind for thousands of years. Their utilisation is still important, mainly because of the high quality of the product, even though they have been partially replaced by synthetic sponges. Major sponge fisheries are still centred around the Mediterranean and Caribbean although there are several commercial or potentially commercial "bath" sponge species in the Pacific.

In the past there have been attempts to harvest commercial sponges throughout the Indo-Pacific, with active fisheries at the turn of the century in northern Australia, Indonesia and parts of Southeast Asia, but in all cases, so far, the Pacific commercial sponges only occur in small populations and only provide a mediocre quality commercial product. Nevertheless, there are still some active sponge fisheries in this region, particularly harvesting of wild populations in the Philippines and an attempt at a commercial farm, culturing sponges, in Pohnpei in Micronesia, but no such attempt has yet been made in New Caledonia. There are two potentially commercial species in the New Caledonian lagoon, *Spongia australis* and *Coscinoderma mathewsi*, but these are neither abundant nor of sufficient quality to support a wild-harvest commercial industry.

There are three major classes of Porifera: Calcarea or calcareous sponges, Hexactinellida or glass sponges and Demospongiae or siliceous sponges. Hexactinellida, or glass sponges, have substantially different structure and function than the other two classes, now recognised as distinct from the other two at the subphylum level. But most of these glass sponges live in deep waters, inaccessible to divers, and consequently they are not dealt with in this book. Calcarea are primarily found in shallow waters, particularly abundant and diverse in coral reefs. Demospongiae, which represent most of the living species today, can be found at all levels in the sea and also in fresh water, with large populations known from some rivers and lakes.

Porifera have had a long geological history. Most of today's living species can be traced back directly to ancestors living in the mesozoic terrains from the Jurassic (208-144 million years ago) and Cretaceous eras (144-66 mya), but some can be traced back to the Cambrian era (570-505 mya). Conversely, other sponge groups that existed during the ancient palaeozoic eras (older than 250 mya) totally disappeared during the Permian-Triassic crisis (260-225 mya). Many fossil sponges, particularly those with rigid-bodied composed of interlocking spicules ("lithistid" sponges), show well preserved skeletons in the fossil record. But for the most part these fossils belong to minor groups, and most soft-bodied sponges had poor fossilisation potential. Their skeletons disintegrated before fossilisation occurred, and for many of these groups we lack definitive information to track their history.

Sponge structure

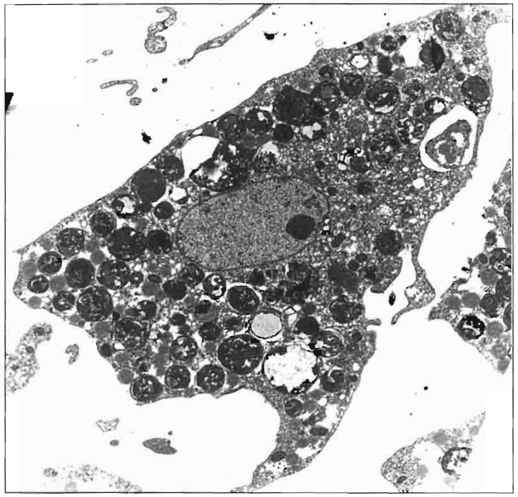
Sponge adults are generally incapable of locomotion, although we now know of some remarkable exceptions to this rule. Survival largely depends on the quality of the surrounding water and the loads of sediments that rain down upon populations. The sponge animal obtains its oxygen, nutrients and minerals for its skeleton from the ambient water column and it excretes organic or mineral waste generated by its metabolism back into the water. Since water moves continuously through the sponge its oxygen, mineral salts and organic nutrient levels can change and vary qualitatively as well as quantitatively. Each sponge species has a shape and an anatomy that is aptly suited to its particular environment and prevailing hydrodynamic conditions. For example, in shallow coastal waters with strong currents, surge and swell we find predominantly soft-bodied species or flexible, whip-like growth forms that can literally bend with the currents. In deeper waters where there is less dramatic movements of water bodies hard-bodied, rigid sponges abound.

Porifera have a unique anatomy. Contrary to most other animals they have no digestive tract, mouth or anus, nor any specialised organs or tissues. The sponge is bounded on its exterior surface by a unicellular layer (**exopinacoderm**), composed of special epithelial cells (**pinacocytes**). Some of these epithelial cells form small external pores (**ostia**) through which water passes into the sponge, and others form larger pores (**oscules**) through which water is expelled. Internally (the **choanosome**) the sponge is excavated by water current canals, also lined by a single layer of pinacocyte cells forming the **endopinacoderm**. The thin exterior layer of the sponge, containing cells, the mineral and organic skeletons, is called the **ectosome**. 'Water pumping stations' (**choanocyte chambers**) are found at certain locations along the water canals, lined by special collar cells with a flagellum (**choanocytes**), unique to the Porifera.

Sponges actively pump water into and out of their bodies using the differential water pressures inside and outside the sponge. A water current is created by the beating of many thousands of choanocyte flagellae. Water is drawn in through the multitude of small ostia or pores, with diameter less than a few tenths of a millimetre, and pumped through the water filtration system with its series of sieves or filters of diminishing size, which serve to extract larger particles from the seawater. These water canals connect directly or indirectly to choanocyte chambers, in which water slows down thus enabling the choanocytes to absorb available nutrients and oxygen. Similarly, waste products are expelled into excurrent canals which have a larger diameter, and finally jettisoned into the surrounding seawater through the oscules which are larger than inhalant pores. The water flow in the inhalant and exhalant canals varies from place to place, being fastest in the area of pores and oscules and slowest in the areas of absorption (choanocyte region). Water circulation can be further controlled by the sponge by diverting the flow into additional, non-choanocytic chambers and sphincter-like sieves or filters, to slow down or increase flow rates as required. Water flow can also be halted completely or redirected to other parts of the body, if there is a particle overflow in the network, for example. It is easy to observe this water flow using fluorescein injected into the water system and subsequently ejected by the sponge. The generation of a strong exhaled current through the oscule is important as it minimises contamination between inhaled and exhaled water, the latter containing no food and molecular waste of no further use to the sponge.

There is a great diversity of aquiferous systems in Porifera. Some are relatively simple with short inhalant canals, a single choanocyte chamber and a single oscule, but most are much more complex reflecting particular ecophysiological adaptations. A hierarchy of complexity of the aquiferous system has its own terminology **asconoid**, **syconoid**, **leuconoid**, from simple to complex. These various modes of water canal systems were at one time considered to be the most important criteria in the taxonomy and evolution of the class Calcarea, whereas it is now recognised that these different grades of body organisation have developed independently in several lines of calcareous sponges, now having little importance to their taxonomy. In the Demospongiae all known species are of the complex (leuconoid) construction, although recent discoveries indicate that some deep sea species lack choanocytes and associated water canal systems completely, being instead carnivorous.

The distribution and size of pores and oscules, and the drainage canals associated with these are frequently related to the general shape of the sponge. The morphology and organisation of the aquiferous system often clearly reflect adaptation of the species to environmental hydrodynamic conditions. For example, in foliose sponges the pores are often on one side and the oscules on the other. In cup or vase-shaped sponges the pores are on the external surface and the oscules are



Archaeocyte
(photo C. Donadey)

Matrix cyanobacteria
(photo J. Vacelet)

within the cavity on the concave side. In most encrusting and massive species oscules are placed on the ends of small stalks or conules, above the level of the surface and away from the pores, to allow the excreted water to be flushed away from the sponge.

Within the sponge the living 'tissue', bounded on all sides by the pinacoderm, is called the **mesohyl**, which includes all the area between the pinacocyte layers, or between pinacocytes and choanocytes, and between the canals and choanocyte chambers. The mesohyl contains a matrix or ground substance composed of a striated protein called **collagen**, an organic skeleton composed of **spongin fibres**, and/or an inorganic skeleton composed of mineral **spicules**. Within this mesohyl are found mobile totipotent cells, capable of changing function as required. Cell types can vary between taxonomic groups, although their recognition and cytological taxonomy is still poorly understood. These cells include generalised amoebocytic 'stock' cells (**archaeocytes**) with large lobopods capable of active phagocytosis, as well as many other types that have become specialised to carry out particular functions within the sponge. Cells that produce the precursors of spongin fibres (**collencytes**) have filopods; those that secrete spicules (**sclerocytes**) are capable of incorporating silica or provoking a calcium deposit, and these migrate to the area within the mesohyl where the mineral skeleton is being deposited; contractile cells occur around excurrent oscules (**myocytes**). Of the many sorts of cells in sponges, known by their characteristic shape and organelles, only few so far have a known function or chemical structure. Attempts have been made to use these cytological characters in a taxonomic framework but with limited success. In addition to these native cells many species have **symbiotic bacteria and cyanobacteria** which play an important role in sponge nutrition in these species.

The distribution of cells within the mesohyl, the deposition of collagen and location of water current canals are more or less homogeneous within the sponge. In some massive sponges, however, it is possible to see a differentiated external layer several millimetres thick, which contains no choanocyte chambers. This **ectosomal** layer is strengthened by collagen fibrils and often also a special mineral skeleton, clearly differentiated from the deeper **choanosomal** region. As a consequence of lacking developed tissues or organs sponges also lack a nervous system, nerve cells, coordination centre, head end or brain. They have only a low level of cellular functional integration, such that any physicochemical information received by a cell is transported within the sponge by contact reactions between non-specialised cells. This process is very slow and is often localised. However, the sponge is not completely without organisation as there is a lot of continuous local controls that can have an effect on the whole sponge, such as contractile oscules and temporarily halting water flow.

Because they have no organised tissues or central nervous system sponges are usually less impacted by minor damage than other animals. A sponge partially eaten by a predator may heal rapidly, with archaeocytes migrating to the site of damage and transforming into specialised cells as required, and normal operation will eventually resume in this region. It is also very easy to isolate sponge cells and let them settle individually. Within a few hours these cells will reassemble randomly and form small spheroid heterogeneous aggregates. These spheroidal aggregates slowly reorganise themselves and spread out to form a new sponge. This remarkable capability of Porifera to reorganise from dissociated cells is unique in the animal world. It is an interesting experiment to combine dissociated cells from two or more species and watch them sort themselves out into distinct species, illustrating the molecular specificity of cell systems, and "self versus not-self" recognition (an important concept in human immunology). This ability to recognise "self" is a key phenomenon in the biological evolution of multicellular animals.

There are no "characteristic" shapes in sponges, as in many other animals. The diverse morphological shapes seen amongst sponges are relatively consistent within individual species and are largely genetically determined. Although these growth forms are subject to phenotypic modification, in response to prevailing environmental conditions, with few exceptions variability in shape is relatively well defined. That is, modifications to 'typical' growth forms in particular species are usually still recognisable as being those species. Sponges grow by marginal extensions in all directions, vertically off the substratum or horizontally across it. Encrusting sponges cover the substrate, with most growth directed horizontally, maximising surface area, whereas massive sponges, including spherical and cushion-shaped species, have predominantly vertical growth with a greater volume to surface area ratio. Between these forms is a whole continuum of shapes, erect, lobate, digitate, cups and fans. Shape is maintained by a mineral and/or organic skeleton. The organic skeleton is supported by collagen fibrils, which are always present irrespective of other components, and often also with spongin fibres. Commercial "bath" sponges have a reticulate skeleton of spongin fibres and once treated and cleaned of sand and other foreign particles, this is all that remains in the commercial product.

The mineral skeleton in Porifera is composed of hydrated or opaline silica (SiO_2), characteristic of the Demospongiae and Hexactinellida, or calcite ($CaCO_3$) found in the Calcarea. There are some demosponges, previously referred to as "sclerosponges", with hypercalcified skeletons containing both a rigid calcitic basal skeleton as well as free siliceous spicules. During bygone eras hypercalcified species were particularly important reef builders, as can be seen easily in the exposed Devonian fossil reefs of central Australia (older than 360 mya). Today hypercalcified sponges remain important contributors to the process of reef accretion, especially in reef cave and deeper water faunas.

Apart from the relatively few living hypercalcified species sponge skeletons are mostly composed of discrete elements called spicules, with amazing morphologies and size ranges, and the skeletal patterns sponges construct have been used as models of strength by many architects. Very often there is a mixed skeleton, with spicules associated in many ways with spongin, enveloped within it, protruding from it or completely outside of it. Some spicules are clearly functional, especially the large ones that provide structure and strength to the body, whereas the functionality of other smaller spicules is often less obvious. Some sponges are able to leave part of their skeleton behind during growth, building a new one in a new area, and this gives the impression of mobility. Other species may change from a basal skeleton to an apical-based growth strategy. Some hypercalcified sponges have lost their free siliceous spicules and only produce a basal, compacted, reticulate skeleton of calcite or aragonite. Other species have only collagen in their skeleton, lacking a mineral skeleton completely.

Sponges have a great range of both sexual and asexual reproductive mechanisms. In sexual reproduction some species are gonochoristic with separate sexes, with individuals producing either eggs or sperm, and some have alternating sexes (protandrous hermaphrodites). Many sponges are oviparous, synchronously releasing male and female gametes into the sea, where fertilisation and development are external to the parent. Other species have internal cross-fertilization, whereby sperm fertilizes eggs retained in the female until they develop into ciliated larvae, at which stage they are freed from the parent by evacuation through the exhalant canals and oscules.

Embryonic development ends when the larvae swim, using their flagellated external cells for locomotion. This mechanism for dispersal is probably severely limited, given that all known larvae are short-lived (from a few hours to a few days), and some are predominantly demersal (crawling) with a very brief swimming phase. Larvae have been observed swimming in a spiral course: they are polarised and rotate along their anteroposterior longitudinal axis. During this phase larvae may first swarm and then scatter with passive dispersal in the prevailing currents. Around the end of the swimming period larvae slow their movements and become completely demersal. They explore the seabed with their forward swimming pole before settling down and attaching to a suitable substratum. This metamorphosis phase is characterised by the transformation of a polarised, ciliated, mobile larva with no aquiferous system, to a fixed sponge with no anteroposterior axis but with a fully operational aquiferous system. This transformation takes only a few hours. The young, settled sponge is only about a millimetre in diameter, and subsequent growth and survival greatly depend on the particular hydrodynamic conditions operating at the time and other biotic factors, such as predatory grazing nudibranchs, or competition from other organisms competing for limited space. There are many known patterns and strategies of larval behaviour, and there are also many species for which no larvae have yet been recorded.

Asexual modes of reproduction include internal or external budding and fragmentation. These strategies are ideal mechanisms for dispersal and recruitment in local populations, and in some habitats, such as *Halimeda* beds and other soft substrates, they are thought to be predominant modes of reproduction. Thus, like corals, local populations may consist mostly of clones from single individuals.

How can you identify a sponge ?

Sponge identifications, to be accessible to the non-specialist, must be based on observable morphology, probably with recourse to a light microscope. Some morphological characters vary substantially between widely separated populations, or those living in different habitats, indicating no more than ecophenotypic variation within the species. Other features are much more consistent between individuals irrespective of their geographic distribution. Unfortunately, we are still not completely sure which of these "variable characters" indicate population variability within a single species and which are consistent in the evolution of species, and thus are more important in sponge taxonomy. This variation and its relevance to species determinations must be assessed by specialists - who appraise a wide range of characters, biochemical, ultrastructural, ecological and reproductive - and incorporated into a classification which can be interpreted in accessible terms.

Over recent years many advances have been made in sponge biology, providing new suites of non-morphological characters discovered from genetic, biochemical and ultrastructural studies. Some of these characters have been useful in supporting or refuting current ideas on morphological-based sponge taxonomy, but in other instances it is difficult to find any morphological characters that correspond to these new schemes: ultimately taxonomy must somehow be related to the morphology of the sponge to be of practical value. Consequently, most sponges are not easy to identify, even for experts, and require specialised techniques as well as an intimate knowledge of the morphological characters. Some of these techniques are outlined below, including the preferred methods for collection, documentation, histological preparation, and a brief explanation of many of the features used to identify sponges. Unfortunately there is, as yet, no taxonomic literature that provides a review or summary of all the morphological characters and all the major groups of sponges below the family level of classification, although such a reference work is in preparation. Knowledge of the vast specialist literature is still essential to effective sponge taxonomy. There are, however, three general books that provide useful insights to sponge classification (see Further Reading).

Scientific terminology

It is inevitable that in a book like this, which attempts to explain complex scientific phenomena in simple terms, some scientific words or phrases must be used. Wherever possible these words and phrases are **highlighted in bold** upon their first citation, and they are defined in the glossary at the end of the book.

Following convention, words given in *italics* refer to proper scientific names of animals, either derived from the Latin or Greek languages or words from other languages with latinised endings. These proper scientific names are given to every species of animal described in the scientific literature. Each name is unique, allowing an accurate 'tag' for any particular species. Sometimes a particular species is given more than one name, for one reason or another, in which case the older, first-used name is usually the valid one, and the younger names are called **junior synonyms**.

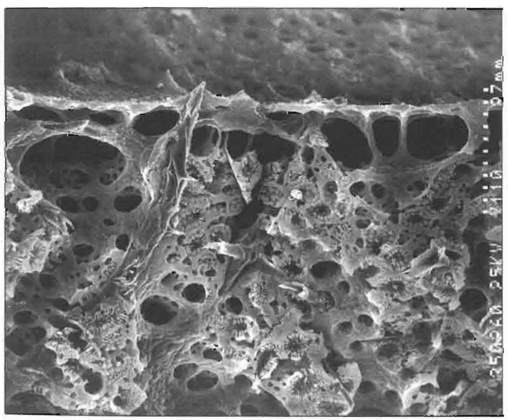
There is a hierarchy of names used in biological classification, starting at the bottom with the "reproductively viable biological unit" - the *species*; a collection of species with common ancestry - *genus*; and then the "higher taxa" - family, order, class, and phylum. Again by convention, only the genus and species names are italicised. Often a person's name and date follow the proper scientific name - *e.g. Ceratopsion clavata* Thiele, 1898. This refers to the person who originally described the species, Dr Thiele, and the date when the description was published. Species names become 'available' for use in biology, to 'tag' a species, once they have been published in the scientific literature, together with a recognisable description of the species. These data, author and date, become important to taxonomists when a conflict arises in choosing the correct proper scientific name for a particular species - such as when a single species has been given several names (synonyms) or when the same name has been used more than once for different species. By convention, when the author's name and date appear in brackets (*e.g. Clathria vulpina* (Lamarck, 1814)), this means that someone has removed the species *vulpina* to another genus (*i.e.* in this case the species was originally described by Lamarck in the genus *Spongia*, but now appears in *Clathria*). The convention governing this protocol, referred to as the International Code of Zoological Nomenclature, is detailed and complex, but its major, ultimate purpose is to avoid the possibility of any particular species having more than one valid 'tag'.

Collection

Most sponges are soft-bodied, many are fragile and colours are generally unstable (*e.g.* aerophobic and soluble pigments). Many sponges are also harmful to humans, producing physical damage (*e.g.* from sharp spicules protruding through the surface) and/or with an irritating mucus and other chemicals, sometimes causing severe dermitis (such as *Biemna hartmani*). Consequently, special care must be taken when collecting to minimise damage to both the sponge and collector. Sponges may be removed from the substrate with a knife or chisel, preferably using protective gloves and clothing. Although identifications are possible from small pieces of sponge these may be less accurate and whole individuals are ideal for taxonomy.

Collections of sponges intended for identification should be accompanied by *in situ* photographs and adequate documentation (locality, habitat, surface features, colour notes, etc.). In many species both colouration and morphology may change dramatically following collection and preservation, and identifications, even by specialists, are often greatly facilitated if there are adequate colour photographs of live material.

Fixation and preservation


Soft parts of the sponge
(photo J. Vacelet)

Sponges may be frozen immediately upon collection, which to a certain extent fixes the colour, or material may be placed directly in 80-90% ethanol solution (the sponges dilute this concentration themselves). Buffered formaldehyde is a less preferable alternative for fixation, and should be used for only brief periods (*e.g.* 24 hours), after which specimens should be transferred immediately to ethanol. Calcareous sponges should not be fixed or preserved in formalin at all.

Sponges may also be air-dried in the sun, although many may lose their shape, most lose their colouration (but few lose their noxious smell!). For several groups of sponges (*i.e.* those which have strong fibre skeletons such as the commercial 'bath sponges'), specimens may be rotted in freshwater and subsequently washed in solutions of potassium permanganate, sodium metabisulphide and hydrochloric acid to soften and clean the fibrous skeleton of incorporated sand particles.

Preparation for spicule identification and histology

Usually sponge identifications require two forms of preparation: one, a spicule preparation (for those species with a mineral skeleton), to determine the structure and geometry of spicules in the skeleton; and second, a perpendicular section through the sponge cut at right angles to the surface to determine the structure and disposition of the skeleton, the water-canal system, and other aspects of its histology.

Spicule preparations
For spicule preparations several simple methods are available, none of which requires extensive experience or sophisticated equipment although these certainly help.

• Bleach digestion
This technique is useful for rapid surveys of spicules within a sponge, although preparations are not as clean as those obtained through an acid digestion process. Sponges with calcareous spicules are routinely prepared in this manner because acid dissolves their calcitic spicules. Small fragments of sponge 'tissue', including portions from both the surface and deeper parts, are placed in small Ehrlenmeyer flasks or directly on microscope glass slides. A small quantity of active bleach (sodium hypochlorite) is added to the fragment, and after a short period the organic components dissolve leaving only the mineral skeleton. The bleach must then be carefully diluted and eventually washed from the spicules several times, replaced firstly with water and then with ethanol. If bleach is not completely removed preparations become crystalline. Finally, clean spicule suspensions are aspirated and pipetted onto a glass slide, the ethanol allowed to evaporate, and mounted. It is important to note that during each stage of pipette wash the suspension should be left to settle for about 10-15 minutes, prior to decanting the supernatant, to avoid accidental decanting of smaller spicules. Using flasks for the actual digestion process, instead of slides, has the advantage that a centrifuge can be used to eliminate the settling time of the supernatant. Conversely, preparations made directly on slides have the advantage that spicules do not have to be pipetted, and hence minimising the potential for losing and missing the smaller spicules.

• Acid digestion
This technique provides cleaner, permanent preparations, but the process involves noxious chemicals and should be undertaken only with suitable facilities (*e.g.* protective clothing, fume extraction). This process uses nitric acid instead of bleach. Fragments of sponge are placed directly on glass slides (or glass cover slips for electron microscopy). Several drops of acid are placed on the fragment, gently heated over a flame until bubbling and all organic matter is digested (this is easily ascertained by eye). The heat-accelerated digestion process produces various oxides, including nitrous oxide, and it is cautioned that these are noxious. It should also be noted that the acid is evaporated rather than burnt, so low heat is preferable (*e.g.* using an alcohol flame rather than gas). Once dry and cool, preparations can be mounted immediately without washing. Siliceous spicules are bonded directly onto the glass by this technique, which makes it useful for both light and scanning electron microscopy. Alternatively, Ehrlenmeyer flasks can also be used for acid digestion without heat, in which case fragments should be left soaking in acid for 24-48 hours, in a fumehood, and spicule residues should be washed and centrifuged as described above. Spicule preparations obtained from both techniques are now ready for covering using a suitable mounting medium (*e.g.* Depex, Canada balsam, Euparol, Durcupon, etc.).

Sponge section

For sponge sections there are more complex procedures involved, using microtome-sectioning or at least thick, hand-cut sections. The object of these techniques is to observe skeletal structures and cytological characteristics so wax embedding techniques, staining and/or simple clearing agents are required. Several techniques are available, most requiring specialist histological facilities.

• Simple clearing

The easiest method to determine the structure of the mineral skeleton is to use thick hand-cut sections cleared in a clearing agent (*e.g.* toluene, xylene, phenol-xylene, Histosol, lactophenol creosote, etc.). A perpendicular section through the surface and deeper skeleton is cut from a larger, preserved fragment of sponge by hand, using a new, clean scalpel or razor blade. Relatively even, thick sections (between 50-100 µm thickness) are possible using hand-cutting techniques, but success is certainly linked with practice. Cut sections are placed directly in a saturated mixture of phenol and xylene (which has been matured for at least 1 week) to clear the section, which eliminates the need for an alcohol dehydration series. Clearing may take between 4-24 hours, depending on the extent of collagen development in particular species. Cleared thick sections can be mounted directly on slides, but cover glasses should be supported with glass slivers or card to provide an even platform.

• Wax embedding

To produce a perfectly uniform section thickness, and for thin sections to observe detailed cytological features such as choanocyte chamber structure, wax embedding and microtome techniques are required. Fragments of preserved sponges should be passed through a dehydration series, cleared in toluene, and wax embedded for at least 2 hours. Sections should be cut from trimmed wax blocks so as to include both the outer surface and inner skeleton. For most species relatively thick sections are required (>50 µm), so as to avoid breaking the spicules *in situ*, but for 'keratose' (non-spiculous) sponges both thick and thin sections are required. Cut sections are again dehydrated, placed in clearing agent for an adequate period to dissolve wax and clear the 'tissue', floated onto slides and mounted.

Sponge identification

A simple analogy of a sponge is a flexible balloon or sac containing a gelatinous ground substance, a roving cell population, water canals and water pumping stations, and organic and/or inorganic structures producing a definite body form. The 'simple sponge' is in fact a very complex histological unit, which even today is not well understood.

There are many morphological characters which can be used to aid in sponge identification including shape, distribution of surface pores, colour, ornamentation of the surface, texture, structure and composition of the organic skeleton and water canal system, and the structure, composition, size and geometry of the inorganic skeleton. In addition, several non-morphological features have proven useful practical tools in sponge taxonomy.

Shape

Many sponges are thought to be morphologically plastic, with individuals and populations potentially differing widely in shape and colouration depending on a complex series of local environmental conditions. Intraspecific genetic differences (clines) are also associated with geographic range and populations, and thus shape (or **habit**) is not a particularly reliable absolute descriptive character. However, this 'problem' is perhaps overemphasised in the literature, and in only few instances have species been shown to be truly polymorphic. Generally species' growth forms can be defined within reasonable limits, and used with a certain degree of caution sponge shape may be informative for particular species determinations. The range of possible shapes seen in sponges is enormous, extending from thin encrustations to massive volcano shapes, finger-like or whip-shapes, 'golf balls', fans and so on.

Size

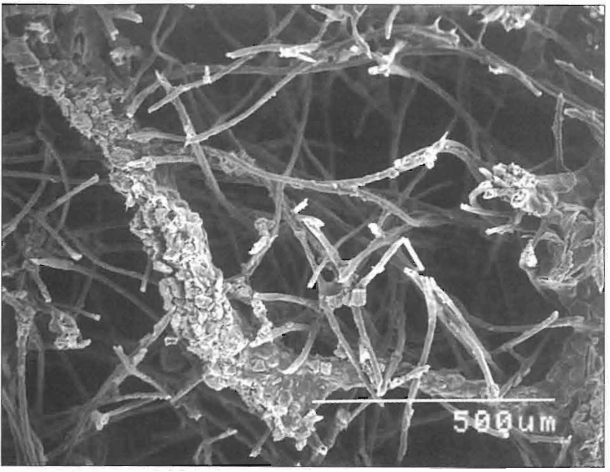
The size to which particular specimens may grow may be influenced by several factors, such as the individual's age, the prevailing environmental conditions (current, sedimentation, light availability, etc.) and of course particular species' genetic potentials. Some species are capable of growing into huge volcano shapes (*e.g. Xestospongia*) whereas other closely related species are merely thinly encrusting on dead coral (*e.g. Petrosia*). Size is more important as a descriptive taxonomic character, such as when comparing populations of particular species or comparing closely related (sibling) species, and is less important as an absolute taxonomic feature.

Colour

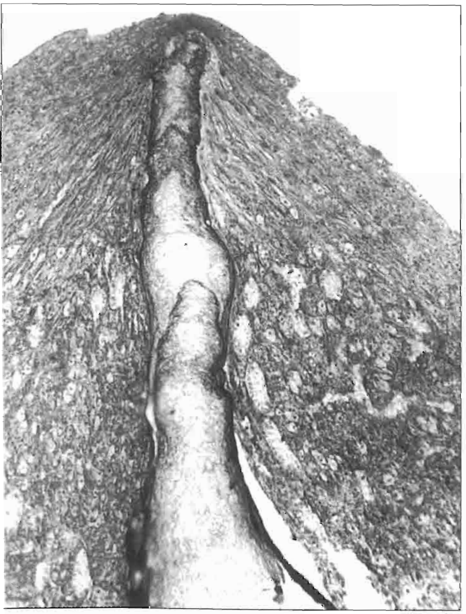
Certain groups of sponges (such as the Verongida), have peculiar pigments that darken upon contact with air (**aerophobic pigments**), and others (such as many Mycalidae and Tedaniidae, order Poecilosclerida) produce a pigmented mucus that stains or irritates human skin. Some groups of sponges are characteristically brightly coloured (*e.g.* Microcionidae, order Poecilosclerida) whereas others are typically drab (*e.g.* Halichondriidae, order Halichondrida), but there is generally no complete correlation between colouration and taxonomic placement. Nevertheless, these characters are useful for field identifications, particularly to differentiate closely related species, and therefore colour notes and/or colour photographs are now considered to be essential for accurate identification. The range of sponge pigments is enormous, varying from drab, colourless forms (black, beige or white) to very colourful species (vibrant reds, greens, yellows and blues, etc.). Sponge colouration can often be attributed to the presence of particular carotenoid pigments, and due to a large proportion of these pigments obtained and modified from the diet, mainly from the plankton, there may be some slight variability between populations of particular species from different localities. Sometimes these differences can be attributed to different specimens having different light regimes. Sponges growing in caves or overhangs are paler than specimens of the same species growing in full light. In contrast, a few species are truly polychromatic, with individuals, sometimes growing side by side, showing dramatic differences in colouration without any obvious ecological differences. By and large, however, colouration is a useful descriptor for species identifications, and when used cautiously colour illustrations, as presented in this book, can be useful tools for field identifications. As noted above, colour may be fixed to a certain extent in live material by freezing specimens prior to preserving them, but most sponge pigments are alcohol soluble and colouration will be leached out into the preserving fluid to a greater or lesser extent. Thus, care should be taken when preserving several species of sponges in the same container, particularly with the aerophobic verongids that tend to stain all other sponges a dark purple colour.

Texture

To an experienced field biologist sponge texture often provides good clues as to the nature of the skeleton and water-canal system inside. A sponge which is rubbery, compressible but difficult to tear or cut may contain no or few spicules but a well developed spongin fibre system (*e.g. Ircinia*); a sponge that is soft, friable and easily torn probably has both fibres and spicules reduced (*e.g. Haliclona*); one that has a hard, stony but easily crumpled texture may lack spongin fibres altogether but have a closely compacted spicule skeleton (*e.g. Petrosia*); sponges incorporating sand into the skeleton are also to a large extent brittle, easily crumbled and incompressible (*e.g. Chondropsis*); and sponges that are hard, incompressible, difficult to cut or break may lack spongin fibres but have interlocking spicules (**desmas**), and/or a dense surface crust of spicules (*e.g. Desmanthus, Geodia*). The permutations are endless. Similarly, the texture of a sponge, the degree to which it can be compressed, and whether it retains its shape after it has been removed from the water may provide a good indication of the histology and water-canal system (the size of choanocyte chambers,



Spongin fibres some with detritus incorporated (photo J. N. A. Hooper)



Spongin fibre (photo J. Vacelet)

the development of the skeleton and mesohyl in relation to the size of water-canals and choanocyte chambers, and the density of the roving cell populations). These features are particularly useful as both field and laboratory characters for the orders Dictyoceratida, Dendroceratida and Verongida (all of which lack a mineral skeleton).

Mucus production and smell

Many sponges produce mucus: usually clear, sometimes pigmented, and in many cases toxic or irritating to the human skin. This feature is certainly characteristic for particular species (*e.g. Aplysilla sulfurea*), sometimes characteristic for a particular genus (*e.g. Thorectandra*), but only rarely consistent at the family level (*e.g.* Desmacellidae, with the well known toxic sponges *Neofibularia* and *Biemna*). Some species characteristically have a sticky surface when alive, such as in *Xestospongia exigua* which sticks to the fingers when touched. Mucus production is particularly common in intertidal tropical species and may serve a physiological role in protecting (*e.g.* cooling) the sponge when exposed to the sun and air. Certainly some sponges literally drip mucus when exposed to the sun during low tides (*e.g. Clathria*), but probably more importantly mucus production may protect or even repel competing species, predators and parasites.

With experience a field biologist may also be able to recognise particular chemical smells emitted by particular species of sponges. Not many of these aromas have yet been documented, nor has this feature yet been quantified, but there are several groups of species that do have unique aromas (*e.g.* acrid smell of *Ircinia*, pungent smell of *Xestospongia*).

Surface ornementation

The presence and distribution of surface pores, ridges, microconules, stalks, digits, protruding spicules and other processes are often important descriptive characters, and sometimes useful features in recognising particular genera. Small inhalant surface pores (ostia) are scattered or aggregated into clusters (**sieve plates** or **porocalyces**). They may be confined to one side of the sponge (**inhalant surface**), with the larger exhalant pores (oscules) only on the other side (**exhalant surface**). This is sometimes seen in vase- or cup-shaped species (*e.g. Xestospongia*). Oscules may be raised on stalks (**fistules**) or flat against the surface and often have a surrounding membranous lip, which may or may not be contractile, with or without subsurface drainage canals (**stellate radiating**) leading away from the pores.

Surface microconules, ridges and undulations are common features in many groups, whereas some species have characteristic, more specialised surface processes (*e.g. Myrmekioderma* with polygonal plates, producing a pineapple-like texture, and apical pore sieve plates; *Spheciospongia* with large oscules on the ends of long papillae poking through the substrate; many *Clathria* with stellate radiating canals surrounding oscules; *Callyspongia* and *Dysidea* with a cobweb-like surface ornamentation composed of spicules or sand, respectively).

Organic and inorganic skeletons

To provide a structure for the mobile cell populations inside the sponge, the small choanocyte water pumps, and the water-canals there are often two types of skeleton present, both of which are secreted by specialised sponge cells:

- An **organic** (spongin fibre) **skeleton** composed of collagen, usually forming strands. The construction of the fibres themselves, the patterns they form, and the material contained within the fibres are important characters used in classification.
- An **inorganic** (spicule) **mineral skeleton** found within and outside spongin fibres. Spicules are constructed of either opaline silica or calcite, and the shape, ornamentation, size, origin and arrangement of these spicules inside the sponge are also important characters used for classification.

Foreign particules

Many groups of sponges incorporate foreign particles into their mesohyl, particularly sand particles and spicules from other sponges, but also including shell debris from Foraminifera, Mollusca, Bryozoa, and filamentous algae. Foreign debris may be found inside spongin fibres, actively taken into fibres by a curious exchange process whereby in some species there is a complete loss of native spicules which are replaced by debris. In other species foreign particles are found within the proteinaceous mesohyl of the sponge but only outside fibres, or they may be restricted to the exterior surface of the sponge only (**sand cortex**). There are several groups of sponges that are notorious in being able to organise foreign particles into a 'foreign skeleton', partially or completely replacing the 'native skeleton' (*e.g. Dysidea, Hyrtios, Phoriospongia, Psammoclemma, Clathriopsamma*). These so-called **arenaceous sponges** are usually easily detected in the field by their harsh, sandy texture.

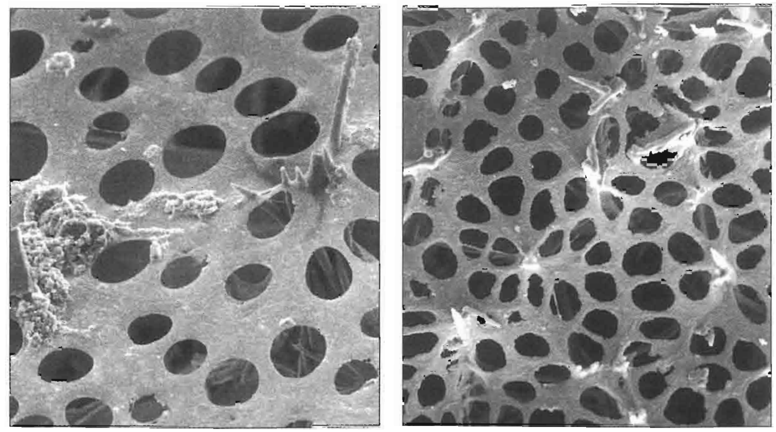
Skeletal structure

Structurally the sponge may be divided into two major skeletal regions:

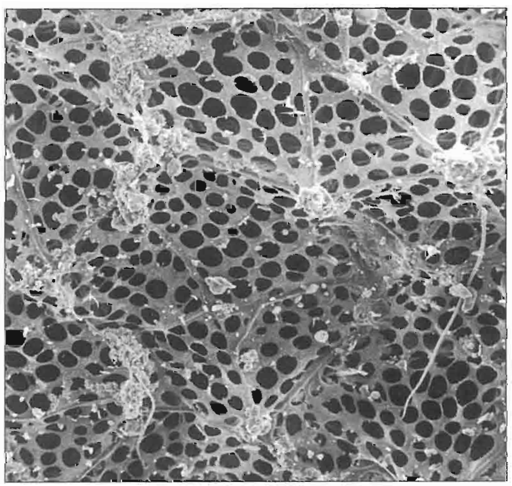
- **The outer surface of the sponge** (**ectosome, dermis or cortex**) bounded by a single layer of epithelial cells on the external surface. In some groups there may be a specialised skeleton on the surface (the **ectosomal skeleton**), composed of both or either spongin fibres and spicules.
- **The inner region of the sponge** (**choanosome**) includes all organic portions of the sponge inside the epithelial cells (mesohyl, comparable to the mesenchyme of higher multicellular animals), including the water current system. Both spicules and spongin fibres may be present in the choanosome, although one or both may be lost in some groups.

Traditionally the choanosomal region near the periphery is called the **subectosome**. The patterns in which the organic and inorganic skeletons grow are informative at all levels of sponge taxonomy and generally useful in their identification. A special terminology has been produced to define this range of skeletal structures, with several categories of skeletal architecture recognised (although combinations and intermediate forms of these may also occur).

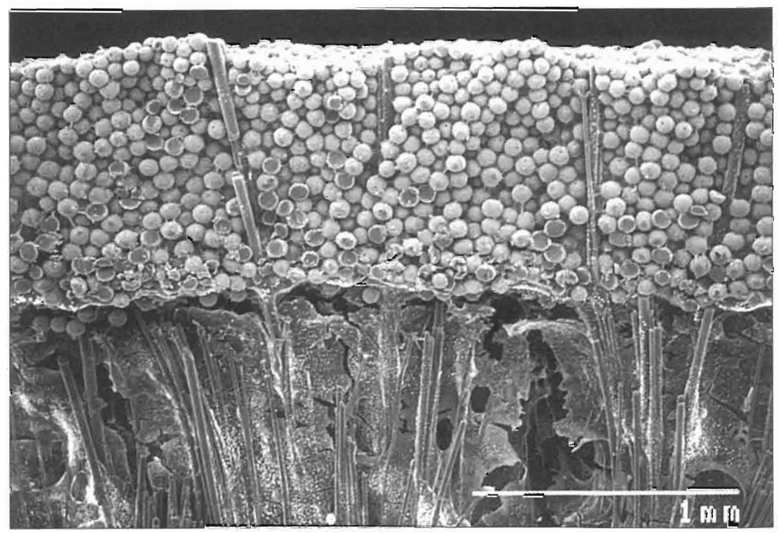
1. Branching and rejoining network (**reticulate**), producing regular triangular meshes (**isodictyal reticulate**) or quadrangular meshes (**myxillid reticulate**).
2. Repeatedly branching but not rejoining (**dendritic**).
3. Diverging, expanding, but not branching (**plumose**).
4. Diverging, simply concentric (**radial**).
5. Disorganised criss-crossed spicule (**halichondroid**).



Perforated ostial surface of ectosome, with renieroid (isodictyal) tangential surface spicule skeleton (photo P. R. Bergquist)



Reticulate spicule skeleton and perforate ectosome (photo P.R. Bergquist)



Thick sponge cortex, with spherasters embedded in ectosome (photo J. N. A. Hooper)

Spongin fibres and filaments

In several orders of sponges the mineral skeleton has been lost completely, and for these groups fibre characteristics are important in their classification. In other groups, where there is both spongin fibres and spicules, the latter may be partially or fully contained inside the former, and thus the skeletal architecture is predominantly dictated by the form of the organic skeleton. In some groups (*e.g.* some Haplosclerida) there are no fibres but spicules are cemented together with granular collagen. Mostly, though, spongin fibres are useful in identification.
Spongin fibres vary both in a hierarchy of size and construction. Three size categories of fibres are generally recognised (primary, secondary, tertiary fibres), sometimes differentiated by both size, construction, and the material contained within each type of fibre.
In addition to these fibres some groups have **collagen filaments** (*e.g. Ircinia*), which are long, thin, convoluted, terminally swollen collagenous structures dispersed within the mesohyl.
Several other classes of fibre construction are recognised, based on the amount of spongin protein deposited when the fibre was secreted, and whether or not this spongin was deposited evenly (homogeneous fibres) or periodically (stratified fibres).

Sponges with heavy spongin fibres, often termed 'horny' or 'keratose' sponges, belong to the orders Dictyoceratida, Dendroceratida and Verongida. The most simple fibres are homogeneous in cross section without a central core (or visible **pith**) (*e.g. Spongia*), whereas the most 'complex' fibres are stratified in cross section, composed of concentric rings of protein ('**bark**'), with an optically diffuse pith in the centre of each fibre (*e.g. Aplysina*). Intermediate forms are also common, such as found in species of *Thorecta* with slightly stratified (**laminated**) fibres (not bark-like), with a granular pith.

Mineral skeleton

The inorganic or mineral skeleton is traditionally the most important feature for identifying sponges. This skeleton may consist of a fused, coral-like **basal skeleton** and/or individual components called **spicules**.

• Basal skeleton

Some groups of sponges secrete a secondary, calcareous (**hypercalcified**), spicular basal skeleton, in addition to free siliceous or calcitic spicules. This feature was once considered diagnostic for a class of sponges known as "sclerosponges", but is now interpreted as a grade of construction found within both Calcarea and Demospongiae. The species concerned (*e.g. Astrosclera*) usually live in coral reefs and their calcareous skeletons contribute in a minor way to the overall accretion of these reefs.

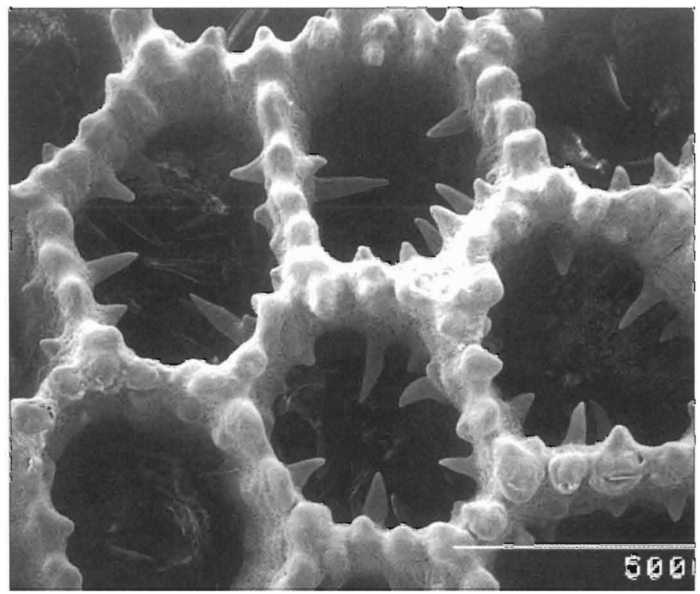
• Spicules

These are classified according to five major criteria:

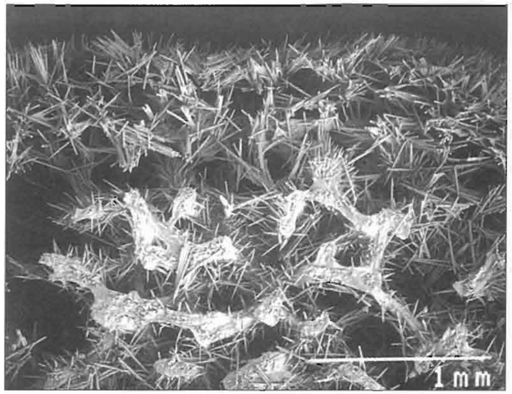
1. Chemical composition – These may be silicate or calcitic, indicating division between the classes Demospongiae and Calcarea.

2. Spicule size – Larger spicules, called **megascleres**, contribute to the skeletal framework within the sponge, whereas smaller ones, **microscleres**, are packed between tracts of megascleres, supporting the soft parts. Spicule sizes are essential criteria in defining species, in some examples providing the only easy clues to distinguishing related species, whereas absolute spicule dimensions are less important at higher taxonomic levels.

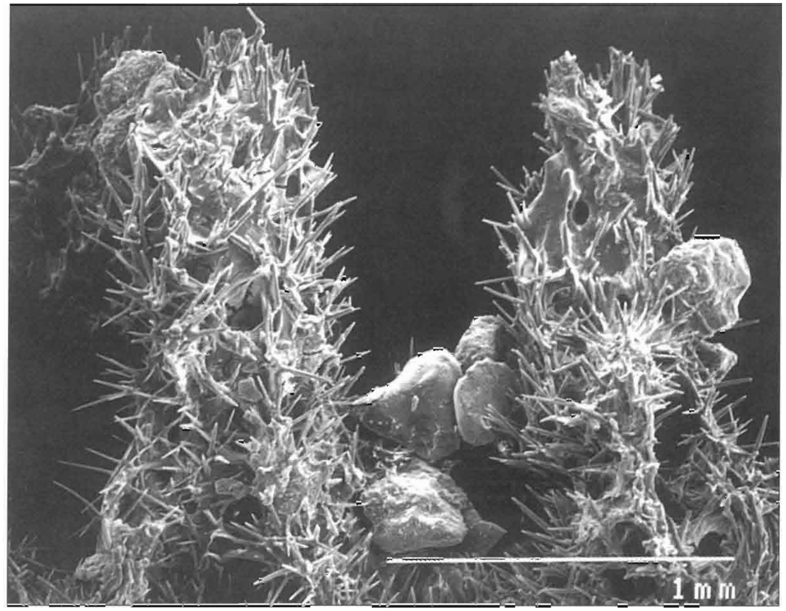
3. Spicule fusion – Most spicules are free within the mesohyl or bound together by the organic skeleton, whereas some are characteristically fused together, producing an interlocking or articulated skeleton. These spicules consist of rigid monospicular skeletons composed of



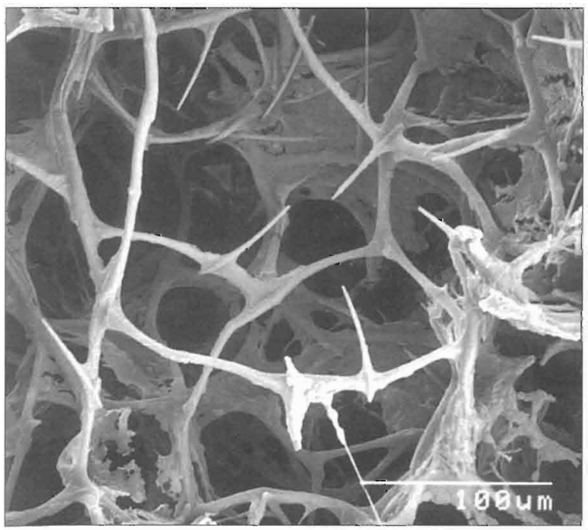
Hypercalcified basal ('sclerosponge') skeleton (photo J.N.A. Hooper)



Plumose ectosome (exterior), reticulate choanosomal skeletons (interior) (photo J.N.A. Hooper)

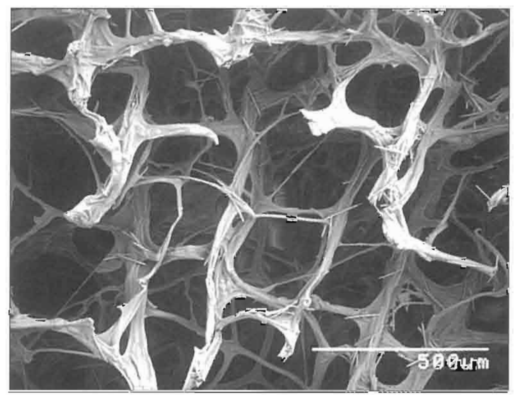


Plumose skeleton, with embedded detritus (photo J.N.A. Hooper)

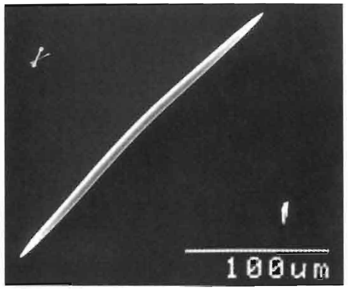


Irregularly reticulate spongin fibres and embedded spicules (photo J.N.A. Hooper)

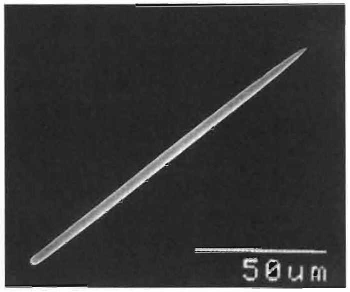
Radial choanosomal skeleton (photo J.N.A. Hooper)



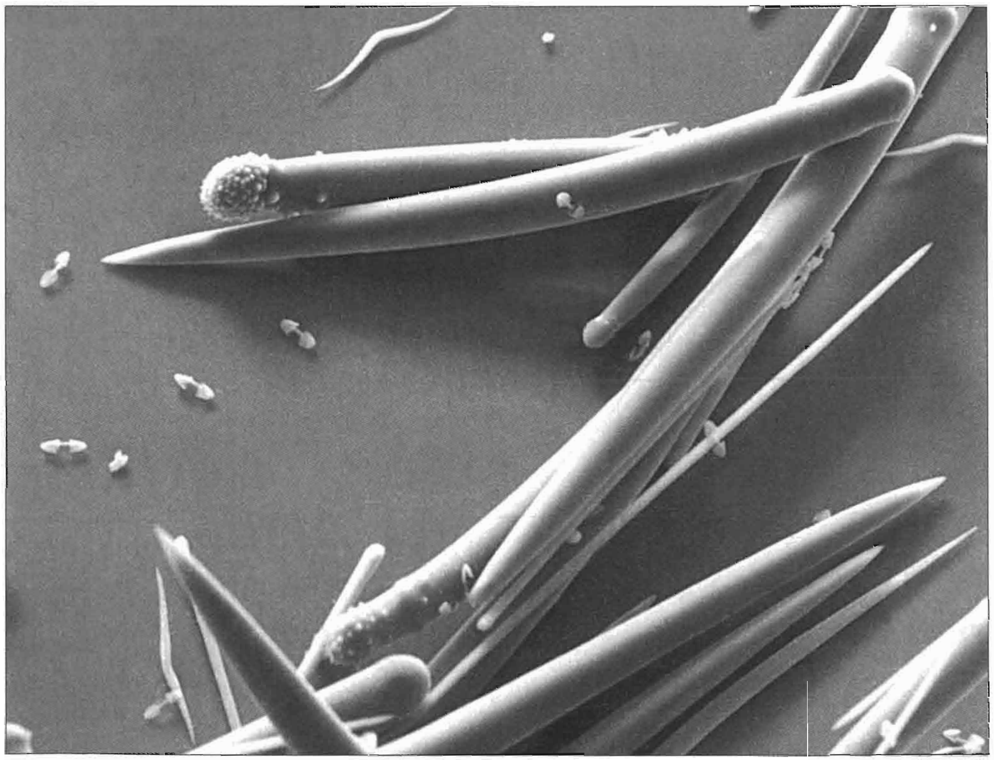
Rectangular reticulate skeleton (photo J.N.A. Hooper)



Oxea
(photo J.N.A. Hooper)



Style
(photo J.N.A. Hooper)



Typical spiculation of the poecilosclerid family Microcionidae: macroscleres: subtylostyles, acanthosubtylostyles and microscleres: isochelae and toxas (photo P.R. Bergquist)

modified **triaxons** (as in the Calcarea order Murrayonida), or special spicules called **desmas** (as in the Demospongiae polyphyletic order Lithistida).

4. Spicule distribution – Localisation of spicules to particular regions is a relatively common phenomenon. These include **ectosomal spicules** (or cortical spicules, found on the surface of the sponge), **principal spicules** (forming the major structural tracts, or found exclusively inside spongin fibres), **auxiliary spicules** (or interstitial spicules located outside the fibres, scattered within the mesohyl and/or just below the surface), and **echinating spicules** (or accessory spicules, poking through the fibres, perpendicular to them). Only few groups of sponges have all four categories of spicules.

5. Spicule shape or geometry –– There is an extremely diverse range of shapes known for the phylum, and this is probably the single most important character in the current system of sponge taxonomy. Even in a single species there may be many sorts of spicules.

Microscleres

•

Meniscoid or **sigmoid** microscleres include a diversity of curved, symmetrical and asymmetrical spicules (chelae and sigmas).

•

Monaxonic microscleres include spicules with only a single axis and one or two rays.

•

Asterose microscleres are tetraxonic, with more than one axis and more than two rays.

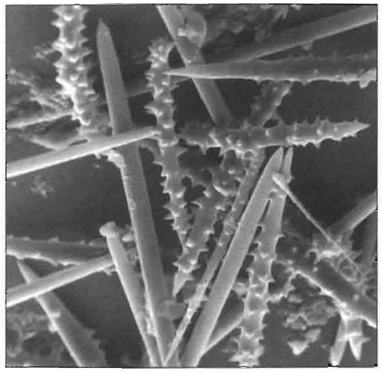
Megascleres

•

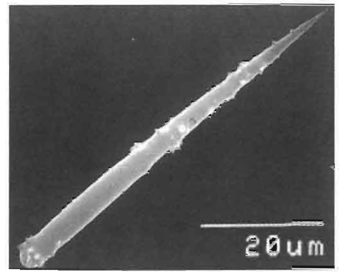
Number of central axes (**axons**): **monaxonic** spicules with no more than two rays (points of growth); **triaxonic** spicules with three perpendicular axes; **tetraxonic** spicules with four rays, each with a central axis.

•

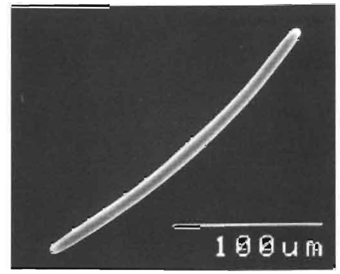
Number of rays (**actines**): **monactinal** spicules have one ray with asymmetrical ends (*i.e.* the spicule is secreted by one or more cells commencing at one end and finishing at another); **diactinal** spicules have two rays, with symmetrical ends (*i.e.* the spicule is secreted in both directions by one or more cells, commencing at the centre); **tetractinal** spicules have more than two rays.



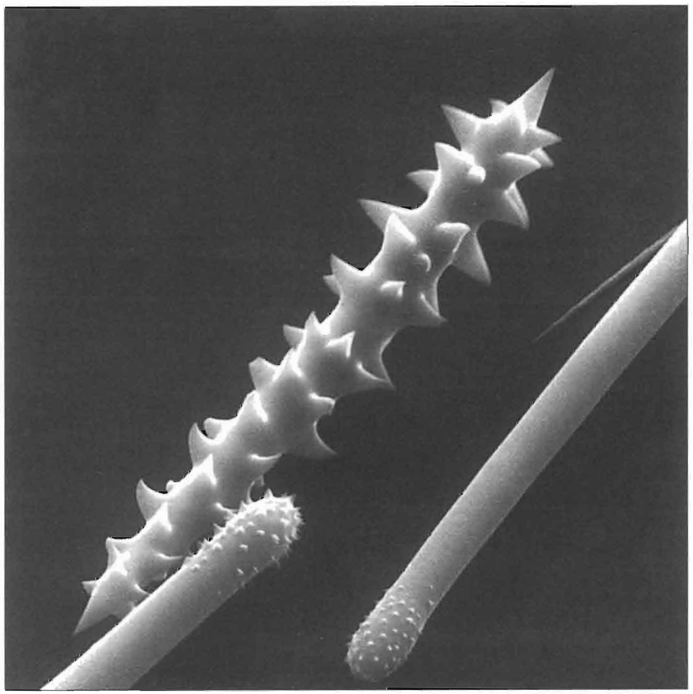
Acanthostyles
(photo P.R. Bergquist)



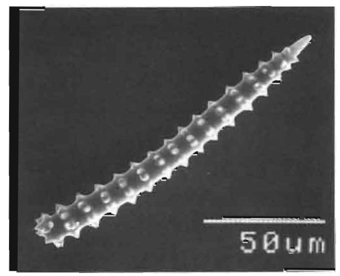
Acanthostyle
(photo J.N.A. Hooper)



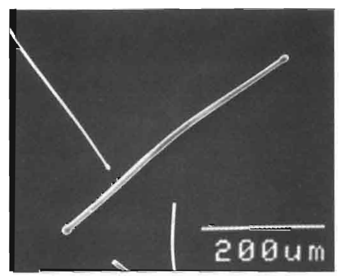
Strongyle
(photo J.N.A. Hooper)



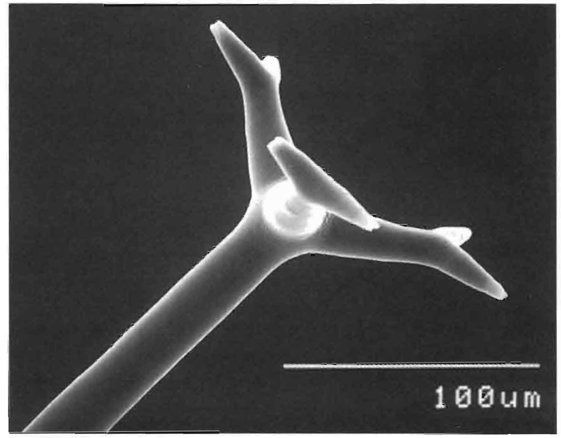
Acanthoxea
(photo P.R. Bergquist)



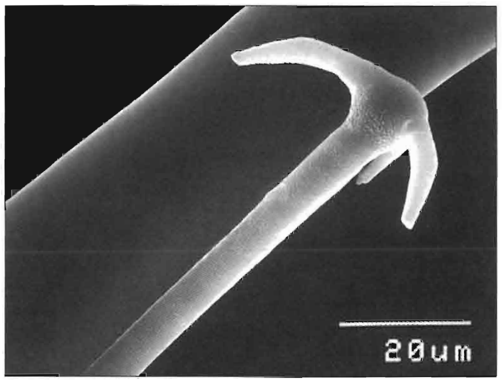
Verticillate acanthostyle
(photo J.N.A. Hooper)



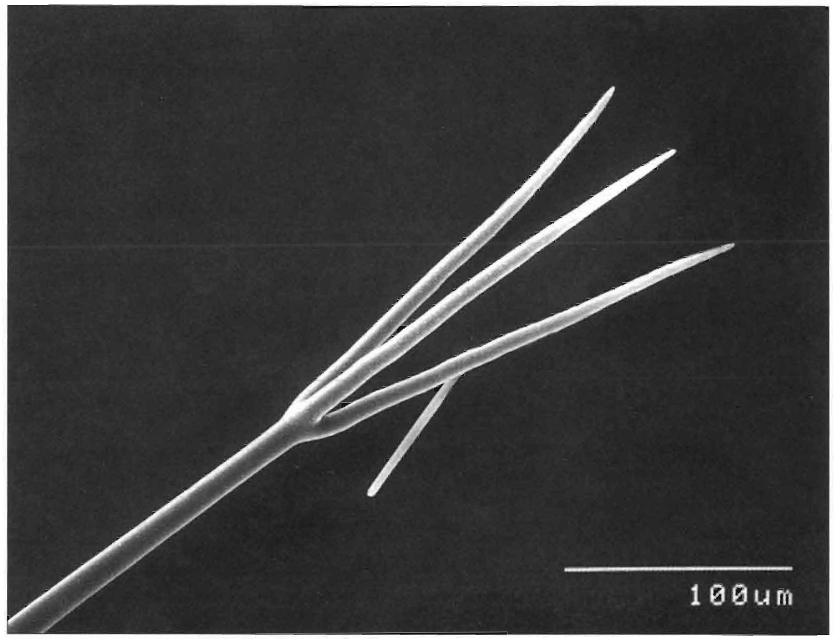
Tylote
(photo J.N.A. Hooper)



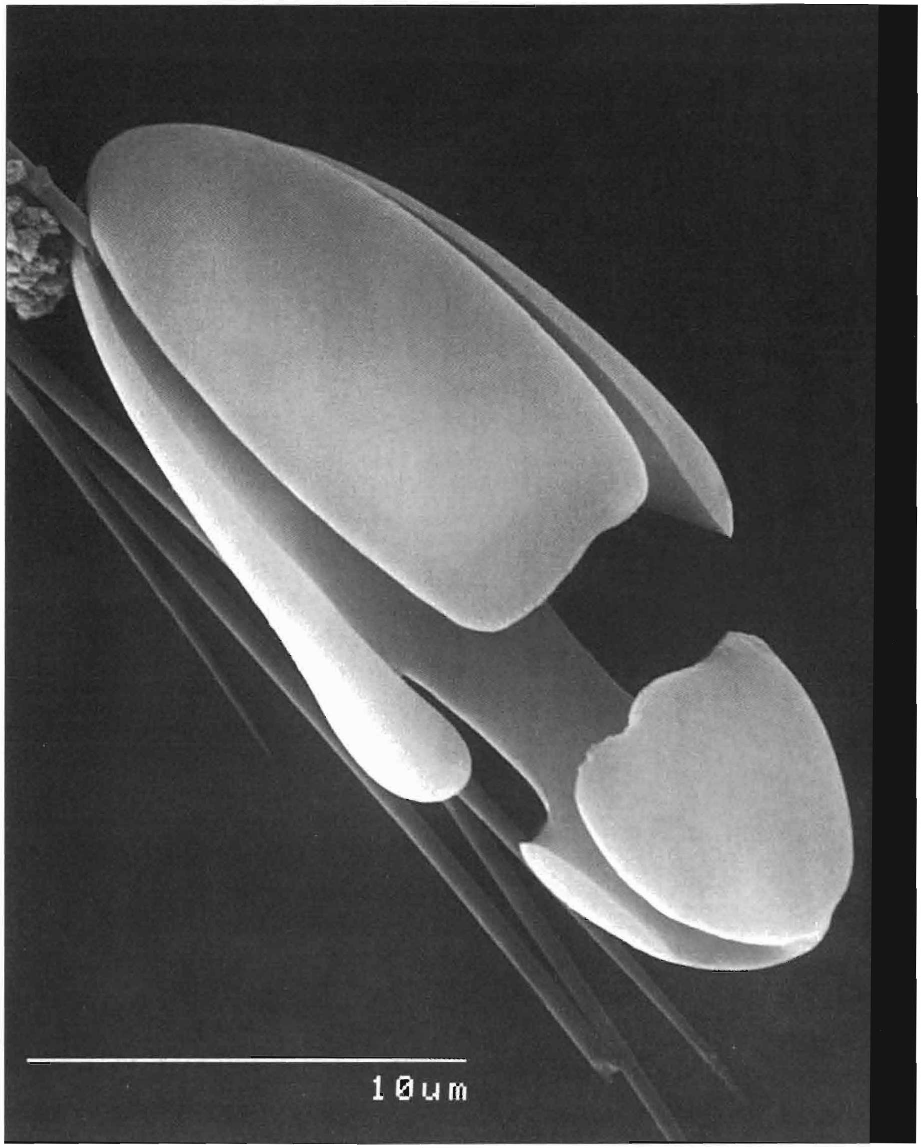
Dichotriaene
(photo J.N.A. Hooper)



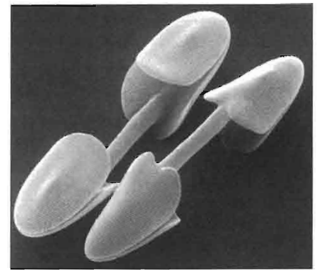
Anatriaene
(photo J.N.A. Hooper)



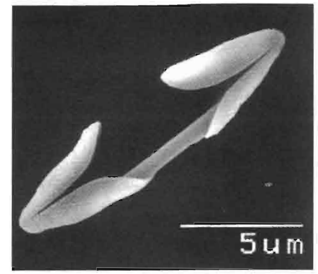
Protriaene
(photo J.N.A. Hooper)



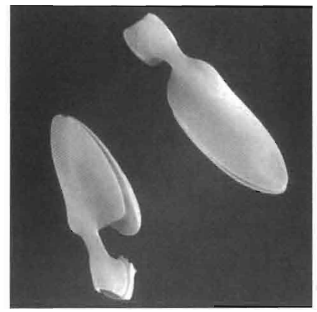
Palmate anisochela
(photo J.N.A. Hooper)



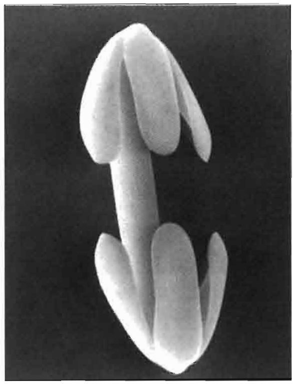
Palmate isochelae
(photo P.R. Bergquist)



Palmate isochelae
(photo J.N.A. Hooper)



Arcuate anisochela
(photo P.R. Bergquist)



Anchorate isochela
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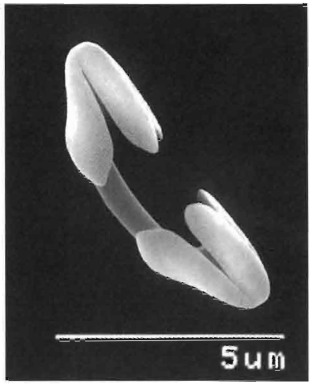

Arcuate isochela
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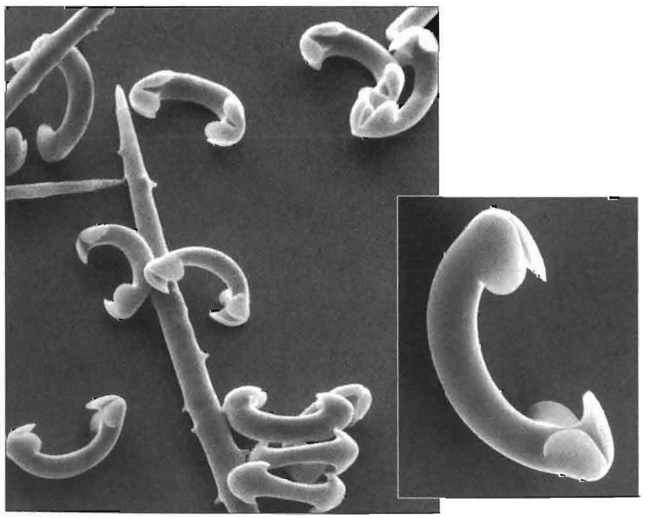
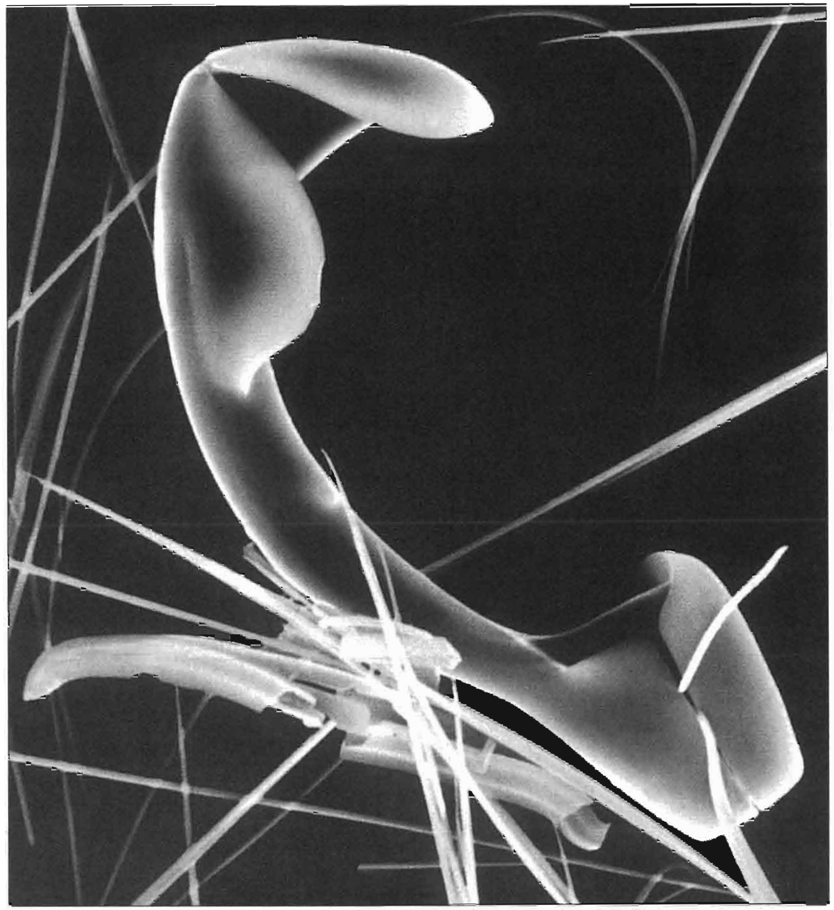
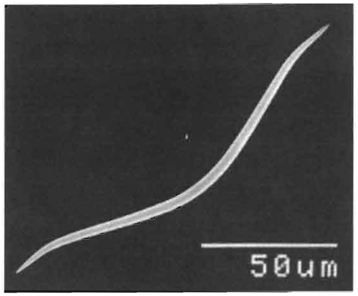


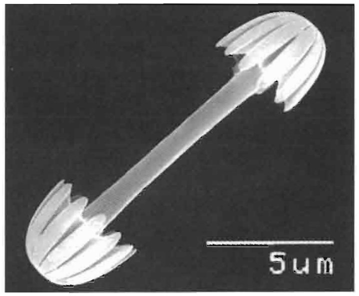
Arcuate isochelae
(photo P.R. Bergquist)



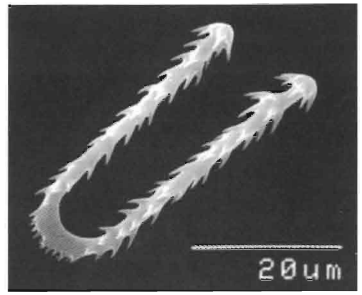
Palmate anisochela
(photo P.R. Bergquist)



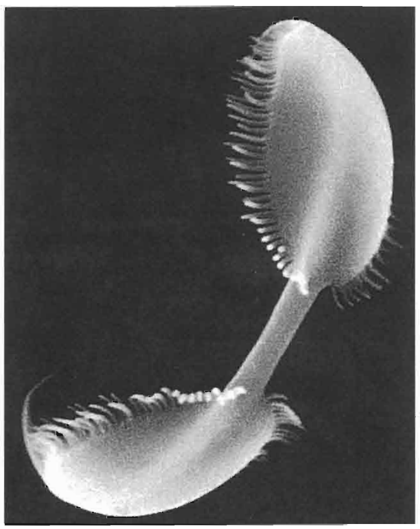
Toxa
(photo J.N.A. Hooper)



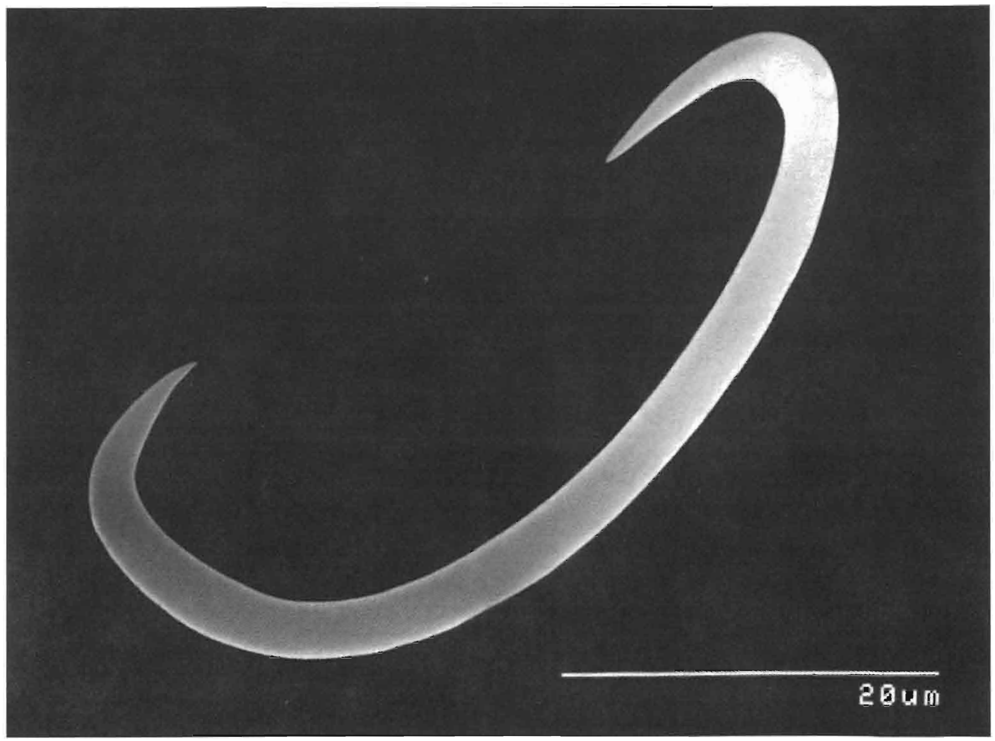
Birotulate isochela
(photo J.N.A. Hooper)



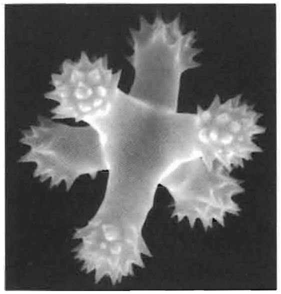
Forceps
(photo J.N.A. Hooper)



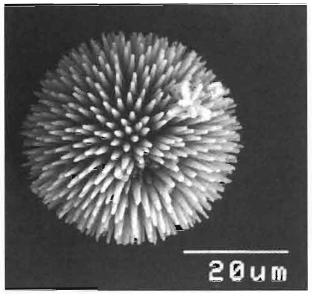
Bipocilla isochela
(photo P.R. Bergquist)



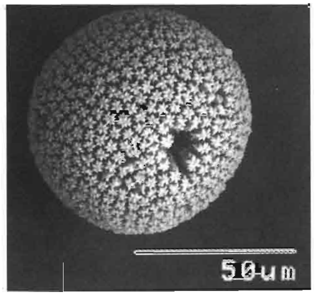
Sigma
(photo J.N.A. Hooper)



Anthaster euaster
(photo P.R. Bergquist)



Oxyspheraster
(photo J.N.A. Hooper)



Anthospheraster euaster
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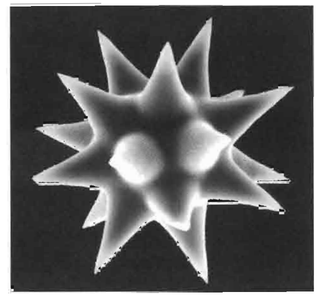
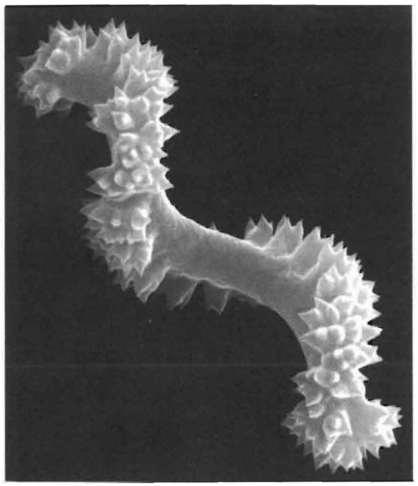
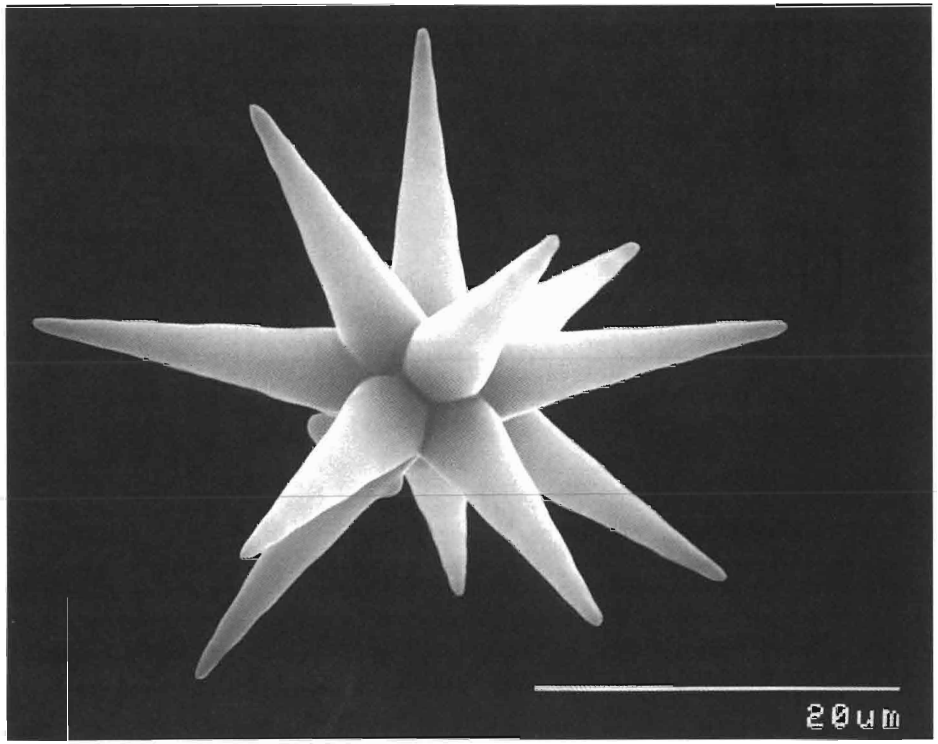


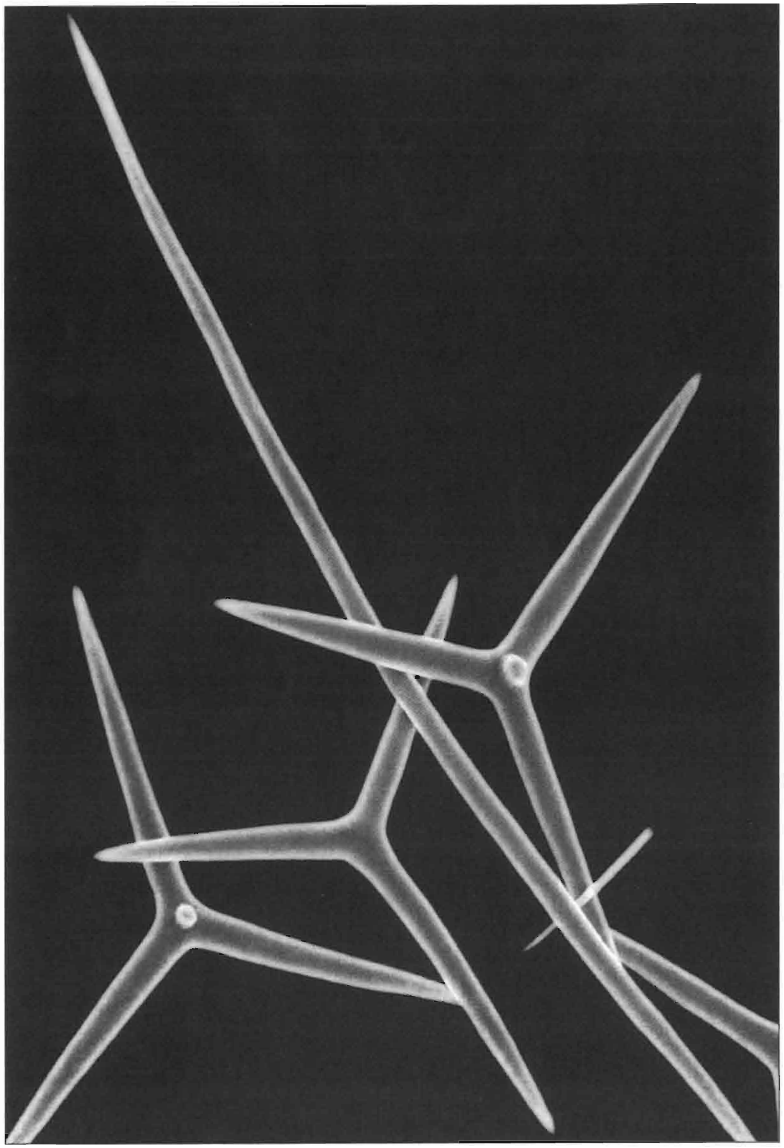
Oxyaster euaster
(photo P.R. Bergquist)



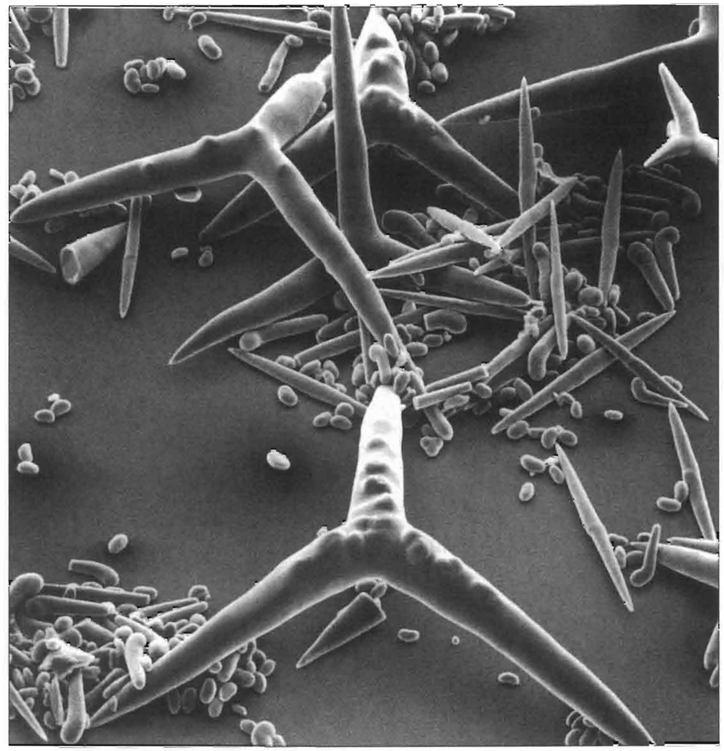
Spiraster
(photo P.R. Bergquist)



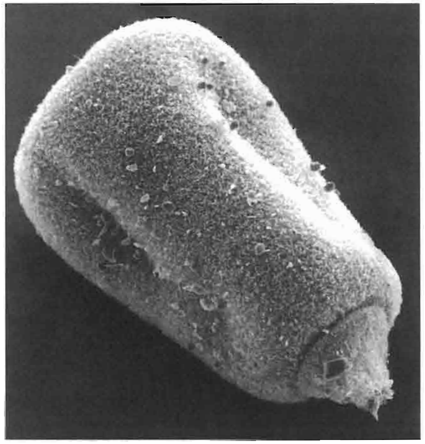
Oxyaster euaster
(photo J.N.A. Hooper)



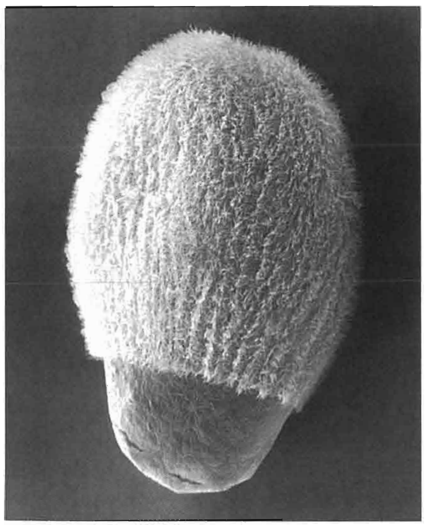
Diactines and tetractines
(photo N. Boury-Esnault)



Triactines, tetractines, diactines and sphaerule-like microdiactines
(photo J. Vacelet)



Parenchymella larva
(photo P.R. Bergquist)



Partially ciliated parenchymella sponge larva
with bare posterior pole (photo P.R. Bergquist)

Cytology

Several cytological characters have been instrumental in providing further understanding of the relationships within the Porifera, particularly at higher taxonomic levels. Foremost amongst these are choanocyte ultrastructure (including the presence, absence and position of the nucleus within the choanocyte), and the distribution of choanocytes and shape of choanocyte chambers (*e.g.* spherical, sac-like or elongate and branching). The characters have been particularly useful in describing relationships between the 'keratose' or aspicular sponges, and more recently in resolving taxonomic problems amongst the Calcarea. Other cytological characters, such as the possession of particular cell types (*e.g.* cells with inclusions), have so far been found to be of limited value, possibly because they are still documented for only few species and poorly understood.

Larvae and reproductive strategy

Larval morphology is known for only relatively few species, but in these cases it appears to be a consistent character useful for sponge taxonomy.
Larval shape (*e.g.* solid **parenchymella**, hollow **amphiblastula**), pattern of ciliation (*e.g.* partial, complete) and mode of locomotion (*e.g.* swimming versus creeping) are all useful descriptive features.
Mode of reproduction, including sexual and asexual modes, has been particularly useful in developing taxonomic hypotheses for sponges.
Several reproductive characters have been important in the detection of cryptic sibling species, such as whether larvae are brooded within the parent or gametes are broadcast into seawater, and the periodicity of spawning events. For example, sympatric populations of closely related species of *Xestospongia* were found to have markedly different reproductive strategies, possibly serving as a mechanism for niche separation (so-called sympatric speciation).
Some of these characters have also been used at higher levels of classification, particularly oviparity versus viviparity, although our knowledge of such strategies is still incomplete.

Ecology

Ecological data are essential in modern sponge taxonomic descriptions, although sadly they are lacking from most of the earlier literature that described many of the known species.
These data are most useful at the species level, with proven success in differentiating living populations of closely related (morphologically similar) species when it is not always possible to do so from preserved specimens.
However, it is still difficult, or impossible in some cases, to reconcile many of the older nineteenth century species descriptions with living populations, and clearly this is one of the major challenges facing sponge biologists for years to come.
This present book goes some way towards doing this for the prominent sponges in the New Caledonian lagoon.

The role of sponges in coral reefs

Sponges play important roles in the biology and geology of coral reefs: they contribute to reef construction, which is a role they played more prominently in geological times; they are amongst the most active agents in coral reef destruction, due to the boring activity of a few species; and they play a unique role in the food chain of a coral reef.

Sponges as Reef Builders

The role sponges play in reef construction has changed considerably throughout geological time. In present seas the framework of reefs is mostly built by the scleractinian or stony corals. Sponges now play a minor role, because the mineral content of their skeletons is relatively small compared to the soft parts, and generally spicules and fibres are dispersed after death. The situation, however, was very different in the Paleozoic and Mesozoic periods when many sponges had solid calcium carbonate and/or siliceous skeletons that remained as stable fossils. These sponges built impressive reefs up to several hundreds of metres thick. 'Sponge reefs' were actually the dominant structures in some periods, such as the early Cambrian (about 550 million years - MY; with the calcified archaeocyathids), during the Permo-Triassic (290 to 210 MY, with calcified stromatoporoids, chaetetids and other 'sclerosponges' being the major constructors) and during the Jurassic (210 to 140 MY; with siliceous 'lithistids' and hexactinellids). The bulk of these sponge reefs were made of calcium carbonate, like the current coral reefs around New Caledonia. We know that the ecology and morphology of those ancient reefs differed markedly from current reefs, but there is no way to determine if they were comparable to the magnificent reefs growing around New Caledonia today.

The major construction role of sponges in ancient reefs was overlooked until recently. It is only since the 1970s that the sponge identity of these major reef builders has been confirmed. Previously it was considered that all fossil calcified organisms were ancestral corals, until 'living fossil' relatives were found deep within caves on modern reefs and in some deep ocean habitats. Some of these 'living fossils' occur on New Caledonian reefs, but are generally difficult to find. Two species, *Astrosclera willeyana* and *Acanthochaetetes wellsi* have been included because of their evolutionary significance.

Why the construction role of sponges diminished after the Jurassic remains a mystery. However, it appears to be coincident with the time that corals acquired their symbiotic zooxanthellae. The corals appeared to have a distinct advantage because they were able to grow faster with the greater supply of energy from the symbionts and, hence, lay down more skeleton.

Although sponges are no longer major reef builders they do continue to play a significant role in reconstruction processes on coral reefs. Sponges are important because they can consolidate fragmented coral rubble, especially broken coral branches, by holding the pieces together prior to the rubble being cemented in place by a combination of chemical and algal processes. Another important function is the infilling of cavities of the reef framework by the fine, silt-sized sediments that are produced by boring (excavating) sponges.

Sponges and Reef Destruction

One important function that sponges play on coral reefs results from the ability of some species to bore into (bioerode) coral skeletons and weaken the calcium carbonate framework. These specialised sponges spend most of their lives within the solid calcium carbonate and spread by burrowing through the skeleton. Species of the Families Clionidae and Spirastrellidae bioerode skeletons of both living and dead corals, making them more fragile, and at the same time producing large quantities of silt-sized sediment (50 to 70 µm diameter). Sponges are the most important bioeroders of corals, although cyanobacteria (blue green algae), fungi and polychaete worms are significant during the early stages of erosion of new corals. Parrot fishes and sea urchins play a major role in breaking down the outer surfaces of corals in the process of grazing on encrusting algae. Most bioerosion of living corals originates in the dead parts of the skeletons, particularly at the base of branching staghorn (*Acropora*) species, such that they become more fragile and susceptible to breakage during storms. This reduces the vertical growth of corals and results in the production of much coral rubble, but also assists in the reproduction of some coral species, because many of the fragments re-attach and continue to grow. Frequently the multiplication of corals by fragmentation is more important than sexual reproduction in occupying the bare space that occurs after storms.

The production of rubble and fine sediment is important in the reef consolidation process. The rapid upward, but loosely structured, growth of corals is transformed into more gradual, but solid formation of reef rock as the rubble and fine sediment become incorporated into the reef framework. These fine sediments are particularly important as they both fill in all the gaps and also pack tightly, like setting concrete. Sponges play a significant role in promoting the upward growth of reefs, which is approximately 4 cm per decade. Therefore reef growth is a dynamic process of upward growth, erosion and breakage followed by infilling, with the sediment and rubble being consolidated by algal and chemical cementation.

Role of Sponges in Reef Food Chains

The importance of sponges in coral reef ecology depends on both the abundance and their activity as filter feeders. Sponges are able to filter enormous volumes of water while removing almost all of the fine food particles.

The abundance of sponges on coral reefs varies considerably, depending on the location of the reef. In general, populations of obvious sponges in the Caribbean are much larger than those on Indo-Pacific reefs; an average of five times greater (whereas in the numbers of species the Indo-Pacific is much more diverse, possibly also by a factor of 5). In New Caledonia, populations on reefs in the lagoon are comparable to those on the Great Barrier Reef, but the populations on the outer barrier are much smaller. The size of sponge populations on Pacific reefs is a direct reflection of the amount of food material in the water. This is probably why sponges are far more prevalent and diverse on the 'dirty' water reefs on the west coast of Australia than in the relatively 'clean' waters of the Great Barrier Reef. Similarly, on the Great Barrier Reef, sponge populations on reefs near the land are about four times greater than populations further out in clean water. On some oceanic reefs of the Indo-Pacific region, sponges are often rare and small, such that they would play a relatively minor role in reef ecology.

Around New Caledonia, sponges vary considerably from the large populations of sponges in the lagoon, which may be spectacularly shaped or coloured, to sparse populations on the outer barrier reef. Surveys were conducted aboard the Orstom research vessel *ALIS* in 1989 around the Grand Isle and on one reef in the Loyalty group of New Caledonia. Sponge biomass at 20 m depth on reefs facing the ocean was generally less than 10 g/m^2 with 1 or 2 sponges per m^2 as compared to a range of 100 to 600 g/m^2 and 3 to 6 sponges per m^2 on the Great Barrier Reef. In the lagoon of New Caledonia, however, populations were five to ten times larger and comparable to many parts of the Great Barrier Reef.

It is possible to find sponges in all areas of a coral reef, where there are stable hard surfaces for larvae and fragments to attach, and where the waves and currents are not too strong. Sponges also occur on some unstable surfaces such as in the lagoon, where they can settle on small lumps of coral or shell or amongst the sea grass beds. Here, many species often do not attach, but can be found rolling around with the gentle currents like 'tumbleweeds' of the prairie (*e.g. Reniochalina condylia*, *Pseudaxinella debitusae*, *Higginsia tanekea*, *Raphoxya sytemma*, *Acarnus caledoniensis*, *Grayella papillosa*). Sponges are rare on the exposed parts of the reef front, particularly in depths less than 10 m, where strong wave action appears to limit their distribution. Populations are larger on lagoon and back reef slopes where turbulence is less, but where there are still sufficient currents to ensure the supply of food and removal of wastes. These habitats are probably more advantageous because organic food produced by corals and algae on the reef front is often carried back across the reef. Sponges are often the most prominent animals between 15 m and 50 m. Exploration by submarines hundreds of metres down the deep slopes on the front of reefs has shown that this habitat is a paradise for sponges. Unfortunately, the beautiful deep cliffs of New Caledonia are rarely visited and remain poorly known.

Sponges play a role in the food chain of coral reefs by recycling much of the dead organic matter. Sponges are efficient filter feeders on the small-sized food fractions, being able to remove approximately 99% of bacteria from seawater, as well as dissolved organic matter, such as sugars and amino acids. It has been estimated that in the Caribbean (Jamaica), where sponges are much more abundant than in New Caledonia, the sponges between 25 and 40 m on the deep slope are able to filter the complete water column above them every day, removing almost all of the particulate food material of plant and animal origin. After the sponges have digested this material, the waste nitrogen in the detritus is converted to ammonia and nitrate, providing a large proportion of this fertiliser for the growth of reef algae.

It seems likely that populations of sponges may act as indicators of pollution, from either farming or sewage, because sponge growth is usually enhanced when there is more organic matter in the seawater. This is becoming evident in the lagoon immediately adjacent to Noumea, where there appear to be more sponges and possibly increased rates of burrowing into live corals by the clionid sponges. Many large coral colonies are dying, because of 'attack' by these boring sponges, which are probably benefiting from increased amounts of food matter.

Many coral reef sponges in the Indo-Pacific region use the same strategy for living in clean, low-nutrient (oligotrophic) waters as do corals, *i.e.* they host symbiotic algae in their tissues to assist in the input of carbon, nitrogen and phosphorous. The major difference is that sponges harbour bacteria-like algae (cyanobacteria or blue-greens), whereas corals have more complex, dinoflagellate symbionts (zooxanthellae). The one major exceptions are the boring (bioeroding) species, which also have zooxanthellae symbionts (*Cliona orientalis*, p. 91; *Spheciospongia inconstans*, p. 92). The enigma is that in corals, the zooxanthellae assist in building coral skeletons, whereas in these sponges, the zooxanthellae probably stimulate the destruction of these skeletons. The major benefit that all of these symbiont algae provide is energy in the form of organic carbon to supplement the small amounts of food filtered from clean, coral reef waters. The content of these algae varies markedly between species. Some sponges have relatively few algae, and these can be seen as a dark red-brown skin on the exposed surfaces. These sponges obtain only a small amount of additional nutrition to supplement that gleaned from the water (an example is *Xestospongia bergquista*, p. 154). There are, however, some specialised species that obtain most of their nutrition from their symbionts - these are called phototrophs (food directly from photosynthesis). Such sponges are particularly prevalent on reefs of the Coral Sea and on the Great Barrier Reef, whereas they are rare on Caribbean reefs. Around New Caledonia, phototrophic sponges are represented by *Cymbastela concentrica* from the lagoon and the encrusting *Dysidea herbacea* throughout the region.

Sponge populations are generally constant and unchanging. We know very little about low predation in sponges on Indo-Pacific reefs, and the sponges are usually slow-growing and long-lived. In the Caribbean, hawksbill turtles (*Eretmocheles imbricata*) are major predators on sponges and probably are significant predators on sponges in the Indo-Pacific region. Fishes, molluscs (especially nudibranchs), starfish, plus many small reef animals will occasionally feed on sponges. While large predators may be absent, there are often large populations of small predators living on and in sponges. If you cut a large sponge open, there is usually a large assortment of small animals living inside. Therefore, the sponge appears to serve as a hotel, sheltering many small mobile animals. Little is known, however, of the relationship between the 'guests' and the 'host' sponge. Some of the guests may be using the sponge as a safe haven, whereas others could be feeding directly on the sponge tissue or stealing food as it comes into the canals.

Throughout the long period of sponge evolution, it is probable that sponges have evolved mechanisms to prevent predation and competition. Some of these involve the production of many compounds, which may be distasteful, thereby deterring other animals from feeding, or the compounds may be toxic to potential predators. These compounds have recently attracted the attention of scientists in the search for drugs against human diseases or agricultural pests. This has led to considerable interest by Orstom, which is concentrating on sponges in the search for drugs to combat cancer, and diseases like AIDS and the common cold. The discovery of some compounds, which have such useful activity has stimulated much interest in the taxonomy of sponges and has been at least partly a catalyst for the production of this book.

The fascinating world of sponge chemistry and chemical ecology

Sponges and the chemicals they produce are now attracting substantial interest globally, both from scientists and the general public as their application as pharmaceuticals and other exciting products becomes a reality. New Caledonian sponges as for other tropical reef faunas are rich sources of these compounds which are new to science. Orstom scientists together with international collaborators are at the forefront of this growing research area.

Sponge chemistry has two major focal points at the present time, marine natural products research, where the search is for compounds which have biological activity, often of an anti-tumour or anti-viral type, and research which seeks to determine the pattern of occurrence of metabolites which can be used in sponge classification. Both these investigative themes are relatively new and out of them has developed the study of allelochemistry or chemical ecology of sponges.

Research into the chemical structure of secondary metabolites of sponges is not new however, as discussion of novel sponge metabolites and their taxonomic distribution dates from studies commenced in the 1940s. It is only over the last twenty-five years however, that research into novel chemicals which exhibit biological activity, in particular those suitable for applications as pharmaceuticals, has been extended from the traditional terrestrial sources to the sea. Sponge metabolites discovered thus far exhibit a high incidence of anti-viral, anti-tumour, anti-fungal, anti-microbial activity and activities which modify immune responses. Today the potential applications of natural products from marine sponges to medicine and industry are seen to be vast. Indeed, there is a number of compounds already in commercial use and others approaching the final phases of drug development. Commercial development of most of these compounds as drugs, industrial biocides or anti-foulants is however often hampered by the complex nature of the chemicals themselves, many of which cannot be synthesised economically with present technology, and many of the compounds are highly toxic in human systems.

The novel metabolites now known from sponges range from very simple to extremely complex molecules which exhibit unusual chemical arrangements. Many of the compounds are halogenated and some have double bond configurations that can be difficult to reproduce synthetically. It is known that certain structural types of sponge metabolite occur in certain sponge families or orders. Hence targeting of particular sponge groups assists in the search for new chemical variants and it has become important that taxonomic and chemical programs proceed together. Particular bioactivities are known to correlate with eco-morphological characteristics and ecologists also have a role in this now multidisciplinary undertaking.

Research involving such multidisciplinary teams is well established in New Caledonia based at Orstom with assistance from international collaborators. To highlight this effort, the discovery of a new anti-tumour compound, Girolline (or Girodazole), from the sponge *Cymbastela cantharella* has provided strong impetus to the research effort in marine natural products carried out at Orstom and focused interest on New Caledonian sponges. In recent summaries of marine natural products work carried out at Orstom, a wide range of biological activity has been demonstrated for New Caledonian species. Sponges constitute a major target group for this programme as it was found that sixty-nine percent of all sponges screened elicited biologically active metabolites (226 species submitted for anti-microbial activity and cytotoxicity bioassay). This compared with 14% of all other phyla combined being active (120 species representing most other groups of marine invertebrates). This is one of the highest rates worldwide. For example, Australian, New Zealand and American data suggest that not more than 40% of sponges screened yield bioactive extracts. New Caledonian sponges also exhibited a high incidence of ichthyotoxicity and immunomodulatory activity (38.3% of sponges possessed ichthyotoxic compounds and 20.6% immunomodulatory compounds compared to 3.0% and 5.5% respectively, of species with this activity from all other phyla submitted for screening at Orstom).

It is possible that many of the marine metabolites which are of pharmacological interest may be used by the organism in the natural environment as chemical defenses to prevent overgrowth and predation. Much of the chemical ecological research to date aims at addressing this possibility and has focused on sponges. Already Bergquist and co-workers have discovered evidence that leads them to think that the presence of bioactive metabolites and the degree and type of activity exhibited should be highly correlated with microenvironmental biological and physical conditions influencing each sponge individual *in situ*. Different ecological roles have been proposed for metabolites which have different types of activity. These hypotheses have been developed by examining the occurrence of bioactive metabolite producing species from a range of habitats from the tropics to Antarctica and contrasting the associated physical and biotic community differences between various habitats.

It was originally assumed that species from the highly diverse tropical reef communities would demonstrate the highest incidence of biological activity in extracted metabolites as "chemical warfare" and competition for space was deemed to be most severe for tropical encrusting invertebrates. Early works produced data which supported these ideas as high numbers of active compounds were discovered from tropical species. In fact these results reflected the intensity of work within the tropics as an equally high incidence of bioactive species has now been reported from temperate and polar regions of the world. *In situ* and laboratory experiments designed to test these chemical ecological hypotheses still remain to be done.

The increased awareness of the potential of marine biological resources, most of which remain as yet undiscovered, has highlighted the need for nations to become aware of biological diversity and the importance of conservation of these resources. Given the present success in finding novel chemicals with potentially valuable biological activities, there is now intense effort to collect representative specimens from as many different parts of the world as possible and from as many different phyla and habitats. This has focused global attention on biodiversity and the need to ensure that the loss of marine habitats and the species within those habitats, is halted. As with the search on land in rainforests for plants and other organisms which may yield compounds for pharmaceutical applications, so it is with marine environments. It now appears likely that many species do not have the wide distributions previously assumed to be characteristic of marine organisms which have potentially long larval life cycle stages. In fact the opposite is the case and most progeny of marine invertebrates and vertebrates alike, settle near parents. These factors together with the increasing impact that pollution and non-sustainable fishing techniques are having on tropical reefs have caused many environmental agencies and researchers to signal a need for habitat protection in an effort to conserve present biodiversity. As the immediate supply of bioactive compounds for assay and development is likely to be obtained directly from natural sources, there is a clear need to gather information about the distribution and abundance of organisms at the species level to provide accurate systematic information and to permit sustainable development.

As mentioned above, many sponge natural products are complex making artificial synthesis impossible or uneconomic. Although harvesting from the wild can sometimes supply extracts in sufficient quantity for testing drugs, often the rarity of host organisms precludes large-scale collections. Consequently, the need to supply compounds of interest in order to continue testing and development of potential pharmaceutical products has led to research into other modes of sponge biomass production. Mariculture techniques, essential to the development of a marine natural product industry, are being evolved with molecular genetic manipulations and cell culture development remaining options for the future.

It is central to much research on marine chemistry to establish whether the sponge, its symbionts or both are responsible for synthesis of the metabolites of interest. Once again this area of research is developing quickly and has led to many ultrastructural and fractionation studies of sponge cells and their microflora. Recent evidence suggests that in many cases, it is sponge cells themselves which are responsible for the synthesis of the novel compounds. Some sponges have massive concentrations of cyanobacteria and other microorganisms in their tissue and in some, metabolites of algal origin coexist with compounds synthesised by the sponge.

It is important to stress that the success of any research into marine natural product chemistry, chemical ecology or biogeography and biodiversity assessment relies on credible biosystematics. Accurate identifications and descriptions of species are essential to all disciplines.

Sponge diversity, distribution and biogeography

Why do sponges live in some places and not in others? How do sponge patterns of distribution compare to those of other phyla, such as corals? And what is the relationship between the sponge fauna of New Caledonia and those of adjacent provinces? These questions concern the study of biogeography, and they involve a very complex mosaic of many factors: some concerning physical and chemical features of the sea, the seabed, and currents surrounding New Caledonia; some with the biological features peculiar to sponges, including their ecology and evolution; and others are related to the ancient geological history of this region such as movements of the seabed. Unfortunately we cannot yet adequately answer many of these sorts of questions because we still know so little about sponge biology, ecology and evolution. However, there is some evidence and we do have many ideas.

To understand patterns of distribution in the species living today, and why these differ from other types of marine invertebrates, we firstly need to understand the features associated with sponge dispersal, recruitment, survivorship and growth rates, and the availability of particular habitats in which to grow. Similarly, to develop ideas about the biogeographic relationships between adjacent sponge faunas we must examine the palaeontological and historical affinities of the species themselves.

Sargassum and limestone platform
(photo P. Laboute)

Dispersal potential

Some phyla of marine invertebrates, such as hard corals, have pelagic larval strategies that enable many species to disperse across wide areas of the Indo-west Pacific. In other phyla, such as echinoderms, larval strategies can be either demersal or pelagic, with corresponding major differences in the dispersal abilities and particular distributions of the species concerned. Conversely, we suspect at this stage that gametes and larvae of most sponges are relatively short-lived (usually less than 24 hours longevity), and during this time larvae have only a brief swimming phase after which they become demersal, creeping across the substrate. Consequently most sponges are thought to have very limited potential for dispersal, restricted to short ranges, supporting our current ideas that regional populations have high levels of species endemism, being isolated from adjacent faunas.

Sexual reproductive products are undoubtedly effective in recruitment of reef sponges, over short distances and short periods of time. However, it is suspected that asexual (clonal) modes of dispersal are widespread, particularly in tropical sponge populations, where adult sponges fragment into small pieces of tissue (called propagules) and reattach. Pelagic rafting of sponge fragments is thought to be minimal, but this is not yet certain. From our limited knowledge the longevity of propagules is variable and possibly not extensive, in which case the potential for rafting may be limited to very few species, if any. Similarly, there appears to be very little mixing between deeper water and shallow water populations, and it is unlikely that sponges can migrate across major depth contours. Consequently, we currently think that the dispersal of sexual reproductive products and asexual propagules may be effectively blocked by wide oceans and deep water barriers, so that shallow-water populations of sponges surrounding islands like New Caledonia may be truly isolated and species consequently evolve into new forms over time.

Conversely, there are other species of shallow-water sponges, possibly up to 5% of species, that have relatively wide distributions throughout the Indo-west Pacific - or more accurately, populations of some species from widely separated, isolated localities do not appear to differ from each other in their morphology. However, there is not yet any chemical or genetic data to confirm or refute these ideas concerning conspecificity of widely distributed populations. Interestingly though, many of these apparently widespread species are associated with the specialised coral reef fauna, and it is speculated that perhaps these may have some special ability to disperse over longer distances (*e.g.* through asexual methods), but there is still very little empirical support for this idea.

Survivorship and growth

Soft-bodied sponges are susceptible to breakage and fragmentation through natural causes (storms, currents), with fragmentation probably a predominant mechanism for local recruitment of shallow-water species. Predators including fishes and turtles are also effective in dispersing fragments within the local area, although it is not certain what proportion of these fragments remain viable once voided by the predators. Their fixed, sedentary lifestyle does not enable sponges to actively evade predators. Nor do many have adequate physical protection such as an armoured surface, although some are thought to be capable of defending themselves using a diverse array of noxious chemicals. These chemicals are also possibly active agents in competition for space against other sedentary animals, such as corals and ascidians.

Growth rates have been documented for a number of species, and are generally slow in comparison to other sessile marine invertebrates. This is at least partially due to the fact that most sponges are heterotrophs, obtaining their nutrients from filter feeding suspended particles in the water column. Heterotrophic species may be efficient in surviving high silt, high energy environments, like those found on the floor of the coral reef lagoon with strong current and high sedimentation, but they are poor competitors against the fast-growing autotrophic (phototrophic) reef building corals. In clear waters corals utilise nutrients produced by the photosynthetic activities of their symbiotic zooxanthellae. There is also a special fauna of autotrophic sponges that obtain some of their nutrients from the photosynthetic by-products of symbiotic cyanobacteria (blue-green algae). Like reef building corals these autotrophic sponges grow relatively quickly, being the dominant sedentary organisms in some clear water reef habitats (*e.g.* reef flats), but this fauna has a very restricted distribution confined to shallow, clear waters. Consequently, the mode of nutrition and the presence or absence of symbiotic microorganisms clearly influences the competitive advantage that a particular sponge may have, and where it can effectively grow and survive.

Habitat availability

Sponges are generally not evenly distributed within all habitats. Some sponges are widely distributed throughout adjacent habitats and are called opportunistic or generalist species, whereas the greatest diversity of species appear to be 'specialists', having very strict ecological requirements (*e.g.* only found in *Halimeda* beds; on shallow-water beach rock; burrowing into mud; bioeroding dead coral; reef-building coralline species, etc.). Within any coral reef system, like New Caledonia, there are many different habitats, and thus patterns of species distributions are generally heterogeneous or patchy, largely determined by the presence or absence of these habitats. In some cases particular habitats are absent from some reef systems completely, with the consequence that some specialist species are absent from the entire reef system. This heterogeneity may be at least partly explained by different geological histories of different reefs, reflected in major differences in reef geomorphology. It also has serious conservation implications, whereby the erosion or destruction of particular habitats may exterminate the specialised species, in which case their genetic resources are irretrievably lost to the system.

Biogeographic affinities

In addition to these complex patterns of habitat distributions and the particular ecological requirements of species is an historical aspect that also influences species distributions. This is the early geological and biological history of the seabed, coastlines and past environmental conditions in these regions. What is the geological history of the region, what are the present patterns of sponge distributions, and how are these related (*i.e.* where did the ancestors of these living species come from)?

Geology and oceanography of the New Caledonian region

Past geological and climatic events are considered to be the main reasons why New Caledonia has an exceptionally high diversity of living plants and animals, both terrestrial and marine, many of which are unique to this region.

New Caledonia, as we know it today, is a small emergent land mass that is part of a much more extensive ridge, the Norfolk Rise. This ridge sits on one edge of the huge Indo-Australian tectonic plate which terminates on its eastern side at an 8 km deep trench near Vanuatu. About 80 million years ago this plate was once part of the larger, ancestral, Gondwana continent, containing the fused land masses of present-day Australia, New Zealand, Antarctica and parts of New Guinea and South America. Although most of the Norfolk Rise is now under water, much more of it may have been emergent from the middle of the Mesozoic era (from 175 MYA), where its life forms were capable of dispersing widely across Gondwana, or around the circumference of its shallow seas. During this time (the Late Cretaceous, 85 MYA), the earth was also virtually circled by a broad, tropical Tethys sea, with the only barriers to sponge dispersal being the great distances between adjacent land masses. This Cretaceous sponge fauna was relatively similar across the broad expanse of the Tethys Sea, at least compared with the many different faunas found in Recent seas.

The subsequent drift of continents and spreading of the sea floor over many millions of years tore apart the austral land mass, and together with substantial volcanic activity there were ridges pushed up from the sea floor, new islands and island arcs emerging or submerging from the seas, and continents and coastlines were reshaped into their present day forms. These events also produced the closure of the once-contiguous Tethys Sea, isolating the sponge fauna initially into two components (Indo-west Pacific and Atlanto-east Pacific regions), and later into many more smaller regions with their own peculiar currents and climates in which separate sponge faunas began to evolve in isolation from each other.

New Caledonia itself is one of the older land masses of the Indo-Australian plate, thought to have been emergent the entire time since the Cretaceous, and was produced by uplifting of a ridge through collision of three separate blocks or arcs on this plate. These islands subsequently became isolated from the other fragments of the Gondwanan supercontinent through the formation of the Tasman Sea and Coral Sea, thought to have occurred from spreading of the seabed. This geographical isolation restricted or perhaps completely blocked the recruitment of many species from adjacent land masses and their coastlines. New species of animals and plants subsequently evolved from these now isolated, once widespread ancestors through the mechanisms of natural selection and adaptation to the particular environmental conditions now present on these islands and their coastal seas.

During the Tertiary period (60-1.6 MYA), when New Caledonia became increasingly isolated from other land masses, there were also marked global changes in climatic conditions and sea levels, and local effects produced by changes in ocean currents around New Caledonia obviously influenced the biological development of these areas. In particular, cycles of glaciation, with associated fluctuations in sea levels, undoubtedly had profound effects on the formation of marine habitats (such as the development of reef structures), and biogeographic patterns (such as opening or closing passages that might act as routes of dispersal and faunal exchange between permanent land masses). Similarly, during this period there were several periods when temperatures changed substantially, particularly during the Eocene (58-37 MYA), Miocene (24-5 MYA) and Pleistocene (1.6-0.1 MYA) eras, partially due to the gradual northwards movement of the whole Indo-Australian plate into the tropics but also to the periodic events of glaciation and consequent sea level changes, and changes to sea circulation as a result of opening or closure of major passages between land masses.

It is these tectonic processes of rifting, drift, uplifting, isolating and the subsequent oceanographic and climatic changes which have influenced the development of the living sponge fauna of New Caledonia. Nevertheless, this fauna may not be completely isolated, with some marine species still continually migrating into this region riding the sea currents or perhaps rafting on the surface of the sea attached to other floating objects. The biogeographical histories of marine invertebrates are especially influenced by the dispersal of these 'foreign invaders'. For some groups of animals, such as reef-building corals, continual colonisation from adjacent provinces is a major feature of present day distributions. Conversely, for animals like sponges with apparently more restricted means of dispersal the present day distributions may be influenced less by 'invasion' than by subsequent evolution of the once widespread ancestors. In fact both mechanisms are true, as will be shown below.

Present patterns of sponge distribution and abundance

Within the New Caledonian lagoon ecosystem and its outer reefs and deeper waters surrounding these reefs it is estimated that there may be up to 600 species of sponges. So far, however, we only know the identity of about half of these, and it is likely that many of the others are new to science (undescribed). Generally, including all the described species of sponges from all habitats, most (71%) are unique (endemic) to New Caledonia, whereas only a smaller proportion also lives in adjacent waters surrounding neighbouring land masses. A few species (perhaps 5% of the fauna) may be truly widely distributed within the Indo-west Pacific region, apparently closely linked to the distribution of coral reefs.

Actual proportions of endemic species may vary greatly between different groups of sponges. Some species are obviously capable of maintaining relatively widespread distributions, perhaps due to more successful dispersal mechanisms of their reproductive products. These include several species of *Xestospongia*, in the family Petrosiidae, which are very widely distributed in shallow waters throughout the Indo-Malay region. Other groups of sponges, such as *Mycale* and *Clathria*, both in the order Poecilosclerida, have many hundreds of species in shallow-water habitats within the Indo-west Pacific. Only few of these are truly widespread, suggesting that their ancestors colonised these coastal waters and subsequently speciated in them relatively successfully.

The sponge fauna of New Caledonia is also clearly stratified in relation to different depth distributions. There is very little apparent mixing between deeper and shallow-water faunas, and each of these faunas has distinct biogeographical relationships. These two faunas are considered separately.

Deeper-water species

Although there are undoubtedly many more deeper-water species (>400 m depth) yet to be discovered in this region, our knowledge of this fauna is relatively good, thanks largely to the work of Orstom, in comparison to adjacent provinces, such as Australia, New Zealand and other southwestern Pacific islands (where fewer comparable deeper-water sponge faunas have been investigated). Approximately 72% of deeper-water sponges are endemic to the New Caledonian region, and we already have some good ideas on their biogeographical relationships, supported to some extent by palaeontological evidence.

Recently, a remarkably rich fauna of desma-bearing sponges ('Lithistida') was described from the deeper waters of the Norfolk Rise, to the south of the island. These 'lithistids' are firm-bodied sponges with rigid interlocking skeletons formed by desma spicules, producing a relatively good fossilisation potential (unlike many of the soft-bodied species). This fossil record gives us the ability to compare species living today with those that lived in the more diverse Cretaceous fauna, during the time of the Tethys Sea. Fossil 'lithistids' (from western Europe) show remarkably close resemblance to living species from New Caledonia, certainly related at the generic level, and it is thought that the living 'lithistids' from New Caledonia have evolved from this ancient Tethyan fauna, unchanged in their morphology over the 80-100 million years that they have been separated. That these lithistids now exist and are isolated, 'relict' species of a once widely-dispersed fauna also suggests that oceanographic conditions in these deeper waters may be similar to those of ancestral seas, and these conditions are relatively stable compared with the more transitory shallow-water habitats of the lagoon. This idea is confirmed by the relict distribution of other groups in deep waters off New Caledonia, such as crinoid echinoderms, bryozoans or lace corals and some crustacean groups, which also have numerous "living fossils".

Many deeper-water, soft-bodied (non-lithistid) demosponges from New Caledonia are similar to those that lived during the Late Eocene fauna (58-37 mya) of New Zealand. This evidence comes from comparisons between these living deeper-water populations and isolated fossil spicules in uplifted sediments from southeastern New Zealand. The New Caledonian and New Zealand populations were probably in contact prior to this time but have since become isolated by geographic and/or oceanographic barriers as indicated by the high proportion of endemic species in both faunas.

In addition, comparisons between these deeper-water sponges from New Caledonia and populations of living species from the bathyal zone of the Azores, western Atlantic, show that although species endemism is exceptionally high they are clearly similar in their generic composition, supporting the ideas that deeper-water sponges, at least, are morphologically ultraconservative and have clearly evolved from widely distributed Tethys Sea ancestors.

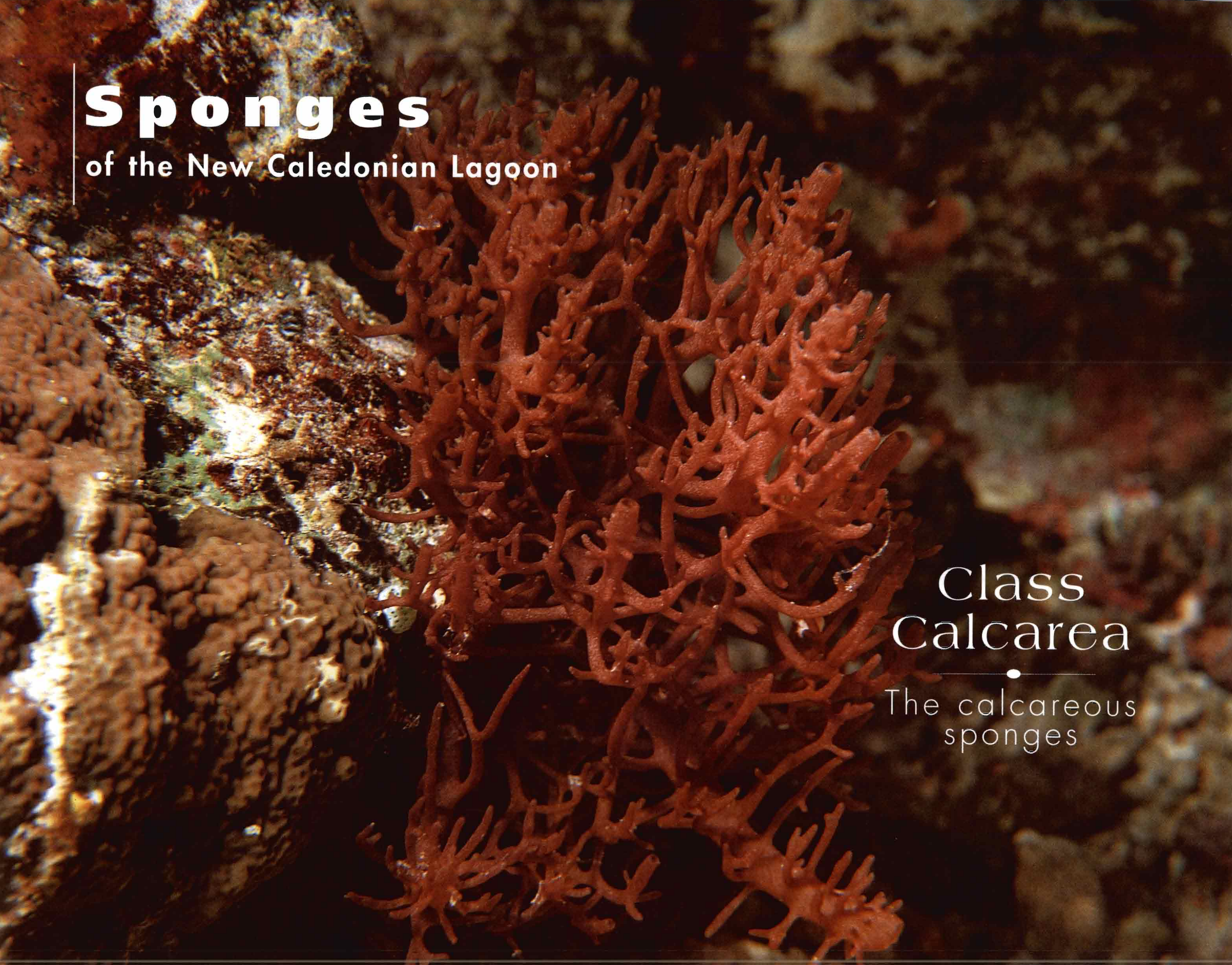
Shallow-water species

In comparison to the deeper-water sponge fauna we still know relatively little about the shallow-water species of New Caledonia, even though this fauna is much more diverse and may be found in many varied habitats throughout the extensive lagoon system and outer reefs. Our current ideas on shallow-water species distributions and their biogeographical relationships are mostly speculative, and there is virtually no corroborative palaeontological evidence. In fact, in many cases we cannot even be certain that we are dealing with the same species in the literature, when described from several localities. Nevertheless, there is some recent evidence from three families of demosponges that provides some information on patterns of species distribution and faunal relationships. These data come from studies of living populations from widely separated provinces within the Indo-west Pacific (and not merely reliant on the sometimes misleading descriptions in the literature).

Generally, there appears to be far fewer (about 45%) endemic species in the shallow-water fauna, although this number can vary for particular families of sponges (perhaps indicating their greater or lesser potentials for dispersal or differences in actual ages of particular species). The taxonomic composition of shallow-water species also clearly differs from the deeper-water fauna, with some families highly successful and extremely diverse in shallow environments but poorly represented in deeper waters, indicating little or no genetic mixing between both these faunas. It is likely that there are much higher rates of speciation and evolutionary divergence in the relatively small, highly competitive shallow-water habitats than in more stable deeper-water environments.

Some species found in the New Caledonian lagoon are also known to live in southern New Guinea, several islands in Micronesia, southern Indonesia and the Great Barrier Reef, indicating that there is currently, or has recently been, genetic contact between these dispersed populations. Conversely, relatively few of these shallow-water species also live in New Zealand. Some species (perhaps 5%) appear to be very widely distributed across the Indo-west Pacific, although this observation is based on morphological interpretation and not genetic data. However, several contemporary studies indicate that these 'widely distributed species' of shallow-water sponges may be far fewer than previously recognised in the older literature, sometimes quoted as 15-20% of species. Closer examination of some of the cited cases of 'cosmopolitan' or 'widely distributed' species show that they consist of two or more isolated (allopatric) sister species, differing from each other in small but significant morphological features. In some cases these findings have genetic and chemotaxonomic supporting evidence, but much still remains to be done in solving these questions (Hooper and Lévi, 1994).

The existence of many endemic species in New Caledonia, and morphological comparisons between these species and their closely related sister species from adjacent provinces, tells us that a certain degree of genetic isolation now exists between these populations and other shallow-water faunas of the Indo-west Pacific. These shallow-water sponges appear to have closest affinities with, and have probably evolved from, species that originally came from the tropical western Pacific (central west Pacific, southwest Indonesia, Philippines, Japan). This suggests that these shallow-water species probably colonised the coral reef habitats around New Caledonia only relatively recently, unlike the deeper-water fauna that has been in place during the islands' northward migrations over millions of years



Class Calcarea

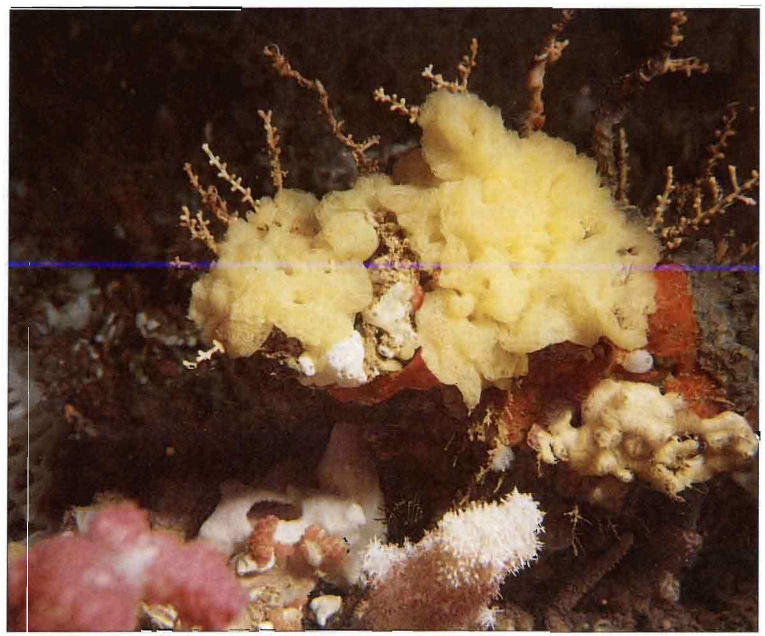
The calcareous sponges

Order
Clathrinida

Family
Clathrinidae

Clathrina sp.

These calcareous sponges have a skeleton composed exclusively of free spicules, without hypercalcified non-spicular reinforcements or spicule tracts. Spicules are usually regular triradiate, with the rays and angles between the rays being equal, and sometimes include parasagittal or sagittal triradiate spicules. The basal system of tetractines is similar to a triactine bearing a fourth actine perpendicular to the plane of the basal system. Young sponges may have only triradiate spicules. Choanocytes have a peculiar structure with the spherical nucleus of the cell in the basal region, and the basal body of the flagellum is not adjacent to the nucleus. Larvae are entirely ciliated hollow blastula (coeloblastula).



Clathrina sp.: Canal Woodin, 28 m (photo G. Bargibant)

External and anatomical Characters
The sponge is formed by thin hollow tubes, copiously ramified and anastomosed. Each tube has a thin wall, whose internal surface is lined by choanocytes, and the external part is sustained by a simple layer of triactines. The wall is regularly pierced by pores.

Dimensions
Tubes diameter: 1,5-2 mm.

Colour
Bright yellow.

Skeletal Characters
The triactines are equiangular and equiradiate, with cylindric actines, somewhat irregular at their distal part.

Ecology and Habitat
25-30 m. Canal Woodin.

Distribution
Yet unknown. This sponge belongs to the group of *Clathrina clathrus* (Schmidt) and *Clathrina aurea* Borojevic & Klautau. Detailed genetic studies will be necessary to identify it at the species level and determine its relationship with other species of the same group.

Family
Leucaltidae

Leucaltis clathria Haeckel, 1872

External and anatomical Characters
Sponge a clathrate mass of large, ramified and anastomosed tubes, with numerous oscula at the end of the tubes. Texture firm, friable. Surface even, shiny. Cortex, 0.4 mm deep, maintained by tangentially disposed large triactines and tetractines. Choanosome maintained by the apical ray of the cortical tetractines. It is composed of elongated, ramified choanocyte chambers and a central atrium, both witha reduced skeleton of small triactines and tetractines.

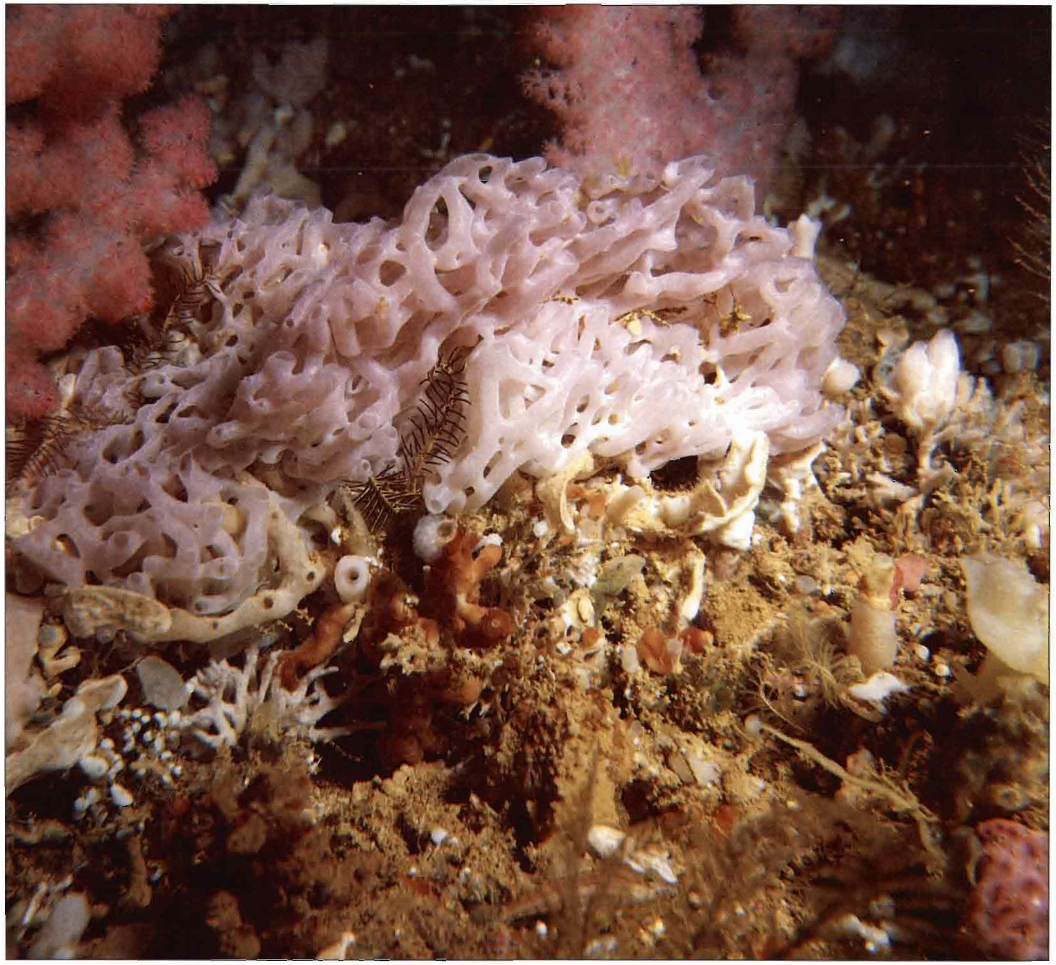
Dimensions
Tubes 2-5 mm in diameter, building a mass of 10 to 15 cm.

Colour
Pale pink to white in life; white to yellowish grey in alcohol.

Skeletal Characters
Cortical triactines, equiangular, actines 400-600 µm x 30-50 µm. Cortical tetractines, actines 800-1200 µm x 100-150 µm. Reduced choanosomal and atrial triactines and tetractines, regular to parasagittal, actines 30-70 µm x 2-3 µm.

Ecology and Habitat
Abundant in Canal Woodin and Banc Gail, 26-40 m.

Distribution
Circumtropical.

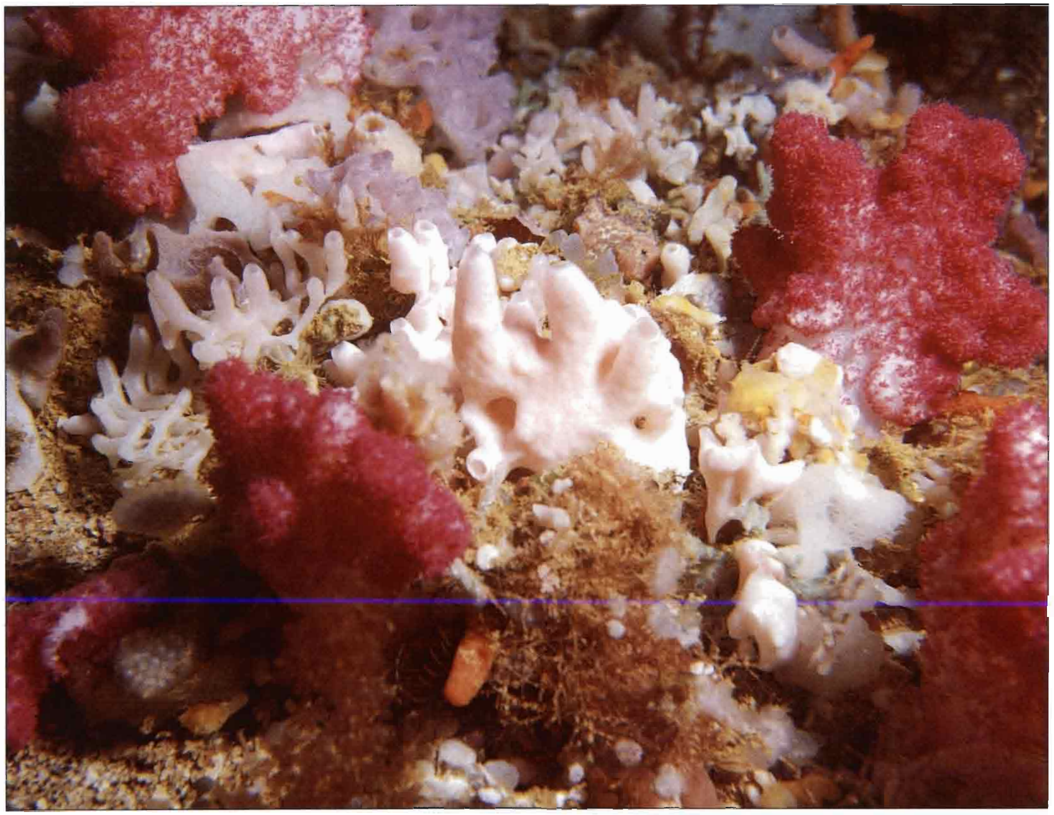


Leucaltis clathria Haeckel: Canal Woodin, 22 m (photo G. Bargibant)

Order
Clathrinida

Family
Leucascidae

Ascaltis grisea (Dendy and Frederick, 1924)



Ascaltis grisea (Dendy and Frederick): Canal Woodin, 36 m (photo G. Bargibant)

Caution: on the photo, *Ascaltis grisea* is the massive sponge in the center. The photo includes also another Calcarea forming small tubes, which is probably *Leucaltis clathria*.

External and anatomical Characters
Sponge massive, forming large folds, brittle and harsh.
The external surface is regular, with very small inhalant pores.
The large flat atrium has a smooth brilliant surface, with large circular openings of exhalant cavities. The sponge is covered by a continuous thin cortex sustained by triactines.
The aquiferous system is composed of anastomosed irregularly arranged clathrate tubes, sustained by a thin skeleton of triactines and rather rare tetractines.

Dimensions
Approximately 10 cm in maximum length.

Colour
White in life, grey in alcohol.

Skeletal Characters
Equiangular and equiradiate triactines, larger in the external surface skeleton (131 µm x 15 µm), and smaller in the internal mass of the sponge (98 µm x 10 µm).
Tetractines with the basal system similar to triactines, and a thin apical ray (108 µm) protruding into the central cavity of the tubes.

Ecology and Habitat
Canal Woodin, 26-36 m.

Distribution
Abrolhos Islands, Australia.

Family
Leucettidae

Leucetta chagosensis Dendy, 1913

Leucetta chagosensis Dendy: Canal Woodin, 36 m
(photo G. Bargibant)

External and anatomical Characters
A massive, subspherical or pyriform sponge with a smooth surface. Large oscules, 1-2 mm in diameter, are surrounded by an elevated margin. Subcortical cavities often visible. The consistency is compact, firm, but friable.

Dimensions
Maximum diameter approximately 10 cm.

Colour
Yellow in the living state, white in alcohol.

Skeletal Characters
Equiangular triactines of various sizes, lying tangentially in the cortex and irregularly scattered throughout the choanosome. A variable number of tetractines surround the larger exhalant canals. Small triactines: actines 100-180 µm x 12-20 µm, bend in the spicules surrounding the oscular margin. Large triactines, located only in the cortical skeleton: conical actines up to 600 µm x 50 µm. Tetractines: basal actines 60-120 µm x 8-12 µm, apical actine thinner.

Ecology and Habitat
Common in the lagoon.

Distribution
Indo-Pacific.

Possible Confusion
Leucetta microraphis (Haeckel), also present in New Caledonia, is more irregular in shape and has giant triactines (actines up to 2 mm), which are found both in the cortex and throughout the choanosome.

Order
Leucosoleniida

Family
Sycettidae

Sycon gelatinosum (Blainville, 1834)

These calcareous sponges have a skeleton composed of only free spicules, which are diactines, triactines or tetractines. The latter two categories are sagittal, or only rarely nearly regular. The larva is an amphiblastula, with a flagellated anterior pole, and a non flagellate posterior pole. The first spicules to be produced are diactines. The choanocytes are generally elongate, with an apical nucleus. The basal system of the flagellum is always adjacent to the nucleus.

Sycon gelatinosum (Blainville): Canal Woodin, 25 m (photo P. Laboute)

External and anatomical Characters

Sponge tubular, branching, 2.5 cm high with a short peduncle (0.4 cm). The cormus is formed through regular ramification of the major basal tubes into the smaller apical ones.
A single osculum is found at the end of each tube, ornated with a short fringe of trichoxea.
Surface regular and smooth. The terminal tufts of dense short diactines that ornate the distal cones of radial tubes form a regular hexagonal pattern on the external surface of the sponge. Each tube has a cylindrical central atrium, into which protrude the large apical actines of the atrial tetractines, curved towards the osculum.
They are occasionally long enough to attain the central part of the atrium and reach those arising from the opposite side of the atrium. The atrium is slightly enlarged in the subosculan region, where the wall of the tube is thinner. The sponge wall is composed of regularly arranged radial tubes that end in distal cones, protected by very dense tufts of distal diactines.

Dimensions

The individual tubes are approximately 1 cm long and 0.3 cm in diameter, building an arbuscle of up to 2.5 cm.

Colour

Yellowish-brown in life and after fixation.

Skeletal Characters

Triactines sagittal, with equal actines (70 µm x 10 µm), or with the unpaired actine longer than the paired ones(122 µm x 10 µm).
Atrial tetractines sagittal, with apical actine (147 µm x 10 µm) much longer than the basal ones (60 µm x 10 µm).
Diactines of distal cones of radial tubes of very irregular size and shape.
The proximal actine can be thinner than the distal one, which is often enlarged in its portion adjacent to the centre of the spicule (80 µm x 10 µm).
Alternatively, they can be of equal thickness, irregularly bended or curved (176 µm x 10 µm).

Ecology and Habitat

Common in the New Caledonia lagoon, especially in Canal Woodin, 26-30 m.

Distribution

Indian Ocean, Indonesia, Australia.

Family
Jenkinidae

Leucascandra caveolata Borojevic and Klautau, 1998

External and anatomical Characters
The sponge has a form of rather loose meshwork composed of delicate tubes, the larger ones up to 1 cm in diameter. The smaller and thinner tubes (in general no more than 2 mm in diameter) rise perpendicularly from the large ones; they are ramified in their distal part, and only occasionally anastomosed, bearing an osculum at the end. The wall of the tubes is thin (up to 0.2 mm, surrounding a large atrium). It is sustained by a stronger cortical and a thin atrial skeleton. The cortex has a continuous layer of triactines and tetractines, arranged parallelly, with the impaired actine placed longitudinally, and the unpaired angle open towards the oscule. The apical actine of the cortical tetractines crosses the sponge wall and its distal part is free in the atrium, slightly curved in the direction of the osculum. The atrial surface is sustained by only rare tangential tetractines, oriented like the cortical ones. The choanoderm forms rather shallow folds, delimiting caveoli of approximately equal depth and width, giving to the choanoderm a honeycomb aspect. The choanosome folds are sustained by small subatrial triactines. The paired actines are slightly curved to fit into the wall of the caveoli, embracing the basis of each caveolus. Each caveolus opens directly to the central atrium.

Dimensions
Up to 25 cm x 25 cm.

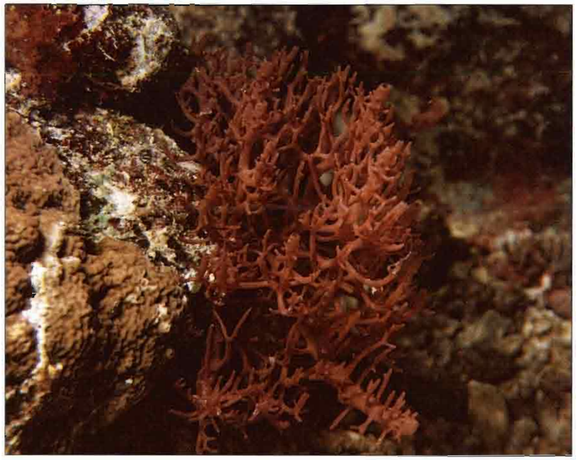
Colour
Brown in life, white in alcohol (alcohol is stained green by algal symbionts).

Skeletal Characters
Large triactines of the external wall with a straight unpaired actine (382 µm x 10 µm), with a widely open unpaired angle and the paired actines (264 µm x10 µm) curved in the direction opposite to the unpaired actine. Smaller triactines of a similar form, unpaired actine 108 µm x 10 µm, paired actines 176 µm x 10 µm. Large tetractines with the basal system similar to large triactines, and the apical ray shorter than the basal ones. Small triactines of the choanoderm folds with a straight unpaired actine, and paired actines curved in their distal part in the right angle with the unpaired actine; all the actines are of the same size (78 µm x 10 µm).

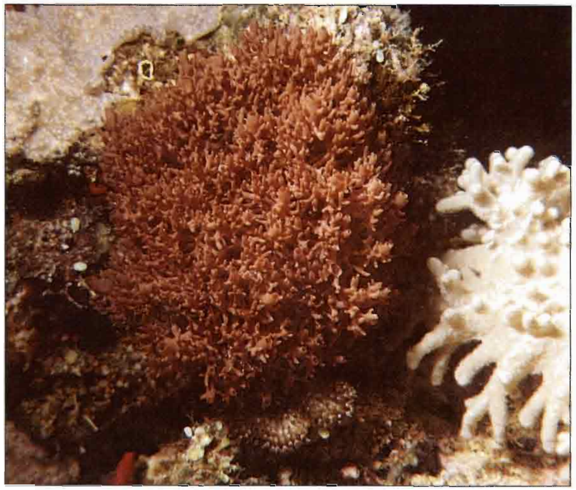
Ecology and Habitat
Common on the east coast of New Caledonia, 15-40 m.

Distribution
New Caledonia.

Possible Confusion
Leucosolenia lucasi and *Leucosolenia stolonifer*, from Australia; both have diactines in their skeleton, and different forms of tri- and tetractines.



Leucascandra caveolata Borojevic and Klautau: Passe de Nakéty, 25 m (photo P. Laboute)



Leucascandra caveolata Borojevic and Klautau, Poindimié, 30 m (photo P. Laboute)

Class Demospongiae

The siliceous sponges

Order
Spirophorida

Family
Tetillidae

Cinachyrella tenuiviolacea (Pulitzer-Finali, 1982)

Spirophorids, or golf-ball sponges, have a typically spherical growth form, with tetraxonid (triaenes) megascleres and large monaxonid megascleres, usually oxeas, producing a radiate pattern. Protriaenes are most common and often protrude from the surface, forming a prickly felt-like layer. Microscleres are contorted microspined sigmaspires. Reproduction is oviparous without a larval stage, or viviparous with production of small, perfectly formed sponges within the parent. Common genera are *Cinachyrella* and *Paratetilla*.

External Characters
Subglobular shape, slightly ovoid; higher than wide. These massive sponges often open up and split to display their internal structure, mainly after being pulled out of the water. At the apex longitudinal exhalant canals merge in a compound oscule. On the surface, near the maximal diameter, numerous apertures are scattered. They are shallow, wide and evenly distended *in situ* at night; they can be collapsed during the day and often not very visible. These inhalant apertures with reticulated membrane, called porocalyces, are the entrance vestibules for sea water.

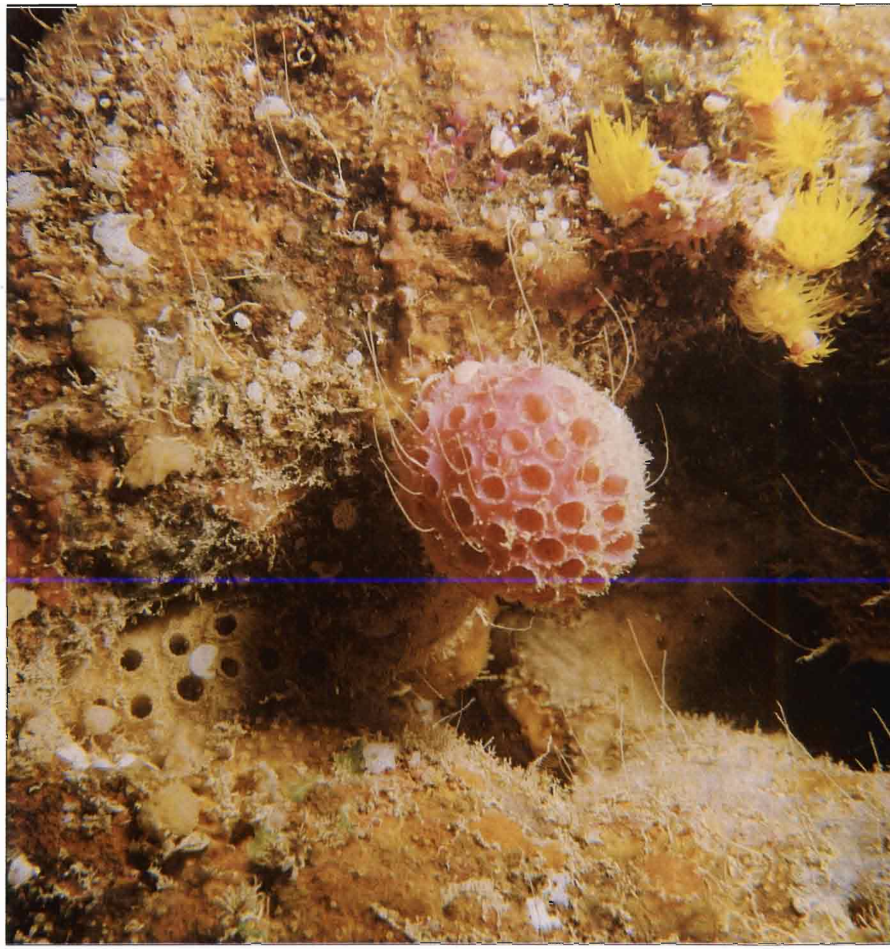
Dimensions
Height 20-60 mm, diameter 20-50 mm; porocalyces 2-5 mm diameter, 3-5 mm deep.

Colour
Pinkish brown *in situ*, reddish brown in alcohol.

Skeletal Characters
Skeleton radial, with columns of spicules radiating in all directions from a sort of central nucleus, located near the sponge basal attachment, to the surface. These tracts of spicules bend, which is how the skeleton gets its spiralled shape, ending up tangential to the surface. There are protruding spicules and the surface is rough. The megascleres of the radial skeleton are mostly 2.5-3 mm long oxeas and 4 mm long protriaenes with three short clads. Anatriaenes with very short clads can also be seen in the ectosome and in the wall of the porocalyces. Sigmaspire microscleres 8-12 µm chord length are found in variable concentrations throughout the skeleton.

Ecology and Habitat
Found under the rocky overhangs, Belep Island, 5-10 m depth.

Distribution
Heron Island, Great Barrier Reef, and New Caledonia.



Cinachyrella tenuiviolacea (Pulitzer-Finali): I. Bélep, 6-10 m (photo G. Bargibant)

Cinachyrella schulzei (Keller, 1891)

External Characters
Hemispherical or subglobular sponge. Surface covered by fine yellow sand, mingled with the projecting part of spicules, mostly broken off. The openings of the scattered oscule and porocalyces are small, circular. When the sponge is cut open the porocalyces are seen to be elongated, deep and narrow, and lined by a reticulate membrane. Texture is firm and compact. The ectosome is soft, with a 1 mm thick cortex.

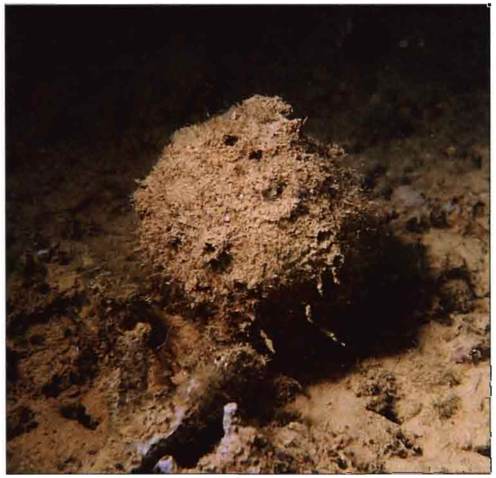
Dimensions
Diameter 60-80 mm, height 40-60 mm; porocalyces 10-25 mm deep.

Colour
Yellowish grey, ectosome light grey.

Skeletal Characters
The skeleton has a radiate arrangement. It consists of bundles of large oxeas and numerous anatrienes, with intervals between them. All bundles radiated from a centrobasal "nucleus", very dense. There are protriaenes near the openings of porocalyces. Small oxeas are scattered between the radial bundles. Oxeas 4-5 mm x 30-50 µm wide; anatriaenes with hair-like shaft and recurved clads, 3-5 mm x 6-18 µm; protriaenes with long shaft and clads 40-50 µm; prodiaenes with two clads 120 µm; small oxeas, slightly roughened, 130-250 µm, spinispires 12-18 µm.

Ecology and Habitat
Rock and coral rubble, 25-38 m depth, Banc Gail and Canal Woodin.

Distribution
New Caledonia, northern Australia, Red Sea and several other Indian Ocean localities.



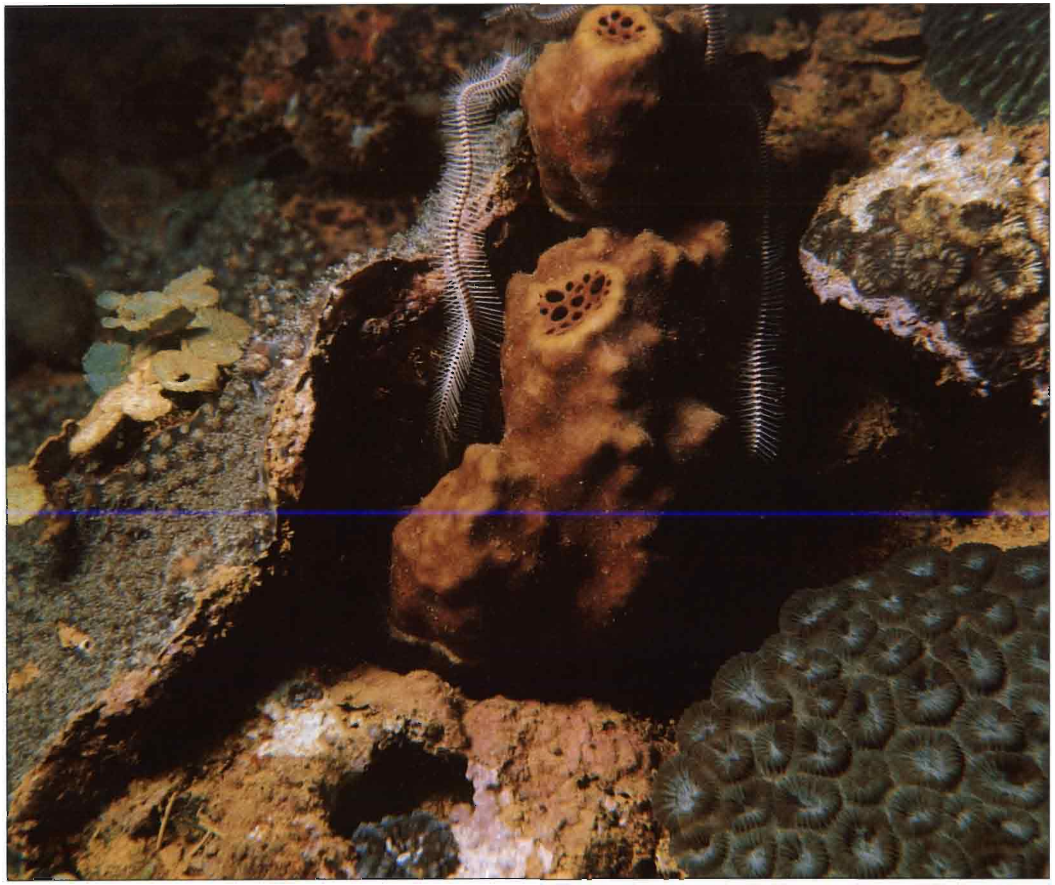
Cinachyrella schulzei (Keller): Banc Gail, 33 m (photo P. Laboute)

Cinachyrella schulzei (Keller): I. Mato: canyon (photo P. Laboute), (by night)

Order
Astrophorida

Family
Ancorinidae

Stelletta (Rhabdastrella) globostellata Carter, 1883



Stelletta (Rhabdastrella) globostellata Carter: Baie de Canala, 10 m (photo P. Laboute)

Astrophorids, also known as choristids, are triaene bearing sponges characterised by the possession of asterose microscleres, although these have been lost in a few groups, as well as microxeas and microrhabd microscleres. Megascleres are tetractinal, usually triaenes together with oxeas but sometimes including calthrops or short-shafted triaenes. The skeleton has radial architecture, which is normally obvious at the surface if not throughout the entire body. Reproduction is oviparous although gametes have only been described for very species, and larval structure is not yet known. Common genera include *Stelletta*, *Geodia* and *Dorypleres*.

Order
Astrophorida

Family
Ancorinidae

Stelletta (Rhabdastrella) globostellata Carter, 1883

External Characters
A massive sponge which is attached by a broad base; the nearly spherical shape may be rendered quite irregular by the substrate architecture and by slight scattered protuberances. Surface smooth, raised into low ridges; oscules congregated into superficial depressions. A thin ectosomal cortex covers the whole of the sponge, with the exception of the oscular areas. The soft choanosome includes radial exhalant canals converging to oscular depressions.

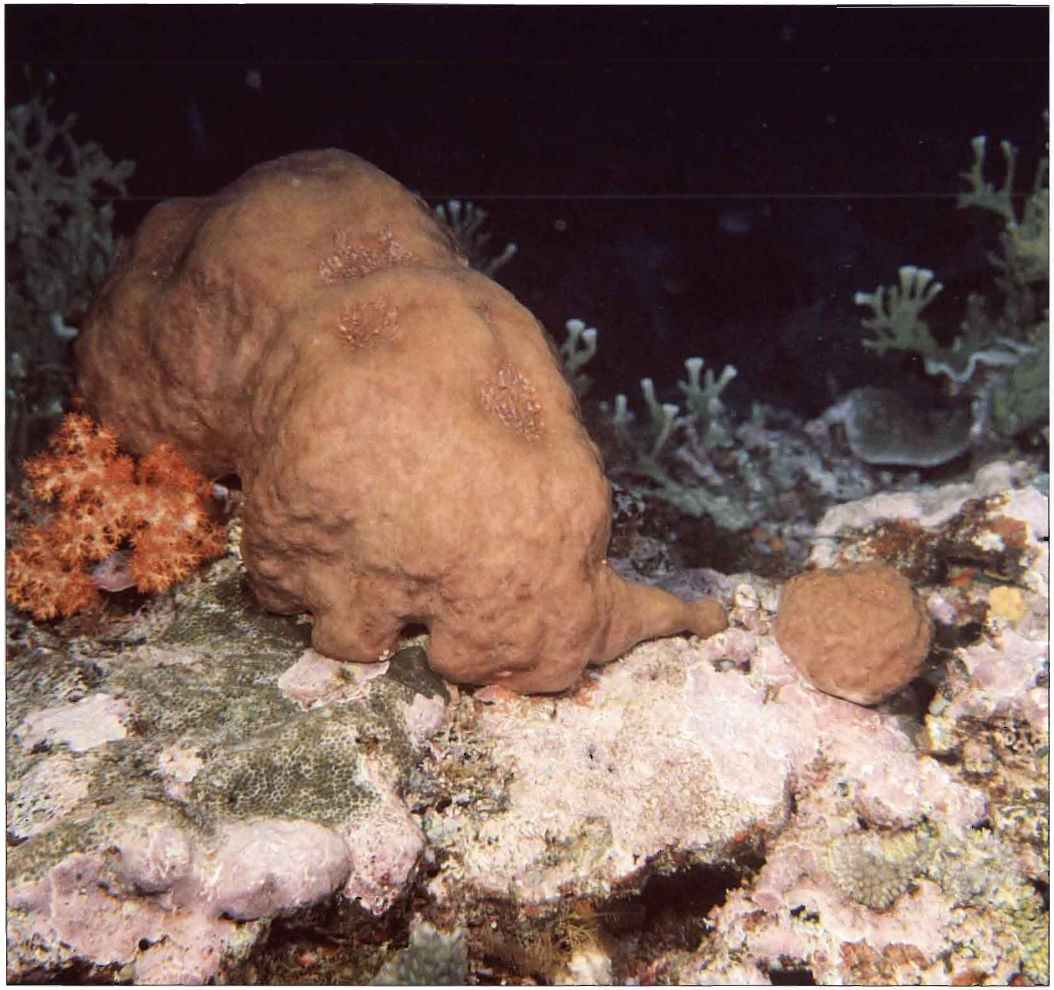
Dimensions
This large sponge is up to 14 cm high, 5-12 cm in diameter above the attachment base. Oscular aperture is 1 to 5 mm in diameter; oscular depression is 5 mm deep; ectosomal cortex is 0.2-0.3 mm in thickness.

Colour
External colour in life yellowish or reddish brown, internally yellow; in ethanol dark and light brown.

Skeletal Characters
The skeleton is not dense. In the choanosome, sligthly curved oxeas are numerous and radial in the subcortical part and these are more irregularly disposed in the internal part (size range: 700-1000 µm x 12-17 µm). Orthotriaenes are only found in the subcortical part of the choanosome. They are few and often very rare (size range: main ray or rhabd: 500-1000 µm x 25 µm; distal rays or clads: 100-160 µm x 25 µm. Cortical spherasters with 10 to 15 conic rays, sometimes with small distal spines (size range: 30-40 µm in diameter). Choanosomal oxyasters, with 7 to 10 slender rays ended by few spines (size range: 25-60 µm in diameter), numerous in walls of exhalant canals.

Ecology and Habitat
Occurs under rocks and boulders and in reef corals cavities: 0-35 m depth.

Distribution
Indian Ocean, S.W. Pacific Ocean (New Caledonia, Salomon Island (described by Lendenfeld, 1888, under the name *Stelletta tethyoides*).

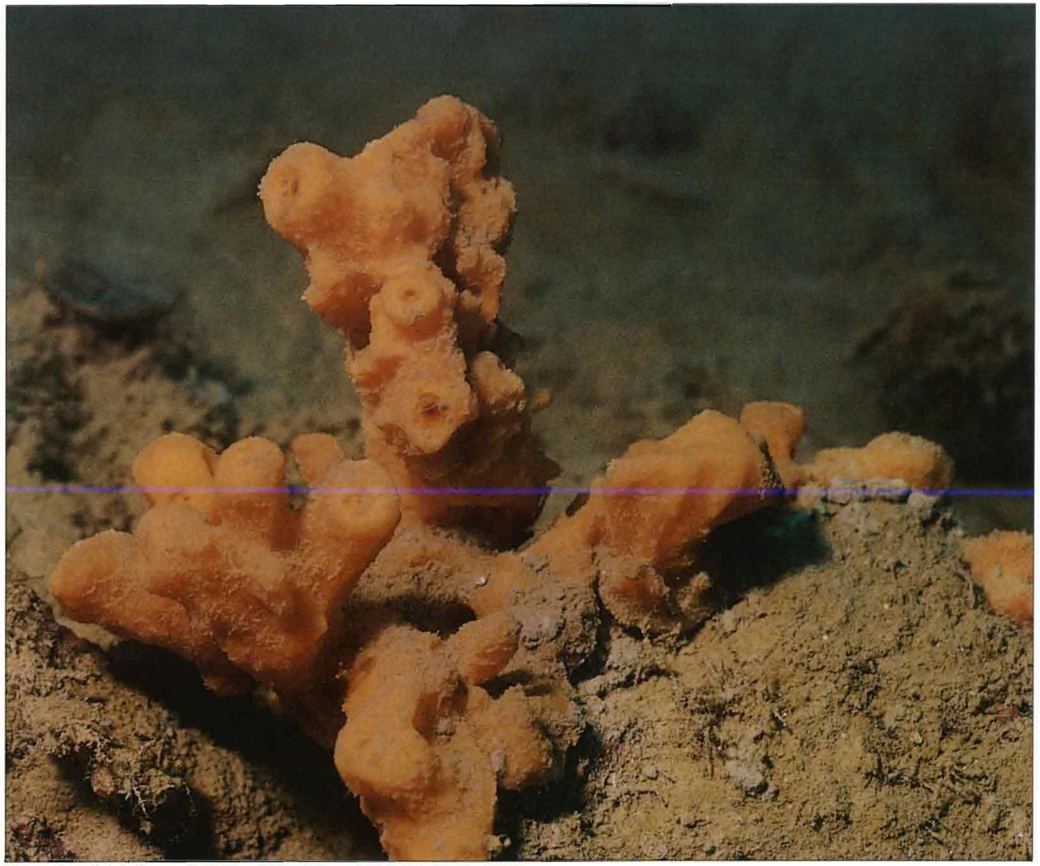


Stelletta (Rhabdastrella) globostellata Carter: Poindimié, 20 m (photo P. Laboute)

Order
Astrophorida

Family
Coppatiidae

Dorypleres splendens de Laubenfels, 1954



Dorypleres splendens de Laubenfels: Grande Rade de Nouméa, 16 m
(photo P. Laboute)

External Characters
Massive sponges forming cushions with raised hollow irregular digits, 20-50 mm high, 1-2 mm diameter. Slightly pulpy texture, crumbly consistency. The whole surface is finely conulose. An isolated spicule protrudes on each conule. The surface is entirely perforated by regularly spaced ostia. These are 50-150 µm diameter openings separated by cellular partitions called trabeculae 50-75 µm diameter, full of microscleres. The thin ectosome is perforated by ostia and covers the longitudinal superficial canals. At the top of each digit is a single oscule surrounded by a pulpy ectosomal annulus. This is the aperture of a deep axial exhalant canal.

Dimensions
45-115 mm high,
75-90 mm wide,
25-60 mm deep.

Colour
Sharp orange,
brownish ocre.

Skeletal Characters
The disorganised skeleton is made up of large intermingled oxeas and many microscleres.
The megascleres are curved oxeas 600-650 µm x 10 µm.
The microscleres are very numerous microxeas and oxyasters that can be separated into three size categories: oxyasters with 4-5 actines and distal spines (actine size 14-20 µm), oxyasters with 6-10 µm long actines also with terminal spines (diameter is about 15 µm), polyactine oxyasters with terminal spines (diameter is 10 µm); the curved microxeas are often centrotylote, 100-150 µm x 2-3 µm.

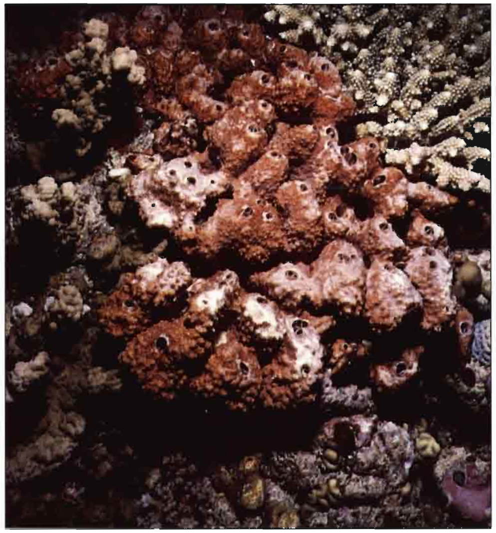
Ecology and Habitat
In bays and lagoons, in sediment-rich areas, shallow water.

Distribution
New Caledonia, Vanuatu (Santo), and Ponape (central western Pacific).

Order
Hadromerida

Family
Latrunculiidae

Diacarnus levii
Kelly-Borges and Vacelet, 1996



Diacarnus levii Kelly-Borges and Vacelet: I. Art, 4-20 m (photo G. Bargibant)

Hadromerida are a relatively cohesive group of sponges with uniform spiculation of mostly pin-like tylostyles. These spicules are arranged in a radial pattern within the skeleton, and this radial construction is always obvious at the surface if not in the choanosome in some species. Spongin fibres are poorly developed if at all present. At the surface the ectosomal spicules are typically smaller than those in the choanosomal skeleton, and usual standing perpendicular to the surface and protruding for a short distance. Microscleres, if present, consist of euasters, streptasters and derivatives, spirasters or spiraster-like spirules, or peculiar asterose-like discorhabds.

Where known, all groups are oviparous, with development of a parenchymella larva (in one case blastula larva) directly in seawater. On coral reefs there are two families both important to the bioerosion of dead coral substrate, the spirastrellids (which are massive) and clionids (which are thinly encrusting and burrow into coral chambers). Hadromerids are often brightly coloured, yellow, orange or greyish-yellow, and found in many parts of the reef but particularly on dead coral. Common genera are *Spirastrella*, *Spheciospongia*, *Cliona* and *Tethya*.

External Characters
Thick erect digitations or lobes, anastomosing in large masses. Texture tough, just compressible, elastic. Surface with low rounded conules, approximately 2 mm high and 2-5 mm apart. Ostia 50 µm in diameter, are found in small, darker depressions of the surface. Oscula at the apices of the digitations surrounded by a white margin, 10 mm diameter in preserved specimens. Surface with rounded depressions containing ostia in stellate arrangements. The cortex is thick (500 µm x 1100 µm) and composed of parallel collagen fibrils in wavy bundles. The choanocyte chambers are from 20 to 25 µm in diameter. Large embryos or parenchymella larvae, up to 1.5 mm in diameter and white or yellow in colour, are frequently observed in the choanosome.

Dimensions
Lobes 30-45 mm in diameter, masses of more than 10 cm.

Colour
Colour in life oak brown, darker in ostial depressions, mottled with cream in patches on the surface and around the oscule margin; cream interior, uniformly white in ethanol.

Skeletal Characters
Plumo-reticulate arrangement with very thick multispicular fibres, 700-1125 µm in diameter, joined occasionally by small short secondary fibres 250-375 µm at right angles to the primary fibres. The fibres radiate toward the surface where they end in large blunt conules. At the tip of the fibre small dendritic tracts 30 to 50 µm in diameter divide and radiate through the cortex to the surface where they form narrow brushes. Megascleres form an erect palisade at the surface. Interstitial megascleres are abundant. Thin spinulate rhabds (spinorhabds) are rare and when present are found only in the superficial layers of the choanosome. Megascleres: strongyles with a slight swelling at the proximal end, 258 µm (210-300 µm) x 1-5 µm. Microscleres: spinulate rhabds (spinorhabds), straight, with swellings or small, irregular spines usually more developed near the apices, always rare, may be absent in some specimens: 58 µm (53-60 µm) x 0.5-2.4 µm.

Ecology and Habitat
4-35 m. Lagoon and fore-reef zone. Fairly common in New Caledonia.

Distribution
New Caledonia, north-eastern Great Barrier Reef.

Family
Acanthochaetetidae

Acanthochaetetes wellsi
Hartman and Goreau, 1975

External Characters
Massive calcified sponge, most often globular, hemispherical or pyriform, rarely subcylindrical. After an encrusting stage, the young specimens generally become pedunculate, with a dead skeletal stalk of variable thickness. In the largest specimens from fore-reef tunnels, the shape may be subspherical with a thin, short stalk hidden by the head margins growing down towards substratum. A well developed epitheca provided with concentric growth lines covers the lower surface of the calcareous skeleton. Traces of regeneration or budding are often visible on the upper surface, with dead masses of skeleton covered by discontinuous living zones often at a level above the previous living surface. Texture stony. Surface regularly mammillate, displaying mostly hexagonal pseudocalicles, 250 to 550 µm in internal diameter. Oscules small, from 100 to 130 µm in diameter, draining astrorhizal system etched into the skeleton and varying from 20 to 50 mm. Choanocyte chambers small (18 to 24 µm in diameter). Masses of storage cells (thesocytes), involved in regeneration, are stored in variable number in the pseudocalicles under the tabulae. Symbiotic bacteria are not abundant and belong to a single morphological type. Spherulous cells with dense, homogeneous spherules present. Reproduction unknown.

Dimensions
Usually 0.5 to 3 cm, up to 30 cm in diameter.

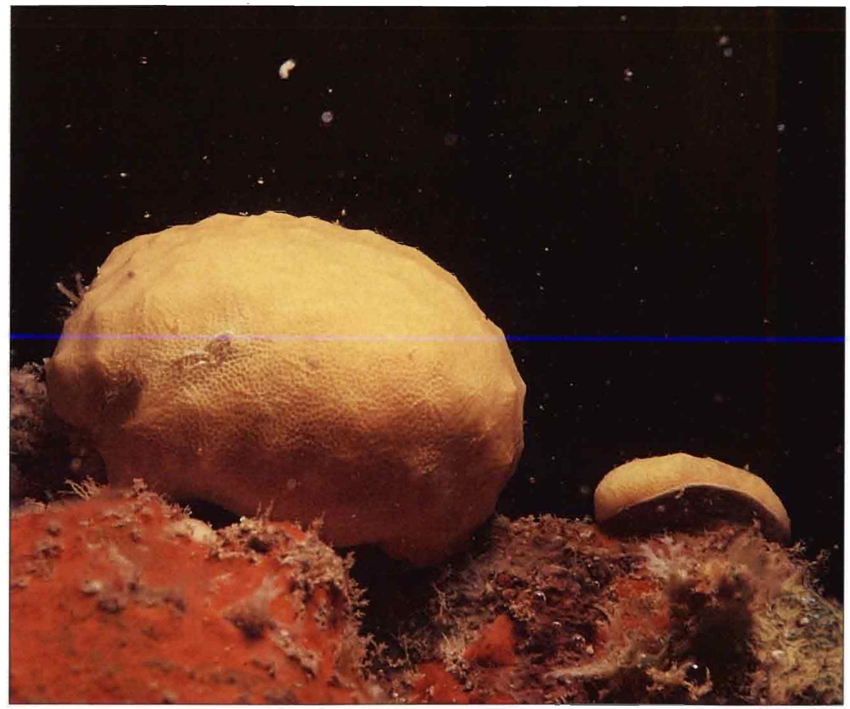
Colour
Clear orange to yellow, internal calcareous skeleton white.

Skeletal Characters
Massive calcareous skeleton, formed of contiguous, vertical tabulate tubes or pseudocalicles, 250 to 550 µm in internal diameter. At the surface the edges of the tubes are crenulate. Conical spines, 35 to 130 µm in length, protrude from the walls into the tubes. Under the choanosome zone, 1.2 to 2.0 mm deep, the tubes are horizontally subdivided by tabulae with a spacing of approximately 150 µm. The tube walls, 65 to 140 µm in width, are perforated by holes, 1.7 to 3.5 µm in diameter, corresponding to fascicles of collagen fibrils anchoring the living tissue in the skeleton. Basal parts are covered by an epitheca. Composition: high-Mg calcite. Microstructure: microlamellar, with crystal fibres, 3 µm/0.1-0.2 µm, disposed in wavy layers in the wall, in longitudinal layers in the spines and the tabulae. Siliceous spicules are usually not entrapped in the calcareous skeleton. However, some microscleres may hold to the crenulate margin of the pseudocalicles. Siliceous spicules: megascleres: tylostyles, 201-400 µm/2.6-7 µm, head: 6.2-10 µm in width, microscleres: thick spirasters, 6-28 µm/5-20 µm.

Ecology and Habitat
Cryptic habitats of the front reef (1-35 m), continental margin of New Caledonia up to 288 m.

Distribution
Pacific Ocean.

Possible Confusions
The calcified sponge *Astrosclera willeyana*, in the same habitat, has a roughly similar shape. It differs from *A. wellsi* by a darker colour, the absence of regular pseudocalicles and spicules.



Acanthochaetetes wellsi Hartman and Goreau: Touho, 30 m (photo G. Bargibant)

Order
Hadromerida

Family Clionidae

Cliona cf *jullieni* Topsent, 1891

Cliona cf. *jullieni* Topsent: Baie du Prony (photo J. Vacelet)

External Characters
Sponge is visible as a veneer over dead coral substrate, beneath which the sponge bores to a depth of several centimeters degrading the coral framework. Oscules surrounded by a thin inflated membrane are 5-10 mm diameter and are occasionally scattered over the sponge surface or grouped. Surface nodulose following contours of coral substrate. Sponge is corky or velvety to the touch and is incompressible.
The surface layers contain zooxanthellae, 4.8-7.2 μm in diameter. The sponge may be associated with zoantharians.

Dimensions
Patches are often 10-20 cm in size unless the sponge has completely covered a piece of coral rubble or an outcrop, in which case the encrustations can be much larger (up to 1 m).

Colour
Deep violet alive and in alcohol.

Skeletal Characters
Spicules are robust tylostyles, straight, gently curved or kinked, with distinct spherical heads. Size range 307-413 μm x 12-19 μm, average 373 μm x 16 μm. The choanosome is crumbly with abundant spicules packed in confusion.
At the surface tylostyles are radially arranged producing a felty texture. Spirasters of two sizes are abundant in a thin crust at the surface and are scattered below this. Size range of the largest spiraster 36-65 μm x 2-4 μm, average 50 μm x 2 μm, these spicules are slender and faintly twisted with 3-4 spirals of thin sharply pointed spines. The smaller spirasters have 1-2 spirals of tubercules rather than sharp spines and can be irregularly angulate.
The size range is 10-24 μm x 1-2 μm, average 14 μm x 1 μm.

Ecology and Habitat
This species of *Cliona* achieves the beta stage in development with a veneer of tissue only visible above the calcareous substrate into which it actively bores. The resultant disintegrated coral is bound within the matrix of the sponge. The sponge is common within a depth range of about 5-35 m in lagoon patch reefs and on outer reef-front walls in smaller patches.

Distribution
New Caledonia, southern barrier reef of Papua New Guinea.

Possible Confusions
None. The identification with *C. jullieni*, from La Réunion, which was described in the alpha stage and with smaller spirasters is tentative. The name *Cliona schmidti* Ridley has been used for various violet burrowing sponges from numerous areas in tropical and temperate seas. A revision is needed for these sponges, and the New Caledonian specimens may prove to belong to an undescribed species.

Order
Hadromerida

Family
Clionidae

Cliona sp.

Cliona sp., I. N'géa, 10 m
(photo P. Laboute)

External Characters
The sponge forms a thick cavernous encrustation above the dead coral substrate or dead bivalves into which the sponge excavates burrows.
Large specimens may be free on the substrate.
Exhalant cylindrical papillae are centrally grouped and 5-7 mm high and wide. These are surrounded by low mushroom-shaped inhalant sieve-like papillae 2-3 mm wide. The surface between these papillae is usually covered in a layer of sediment. Compressible and crumbly, leathery with a feel of cork when alive.

Dimensions
The sponge ranges in thickness from 1-3 cm and forms small or large patches depending on the substrate. Average patch diameter 20 cm.

Colour
Dull mandarin orange when alive, coffee-coloured in alcohol.

Skeletal Characters
Spicules are gently curved slender subtylostyles with prominent spherical subterminal heads. Size range 211-345 µm x 5-7 µm, average 289 µm x 6 µm. These spicules are packed in confusion in a compact cortical region 300-1800 µm deep. At the surface of the cortex tylostyles are radially orientated forming a palisade. Beneath the cortex is a crumbly cavernous choanosome which has incorporated much calcareous debris. Tylostyles are arranged in loose bundles or vaguely reticulate radiating tracts within the choanosome. Short squat spirasters with relatively few tuberculate spines are found occasionally at the sponge surface and are rare beneath it. Size range 10-14 µm, average 12 µm. Microxea in trichodragmata are abundant within the choanosome. Size range 79-96 µm, average 88 µm.

Ecology and Habitat
This species of *Cliona* achieves the beta stage of development, the sponge encrusts thickly above the substrate that it excavates. It may also becomes massive and free-living (gamma stage). Common in silty lagoon patch reefs, 1 to 10 m.

Distribution
New Caledonia.

Possible Confusions
None (distinct by its colour from other massive burrowing sponges of New Caledonia). This may be an undescribed species of the group of *Cliona celata*, possibly endemic to New Caledonia.

Cliona orientalis Thiele, 1899

External Characters
Sponge bores dead coral substrate to a depth of several centimeters and is visible on the exterior as a 1-2 mm thick covering. Oscules are large and conspicuous with raised differentially coloured membranous collars, and are scattered regularly over the sponge surface. The surface is velvety to the touch and the sponge is incompressible.

Dimensions
The size of the sponge is dictated by the size of the coral rubble or substrate it is boring. Patches are frequently 30-40 cm in diameter, and may cover several square meters.

Colour
Olive brown with paler khaki patches where underlying coral is visible, oscular collars deep yellow when alive. Pale gold in alcohol.

Skeletal Characters
Spicules are straight or occasionally curved tylostyles with spherical to oval heads. Some specimens may also have tylostrongyles. Size range 249-374 µm x 7-11 µm, average 336 µm x 9 µm. These spicules are packed without orientation throughout the sponge. Spicules are radially orientated at the surface where they form an erect palisade. Spirasters are abundant at the surface and scattered below this. These spicules are perfectly regular with 1-3 spirals with abundant fine regular dentation along the outside of the spirals. Single spirals appear as anthosigmas. Size range 12-36 µm, average 23 µm.

Ecology and Habitat
This species achieves a beta stage in development with a veneer of tissue only visible above the calcareous substrate into which the sponge actively bores. It often displays grazing scars made by scarid fishes. Association with a large number of associated zooxanthellae is constant. Very common in lagoonal environments.

Distribution
Indopacific.

Cliona orientalis Thiele: Nouméa, I. Maître 5 m (photo P. Laboute)

Family Spirastrellidae

Spheciospongia inconstans

Spheciospongia inconstans: Nouméa, I. Croissant, 10 m. Seagrass bed (photo P. Laboute)

External Characters
The sponge is irregularly sub-spherical and attached basally to the substrate by the incorporation of much coral debris into the sponge base. At the top of the sponge is a broad slightly raised apical depression in which numerous oscules are grouped. The surface is relatively even without any digitate processes but is scattered with numerous highly characteristic circular or meandrine openings flush with the surface. These extend several centimeters into the sponge body rendering the cortex and top 10 cm of the sponge cavernous. The texture is woody, barely compressible, and faintly corky to the touch.

Dimensions
These sponges can grow up to 40-50 cm diameter with slightly less height. The apical oscular depression is approximately 10 cm across.

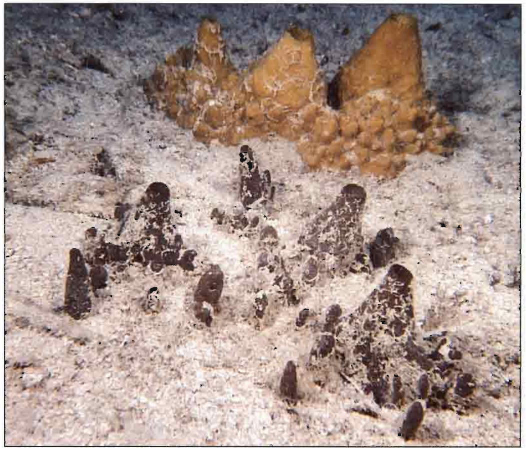
Colour
Golden to brownish orange alive externally, more grey internally, paler in alcohol.

Skeletal Characters
Spicules are two sizes of tylostyles with oval elongate heads and frequently strongylote distal ends. The largest of these are straight or irregularly curved and are frequently modified to subtylostyles, size range 336-480 µm x 12-17 µm, average 399 µm x 14 µm and are packed in confusion deep within the choanosome. Within the cortex spicules are arranged in loose, thick vaguely radial tracts separated by areas which lack spicules and contain tracts of collagenous fibrils. The smaller tylostyles are straight and pin-shaped and are arranged in brushes at the surface of the sponge, projecting beyond the surface. The size range is 173-268 µm x 7-10 µm, average 223 µm x 8 µm. Spirasters are scattered in patches at the surface of the sponge, and consist of 1-2 spirals with occasional short sharp spines, size range 10-19 µm, average 14 µm.

Ecology and Habitat
Common in shallow fringing reef flats and seagrass beds within the lagoon, but found down to 18 m depth within the lagoon. The characteristic tunnel openings in this sponge support communities of brittle stars and various crustaceans. The surface tissue of this species is packed with zooxanthellae.

Distribution
IndoPacific.

Spheciospongia vagabunda (Ridley, 1884)



Spheciospongia vagabunda (Ridley): Nouméa, I. Maître, 15 m (photo P. Laboute)

Spheciospongia vagabunda (Ridley): I. Maître, 15 m (photo P. Laboute)

External Characters
Growth form variable, sponges are massive usually forming one or several steep-sided central cones, frequently surrounded by short blunt basal papillae-like projections, buried basally in sand substrate or burrowing into dead coral substrate. Sponges also form simple smooth conical projections particularly in the juvenile stage. Oscules are large and prominently elevated on the tops of the central cones.
These oscular turrets may elongate and become aligned perpendicular to prevailing currents in shallow reef-flat and lagoonal environments.
Texture moderately soft and compressible alive, flexible, firm and just compressible in alcohol and after handling in the field.
The surface is relatively smooth and undulating to sharply nodulose and almost digitate, corky and velvety to the touch.

Dimensions
Up to 30 cm basal diameter and 20 cm height.
Basal papillae are about 3-4 cm high, single conical projections are about 5-10 cm high.

Colour
Specimens can be one of several colours, deep violet brown externally and rust brown internally when alive, chocolate brown in alcohol; honey yellow or mustard externally, brownish yellow internally alive and dull brownish yellow in alcohol; other external colourations range from medium to dark brown to bright yellow and bright orange-yellow, yellowish-grey, light grey.

Skeletal Characters
Spicules are grouped in loose vaguely radiating tracts within the choanosome and are packed without orientation below the surface of the sponge.
The interior of the sponge is relatively cavernous with huge canals surrounded by collagenous tissue. Spicules are in two sizes, the largest which dominate in the choanosome are slender and straight or slightly curved tylostyles and subtylostyles with slender oval heads, frequently with strongylote distal ends, size range 413-662 µm x 5-11 µm, average 532 µm x 8 µm. Smaller straight pin-shaped tylostyles, frequently also with strongylote distal ends, size range 202-355 µm x 5-6 µm, average 270 µm x 5 µm, are arranged perpendicular to the sponge surface in brushes. Spirasters in two sizes are abundant at the surface of the sponge and line internal canals, and are less abundant scattered within the choanosomal tissue. The largest spirasters have 2-4 gentle curves with regular tuberculate dentition along the outside of each curve, size range 19-38 µm, average 29 µm, the smaller spirasters possess only a single curve and tuberculate dentition and the size range is 5-12 µm, average 9 µm.

Ecology and Habitat
This species is abundant and conspicuous in the deep lagoon floor buried basally in the sand, or amongst seagrass and coral rubble in the back reef environment. All sponges incorporate sand and coral rubble in their base as an anchoring mechanism and are capable of actively boring dead coral substrate buried in the sand. The superficial tissue of the brown morph contains rare zooxanthellae.

Distribution
Papua New Guinea, New Caledonia, Torres Straits, Philippines, Sri Lanka, Indian Ocean.

Order
Agelasida

Family
Agelasidae

Agelas sp.

Agelasids are oviparous sponges, very abundant in coral reefs, although there are few species. *Agelas* shows superficial resemblance to commercial "bath" sponges in their spongy texture and fibrous skeleton, frequently with bright orange colouration. Their precise affinities are still uncertain although they show closest similarities to some axinellids in their biochemistry. Growth forms are typically branching, tubular, fan-shaped or massive. The organic skeleton has very well developed spongin fibres, forming regular or irregular reticulate meshes, and fibres are echinated by short styles with verticillate spines. There are no microscleres. Another genus common in coral reefs, *Astrosclera*, is hypercalcified with an aragonitic reticulate basal skeleton. Free verticillate-spined styles are embedded in the soft tissues that cover only the outer part of the basal skeleton.

Agelas sp. Nouméa S.: Banc Gail, 30 m (photo P. Laboute)

External Characters
Massive, lobate, irregularly shaped sponge; surface perforated with numerous 3-4 mm craters containing an aperture corresponding to an operculated Cirripede cavity. Rough surface, slightly hispid; few oscules, compressible and elastic texture.

Dimensions
120 x 70 mm wide,
70 mm high,
oscules 5-10 mm diameter.

Colour
Reddish brown, brown.

Skeletal Characters
Choanosomal skeleton is more or less made of collagenous spongin. It consists of primary lines of spicules, 4-5 spicules wide, linked by transverse spicules more or less oblique. When there is a large amount of spongin a fibrous skeleton develops, up to 50 µm diameter, multispicular, ascending fibres containing verticillate acanthostyles and acanthoxeas. Hispidating spicules or linking spicules are then within unispicular fibres. Sometimes linking fibres contain no spicules, 20-30 µm diameter, The distance between ascending primary fibres is approximately 200-250 µm, or about the length of a spicule. Acanthostyles with verticillate whorls of spines, 20-26 whorls per spicule; acanthoxeas vary in spination but always fewer than acanthostyles; spicule dimensions 200-300 µm long. The large number of spined whorls on spicules and the presence of numerous acanthoxeas seem to be representative of this species.

Ecology and Habitat
Found on sediment-rich seabed in the lagoon, Banc Gail, 35 m depth.

Distribution
Known only from New Caledonia.

Order
Agelasida

Family
Agelasidae

Agelas ceylonica Dendy, 1905

Agelas ceylonica Dendy: Nouméa S.: Banc Gail, 25 m (photo P. Laboute)

External Characters
Massive sponge with a continuous basal part covering the substrate. Lamellar, trabecular digits arise from this base. They are sometimes anastomosing, separated by cavities of similar diameter. The surface is hispid and an aspicular membraneous ectosome covers the sponge, perforated by inhalant apertures often opening into shallow furrows. The texture is elastic, with a strong resistance to pulling off.

Dimensions
50 mm high, 40-50 mm wide, trabeculae 10-40 mm long, 3-10 mm wide.

Colour
Brownish ochre to orange.

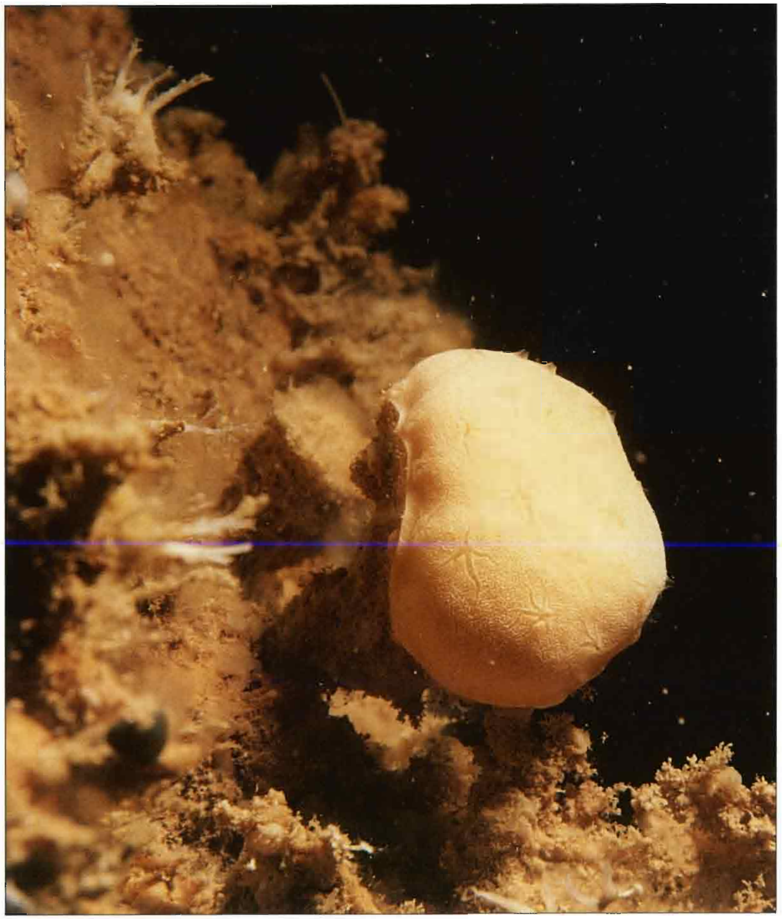
Skeletal Characters
The skeleton is made of a network of spongin fibres whose surface is finely punctuated or striated. The mesh size is about 200-400 µm wide. Some ascending fibres can be found, mainly near the surface. All spicules are located perpendicularly or obliquely around the fibres. In ascending fibres, near the surface, the acanthostyles are barely curved and stacked against fibres. Verticillate acanthostyles slightly curved near the base, with 14-118 whorls of spines, 100-210 µm x 8-18 µm. Scattered smaller spicules may be found around the basal plate.

Ecology and Habitat
In the lagoon, Banc Gail, 35-38 m depth.

Distribution
Indian Ocean, New Caledonia, central Pacific, Indonesia.

Family
Astroscleridae

Astrosclera willeyana Lister, 1900



Astrosclera willeyana Lister: Touho 30 m (photo G. Bargibant)

External Characters

Sponge massive, globular, bulbous, cushion-shaped or cylindrical. Young specimens are encrusting and grow upwards into a cylindrical structure, with a dead stalk and a living "head" which progressively becomes rounded and larger than the stalk (bulbous shape). In the largest specimens from fore-reef tunnels, the shape may be subspherical with a stalk hidden by the head margins growing down towards substratum. Growth rings are visible on the epitheca covering the lower surface, but there is no trace of regeneration or budding. Several heads may be present on the same dead skeleton. Bathyal specimens mostly cylindrical. Texture is stony. Surface smooth, although irregularly mammillate in some large specimens. Oscules small, 2 to 5 cm, in the centre of an astrorhizal system etched into the skeleton. Choanocyte chambers small (ca 20 µm). Tissue containing morphologically highly diverse intercellular bacteria which are one of the main components of the tissue. No well defined spherulous cell. The sponge incubates embryos of parenchymella-type.

Dimensions

Usually 0.5 to 2.5 cm in diameter, up to 16.5 cm.

Colour

Orange to brown, internal calcareous skeleton white.

Skeletal Characters

Calcareous skeleton alveolar on the surface, solid in the backfilled central parts. Tabulae absent. Basal parts covered by an epitheca. Composition: aragonite. Microstructure spherulitic, built up of polygonal sclerodermites 10 to 60 µm in diameter, with crystal fibres, 1-3 µm in diameter, arranged in a radiate structure. The sclerodermites are secreted inside cells dispersed in the living tissue, as granules which pass through a spheraster-like stage and are incorporated into the superficial parts of the solid skeleton when their size is 20 to 25 µm.

Siliceous spicules, acanthostyles with verticillate spines, usually with a swelling in the basal third, are present in the living tissue in sponges from the Indian Ocean. In SW Pacific (Great Barrier Reef, Australia, New Caledonia), acanthostyles are found only in young specimens (less than 18 mm), 30-115 µm x 1.1-5.3 µm, with spines usually vestigial or absent. Siliceous spicules are absent in Central Pacific.

Ecology and Habitat

Under surfaces of coral rubble, reef cavities, caves, deep cliffs. Size is smaller on the back reef. The largest specimens have been found in tunnels of the front reef exposed to surge (Touho). Very abundant. Depth range: 1 to 288 m.

Distribution

Indo-Pacific tropical area: Red Sea, Indian Ocean (Madagascar, Comoro Islands, Christmas Island, Mascarene Islands), Pacific (Philippines, Great Barrier Reef, New Caledonia, Guam, French Polynesia).

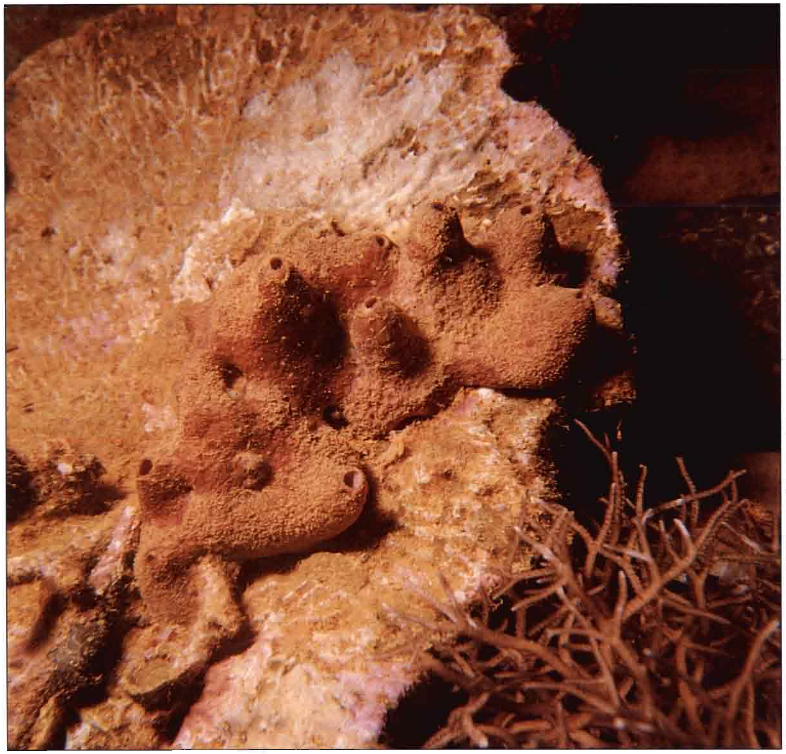
Possible Confusions

Acanthochaetetes wellsi, in the same habitat, differs by the yellow colour, the presence of hexagonal pseudocalicles in the skeleton and by spiculation,

Order
Halichondrida

Family
Halichondriidae

Axinyssa aplysinoides (Dendy, 1921)



Axinyssa aplysinoides (Dendy): Baie laugier, 20-30 m (photo P. Laboute)

R. van Soest, (1994) has recently proposed to merge in the order Halichondrida all sponges previously included in two orders Halichondrida and Axinellida.

Halichondrida are frequently drab, massive sponges in which the choanosomal skeleton is mainly composed of styles or oxeas, of widely diverging sizes. Spicule categories are not usually functionally localised to any particular region of the skeleton. Skeletal structures are characteristically disorganised, with spicules forming criss-crossed ("halichondroid") reticulations or dendritic tracts. Spongin fibres are poorly developed or absent, although moderate amounts of collagen may be present in the skeleton. The ectosomal skeleton may be organised into a tangential layer of spicules or erect spicule bundles, with minimal collagen and typically large cavities in the peripheral region. Microscleres are not usually present although some species may have raphides, microxeas, or spined microxeas with a central bend. Common genera are *Axinyssa*, *Halichondria* and *Trachyopsis*.

External Characters
Massive and compact, with rounded contours, more or less digitate or lobate. Surface with a minute reticulation of raised ridges, variously developed in different parts of the surface. Few oscules on one side of the sponge or below the rounded top of lobes. The texture is compact, slightly elastic. Subdermal cavities are present.

Dimensions
130 x 20 x 40 mm.

Colour
Grey.

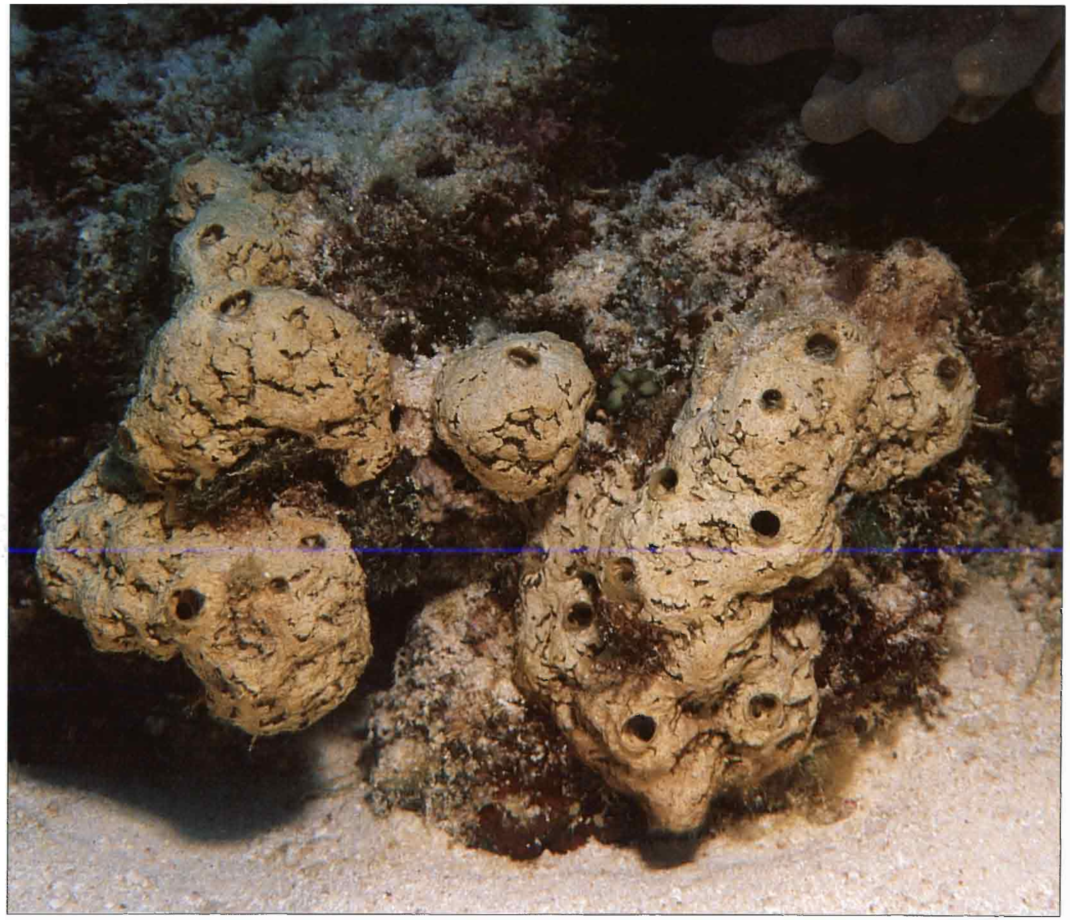
Skeletal Characters
The skeletal arrangement is rather dense, with ill-defined spicule tracts near the surface but without true fibres. Ectosome with an ostiolar pigmented layer and a collenchymatous layer. Megascleres are oxeas slightly curved, measuring about 800-1100 µm x 8-20 µm. Spicules in the upper part of the skeleton are prominent.

Ecology and Habitat
Baie Laugier.

Distribution
New Caledonia, NW Australia, Indonesia, Philippines, western Indian Ocean (Amirante, Seychelles).

Family
Dictyonellidae

Liosina paradoxa
Thiele, 1899



Liosina paradoxa Thiele: I. Ua, 20 m
(photo G. Bargibant)

External Characters
Thickly encrusting to massive sponge, with oscules raised as turrets. Oscular rims are smooth and rounded.
The sponge is distinctive in possessing a coloured mosaic pattern over its surface. The sponge is slightly compressible and can be torn. Surface feels fibrous to touch.

Dimensions
The sponge forms a thick encrustation 20-50 mm deep, with short lobes of 10-20 mm high. It can grow to patches of 200 mm diameter.

Colour
Off-white, with a mottled orange mosaic pattern over the surface. In ethanol it is also off-white.

Skeletal Characters
Common spicules are strongyles (185-400 µm x 5-10 µm). Very large oxeas also exist (640-800 µm x 5-12 µm).
There are no microscleres. Spicule tracts are not well formed and a weakly developed reticulum of spicule bundles is widely separated, cross-linked by smaller groups of megascleres. Pigmented cells are distinct and particularly dense at the surface, although patches of pigmented cells are also dispersed throughout the choanosome, making it difficult to observe the skeletal structure.

Ecology and Habitat
Grows in high current areas in densely encrusted communities on flat reef bases. It is most common in reef pass areas where sediment is absent. It ranges in depth between 16 and 25 m.

Distribution
Reef passages and high current areas around southwestern part of New Caledonia.

Order
Axinellida

Family
Axinellidae

Cymbastela cantharella
(Lévi, 1983)

These sponges often have a centrally compressed axis of oxeas, styles or strongyle megasclere spicules, some curved or sinuous, usually clearly differentiated from the subectosomal and ectosomal skeletons which may be plumose, plumo-reticulate or radial. Ectosomal skeletons are frequently in the form of erect spicule brushes, usually of a smaller size than the choanosomal spicules. Spongin fibers are not generally well developed but there may be moderate amounts of collagen bonding spicules together in the skeleton. Microscleres are absent from many species, or may include only raphides, although some families currently included here do have diverse forms. Reproduction is oviparous. Species are often tree-shaped, digitate or fan-shaped, and flexible growth forms are common. Colours may be bright including yellows, reds and oranges. In coral reefs genera such as *Axinella, Acanthella, Ptilocaulis and Cymbastela* are common.

External Characters
Short, erect, cup-shaped or vasiform sponges, with thick lamellae, usually with convoluted margins, occasionally with secondary cups or lamellae growing inside primary cup, often with buttresses and exterior secondary projections, and with a short, cylindrical basal stalk. Surface is predominantly smooth, with distinct interior (porous) and exterior (smooth) faces of lamellae. The interior surface has abundant small oscules, each surrounded by a lightly raised membraneous lip. The texture is firm, flexible, slightly compressible.

Dimensions
Cups up to 150 mm high, 170 mm maximum diameter, lamellae about 6 mm diameter, basal stalk up to 40 mm long, 17 mm diameter, oscules up to 2 mm diameter, about 2 mm apart.

Colour
Pale orange-brown alive, beige when preserved.

Skeletal Characters
Ectosomal skeleton is membraneous, with heavy collagen, through which choanosomal oxeas protrude, individually or in plumose bundles, arising from the ascending radial tracts in the subdermal skeleton. Choanosomal skeleton is plumo-reticulate, without axial compression or any differences between the axial and extra-axial regions. Choanosomal skeleton divided into two components: one with longitudinal spongin fibres running radially through lamellae, cored by tracts of oxeas, becoming plumose near the surface, and the other with transverse single or sparse tracts of oxeas interconnecting the radial fibres. The overall skeleton appears nearly disorganised, almost halichondroid. Megascleres consist of: choanosomal oxeas [short, slender, slightly curved, symmetrical, occasionally asymmetrical, tapering, fusiform, usually with slightly telescoped points (143-245 µm x 2.5-12 µm)]. Microscleres are absent.

Ecology and Habitat
Growing on hard bottom coral reef substrate, 10-60 m depth.

Distribution
Known only from the southern New Caledonian lagoon and outer reef.

Cymbastela cantharella (Lévi): Passe de Yandé, 30 m (photo J.L. Menou)

Order
Axinellida

Family
Axinellidae

Cymbastela concentrica (Lendenfeld, 1887)

Cymbastela concentrica (Lendenfeld): I. Rédika, 20 m
(photo P. Laboute)

Cymbastela concentrica (Lendenfeld): St Vincent
(photo P. Laboute)

Cymbastella concentrica (Lendenfeld): I. M'Boa, 13 m
(photo P. Laboute)

External Characters
Growth form usually vasiform, but varying from more or less symmetrical cup-shaped with small basal stalk, to vasiform with symmetrical or asymmetrical lamellae, to thickly encrusting plate-like, attached directly to the substrate. Lamella thickness variable, ranging from card thin to thick and rubbery. Surface is typically convoluted, with multiple lamellae inside cups or with digitate projections on exterior surface, but some specimens lack any surface ornamentation altogether. Lamellae are smooth, even or irregular. Texture is flexible, compressible, velvet-like.

Dimensions
Size up to 150 mm high, 140 mm maximum width, lamella thickness 1.0-3.5 mm.

Colour
Pale beige, olive-brown or reddish-brown alive, beige or brown when preserved.

Skeletal Characters
Ectosomal skeleton is membraneous, without any specialised skeleton, but it appears as microscopically villose due to protruding spicules from the peripheral skeleton which usually form plumose brushes. Choanosomal skeleton is reticulate, less obviously plumo-reticulate, with poorly differentiated axial and extra-axial regions. Fibres in the axial region of the skeleton are only slightly condensed, forming an open reticulation, and cored by uni- or paucispicular tracts of choanosomal oxeas. Extra-axial fibres are reticulate, slightly plumose, with few coring spicules, whereas spicules inside the spongin fibres at the surface of the sponge diverge into plumose spicule bundles. Megascleres consist of: choanosomal oxeas, variable in size, usually slender, fusiform, straight or slightly curved, symmetrical, faintly telescoped points (67-142 µm x 2.5-5 µm). Microscleres are absent.

Ecology and Habitat
Found in the lagoon, inshore fringing reef or platform coral reef fauna, fixed on coral fragments, sandy and rubble substrates, 10-30 m depth.

Distribution
Northern, central and southern Queensland, and southwest lagoon of New Caledonia.

Possible Confusions
Phyllospongia foliascens in New Caledonia lagoon; also *Cymbastela stipitata* and *Cymbastela coralliophila* in tropical Australasia.

Order
Axinellida

Family
Axinellidae

Reniochalina condylia Hooper and Lévi, 1993

External Characters
Thickly encrusting plate with prominent low, conical-bulbous, digitate projections on the upper surface, each with a single, large osculum on the apex. Surface is membraneous, even, porous on the upper surface, without ornamentation other than large bulbous digits. Subdermal spicule bundles are clearly visible below the translucent dermal membrane.

Dimensions
Encrusting plate 260 mm diameter, 10-35 mm thick, bulbous digits 14-23 mm high, 10-14 mm maximum diameter, oscules 3-5 mm diameter.

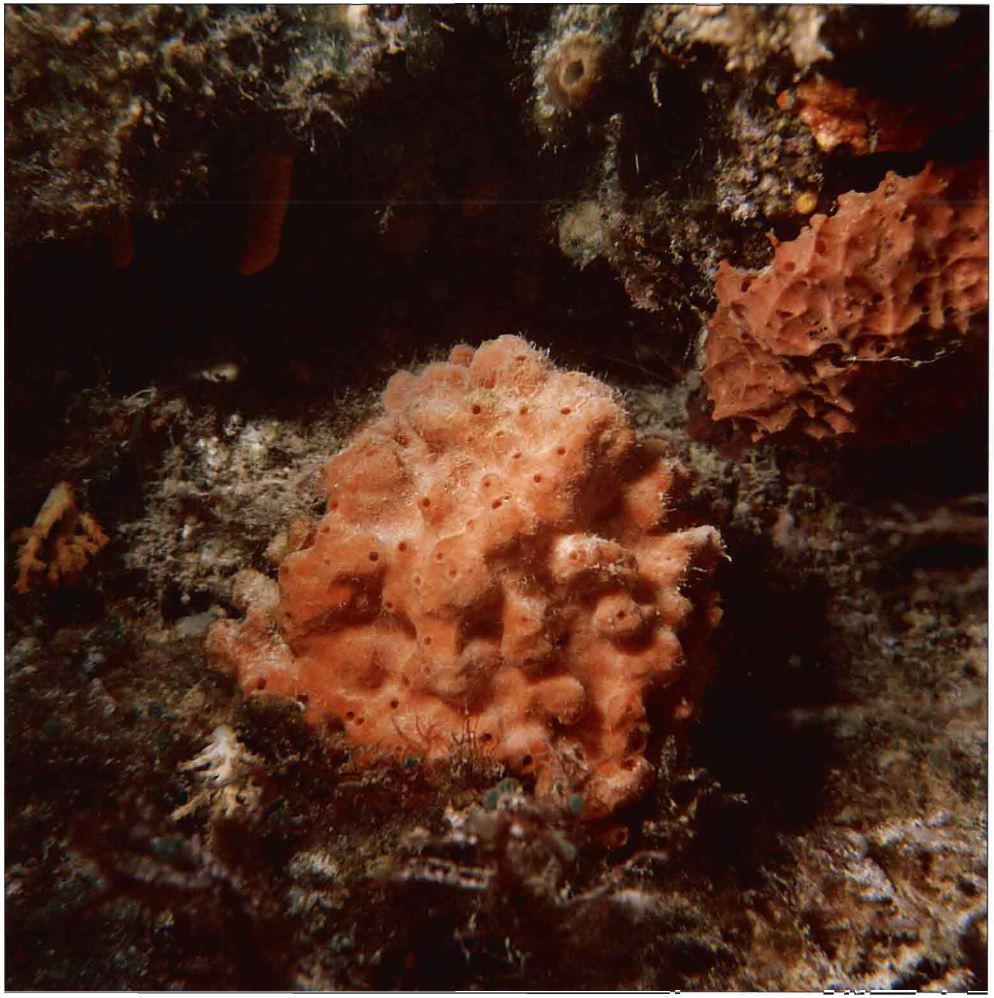
Colour
Pale orange alive, pale grey-brown when preserved.

Skeletal Characters
Ectosomal skeleton membraneous, without specialised spicules but with plumose brushes of choanosomal spicules lying directly under, and supporting, the surface membrane. Choanosomal skeleton is plumo-reticulate, without axial compression or any differentiation between the axial and extra-axial regions. The skeleton is divided into primary spicule tracts, ascending to and diverging at the surface, and secondary spicule tracts which are predominantly transverse, with fewer spicules, and more or less interconnecting the primary tracts. Spongin fibres have only very light spongin. Megascleres consist of a single category of structural spicule, varying from oxeas to styles, with various intermediate forms also present [slightly curved, slightly asymmetrical oxeas most common; styles with evenly rounded and slightly curved bases less common; asymmetrical anisoxeas rare spicules have fusiform points, tapering, sharply pointed or occasionally rounded points (208-289 µm x 10-14 µm)]. Microscleres are absent.

Ecology and Habitat
Uncommon, growing on coral rubble and substrate, 16-22 m. depth. This species possibly rolls around the soft substrate of the lagoon floor, with only small pieces of rubble embedded into the sponge as point of attachment.

Distribution
Known only from the southwest lagoon of New Caledonia.

Possible Confusions
Species of *Higginsia* in New Caledonia.



Reniochalina condylia Hooper and Lévi (holotype): I. Ua, 22 m (photo P. Laboute)

Order
Axinellida

Family
Axinellidae

Axinella carteri (Dendy, 1889)

External Characters
Flabellate growth form, with massive, lobate, irregularly planar or globular branches composed of relatively thick, flattened planar or buttressed lamellae with irregular margins. The sponge is attached to the substrate directly or by a small basal stalk. Surface is fleshy, conulose, rough. Conules are irregular, solitary or fused together to form meandering surface ridges. The texture is rubbery, compressible, and easily torn. Oscules are on the margins of lamellae, usually between the surface conules.

Dimensions
Sponges 110-400 mm high, branches up to 350 mm wide, 4-11 mm thick, basal stalk 20-90 mm long, up to 40 mm diameter, surface conules 3-5 mm high, oscules 2-5 mm diameter.

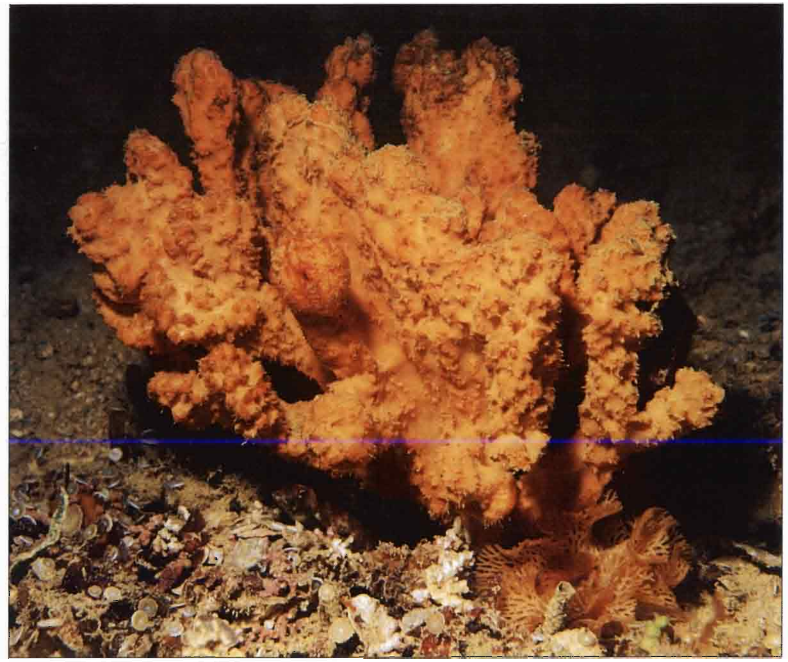
Colour
Bright orange-brown alive, pale orange-brown when preserved. The surface is slightly darker than the interior of the sponge.

Skeletal Characters
Ectosomal skeleton is membraneous, composed of a band of heavy collagen slightly more darkly pigmented than collagen in the choanosomal region, with extra-axial spicules only sparsely protruding into the ectosomal region. Choanosomal skeleton consists of an axial skeleton condensed into several multispicular bundles running more or less longitudinally through lamellae. These bundles are composed of long slender styles, bound together by very light spongin fibres, and interconnected at irregular angles by vaguely plumose sparse tracts or individual extra-axial styles. The spongin fibre reticulation is relatively close-meshed. Megascleres consist of only a single category of style, variable in thickness, occasionally strongylote, long, robust, slightly curved symmetrically near base, sharply pointed, evenly rounded base (415-588 µm x 12-28 µm). Microscleres are absent.

Ecology and Habitat
This species is a common component of Indo-Pacific coral reefs. In New Caledonia it is usually found in both the lagoon and outer reef slope, associated with living and dead coral. It appears to be most common in areas of strong current, attached to coral rubble or rock, in sand and sea grass beds. Known depth range extends from 10-40 m.

Distribution
Widespread throughout the Indo-Pacific, extending from the Red Sea, Arabian Gulf, western Indian Ocean (Cargados Carajos, Diego Garcia, Amirante, Salomon, Seychelles Islands, Comores, Madagascar), Gulf of Manaar, Sri Lanka, southern Indonesia, Papua New Guinea, Great Barrier Reef and southern lagoon of New Caledonia.

Possible Confusions
Phakellia stipitata, *Stylissa flabelliformis* and *Stylotella aurantium* from the New Caledonia lagoon.



Axinella carteri (Dendy): Chenal de l'I. Maître, 20 m (photo G. Bargibant)

Acanthella pulcherrima Ridley and Dendy, 1886

External Characters
Small flattened, club-shaped sponges, with short cylindrical stalk, enlarged basal holdfast, and several very thin, leaf-like, flattened branches with even margins. Surface is evenly conulose; conules are rounded or pointed, more or less arranged in ridges, running longitudinally along branches, with ridges producing an almost striated pattern. Oscules and pores are not easily visible. Texture is firm and flexible.

Dimensions
Fans are 75-120 mm long, 58-75 mm maximum thickness, basal stalk 12-22 mm long, 7-10 mm wide, branches 10-30 mm maximum width, 4-8 mm thick, surface conules or ridges up to 5 mm high.

Colour
Pale orange-brown or brown alive, pale beige when preserved.

Skeletal Characters
Ectosomal skeleton is membraneous, fleshy, without specialised spicules, but with extra-axial styles protruding slightly from the tops of surface conules, whereas between these conules the ectosome is merely collagenous, with more darkly pigmented, granular collagen than found in the choanosomal region. Choanosomal skeleton is divided into distinct axial and extra-axial regions. The axis is tightly compressed, occupying only about 30% of the branch diameter, running longitudinally through branches, and cored by closely reticulate sinuous strongyles more or less interlocked and criss-crossed within the axis.
The extra-axial skeleton consists of radial tracts styles, individually or in plumose bundles, embedded in and standing perpendicular to the axis. Axial spicules are bound together by heavy spongin fibres, with fibre reticulation producing elongate meshes, whereas extra-axial spicules are free within the mesohyl and not associated with spongin fibres except where embedded into the axis.
Megascleres consist of: axial styles, thick, straight or slightly curved near base, fusiform points, evenly rounded or slightly constricted bases (253-413 μm x 2-9 μm); extra-axial strongyles usually sinuous, occasionally completely straight or vermiform, thick, evenly rounded bases (449-552 μm x 2-6 μm). Microscleres are absent.

Ecology and Habitat
Uncommon, on coral rubble, 15-50 m depth, in areas of strong current.

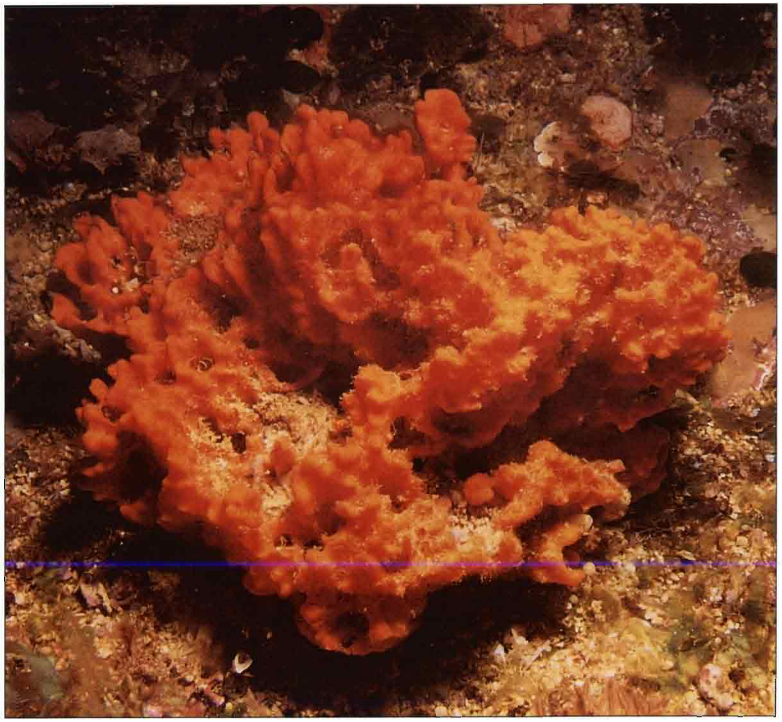
Distribution
Southern New Caledonian lagoon, Cape York, Torres Strait, Great Barrier Reef, Cargados Carajos, Indian Ocean.

Acanthella pulcherrima Ridley and Dendy: Canal Woodin, 28 m (photo P. Laboute)

Order
Axinellida

Family
Axinellidae

Phakellia stipitata (Carter, 1881)



Phakellia stipitata (Carter): Canal Woodin, 18 m (photo G. Bargibant)

External Characters

Flabellate sponge, with one or more fans aligned face-to-face, attached to a common basal stalk and a broad basal holdfast. Fans composed of irregularly fused and reticulated branches, excavated by wide meshes between reticulations, producing thick, nearly bulbous branches. Surface is clathrous, excavated, with regularly spaced conules. Conules have rounded tips and are usually joined together by low ridges, surrounding the large surface excavations (meshes), producing a 'goose-flesh' appearance. Large oscules are situated on the margins of fans, slightly raised above the surface, and slightly more darkly pigmented than the rest of the surface. Texture is firm, rubbery, difficult to tear, and the sponge usually requires cutting off substrate.

Dimensions

Fans 90-130 mm long, 70-110 mm wide, 40-90 mm thick, basal stalk up to 30 mm long, 15-20 mm diameter; surface conules 5-20 mm high, 10-20 mm apart; oscules 15-25 mm diameter.

Colour

Bright orange-brown alive, orange-yellow when preserved.

Skeletal Characters

Ectosomal skeleton membraneous, heavily collagenous, darkly pigmented, without special spicules and only the points of extra-axial styles barely protruding through the surface (and these usually only on the ends of the surface conules). Choanosomal skeleton with clearly differentiated axial and extra-axial regions. Axis moderately compressed, with short, heavy, reticulated spongin fibres. These fibres are only partially cored by tracts of styles. The extra-axial skeleton is not well formed (as in some other species of *Phakellia*), and consists merely of radially arranged styles, standing perpendicular to, or at acute angles to, the axis. Megascleres consist of: axial and extra-axial styles, long, slender, straight or slightly curved, with abrupt points, and sharp or slightly telescoped tips, evenly rounded or occasionally oxeote bases (301-545 μm x 3-15 μm). Microscleres are absent.

Ecology and Habitat

Associated with living and dead coral, flat bottom, consolidated substrate and strong current, depth range from 10-25 m.

Distribution

Tropical Indo-west Pacific, from the Gulf of Manaar, Sri Lanka, to southeast Queensland and southern lagoon of New Caledonia.

Possible Confusions

Axinella carteri from the New Caledonia lagoon.

Stylissa aurantium (Kelly-Borges and Bergquist, 1988)

Stylissa aurantium: Canal Woodin, 26 m (photo P. Laboute)

Stylissa aurantium (Kelly-Borges and Bergquist): I. Surprise 1-4 m (photo P. Laboute)

External Characters
A massive mound-shaped sponge, with prominent oscules (2-3 mm diameter) arranged along ridges. Oscules are ringed with a smooth flange (1-2 mm). The surface is uneven and is leathery to the touch. The sponge is very compressible, and easily torn.

Dimensions
It has up to a 60 mm basal diameter, and on average, grows to 30 mm in height.

Colour
Bright yellow externally and internally, dull yellow in ethanol.

Skeletal Characters
Styles are long and wavy, of variable length (160-200 x 30 µm). Rare isochelae were also observed in the specimen examined, but were thought to be foreign. Megascleres are arranged in a loosely plumo-reticulate structure, rising to a thick layer of epidermal cells. Surface spiculation appears relatively sparse.

Ecology and Habitat
Grows on the undersides of ledges and within caves on the outer reef slopes. It has been found in shallow-water depths, to 5 m.

Distribution
On the extreme northern parts of New Caledonia. Papua-New Guinea.

Order
Axinellida

Family
Axinellidae

Stylissa flabelliformis (Hentschel, 1912)

External Characters
Thickly flabellate sponges with flabellate-digitate branches, usually growing in more than one plane, with even or uneven digitate margins, and usually attached to the substrate by a small cylindrical basal stalk. Surface is characteristically rough, striated, conulose, shaggy, with either longitudinal striations in larger specimens, or an irregularly conulose, sculptured surface in younger material. Surface is soft, fleshy in life, contracting when preserved to produce a harsh texture. Oscules are visible on the apex of surface ridges and margins of branches, with a large membraneous lip surrounding each exhalant pore. Fleshy parts of the surface are porous, predominantly between surface conules and ridges.

Dimensions
Fans are 120-450 mm long, 70-180 mm wide, 140 mm maximum span of branches, up to 30 mm maximum thickness, basal stalk 20-75 mm long, 11-45 mm diameter, oscules up to 14 mm diameter.

Colour
Dark orange-brown in life, with a paler membraneous ectosome, and brighter orange interior, red-brown when preserved, and the sponge often produces an orange mucus upon collection.

Skeletal Characters
Ectosomal skeleton is fleshy, darkly pigmented, heavily collagenous, without specialised spicules but with the points of styles from the peripheral choanosomal skeleton protruding through the surface, but these are mainly in the vicinity of surface conules, whereas between conules, in the fleshy part of the surface, there are only a few spicules present. Choanosomal skeleton is plumo-reticulate, although it appears disorganised due to the proportionally larger size of megascleres in relation to spongin fibres. Axial and extra-axial skeletons are only slightly differentiated. The axial region is reticulate, with heavy spongin fibres forming rectangular meshes, and fibres are cored by multispicular tracts of styles. The extra-axial skeleton is vaguely plumo-reticulate, with ascending tracts of styles interconnected irregularly by smaller transverse tracts of styles. Megascleres include one category of styles, variable in thickness, predominantly robust, slightly curved near the base, rarely straight, evenly rounded bases rarely rhabdose, tapering to fusiform points, occasionally modified to strongyles (339-516 µm x 6-22 µm). Microscleres are absent.

Ecology and Habitat
Found on coral reefs, fringing and patch reefs, outer-reef slopes and in inter-reef regions of the lagoon, growing on live coral, coral rubble and sand substrates, 5-70 m depth. In New Caledonia the species is moderately common within the lagoon, less abundant on the outer reefs.

Distribution
Indian Ocean and Indo-west Pacific, known from the Seychelles, southeastern Indonesia, Arafura Sea, Timor Sea, central coast of Western Australia, Japan and southern lagoon of New Caledonia.

Possible Confusions
Axinella carteri, *Phakellia stipitata* and *Stylotella aurantium* from the New Caledonia lagoon.

Stylissa flabelliformis (Hentschel): Nouméa, Baie de Ste Marie, 6 m (photo P. Laboute)

Ptilocaulis fusiformis Lévi, 1967

External Characters
Digitate or arborescent digitate, with cylindrical bifurcating branches tapering towards their ends, on a short basal stalk and broad basal holdfast. Surface is prominently conulose, with more or less evenly distributed conules, usually forming meandering ridges running longitudinally along branches. Conules are interconnected by a fleshy surface membrane, usually pierced by small inhalant pores (ostia) just visible between conules. Oscules are small, only rarely seen, located near the apex of branches. Texture is firm and flexible.

Dimensions
Digits 42-110 mm long, 23-55 mm long, up to 10 mm diameter, basal stalk 15-19 mm long, 7-10 mm diameter, basal holdfast 12-21 mm diameter; surface conules up to 5 mm high; oscules 1.5-2 mm diameter.

Colour
Pale orange, yellow-brown alive, pale orange-brown when preserved.

Skeletal Characters
Ectosomal skeleton is fleshy, membraneous, with sparse plumose brushes of long, sinuous spicules that barely protrude through the surface, and these are restricted mainly to the tips of conules. Ectosomal membrane is highly collagenous, more darkly pigmented than the choanosomal mesohyl, and it has small quantities of embedded detritus. Choanosomal skeleton is plumo-reticulate, with clearly differentiated axial and extra-axial regions. The axial skeleton is compressed, composed of a heavy spongin fibre forming a close-set reticulation, cored by plumose tracts of shorter anisoxeas and fewer sinuous strongyles. The extra-axial skeleton corresponds exactly with the distribution of surface conules. Extra-axial fibres are plumo-reticulate, running predominantly laterally through branches in cross-section, and these fibres are cored by multispicular plumose tracts of both sinuous strongyles and anisoxeas. Extra-axial skeletal columns are separated by large areas, cavernous areas (canals), noticeably more cavernous near the surface than in the axis, and columns are covered by an external layer of collagen stretched between surface conules. Megascleres consist of: two sizes of spicules, although these clearly intergrade in their size and morphology; strongyles long, thin, curved or sinuous, predominantly in extra-axial region of the choanosome and at the surface, with asymmetrical (styloid), or symmetrical rounded (strongylote) ends (414-900 µm x 2-6 µm); and anisoxeas shorter, slightly curved, thin, found predominantly in the axial skeleton although also dispersed near the surface, usually with symmetrical rounded or pointed, usually telescoped ends ('oxeas'), or less often 'styloid' with asymmetrical ends (points and evenly rounded bases) (196-350 µm x 2.5-11 µm). Microscleres are absent.

Ecology and Habitat
Growing on coral reef, 20-40 m depth, on hard substrate in areas of strong current.

Distribution
Known only from the southern New Caledonian lagoon.

Possible Confusions
Ptilocaulis epakros, *Aulospongus clathrioides* from New Caledonia lagoon.

Ptilocaulis fusiformis Lévi: Canal Woodin, 25-35 m (photo G. Bargibant)

Order
Axinellida

Family
Axinellidae

Ptilocaulis epakros Hooper and Lévi, 1993

Ptilocaulis epakros Hooper and Lévi (holotype): Canal Woodin, 40 m (photo P. Laboute)

External Characters
Arborescent, bifurcate branching, with thin, cylindrical branches covered with papillae, tapering towards pointed tips, and with a long, unornamented stalk and expanded basal holdfast. Surface is heavily papillose, composed of long, close-set, sharply pointed, soft papillae. The tips of the papillae are bifurcate and/or hispid, and the base of each papilla is interconnected to adjacent papilla by a membraneous ridge running longitudinally along branches and slightly elevated above the surface of the sponge. Oscules were not observed, but minute ostia are scattered between surface papillae.

Dimensions
Digits 200 mm long, 70 mm maximum lateral branch span, 27-60 mm long, 5-17 mm wide, basal stalk 75 mm long, 4 mm diameter, basal holdfast 13 mm diameter; surface papillae, 2-4 mm long, 0.5-1 mm diameter, up to 2 mm apart.

Colour
Pale yellow-brown alive, beige in ethanol.

Skeletal Characters
Ectosomal skeleton is fleshy, membraneous, without specialised spicules, with sparse detritus embedded in and on the surface, and a heavy collagenous, aspicular matrix lying between the surface papillae (= surface ridges) and on the sides of each papilla. The apex of each papilla has plumose brushes of choanosomal styles protruding slightly through the surface. Choanosomal skeleton is plumo-reticulate, with clearly differentiated axial and extra-axial regions. Axial skeleton is compressed, occupying only about one half of the branch diameter, and composed of heavy, bulbous, very short spongin fibres forming a close-set reticulation. These axial fibres are cored by tracts of thin spicules, occupying only a small proportion of fibre diameter. The extra-axial skeleton is extensive, including the area immediately surrounding the axis of branches, as well as the elongated, slender skeletal columns (= papillae). The extra-axial skeleton is composed of primary and secondary fibre systems, differentiated mainly by presence or absence of coring spicules. Both fibre systems are composed of heavy spongin fibres producing a relatively wide-meshed elongate reticulation. Ascending extra-axial fibres are cored by multispicular, plumose columns of choanosomal styles, with spicule tracts becoming heavier towards the surface and protruding through it. Transverse, connecting fibres are aspicular or have single long, thin strongyles inside. Megascleres include two categories of spicules clearly differentiated in morphology but not obviously localised to any particular region of the skeleton: sinuous strongyles, single, long, thin, found sparsely in transverse, connecting fibres (424-488 µm x 1.5-2 µm); styles or styloids, account for most spicules, short or long, slender, straight or slightly curved asymmetrically, evenly rounded or tapering mucronate bases, and hastate, fusiform or telescoped points (134-328 µm x 2.5-5 µm). Microscleres are absent.

Ecology and Habitat
Found in the inter-reef region, 40 m depth.

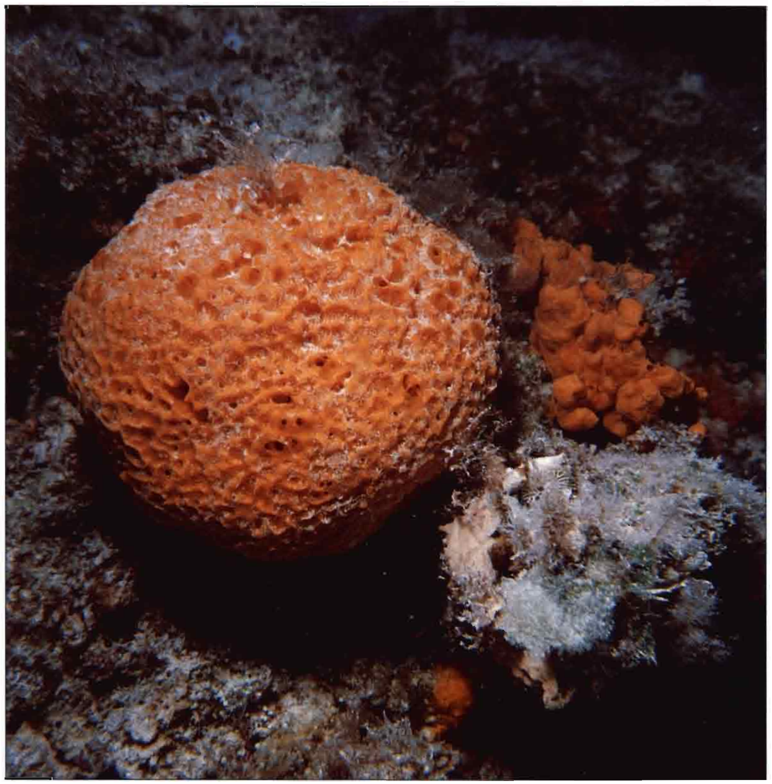
Distribution
Known only from the southern New Caledonian lagoon.

Possible Confusions
Ptilocaulis fusiformis and *Aulospongus clathrioides* from New Caledonia lagoon.

Order
Axinellida

Family
Axinellidae

Pseudaxinella debitusae Hooper and Lévi, 1993



Pseudaxinella debitusae Hooper and Lévi: Canal Woodin, 33 m (photo P. Laboute)

External Characters
Massive, spherical, or irregularly subspherical, cushion-shaped, loosely attached to large pieces of detritus (*e.g.* dead coral, mollusc valve), or occasionally rolling free on the substrate ('tumbleweed sponge'). Surface microconulose, with goose-flesh appearance, covered by small conules scattered over the entire surface, interconnected by a semi-translucent dermal membrane. Large oscules are scattered over the 'upper' surface, typically found in slight depressions on the surface but surrounded by a slightly raised membraneous lip. Texture is soft, compressible, relatively easy to tear.

Dimensions
Sponges 55-80 mm diameter, 32-40 mm maximum height from the substrate; surface conules 1-2 mm diameter, less than 0.5 mm high; oscules up to 10 mm diameter.

Colour
Orange to orange-yellow alive, beige or light brown when preserved.

Skeletal Characters
Ectosomal skeleton membraneous, fleshy, with darkly pigmented collagen, without specialised spicules although the tips of choanosomal spicules protruding from the surface in sparse plumose brushes. Choanosomal skeleton is plumo-reticulate, without axial compression or any noticeable difference between the axial and extra-axial regions. The spongin fibre skeleton is reticulate, with predominantly ascending primary fibres, interconnected by shorter thinner secondary fibres, producing oval meshes. The spicule skeleton is plumo-reticulate, vaguely subrenieroid, although the plumose component is emphasised over the reticulate component, with clearly differentiated thicker primary spicule tracts ascending to the surface, interconnected by thinner secondary transverse spicule tracts. Megascleres include: one category of spicules only, predominantly oxeas, rarer styles and strongyloxeas, long, slender, usually asymmetrically curved (but not rhabdose), sometimes straight, mostly sharply pointed, sometimes with telescoped and bifurcate points (223-503 µm x 2-15 µm). Microscleres are absent.

Ecology and Habitat
Found on subtidal fringing coral reefs, coral rubble and *Halimeda* soft bottom substrates, 5-35 m depth. On soft substrates it is usually unattached whereas on coral reefs it is attached to the substrate.

Distribution
Known only from the southern New Caledonian lagoon.

Possible Confusions
Other 'tumbleweed' sponges in the New Caledonia lagoon: *Reniochalina condylia*, *Rhaphoxya systremma*, *Higginsia massalis*, *H. tanekea*.

Rhaphoxya systremma Hooper and Lévi, 1993

Raphoxya systremma Hooper and Lévi (holotype): Nouméa, I. Maître, 22 m (photo P. Laboute)

External Characters

Spherical or subspherical, globular growth form, consisting of aggregated, globular lamellae, together producing a conglomerated honeycombed-like reticulation with numerous, oval, cell-like cavities and large canals excavating the entire sponge. Sponges are only loosely attached to pieces of coral rubble or shell fragments, or occasionally rolling free on the substrate. Surface is membraneous, gelatinous, irregularly convoluted, with prominent rounded papillae, which are most abundant on the apical surface of the sponge. The largest papillae located near the apex of the sponge surround one or more oscules, although these also occur in other places on the surface, such as on the ridges located between papillae. Texture is soft, compressible, difficult to tear.

Dimensions

Sponges 32-75 mm high, 28-60 mm diameter, surface papillae up to 3 mm high, 2 mm diameter; oscules 2-4 mm diameter.

Colour

Pale or dark orange-brown alive, beige to dark brown when preserved.

Skeletal Characters

Ectosome is fleshy, darkly pigmented, without spongin fibres or spicules but with a thick collagenous layer between the surface and the beginning of the choanosomal spongin fibre skeleton.
This collagenous layer is thicker in between surface ridges and papillae than on top of these structures.
In addition, sparse plumose brushes of choanosomal spicules may also protrude through the surface, especially on the tips of the papillae.
Sparse deposits of detritus are also dispersed over the surface and incorporated into the ectosomal collagenous layer.
Choanosomal skeleton is plumose, slightly plumo-reticulate, without axial compression or differentiation between the axial and extra-axial skeletons.
The skeleton consists mainly of diverging, meandering, sinuous spongin fibres and spicule tracts.
The spongin fibre system is composed of primary fibres, ascending to the surface, with fibres cored by thick tracts choanosomal megascleres, interconnected by shorter secondary, transverse, spongin fibres usually without spicules.
Generally, the reticulate, connecting secondary spicule tracts are greatly reduced in proportion to the primary plumose ascending skeleton.
Fibre reticulation is more cavernous in the peripheral region than in the axis.
Megascleres consist of: only one category of choanosomal spicule varying from strongyles to oxeas, symmetrical, evenly rounded, or sharply pointed, usually telescoped ends, majority strongylote, sinuous, very slender (201-382 µm x 2-5 µm).
Microscleres are absent.

Ecology and Habitat

Found on coral rubble in the inter-reef region, on soft bottoms and *Halimeda* beds, 18-30 m depth.

Distribution

Known only from the New Caledonian lagoon and the northern Great Barrier Reef.

Possible Confusions

Other 'tumbleweed' sponges in the New Caledonia lagoon: *Reniochalina condylia*, *Pseudaxinella debitusae*, *Higginsia massalis*, *H. tanekea*.

Family Desmoxyidae

Myrmekioderma granulata (Esper, 1830)

Myrmekioderma granulata (Esper) I. Chesterfield, 28 m (photo J.L. Menou)

External Characters
Massive, sub-cylindrical, vaguely elongate, rounded, bulbous growth form, partially burrowing in soft sediments or excavating hard sediments. Surface is pineapple-like, convoluted, crustose, with large conules or rounded or polygonal plates slightly raised above the surface and separated by shallow but distinct grooves. The apex of the sponge has irregularly meandering or discrete excavated channels (deep sieve plates or porocalyces) containing large oscules especially near the apex of the sponge, and each oscule is surrounded by a raised membraneous lip. The exterior surface of the sponge is invariably silt-covered, and the interior is soft, mango-like. Texture is harsh, firm, spiculose.

Dimensions
Grows up to 350-850 mm long, 200-600 mm wide, 160-400 mm thick, exceptionally larger than 1 metre; surface polygonal plates 18-35 mm diameter; porocalyces up to 60 mm deep, oscules up to 50 mm diameter.

Colour
Light orange-brown to bright orange exterior alive, often with silt-covered 'dusty' surface, orange-brown exterior and beige interior when preserved.

Skeletal Characters
Ectosomal skeleton consists of a distinct, thick, detachable crust of smaller oxeas, with the innermost layer nearly horizontal and the outermost layer nearly perpendicular to the surface, together forming a continuous palisade of spicules. Ectosomal crust is supported below by long, pillar-like tracts of large oxeas, usually widely spaced, producing a cavernous subdermal region containing sparse collagen, collagenous fibrils, bundles of raphides and sparsely scattered smaller oxeas. Choanosomal skeleton is cavernous, reticulate, with differentiated primary and secondary spongin fibres and spicule tracts. Primary fibres are ascending, widely spaced, cored by thick tracts of larger oxeas, interconnected by secondary transverse fibres containing fewer coring oxeas. Spongin fibre meshes are evenly rectangular, triangular or irregularly oval. Megascleres consist of: two categories of oxeas of similar morphology, clearly distinguished only by their size and distribution within the skeleton; both are entirely smooth or the larger ones may have sparse spines over the entire surface, straight or slightly centrally curved, rarely asymmetrical, tapering to sharp points (smaller oxeas - 319-708 μm x 4-12 μm; larger oxeas - 644-782 μm x 13-22 μm). Microscleres include raphides mostly in bundles (trichodragmata), hair-like (bundles 140 x 15 μm).

Ecology and Habitat
Common habitats range from heavily sedimented fringing coral platforms and coral pools, in sand, silt, beach rock and dead coral rubble substrates, to pristine coral reef slopes, often in spurs and grooves; found from sublittoral depths to approximately 20 m depth. In the southern lagoon of New Caledonia this species is uncommon, whereas in other areas of the Indo-west Pacific it is sometimes a prevalent member of the coral reef fauna.

Distribution
Widely distributed throughout the Indo-west Pacific: Madagascar, Aldabra, Seychelles, Gulf of Manaar, Indonesia, northwest Australia, central western Pacific (Ponape, Truk, Ebon Atoll, Palau, Ifaluk) and southwest Pacific (Chesterfield Islands and southern lagoon of New Caledonia).

Order
Axinellida

Family
Desmoxyidae

Higginsia tanekea
Hooper and Lévi, 1993

Higginsia tanekea Hooper and Lévi (holotype): N. Lagoon: 27 m (photo P. Laboute)

External Characters
Massive, irregularly bulbous, subspherical, subcylindrical sponge, without stalk or other processes, loosely attached to the substrate, with embedded detritus on 'ventral surface', or unattached and rolling free on the substrate. Surface is slightly bulbous, with low, rounded ridges, distinct skin-like, detachable dermis and irregularly dispersed microconules. Conules conical or elongate, irregular in shape, interconnected by shallow canals and grooves. Surface is smooth. Texture is soft, compressible, relatively fragile, easily torn. Internal consistency porous, cavernous. Oscules not prominent.

Dimensions
210 mm long, 80 mm wide, 55 mm thick; surface conules up to 2 mm diameter, not raised more than 2 mm from the surface.

Colour
Pale orange alive, beige when preserved.

Skeletal Characters
Ectosomal skeleton consists of a collagenous darkly pigmented layer with sparsely dispersed thin ectosomal oxeas. These ectosomal oxeas form paratangential tracts on the surface and are interdispersed with a crust of acanthoxeas mostly erect on surface. The acanthoxeas are mostly confined to peripheral skeleton. Choanosomal megascleres do not protrude beyond the surface. Subdermal region is cavernous with sparse tracts of choanosomal megascleres supporting the dermal layer. Choanosomal skeleton is halichondroid-reticulate, with vaguely ascending spongin fibres and skeletal tracts forming a wide-meshed reticulation. Spongin fibres are divided into primary ascending fibres, cored by thick tracts of larger oxeas, interconnected by secondary transverse fibres, with fewer coring large oxeas. The spongin fibre and spicule reticulation form cavernous oval or elongate meshes, wider in the peripheral skeleton than deeper in the choanosome. Megascleres include choanosomal oxeas occasionally styloid, long, slender, symmetrically curved, sharply pointed (628-993 µm x 4-14 µm) ectosomal oxeas, same morphology, shorter, thinner (392-622 µm x 3-7 µm). Microscleres include acanthoxeas mostly long, slender, with slight angular central curvature, occasionally straight or with acute bend, sharply pointed, with evenly dispersed, large spines (71-143 µm x 1.5-4.5 µm).

Ecology and Habitat
Found in soft sediments including *Halimeda* beds in the inter-reef region of the lagoon, 27 m depth. This species rolls around on the soft substrate of the lagoon floor.

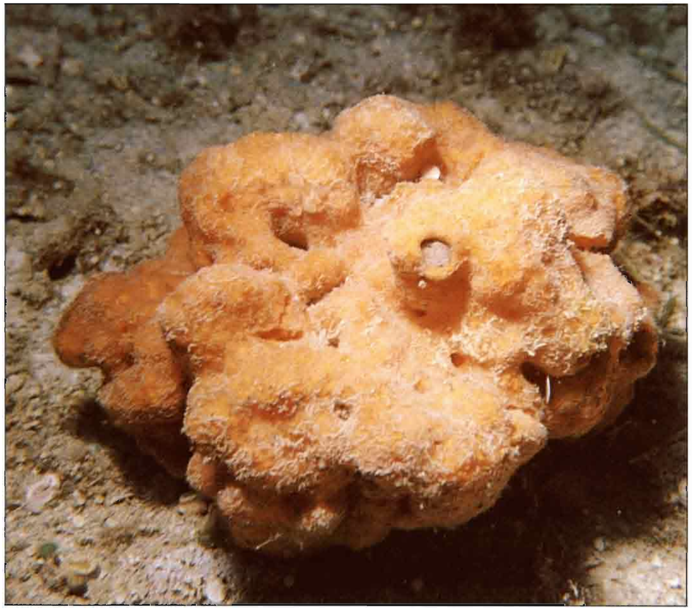
Distribution
Known only from the northwest of the New Caledonia lagoon.

Possible Confusions
Other 'tumbleweed' sponges from the New Caledonia lagoon: *Reniochalina condylia*, *Pseudaxinella debitusae*, *Higginsia massalis*, *Rhaphoxya systremma*.

Order
Axinellida

Family
Desmoxyidae

Higginsia massalis Carter, 1885



Higginsia massalis Carter: Nouméa: S.E. I. Maître, 24 m (photo P. Laboute)

External Characters

Massive, elongate, irregularly subspherical, without stalk or other processes, attached directly but loosely to the substrate with embedded detritus in the 'ventral surface', or rolling freely on the substrate ('tumbleweed' sponge). Surface is uneven, irregular, lumpy, with a distinct skin-like detachable dermis, covered with irregularly shaped microconules. Conules form meandering ridges and valleys. Large oscules slightly raised above the surface and each with a membraneous lip, and smaller ostia visible between ridges. Texture is soft, compressible, easily torn. Internal consistency is compact, only slightly cavernous, spiculose, friable.

Dimensions

73 mm long, 46 mm diameter; surface microconules up to 3 mm diameter, raised no more than 2 mm from the surface; oscules 3-6 mm diameter.

Colour

Pale orange alive, grey-brown when preserved.

Skeletal Characters

Ectosomal skeleton is minutely hispid due to a sparse layer of erect, long extra-axial styles protruding through the surface. Ectosome is highly collagenous, darkly pigmented, and also contains sparse, paratangential tracts of smaller, thinner oxeas and a thick, paratangential crust of acanthoxeas. These acanthoxeas are mainly confined to the dermal skeleton. Subdermal region slightly cavernous, with elongate canals. Choanosomal skeleton is plumo-reticulate, verging on disorganised-halichondroid. The axis lacks any well developed compression, and there is only poorly differentiated axial and extra-axial regions. The extra-axial spicule tracts are only slightly more plumose than the reticulate choanosomal spicule tracts, and the extra-axial region also contains long extra-axial styles, usually standing perpendicular to the surface. The choanosomal skeleton consists of thicker primary ascending spicule tracts, interconnected by shorter, thinner, secondary transverse spicule tracts, both cored by long choanosomal oxeas with fewer thinner 'ectosomal' oxeas also interdispersed. The spongin fibre system is poorly developed, and spicules appear to be cemented together primarily by granular collagen. Megascleres consist of: choanosomal oxeas, robust, long, straight or slightly curved, usually symmetrical, sharp pointed or rarely telescoped points (841-936 μm x 12-18 μm); extra-axial styles, usually very long, slender, slightly curved, sometimes straight or sinuous, evenly rounded bases, sharply pointed or slightly telescoped points (632-2121 μm x 6-10 μm); ectosomal oxeas long, slender, usually slightly curved, sometimes greatly curved or sinuous, sharply pointed (512-843 μm x 2-8 μm). Microscleres include acanthoxeas long, slender, slightly angularly curved, sharply pointed, evenly covered with small spines, spines larger at centre of spicule than on ends of spicule (74-137 μm x 2-4.5 μm).

Ecology and Habitat

Found in the inter-reef region, on soft substrates including sand and *Halimeda* beds, and coral rubble, 10-25 m depth. This species possibly rolls around on the soft substrate of the lagoon floor, with only a tenuous attachment to small particles in the substrate.

Distribution

Southern Australia and southern New Caledonia lagoon.

Possible Confusions

Other 'tumbleweed' sponges from the New Caledonia lagoon: *Reniochalina condylia*, *Pseudaxinella debitusae*, *Higginsia tanekea*, *Rhaphoxya systremma*.

Order
Poecilosclerida

Family
Mycalidae

Mycale (Zygomycale) parishi
(Bowerbank, 1877)

This order contains more living species than all other Recent Porifera. Up to 25 families have been recognised, most being typical in having chelae microscleres which characterise the group, but several atypical families are also now included even though they lack chelae. Sponges of this order have monactinal, diactinal or both sorts of megascleres, usually associated with well developed spongin fibres. Structural megascleres are frequently localised to distinct regions within the sponge. Microscleres are very diverse and typically include meniscoid forms such as chelae and sigmas, and other diverse forms (toxas, raphides, microxeas). These small spicules do not generally take part in the construction of the principal skeleton, but are dispersed throughout all the regions of the sponge or sometimes concentrated in particular places (such as near the surface or around exhalant canals).

Poecilosclerids sponges have no characteristic forms, although encrusting, branching and digitate shapes are common, and many species are brightly coloured. Where known they are viviparous, incubating their larvae within their tissues, which eventually develop into a short-lived, free-swimming, uniformly ciliated parenchymella with bare posterior poles. Poecilosclerids are found in all reef habitats and in other parts of the coast such as ports and harbours, and they range in distribution from the intertidal zone to deeper waters on the outer-reef edge.

Foremost amongst these spicules are chelae, found in *Mycale, Phorbas, Damiriana, Crella, Clathria*. Also present in some groups are toxas, in the form of a bow or accent circonflexe, found in *Clathria, Mycale, Acarnus* and others, and sigmas with c-and s- shapes, seen in *Neofibularia, Mycale*. These microscleres are fairly consistent within each species, are largely characteristic of families, and are known to have an ancient origin which provides interesting clues in aiding a reconstruction of the phylogeny of the Poecilosclerida.

Order
Poecilosclerida

Family
Mycalidae

Mycale (Zygomycale) parishi (Bowerbank, 1877)

External Characters
An unevenly branching sponge which presents an overall shaggy appearance. The basal portion of main branches is irregularly shaped and encrusting in nature, with many bulges and creases. Branches end in tapered fingers projecting vertically, and branching commonly occurs in all planes. Distal portions of most branches have many small projections, hinting of further branching.
Oscules 1 mm diameter, irregularly positioned on the sides of the main branches. They appear as clusters, slightly raised above the surface of the sponge.
A dermal membrane is present and gives the sponge surface a papery appearance. The sponge is otherwise tough. The surface is very soft and the sponge is compressible in life, though firm when preserved.

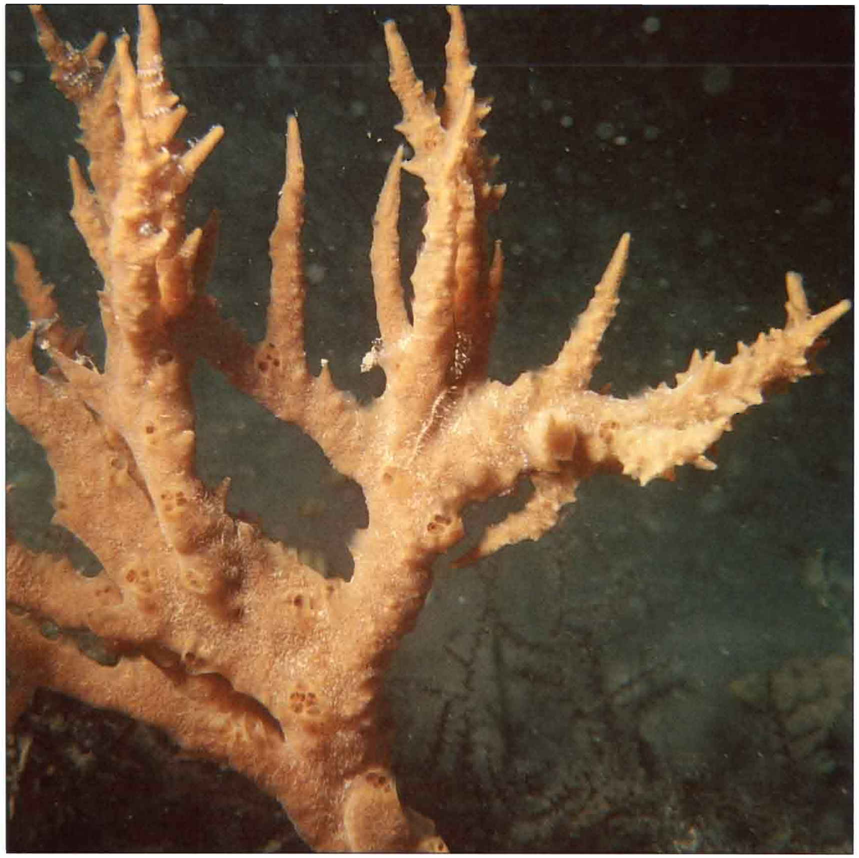
Dimensions
This sponge commonly stands to 400 mm high, with branches approximately 20 mm thick at their midpoint. The encrusting base can be up to 150 mm in diameter and varies according to the substrate.

Colour
The sponge is commonly light brown in colour, but can range to purple. Light brown internally. Fawn in ethanol.

Skeletal Characters
Megascleres are styles, which may be slightly subtylote (259-296 µm x 5-6 µm). Microscleres are 'c' and 's'-shaped sigmas of two sizes (20 µm x 1 µm and 75 µm x 5 µm) and toxas of different sizes (100 µm and 5 µm). Anisochelae of two sizes (5 µm and 75 µm) and palmate isochelae (10 µm) are present. Reticulating bundles of megascleres lace the surface with abundant interstitial megascleres, as well as toxas and sigmas. Spicular tracts form an anastomosing structure, orientated perpendicularly to the surface.

Ecology and Habitat
Grows in flat, muddy lagoon and harbour habitats where waters are turbid. It is often associated with antipatharian coral communities. Depth range between 10-15 m.

Distribution
New Caledonia, Indian Ocean, Hawai Island.



Mycale (Zygomycale) parishi (Bowerbank): Nouméa, N. de Nouville, 8-12 m (photo P. Laboute)

Order
Poecilosclerida

Family Desmacellidae

Neofibularia hartmani Hooper and Lévi, 1993

Neofibularia hartmani Hooper and Lévi: Nouméa, I. Maître, reef flat (photo P. Laboute)

Neofibularia hartmani Hooper and Lévi: Passe de Boulari, 30 m (photo P. Laboute)

External Characters
Thickly lobate, massive, bulbous-encrusting sponge, with lobes/bulbs fused to adjacent bulbs. The species has well developed surface sculpturing of close-set, interconnected, small conules, forming web-like striations on the surface. Large oscules, situated on the apex of bulbs, have slightly raised lips which contract to a smaller diameter when these animals are removed from water. This sponge produces abundant clear mucus. It is TOXIC and it is advisable to wear protective gloves when handling it.

Dimensions
Individual lobate-bulbs measure between 20-55 mm diameter, about 40 mm maximum high, with fused adjacent bulbs together spreading about 120 mm across the substrate. Oscules measure between 2-8 mm diameter.

Colour
Pale yellow-brown or khaki-brown alive, often partially silt-covered, dark brown in ethanol.

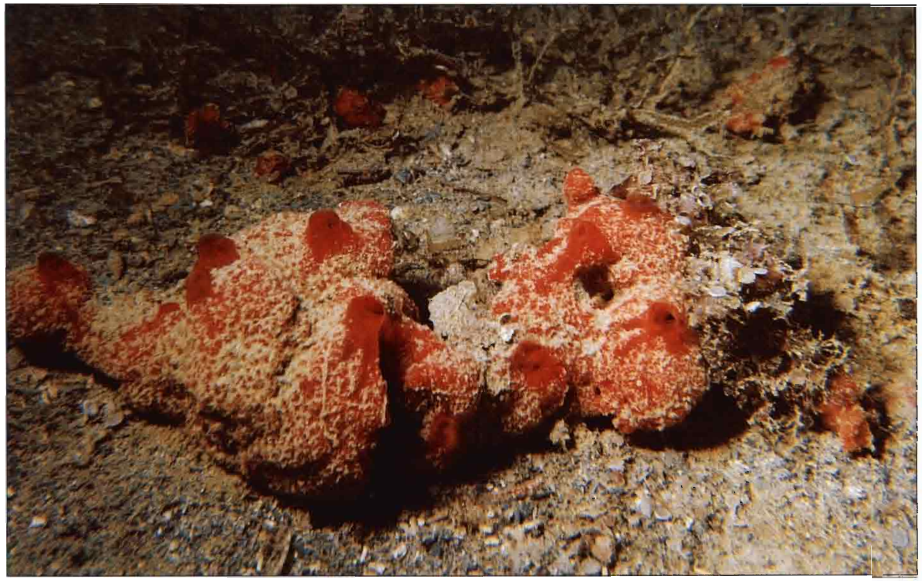
Skeletal Characters
Ectosome is membraneous, lightly arenaceous, with abundant heavily pigmented spongin. There is no specialised spicule skeleton, but irregular plumose tufts of choanosomal strongyles may protrude through the surface, or lie paratangentially or erect on the surface, more or less corresponding to position of surface conules. The choanosomal skeleton is reticulate, with differentiated primary (multispicular) and secondary (uni- and paucispicular) spongin fibres. Primary fibres are usually fully cored by principal strongyles; secondary fibres have fewer principal strongyles. The fibre reticulation produces elongate, oblong or oval meshes, with moderate quantities of collagen and foreign particles, and abundant microscleres in between. Principal spicules are strongyles, long, slightly curved, symmetrical or asymmetrical (size range 218-280 µm x 3-9 µm). Microscleres consist of: microxeas clearly divided into two size categories, both relatively long, thick, widest in the middle (size range of longer 69-94 µm x 0.8-2.0 µm, size range of smaller 28-51 µm x 0.5-1.2 µm); raphides, abundant, long, straight, hair-like (size range 79-115 µm x 0.2-0.8 µm); sigmas incompletely divided into two sizes, both with c- and s-shapes, relatively thick, evenly curved at the centre (size range of larger 50-85 µm x 1.8-3.5 µm, size range of smaller 13-36 µm x 0.8-1.5 µm).

Ecology and Habitat
Found on the reef flat and shallow subtidal region, on consolidated dead coral pavement, usually covered in fine silt, 1-15 m depth.

Distribution
Southern New Caledonian lagoon.

Family
Iophonidae

Acarnus caledoniensis Hooper and Lévi, 1993



Acarnus caledoniensis Hooper and Lévi (holotype): I. Maître, 23 m (photo P. Laboute)

External Characters
Small spherical or subspherical sponges, often covered with small conules, evenly scattered over the surface, and silt. This species is not firmly attached to the substrate and it appears to be able to roll around the seabed following the water movement. Oscules are large and usually only seen on the upper surface, and each oscule is surrounded by tall membraneous lip. Both the oscular lips and microconules collapse to a certain extent when the sponge is taken into the air, and these may not be seen in preserved specimens.

Dimensions
Sponges may grow up to 90 mm diameter, 45 mm high, with surface microconules about 3 mm diameter, oscules between 8-15 mm diameter, and oscular lips raised 8-18 mm above the surface.

Colour
Red-orange body, darker red 'fistules', body silt-covered when alive, light brown in ethanol.

Skeletal Characters
Ectosomal skeleton with paratangential layer of tylotes, although many also protrude through the surface. Choanosomal skeleton is composed of plumose skeletal tracts, running side by side ascending to the surface, but they appear to be slightly reticulate, or even vaguely halichondroid in arrangement, due to the abundance of echinating spicules (two sizes of both acanthostyles and cladotylotes) interconnecting adjacent skeletal columns. Spicules are not enclosed within spongin fibres, but aggregated by more granular collagen. Spicule tracts are cored by compact lines of principal spicules (subtylostyles with microspined bases), which also protrude through the tracts in plumose array or at more acute angles. Numerous microscleres are also dispersed between spicule tracts, with radial columns of toxas particularly abundant. Megascleres consist of: principal subtylostyles slightly curved, sharply pointed, with swollen microspined bases (size range 266-423 µm x 4-11 µm); ectosomal tylotes [straight, basally microspined (size range 299-383 µm x 3-7 µm)]; echinating cladotylotes of two sizes, both slightly curved, the larger with recurved spines concentrated in middle of shaft, the smaller with granular spines, both with the shaft thicker at the base than apex, main cladome at apex with four sharply pointed long clads, minor cladome at base with four small clads (size range of larger 122-206 µm x 1.5-4 µm, width at base 2.5-6 µm; size range of smaller 68-152 µm x 1.5-3 µm, width at base 2-4 µm); echinating acanthostyles of two sizes, both cylindrical, straight, with fewer spines in centre of shaft than at ends (size range of larger 89-138 µm x 2-4 µm; size range smaller 69-84 µm x 1.5-4 µm). Microscleres consist of: two varieties of toxas, the smaller very thin, with angular central curvature and recurved arms, the larger very long, slender, with straight or slightly reflexed arms, and angular central curvature (size range of smaller 48-141 µm x 0.5-1.4 µm, size range of larger 119-416 µm x 0.4-3 µm); palmate isochelae size range 14-22 µm long.

Ecology and Habitat
Common species, dispersed in *Halimeda* beds, on soft bottom with sand and coral rubble substrates, rolling across the seabed or only loosely attached to other benthos. Depth range between 5-25 m.

Distribution
Southern lagoon of New Caledonia only.

Possible Confusions
Other 'tumbleweed' sponges in the New Caledonia lagoon: *Rhaphoxya systremma*, *Reniochalina condylia*, *Pseudaxinella debitusae*, *Higginsia tanekea*, *Higginsia massalis*, and spherical morphs of *Grayella papillosa*.

Order
Poecilosclerida

Family Coelosphaeridae

Waldoschmittia schmidti (Ridley, 1884)

External Characters
Massive lobate sponge, appears minutely conulose over the entire surface as the outer epithelial membrane is translucent and drapes over skeletal projections. Oscules are of variable diameter depending on the pumping rate of the sponge, but commonly up to 10 mm diameter. Oscules are approximately 5-10 mm in diameter and are apically positioned on each lobe, surrounded by a smooth, thin membrane, forming a collar of 2-3 mm width. Internal exhalent canal divisions may be easily seen inside oscules. Surface texture is smooth to slightly fibrous and the sponge is compressible and easily torn. The sponge when growing on sediment flats is not well attached to the substratum, and is usually anchored by attaching to small coral and shell fragments.

Dimensions
Sponges commonly grow to 150 mm long x 100 mm wide and 70-100 mm high. Individual lobes are approximately 50 mm in diameter and do not extend more than 30 mm above the general sponge base. Within sediment flat habitats small-rounded individuals approximately 5 cm spherical diameter, are commonly seen and appear to be highly mobile in currents.

Colour
Colour in this species is highly variable, ranging from grey-blue, through fawn to burnt orange. On lower basal surfaces and in shaded conditions colour tends to pale grey. The sponge is uniformly fawn in colour internally. In ethanol it is uniformly dull yellow.

Skeletal Characters
Megascleres are oxeas with smooth points, although some are slightly stepped (size range 185-196 µm x 4 µm) and tylotes (240 µm x 2-4 µm). Microscleres are unguiferous isochelae of variable size (20-21 µm) plus 'c' and 's'-shaped sigmas (18 µm long). The skeleton consists of a plumo-reticulate array of megasclere tracts, with abundant interstitial spiculation. A spicular lattice-work forms a delicate, slightly detachable dermal layer. Rising spicular plumes from the choanosome flare near the surface, such that spicules lie horizontal to the dermal plane.

Ecology and Habitat
The sponge is associated with coral rubble and *Halimeda* beds, and occurs where fine sediments accumulate on flat areas of reef in regions of reduced current. It is a common species within its range. Depth range between 15-35 m. Non-attached forms are common.

Distribution
New Caledonia particularly common within the lagoon south of Noumea. Red Sea, Indian Ocean.

Waldoschmittia schmidti (Ridley): Banc Gail, 27 m (photo P. Laboute)

Order
Poecilosclerida

Family Crellidae

Crella spinulata (Hentschel, 1911)

External Characters
Groups of solitary, conical or cylindrical digits, erect on the substrate, with a common basal attachment on or below the substratum surface. Digits are evenly cylindrical or slightly flattened, occasionally bulbous-encrusting in sand sediments. The surface is slightly conulose, granular, with a visible dermal membrane and a relatively even texture. Oscules are prominent in live material, evenly dispersed over the sides and apex of digits, slightly raised above the surface with membraneous lips.

Dimensions
Digits are up to 60 mm high, 20 mm basal diameter, and 9 mm diameter at apex. Oscules are about 1-2 mm diameter, standing 2-3 mm above the surface; areolate pores are not present (cf. *Crella papillosa*).

Colour
Red-orange to vivid-red alive, orange-brown in ethanol.

Skeletal Characters
The ectosome is a thick crust of ectosomal acanthoxeas lying tangential to the surface, with plumose brushes of smooth principal oxeas (from the major choanosomal spicule tracts) protruding slightly and standing perpendicular to the surface crust. The choanosomal skeleton is composed of two distinct structures. The main skeleton is a meandering reticulation of thick, well formed spongin fibres, fully cored by multispicular tracts of smooth principal oxeas (which eventually protrude through the surface). The secondary skeleton is renieroid, more or less regularly reticulate, overlaying the primary reticulate fibre skeleton, and each element of the secondary renieroid skeleton is composed of two or more acanthoxeas joined at their nodes by collagenous spongin. The secondary skeleton ceases just below the surface crust whereas the primary skeleton continues through it. Megascleres are principal oxeas [entirely smooth, long, thin, slightly curved, usually symmetrical, occasionally modified to styloids, usually with hastate points (size range 256-331 μm x 1.8-4.0 μm); ectosomal and accessory (choanosomal) acanthoxeas identical in morphology and size, long, thin, symmetrically curved, with small granular spines evenly dispersed over entire spicule, with sharp fusiform points (size range 148-157 μm x 1.5-3.0 μm). Microscleres are arcuate isochelae including rudimentary, poorly silicified examples (size range 18-22 μm long)].

Ecology and Habitat
Partially burrowing into soft sediments (sand, gravel, shell-grit, coral rubble), or bioeroding dead coral substrates, rarely found on live coral substrate. Known depth range is 3-55 m.

Distribution
Tropical Australasia: known from Shark Bay, Houtman-Abrolhos Islands and Northwest Shelf, Western Australia; Timor Sea and Darwin region, Northern Territory; Penguin Channel, Snake Reef, Stanley Reef, Howick Islands and Whitsunday Islands, Great Barrier Reef, Queensland, and southern lagoon of New Caledonia.

Possible Confusions
Similar in colouration to *Crella papillata* and several species of *Clathria* from the New Caledonia lagoon.

Crella spinulata (Hentschel): Canal Woodin, 33 m (photo P. Laboute)

Order
Poecilosclerida

Family
Crellidae

Crella papillata (Lévi, 1958)

Crella papillata (Lévi): Île Ouen, récif U, 10 m
(photo P. Laboute)

External Characters
Thickly encrusting to massive sponge, with many mound-like projections. Oscules are haphazardly positioned and are up to 3 mm in diameter. The surface is distinctively covered in small 1-2 mm diameter papillae-like projections, which group inhalent pores. The surface is soft to touch and readily detachable.

Dimensions
The sponge is variable in shape, commonly up to 150 mm long, but can grow to 200 mm.
It is 100-150 mm wide and 100 mm high.

Colour
In life, bright red throughout. Crimson in ethanol.

Skeletal Characters
Megascleres are long styles (270-290 µm x 1-5 µm) and finely spined acanthoxeas (100 µm x 1-3 µm). No microscleres. Spicules are grouped into plumose tracts perpendicular to the surface. Interstitial spicules are abundant. Surface spiculation is distinct, particularly in the region of papillae, as acanthooxeas form continuous palisades, orientated tangentially to the surface plane and radiating around papillae.

Ecology and Habitat
This sponge is found in shallow-reef flat habitat, 8-25 m deep, within the lagoon. Often associated with algal communities.

Distribution
Southwest New Caledonian lagoon. Red Sea.

Family Phoriospongiidae

Strongylodesma sp.

External Characters
Massive sponge with distinctive surface oscule and pore area structure. Oscules are large, up to 10 mm diameter, and have a smooth, thin flange. Internal canal divisions are readily seen within. Pores are grouped on raised mushroom-shaped projections, 5 mm diameter, and cover the entire surface on most specimens. Other individuals have reduced 'pore' regions with the remaining sponge surface smooth. The texture is smooth, slightly fibrous to touch and the sponge is compressible. Can be torn. Free-living specimens, as spherical fragments, have been seen.

Dimensions
Sponges normally 80-100 mm diameter, 60 mm high.

Colour
In life, light brown internally and externally. In ethanol very dark brown.

Skeletal Characters
Megascleres are strongyles of one size (190 µm x 5 µm). They have a distinctive uneven axial canal running their length. Microscleres are absent. Densely packed pigmented cells make it difficult to see the skeletal structure. Megascleres are densely incorporated into an irregular fasciculation of tracts, which appear to be orientated tangentially to the surface.

Ecology and Habitat
Associated with lagoonal sand flats and *Halimeda* beds. Free-living forms, presumed to be fragments, are common and observed in various stages of attaching to shell and coral fragments. Depth range is 10-30 m.

Distribution
The sponge is common in lagoon sand flat habitats where sediments are relatively free of mud.

Strongylodesma sp.: Nouméa, I. Croissant, 10 m. Seagrass bed (photo P. Laboute)

Order
Poecilosclerida

Family
Anchinoidae

Hamigera strongylata
(Burton, 1934)

External Characters
A thickly encrusting sponge with uneven bulges and creases. The surface appears slightly translucent and is covered in distinctive crater-like marks, which act as inhalent pores, 2-5 mm diameter. Oscules are less abundant, slightly raised (1 mm) above the surface and rimmed by a thin membrane. The surface is smooth to touch and very soft. The sponge is slightly compressible and is easily torn.

Dimensions
Up to 100 mm in diameter and 10-20 mm thick when 'inflated'.

Colour
In life the sponge is yellow, externally and internally. In ethanol, dark brown.

Skeletal Characters
Megascleres are tylotes (222 µm x 5 µm). Microscleres are 'c'-shaped sigmas (37 µm) and isochelae. Megasclere tracts rise from the base of the sponge, perpendicular to the surface. The ectosome is distinct as spicules spread tangentially over the surface sometimes forming radiating arrays around pore areas.

Ecology and Habitat
A rare species found on steep slopes in light to moderate currents. The specimen examined was collected from the shipwreck of the *Snark*. This species appears to favour shaded conditions with little sediment. Depth range 5-15 m. Canal Woodin.

Distribution
New Caledonia: Great Barrier Reef.

Hamigera strongylata (Burton): Chenal des 5 milles, 5 m (photo P. Laboute)

Clathria (Clathriopsamma) rugosa Hooper and Lévi, 1993

Clathria (Clathriopsamma) rugosa Hooper and Lévi: S. Lagoon, I. Kie, 20 m (photo P. Laboute)

Clathria (Clathriopsamma) rugosa Hooper and Lévi: Banc Gail, 31 m (photo P. Laboute)

Clathria (Clathriopsamma) rugosa Hooper and Lévi: Baie de St Vincent, near la Passe (photo P. Laboute)

External Characters
Flabellate, palmate-digitate or digitate sponges, occasionally simply subspherical, massive, varying considerably in size and development of the digitate margins. The typical growth form is hand-shaped, consisting of several cylindrical digits arising from the margins of a fan, which has a short cylindrical stalk often attached to coral rubble or dead molluscs. The surface ornamentation varies (three varieties): the typical form is optically smooth, even and membraneous when alive, with a few microconules along the margins of digits. When taken out of water the ectosomal membrane is destroyed, and the surface beneath is very porous. Small oscules are mainly on the margins, less abundant on the lateral surface of fans and digits, typically with a membraneous lip slightly raised above the surface of the sponge. No subdermal sculpturing is present around oscules. Another variety exists which is similar to typical forms but has enlarged oscules, each with star-shaped canals running under the surface (astrorhizae). A third variety, associated with subspherical, massive specimens, has oscules raised above the surface on short stalks (fistules).

Dimensions
Individual digits 15-140 mm long, combining to produce more or less fan-shaped growth forms 70-340 mm long, 45-140 mm maximum width, 10-20 mm thickness, generally with short stalks 30-50 mm long. Oscules 2-3 mm diameter, fistules, if present up to 12 mm long, 4 mm diameter.

Colour
Bright red-orange alive, light grey-brown preserved.

Skeletal Characters
Ectosomal skeleton with brushes of auxiliary subtylostyles forming irregular paratangential brushes on the surface, and also with a lightly arenaceous cover. Choanosomal skeleton reticulate, with heavy spongin fibres, relatively widely spaced, divisible into primary and secondary components. Primary fibres sparsely cored by tracts of principal styles, usually ascending towards the surface but not protruding through it, heavily echinated by acanthostyles, also containing sand grains. Secondary fibres usually uncored, without detritus, but heavily echinated by acanthostyles. Megascleres consist of principal styles short, straight, with slightly subtylote bases, rounded or abruptly pointed tips, usually completely smooth, occasionally with sparse spines over shaft and both ends (size range 134-159 µm x 4.5-8 µm); auxiliary styles or styloids subdermal, with some diactinal modifications, long, straight with slightly subtylote microspined bases, rounded microspined points, and completely smooth shaft (size range 162-206 µm x 2-4.5 µm); echinating acanthostyles short, cylindrical, slightly subtylote bases, rounded, slightly swollen tips, evenly spined; spines small, granular (size range 58-91 µm x 4-7 µm). Microscleres include: palmate isochelae (size range 12-17 µm); toxas, slightly curved at centre, recurved and sharply pointed at tips (size range 24-122 µm x 0.8-3 µm).

Ecology and Habitat
Living on dead coral, coral rubble, *Halimeda* beds and sand substrates; depth range between 3-38 m.

Distribution
Southern lagoon of New Caledonia.

Possible Confusions
Clathria flabellifera in the New Caledonia lagoon, and *Clathria australiensis* widespread in Australasia.

Order Poecilosclerida

Family Microcionidae

Clathria (Clathriopsamma) litos Hooper and Lévi, 1993

Clathria (Clathriopsamma) litos Hooper and Lévi: I. Maître, 25 m (photo G. Bargibant)

Clathria (Clathriopsamma) litos Hooper and Lévi (holotype): Nouméa, Baie des Citrons, 15 m (photo P. Laboute)

External Characters
Clumps of branching, cylindrical digits, each digit at least partially fused to adjacent branches, attached to a common base, forming a large branching, non-anastomosing growth form. Digits more or less regularly cylindrical, usually divided at least once, and often expanded and with an oscule at the end of each branch. Surface is porous, both when alive and when preserved. When alive there are wide fibre meshes lying on the surface with a thin membrane stretched over the fibres, but this usually breaks off when preserved, leaving a honeycombed appearance. Each large oscule is surrounded by a membraneous lip, and also has a single groove (drainage canal) running down branches. In life this drainage canal is covered by a membrane, but this disappears after preservation, leaving a large furrow on the lateral side of each digit. Surface is shaggy, microconulose, with fibre endings protruding through the ectosomal membrane. The texture is very soft, fragile, insubstantial, easily torn, and slightly sandy to touch.

Dimensions
Individual digits 25-65 mm long, 8-16 mm diameter, forming clumps 240 mm wide, 115 mm maximum height, 90 mm maximum thickness; oscules 6-13 mm diameter, drainage canals up to 4 mm wide, 5 mm deep.

Colour
Pale orange-brown alive, beige when preserved.

Skeletal Characters
Ectosomal skeleton is membraneous, without spicules, with the points of spongin fibres protruding from the surface for a short distance, and also with moderate quantities of detritus, mostly sand grains, scattered on both the exterior and interior of the surface spongin fibres. Choanosomal skeleton has irregularly reticulate structure. There is no structural spicule skeleton, but the spongin fibre system is well developed, with differentiated primary and secondary fibres. All fibres are lightly laminated but without central pith, and with sparse deposits of detritus also incorporated into some primary fibres, whereas the secondary fibres are completely clear. Fibre meshes are cavernous, oval or elongate, and light brown collagen is dispersed between the fibres containing sparse microscleres and abundant detritus (sand and foreign spicules). Megascleres are absent. Microscleres include: arcuate isochelae, uncommon, large, thick, with well developed alae (size range 16-24 µm); toxas, rare, long, thick, slender, with generous central curvature, with long straight (unreflexed arms) (size range 114-196 µm x 1.5-2.5 µm).

Ecology and Habitat
Living on coral rubble and soft bottom, sand and silt substrates, in shallow water, 15-25 m depth.

Distribution
Southern lagoon of New Caledonia.

Possible Confusions
Echinochalina (Protophlitaspongia) menoui in the New Caledonia lagoon; *Clathria (Isociella) eccentrica* from tropical Australasia.

Order
Poecilosclerida

Family
Microcionidae

Clathria (Thalysias) vulpina (Lamarck, 1814)

External Characters
Many folded and rejoined lamellae fusing together to produce elongate tubular, tubulo-digitate, flabellate or sometimes simply subspherical growth forms, but always with cavernous reticulate construction. Surface is fleshy alive, composed of many rounded conules, small digits, or spiky projections on ridges and the margins of the surface, with the area between surface conules excavated to produce a cavernous interior. Large oscules are located at the apex of many surface projections or on the margins of branches, usually raised above the surface and with a membraneous lip.

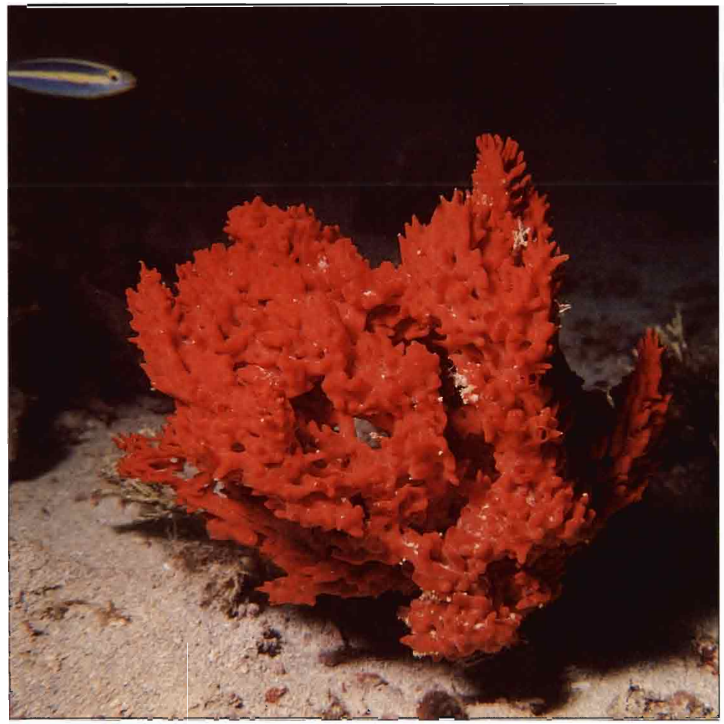
Dimensions
Sponges vary from small (70 mm diameter) to massive branching lobes (up to 300 mm diameter); oscules up to 6 mm diameter.

Colour
Vivid red to red-orange alive, beige when preserved.

Skeletal Characters
Ectosomal skeleton varies from well developed, with erect brushes of both ectosomal and subectosomal auxiliary styles (found mainly on the surface conules), to poorly developed with paratangential or tangential auxiliary spicules lying on the surface (found mainly between surface conules). The subdermal region is usually cavernous, with slightly plumose tracts of choanosomal styles. Choanosomal skeleton is regularly reticulate, with well developed spongin fibres forming more or less square meshes, differentiated into primary, multispicular, ascending fibres, and secondary, uni- or paucispicular, transverse connecting fibres. Fibres are cored by both choanosomal principal styles (most common) and long, slender subectosomal auxiliary styles. Fibres are heavily echinated by acanthostyles. Megascleres consist of: principal styles, smooth, slightly curved near the base, with rounded or slightly subtylote bases, sharply pointed (140-195 µm x 5-8 µm); subectosomal auxiliary styles, long, thin, straight, rounded smooth bases, sharply pointed (142-244 µm x 2-5 µm); ectosomal auxiliary styles, short, thin, straight, rounded smooth bases, rarely microspined bases, sharply pointed (79-128 µm x 2-4 µm); and echinating acanthostyles; spines mostly on base and pointed ends, slightly subtylote bases (37-59 µm x 2.5-6 µm). Microscleres consist of: palmate isochelae, generally two sizes of these are found in the species, but in New Caledonian populations these have been lost; and toxas, thin, hair-like, with central curve and slightly reflexed or straight arms (18-194 µm x 0.5-0.8 µm).

Ecology and Habitat
Growing on soft sediments and coral rubble, *Halimeda* beds and beach rock, from 15-30 m depth.

Distribution
Widely distributed throughout the tropical and subtropical waters of the Indo-Pacific, from Mozambique, Madagascar, Amirante Island, Seychelles Island, Aldabra Island, Red Sea, west coast of India, Gulf of Manaar, Sri Lanka, Mergui Archipelago, Andaman Sea, Straits of Malacca, throughout the Indo-Malay archipelago, Philippines, Vietnam, Japan, Guam, Papua New Guinea, west, north, and eastern Australia and southern lagoon of New Caledonia.



Clathria (Thalysias) vulpina (Lamarck): Nouméa, I. Maître, 25 m (photo P. Laboute)

Order
Poecilosclerida

Family
Microcionidae

Clathria (Thalysias) flabellifera Hooper and Lévi, 1993

External Characters
Flabelliform, flattened in one plane, composed of fused digitate branches with some gaps on the surface due to incomplete branch fusion, and with uneven digitate margins. Surface is even, slightly folded, without conules or other processes, but with prominent oscules each surrounded by whitish subdermal drainage canals (astrorhiza) radiating in all directions (these are not visible in preserved material).

Dimensions
Fans up to 170 mm high, 230 mm wide, up to 8 mm maximum thickness; oscules approximately 2 mm diameter.

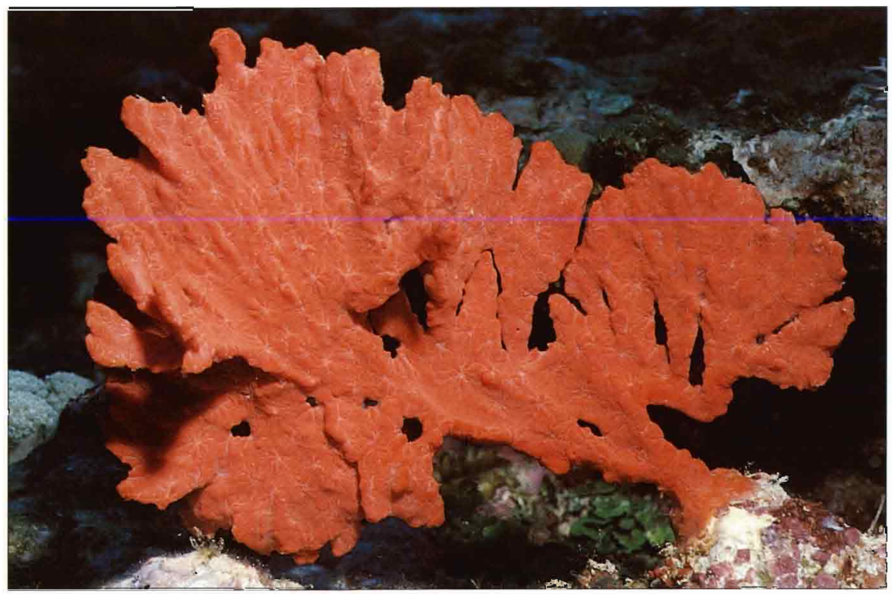
Colour
Red to orange-red alive, pale cream when preserved.

Skeletal Characters
Ectosomal skeleton varies from well developed, with erect brushes of both ectosomal and subectosomal auxiliary styles forming a continuous palisade on the surface, to poorly developed with sparse tangential or paratangential auxiliary styles lying on the surface. Choanosomal skeleton regularly reticulate, with long ascending primary spongin fibres and short transverse secondary fibres, producing square meshes near the surface but more compact oval meshes in the axis. Primary fibres cored by multispicular tracts of choanosomal principal styles, secondary fibres paucispicular, and echinating acanthostyles are abundant. Megascleres include: principal styles, short, robust, straight, slightly subtylote, smooth bases, sharply pointed (139-163 µm x 6-9 µm); subectosomal auxiliary styles, long, slender, straight, slightly subtylote, smooth bases, sharply pointed (209-293 µm x 3-6 µm); ectosomal auxiliary styles, short, slightly subtylote, usually smooth, sometimes microspined (98-179 µm x 2-4 µm); and echinating acanthostyles, robust, small spines mostly on bases and points (49-84 µm x 3-7 µm). Microscleres include: palmate isochelae (11-15 µm) and two categories of toxas most common are short, thick, centrally curved, reflexed arms (13-48 µm x 1-2.5 µm); others long, hair-like, with small central curve and straight arms (49-204 µm x 0.5-1 µm).

Ecology and Habitat
Coral reef and coral rubble, depth 38 m.

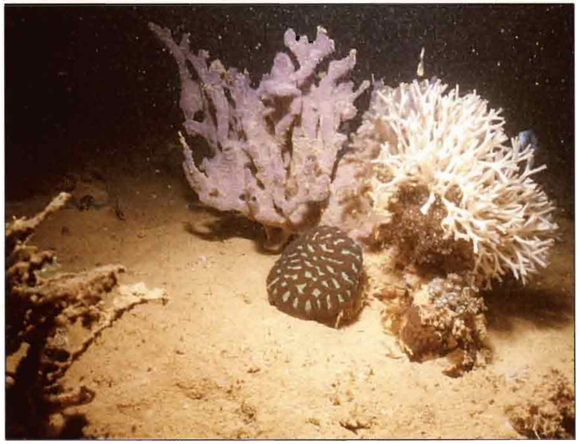
Distribution
Known only from the Isle of Pines, southwest New Caledonian lagoon.

Possible Confusions
Clathria rugosa in the New Caledonia lagoon; also resembles *Clathria cancellaria* from northwest Australia.

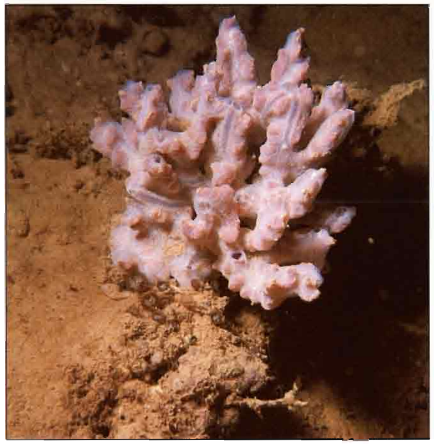


Clathria (Thalysias) flabellifera Hooper and Lévi (holotype): E. Île des Pins, 30 m (photo J.L. Menou)

Clathria (Thalysias) corneolia Hooper and Lévi, 1993



Clathria (Thalysias) corneolia Hooper and Lévi: Banc Gail, 30 m (photo P. Laboute)



Clathria (Thalysias) corneolia Hooper and Lévi: Chenal de Tiaré, between Ton Du and I. lé, 20 m (photo P. Laboute)

External Characters
Clumped, branching growth form, usually with bulbous subcylindrical branches or sometimes with thinly arborescent branches, attached to a common base, entirely free or partially fused with adjacent branches, and with one or more points of attachment to the substrate. Branches are bulbous-cylindrical alive, contracted and slightly flattened when preserved, usually bifurcated and reticulated, tapering to rounded tips. The surface is optically even, without any noticeable protrusions, with a membraneous ectosome stretched between adjacent branches most clearly seen in live specimens but partially collapsing when preserved. Lateral edges of all branches have prominent subdermal drainage canals. Large oscules on apex of branches surrounded by prominent membraneous lip.

Dimensions
Clumps of branches range from 70-190 mm high, and branches range from 5-45 mm diameter, contracted when preserved. Oscules are up to 25 mm diameter.

Colour
Pale red-pink alive, pale pink-brown when preserved.

Skeletal Characters
Ectosomal skeleton with well developed bundles of ectosomal styles forming plumose brushes, are perched on the end of terminal spongin fibres at the surface, and these peripheral fibres are usually more swollen than those in the axis of the sponge. Subdermal spongin fibres form cavernous meshes, whereas spicules coring these fibres are more or less plumose, cored by plumose tracts of subectosomal auxiliary styles. The choanosomal skeleton is irregularly reticulate, with well developed primary and secondary spongin fibres. The spongin fibre reticulation in the axis of the skeleton forms elongate meshes; primary fibres are paucispicular, cored by subectosomal auxiliary styles, and secondary fibres do not contain any spicules or they are rarely cored by few auxiliary styles. Both acanthostyles and principal styles echinate fibres, but these are sparse. Megascleres consist of: principal styles [echinating fibres, straight, sharply pointed or with telescoped points, evenly rounded or tapering bases, some with vestigial spines on shaft (intermediate between principal styles and acanthostyles) (98-222 µm x 5-11 µm); subectosomal auxiliary styles, straight, sharply pointed, slightly subtylote, smooth bases (265-308 µm x 3-7 µm); ectosomal auxiliary styles, straight, sharply pointed, slightly subtylote (95-153 µm x 2-4 µm)]; and acanthostyles echinating fibres, short, stout, sharply pointed or with telescoped points, evenly rounded or slightly subtylote bases, spines mostly on the base and midway along the shaft, sometimes verticillate (36-59 µm x 3-6 µm). Microscleres include: palmate isochelae, two sizes, some of the larger twisted forms (8-11 µm and 2-4 µm); and toxas thin, with large central curvature, with straight or slightly reflexed arms (12-145 µm x 0.8-2.5 µm).

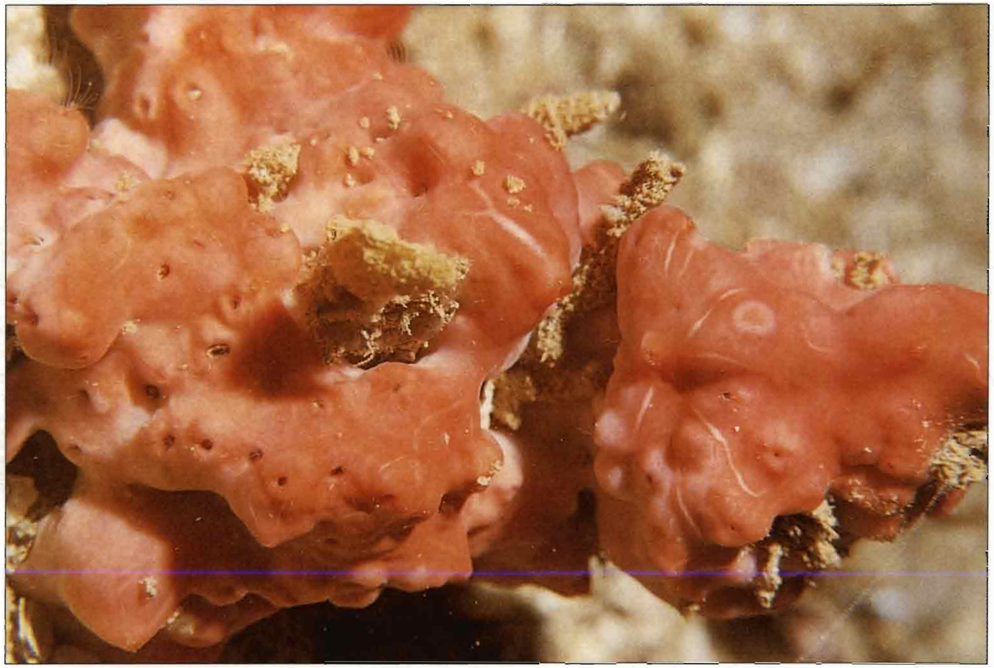
Ecology and Habitat
Uncommon, found in sand, coral rubble, and *Halimeda* beds, with depth range between 18-35 m.

Distribution
Only known from the southwest coast of the New Caledonian lagoon.

Order
Poecilosclerida

Family
Microcionidae

Clathria (Thalysias) araiosa Hooper and Lévi, 1993



Clathria (Thalysias) araiosa Hooper and Lévi: (holotype) Récif des 5 milles, 8 m (photo G. Bargibant)

External Characters
Bulbous, lobate, thickly encrusting. Surface is uneven, composed of numerous fused bulbs, each with an apical osculum raised slightly on a membraneous lip, and white or pale red subdermal drainage canals (astrorhiza) radiating away from each oscule.

Dimensions
Encrustations up to 15 mm thick. Oscules up to 4 mm diameter.

Colour
Pale red alive, beige when preserved.

Skeletal Characters
Ectosomal skeleton is well developed, dense, with a single layer of ectosomal auxiliary styles forming compact brushes on the surface, perched over the ends of the subectosomal spicule brushes below. Choanosomal skeleton hymedesmoid, with a thin layer of spongin lying on the dead coral substrate, and with choanosomal principal styles and echinating acanthostyles embedded in this basal spongin and standing perpendicular to the substrate. At the ends of the erect choanosomal styles are brushes of subectosomal auxiliary styles, in 2-3 separate layers, producing straight or sinuous subdermal spicule tracts. Megascleres include: choanosomal principal styles, short, slightly curved near base, sharply pointed, smooth, evenly rounded or slightly subtylote (126-267 µm x 6-7 µm); subectosomal auxiliary styles, straight, sharply pointed, smooth, rounded or slightly subtylote (278-365 µm x 3-6 µm); ectosomal auxiliary styles straight, smooth, evenly rounded, non-tylote (121-183 µm x 3-4 µm); echinating acanthostyles, slender, slightly subtylote, sharply pointed, small spines mostly on base and midway along shaft (50-72 µm x 3-5 µm). Microscleres include: palmate isochelae (15-18 µm); toxas, small, thin, slightly curved at centre, usually with straight arms (12-42 µm x 0.5-2 µm).

Ecology and Habitat
Dead coral, 30 m depth, in areas of strong currents.

Distribution
Known only from the southwest lagoon of New Caledonia.

Clathria (Thalysias) hirsuta Hooper and Lévi, 1993

Clathria (Thalysias) hirsuta Hooper and Lévi: I. des Pins, 30 m (photo G. Bargibant)

External Characters
Erect flattened digit, with honeycombed surface structure excavated by pores and canals that pass completely through the sponge 'body'. Surface is ornamented by many microconules, which are close together, pointed, usually dividing once or twice at their points, and situated on the ends of flat, lamellate surface processes which encircle the edges of the excavated canals and join together to produce the honeycombed surface structure. The texture is firm, compressible, and difficult to tear. Oscules are scattered over the surface, situated between microconules.

Dimensions
Digit is 65 mm long, 40 mm wide, 30 mm thick; surface conules 2-4 mm long, 5-9 mm wide, up to 2 mm thick; oscules are up to 5 mm diameter, scattered over surface between microconules.

Colour
Tips of surface microconules red, honeycombed portion of sponge pale mauve-red alive, with slightly striated, paler surface sculpturing (subdermal drainage canals) also visible in between surface conules. Sponge is evenly beige in ethanol.

Skeletal Characters
Ectosomal skeleton with a sparse tangential or paratangential layer of intermixed ectosomal and subectosomal auxiliary styles, but not producing an erect, specialised *Thalysias*-like skeleton. Choanosomal skeleton dominated by well developed, horny spongin fibres, with mineral skeleton greatly reduced. The spongin fibre skeleton has differentiated primary and secondary fibres. Primary fibres are predominantly ascending, cored by multispicular tracts of spicules; secondary fibres are mostly transverse, shorter and thinner, interconnecting primary fibres are cored by pauci- or unispicular tracts of spicules. All fibres are cored by subectosomal auxiliary styles intermixed with fewer principal choanosomal styles, and echinated by sparse echinating acanthostyles. Coring spicules occupy only a small proportion of the fibre diameter, usually confined to the centre of each fibre. The fibre reticulation forms triangular, oval or elongate meshes, more compact in the axial region than in the peripheral skeleton. Megascleres include: choanosomal principal styles (found exclusively in fibres) are scarse, very slender, straight, sharply pointed, with smooth evenly rounded bases (size range 114-158 µm x 2-5 µm); subectosomal auxiliary styles (found inside fibres and also in the subdermal skeleton) are long, very slender, straight or rarely slightly curved, with tapering sharp points, and with bases that are nearly oxeote (tapering to pointed or small rounded ends) (size range 163-242 µm x 1.8-4 µm); ectosomal auxiliary styles are short, straight, very slender, with evenly rounded bases (size range 81-98 µm x 0.8-2 µm); echinating acanthostyles are scarse, short, slender, sharply pointed, with vestigial spines and very slight subtylote bases (size range 34-56 µm x 2-4 µm). Microscleres include: toxas, uncommon, raphidiform, with slightly angular or rounded central curvature and straight arms (size range 65-172 µm x 0.2-0.5 µm). Isochelae are absent.

Ecology and Habitat
Found on coral reef, rock and coral rubble substrates, 20-30 m depth range.

Distribution
Northern, central and southern inshore coastal waters of Queensland, and the southeast of the New Caledonia lagoon.

Possible Confusions
None in New Caledonia; *Clathria (Thalysias) cactiformis* widely distributed throughout the warm temperate and subtropical Indo-west Pacific region.

Order Poecilosclerida

Family Microcionidae

Clathria (Clathria) menoui Hooper and Lévi, 1993

Clathria (Clathria) menoui Hooper and Lévi (holotype): I. N'da, 47 m (photo J.L. Menou)

External Characters

Massive, encrusting on coral, composed of fused, bulbous, lobate-digitate projections attached to a common encrusting base. Smaller bulbous, conulose digits cover the apex of each larger digit. Surface is fleshy, porous, membraneous. Margins of digits are longitudinally striated, uneven, and the apex of most digits have a single large oscule with a prominent membraneous lip. Each oscule is surrounded by a radiating subdermal canal system (astrorhizae), with large canals covered by a smooth membraneous surface (in contrast to adjacent surface which is highly porous and excavated by large ostia). Texture spongy, elastic, and difficult to tear.

Dimensions

Sponges growing to 40 mm high, 60 mm wide, and extending for 180 mm along the substrate; bulbous digitate surface projections 15-35 mm high, 21-53 mm wide, 3-6 mm thick; smaller conulose digits 4-5 mm diameter, up to 5 mm high; oscules 2-6 mm diameter.

Colour

Orange-brown alive, with bright yellow larvae; light beige when preserved.

Skeletal Characters

Ectosome is membraneous, with a thin layer of subectosomal auxiliary subtylostyles lying tangential to the surface, through which protrude the tips of spongin fibres. Terminal fibres taper to one or two sharp points, and each fibre has a sparse paucispicular core of vestigial spicules which protrude through the end of fibres. Choanosomal skeleton is irregularly reticulate, cavernous, with the spongin fibre system dominant over the spicule skeleton. Spongin fibres are only poorly differentiated into primary and secondary categories. Primary fibres are more or less ascending, cored by uni- or paucispicular tracts of principal subtylostyles, sometimes uncored or cored by vestigial spicules of indeterminant origin (resembling fibre pith). Coring spicules occupy only a very small proportion of fibre diameter. Secondary fibres interconnect the primary fibre system at irregular intervals, more or less transverse, usually uncored or rarely unispicular. Fibre meshes are large and irregular, generally oval or elongate. Echinating spicules are abundant. Megascleres include: choanosomal principal spicules (coring spongin fibres) are nearly vestigial, always with blackened axial canals, barely different from auxiliary spicules, short, straight, slender subtylostyles, with prominent tylote bases and sharply pointed tips (size range 82-96 µm x 2-3.5 µm); subectosomal auxiliary subtylostyles (in ectosomal skeleton and scattered between fibre meshes) are long, slender, straight or very slightly curved near the tip, with prominent subtylote bases, often tear-drop shaped, and long, tapering, sharply pointed tips (size range 154-185 µm x 1.8-3 µm); echinating spicules are entirely smooth, straight subtylostyles, with well marked constricted "necks", evenly rounded bases and sharply pointed tips (size range 27-34 µm x 1.5-3 µm). Microscleres include: toxas are very rare, exceedingly slender (raphide-like), with only slight angular curvature at the centre and straight arms (not reflexed) (size range 62-85 µm x 0.5-0.8 µm). Isochelae are absent.

Ecology and Habitat

Attached to dead *Antipatharia* in coral reefs, 15-30 m depth.

Distribution

Southern New Caledonian lagoon.

Possible Confusions

None in New Caledonia; *Clathria* (*Isociella*) *eccentrica* from tropical Australasia, and *Echinoclathria leporina* from southern Australia in external morphology.

Echinochalina (*Echinochalina*) *intermedia* (Whitelegge, 1902)

External Characters
Massive, irregular, lobate, bulbous-digitate sponge, with small bulbous lobes forming digits (but collapsing and becoming flattened when the sponge is preserved) covering the entire mass, and the whole sponge is excavated by large oscules. Together these excavations and fused adjacent bulbous digits produce a honey-combed clathrous growth form. The surface has a paler, "dusty", translucent, skin-like membrane covering the entire surface, except around the large oscules, which are usually distributed on the tips of bulbous digits.

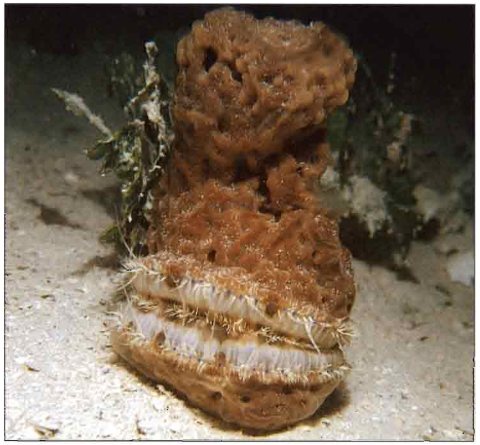
Dimensions
Sponges may grow up to 400 mm high, 300 mm maximum thickness, and oscules are between 10-30 mm diameter.

Colour
Orange-brown alive, beige when preserved.

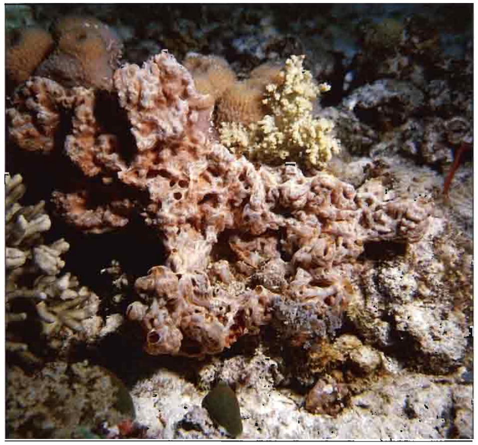
Skeletal Characters
Ectosomal skeleton membraneous, with some sand embedded but without specialised spicules, although auxiliary spicules from subdermal skeleton may poke through the surface. The primary choanosomal fibres also terminate close to the surface, sometimes protruding slightly through the dermal membrane and producing low conules. Choanosomal skeleton irregularly plumo-reticulate, with well developed spongin fibre skeleton (but poorly differentiated primary and secondary fibres). Primary fibres more or less ascending to the surface, meandering through the choanosome, cored by multispicular tracts composed of auxiliary spicules. Secondary fibres usually interconnecting primary fibres, without spicules or with uni- or paucispicular tracts inside fibres. Fibre meshes cavernous, irregular, eliptical or oval, containing heavy deposits of detritus (but not inside the spongin fibres themselves), and fibres are sparsely echinated by thin principal styles. Megascleres include: principal styles echinating fibres, short, thin, straight, hastate points, rounded, rarely subtylote, smooth bases (64-113 µm x 2-4 µm); auxiliary spicules, coring fibres, long, very thin, straight, hastate points, smooth, rounded bases, ranging from styles, tornostyles, or strongyles in about equal proportions; usually with blackened axial canals (169-189 µm x 1.2-2.5 µm). Microscleres are absent.

Ecology and Habitat
Growing on coral rubble and coral pinnacles, with recorded depth range in the New Caledonian lagoon between 15-35 m in areas of low current.

Distribution
This species is probably widely distributed throughout the Indo-west Pacific, although it has so far been collected only from the southwest lagoon of New Caledonia, Direction Island, Frankland Islands, Sudbury Reef and Stanley Reef on the Great Barrier Reef, Queensland, Mooloolabah and Moreton Bay on the southern Queensland coast, the Illawarra region in New South Wales, the Dampier Archipelago on the Northwest Shelf of Western Australia, and Cargados Carajos in the Indian Ocean.

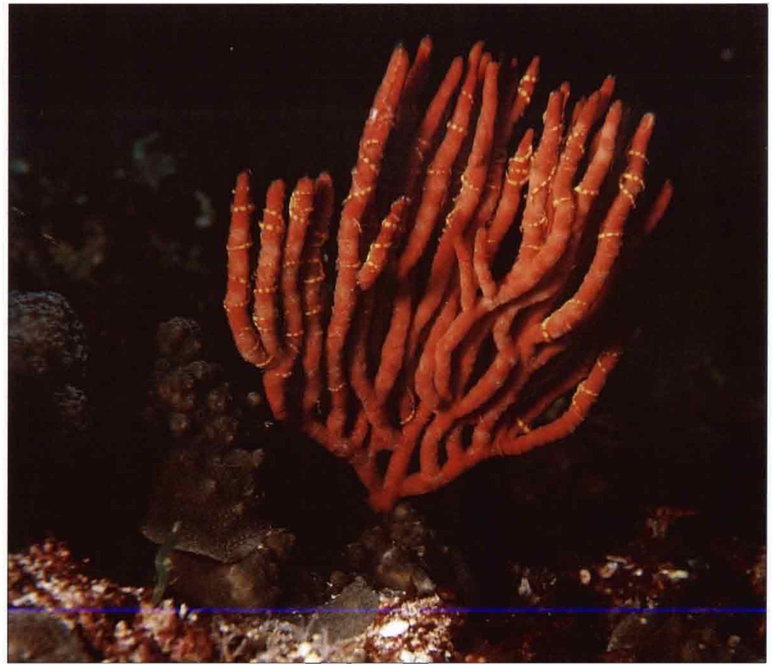


Echinochalina (Echinochalina) intermedia (Whitelegge): N. Lagoon, N. de Paaba, 25 m (photo P. Laboute)



Echinochalina (Echinochalina) intermedia (Whitelegge): S.E. I. Ua, 16 m (photo G. Bargibant)

Echinochalina (*Protophlitaspongia*) *laboutei* Hooper and Lévi, 1993



Echinochalina (Protophlitaspongia) laboutei Hooper and Lévi (holotype): Récif des 5 milles, 8 m (photo P. Laboute)

External Characters
Branching digitate sponge with short cylindrical stalk and holdfast, long cylindrical branches, frequently dividing midway along their length, tapering to rounded tips at their ends. Surface is even, slightly bulbous, with concentric swellings and constrictions at more or less regular intervals along branches, superficially reminiscent of an *Isis* gorgonian. The surface is microscopically porous, finely hispid, with fibre endings from the choanosome protruding slightly through the surface. Oscules not visible. Texture firm, slightly compressible, branches flexible, whip-like.

Dimensions
Sponge is 220 mm high, stalk 28 mm long, 9 mm diameter, branches 3-6 mm diameter, branch constrictions 2-4 mm apart.

Colour
Bright red alive, beige when preserved.

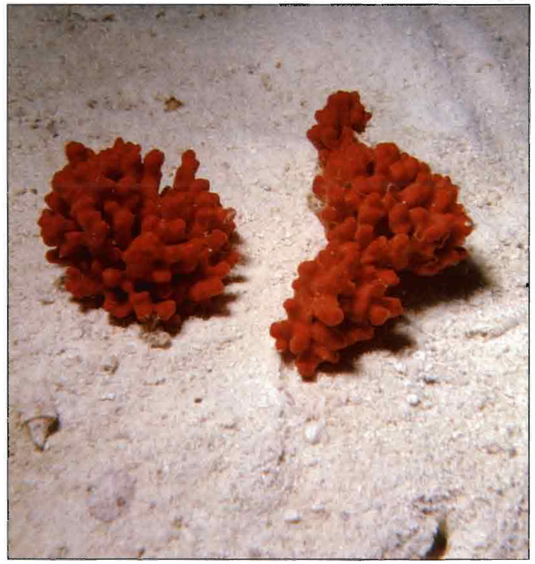
Skeletal Characters
Ectosomal skeleton with auxiliary styles standing perpendicular, or lying paratangential, to the surface, usually forming sparse bundles, and always lying outside the spongin fibres. The ectosomal skeleton is dominated by the well developed peripheral fibre skeleton, with tapering erect fibre endings protruding through the surface. The peripheral spongin fibres lying perpendicular to the surface always have a unispicular core of larger oxeas, protruding a short distance through the fibres, whereas echinating oxeas are sparse on these peripheral fibres. Choanosomal skeleton is regularly reticulate, almost renieroid, with a condensed axial region which is clearly differentiated from the peripheral extra-axial skeleton. The organic spongin fibre skeleton is emphasised over the inorganic spicule skeleton. Fibres are differentiated into primary and secondary elements, and there are also differences in the axial and extra-axial fibre skeletons. Primary fibres in axis, running longitudinally through branches, are cored by sparse plumose brushes of choanosomal principal oxeas; these are interconnected by shorter, thinner, secondary fibres, 50-90 µm diameter, without coring spicules, together forming compressed oval meshes in the axial region. Primary fibres in the extra-axial region are radial, extending from the edge of the axis to the surface, 50-90 µm diameter, cored by unispicular tracts of choanosomal oxeas, usually end-on-end, rarely overlapping; these fibres are interconnected by secondary fibres, usually without coring spicules, running transversely through the branches; fibre meshes in extra-axial and peripheral regions of the skeleton are oval or elongate and generally larger than those in the axis. There is also a sparse tertiary fibre network, which is aspicular and subdivides the extra-fibre skeletal meshes. Echinating oxeas are heavier in the axial than the peripheral regions, scattered mainly (but not exclusively) on primary fibres. Megascleres consist of: choanosomal (principal) oxeas, coring fibres, short, straight, stout, hastate sharp points, telescoped ends (57-108 µm x 1.8-4 µm); echinating oxeas, shorter, thinner than principal oxeas, hastate points, telescoped ends (28-42 µm x 2-4 µm) ectosomal auxiliary styles, long, slender, straight or sinuous, slender, rounded bases, tapering raphidiform points (115-194 µm x 1-2.5 µm). Microscleres are absent.

Ecology and Habitat
Uncommon, growing on coral rubble and coral reef substrates, 40 m depth.

Distribution
Known only from the southwest lagoon of New Caledonia.

Possible Confusions
None in New Caledonia; *Echinochalina* (*Protophlitaspongia*) *oxeata* from the Great Barrier Reef.

Echinochalina (Protophlitaspongia) bargibanti Hooper and Lévi, 1993



Echinochalina (Protophlitaspongia) bargibanti Hooper and Lévi (holotype): S.W. Lagoon, between I. Tere and I. N'Da, 30 m (photo P. Laboute)

External Characters
Lobate-digitate mass composed of clumps of partially fused, small, thick digits, joined to a common base encrusting on a dead bivalve. Digits are bulbous, cylindrical, thicker at the apex than at the point of attachment to the base, usually with a single point, sometimes with two or three, often partially fused with adjacent digits midway along the stem, together producing a vaguely reticulate, excavated, honeycombed mass. Digits have even, rounded tips, either unornamented or with few, large conules (or secondary digits) near the margins. Oscules are small, located mainly on the ends of, or between, the surface conules, and they have slight subdermal sculpturing (astrorhizae), radiating away from each pore, but this is not extensively developed. Texture is rubbery, compressible, and difficult to tear.

Dimensions
Sponge is 65 mm high, 57 mm wide; digits are 18-35 mm long, 8-15 mm diameter; surface conules 6-12 mm high, 4-9 mm diameter, approximately 3-7 mm apart; oscules 1-2 mm diameter.

Colour
Dark red alive; dark grey brown when preserved.

Skeletal Characters
Ectosomal skeleton is a sparse, tangential or paratangential layer of auxiliary subtylostyles dispersed over the surface. In thick parts of the skeleton (*e.g.* surface digits) auxiliary subtylostyles may form sparse, erect plumose brushes, but usually these spicules are scattered. Terminal primary fibres protrude through the surface spicule skeleton and contain a core of principal oxeas, the ends of which protrude slightly through the ends of fibres. Choanosomal skeletal architecture is regularly reticulate, without any differentiation between axial or extra-axial/peripheral regions. Spongin fibres dominate the skeleton, and spicules are both greatly reduced in abundance and poorly silicified (all with blackened axial canals). Spongin fibres are divided into primary ascending and secondary transverse (connecting) components, with a very thin tertiary network also apparent. Primary fibres are cored by uni- or paucispicular tracts of choanosomal principal oxeas, occupying only a small proportion of fibre diameter. Secondary connecting fibres, usually transverse, are aspicular or unispicular, and tertiary fibres are invariably aspicular. Fibre meshes are cavernous, square or rounded, containing very little visible collagen, although distinct clumps of granular collagen and principal oxeas and isochelae are scattered within the choanosome, particularly around the major fibre nodes. Echinating acanthostyles are sparse, usually associated with small fibre nodes protruding from a primary or secondary fibre. Megascleres include: choanosomal principal oxeas (coring fibres), relatively short, slender, with hastate, sharply pointed ends, occasionally telescoped points (size range 55-98 µm x 0.8-3 µm); ectosomal auxiliary subtylostyles are long, slender, invariably straight, with enlarged subtylote bases, rounded or slightly pointed, and tapering to sharply pointed or slightly rounded tips (size range 144-278 µm x 1.0-3.5 µm); echinating oxeas are rare, similar in morphology to principal oxeas, but marginally shorter and of similar thickness (size range 32-58 µm x 1.0-2.5 µm). Microscleres include: palmate isochelae, unmodified, moderately large, moderately common, usually found aggregated in clumps of collagen in the choanosome (size range 14-21 µm); toxas are absent.

Ecology and Habitat
Free, growing on sand substrate, 30 m depth.

Distribution
Southwest lagoon of New Caledonia.

Possible Confusions
Clathria rugosa from the New Caledonia lagoon.

Family
Raspailiidae

Raspailia wilkinsoni Hooper, 1991b

Raspailia wilkinsoni Hooper, juvenile: Nouméa, outer reef slope, 50 m (photo P. Laboute)

External Characters
Branching, digitate, bushy, with cylindrical stalk and basal holdfast attaching the sponge to the substrate, and bifurcate, thickly cylindrical branches, tapering to sharp points at their apex. The surface is shaggy, prominently microconulose on branches but more compact on stalk, and the surface conules are narrow and close-set. Oscules are not obvious but ostia are very small and scattered between the surface conules. The texture is firm, compressible, with flexible branches and more rigid stalk.

Dimensions
80-200 mm high, 60-110 mm maximum branch thickness, basal stalk 12-85 mm long, 4-8 mm diameter, branches 25-95 mm long, 5-11 mm diameter, surface conules up to 3 mm long.

Colour
Dark orange-brown alive, dark brown when preserved.

Skeletal Characters
Ectosomal skeleton is membraneous, without specialised 'raspailiid' skeleton, although the small whispy ectosomal auxiliary oxeas are scattered in the peripheral region lying tangential to the surface. The subectosomal region is dominated by micro-digitate projections formed by plumose tracts of long subectosomal auxiliary oxeas/styles, protruding through the surface for a short distance, and usually in bundles. Subectosomal plumose spicule tracts are interconnected by transverse spicule tracts composed of choanosomal principal oxeas, and the whole peripheral skeleton is cavernous. Together the peripheral spicule tracts are heavily echinated by acanthostyles, more so than in the axial region. Choanosomal skeleton is reticulate, with a well developed compressed axial skeleton and reticulate extra-axial skeleton. Axis has tightly compressed reticulate spongin fibres cored by choanosomal oxeas and lightly echinated by acanthostyles. Megascleres consist of: choanosomal principal oxeas, long, thin or thick, symmetrically curved, tapering to sharp points (188-285 µm x 4-10 µm) subectosomal auxiliary spicules predominantly oxeas, less commonly styles, long, thick, straight or slightly curved, often anisoxeote, rounded bases (for styles), sharply pointed (255-524 µm x 8-12 µm); ectosomal auxiliary spicules, short, thin, whispy, varying from symmetrically curved oxeas to sinuous anisoxeas, sharply pointed (106-208 µm x 1-2.5 µm); echinating acanthostyles, subtylote bases, rounded blunt tips, long slender spines mainly on base and apex of spicules (52-62 µm x 2.5-4.5 µm). Microscleres are absent.

Ecology and Habitat
Uncommon, growing on live and dead coral substrates, 60 m depth.

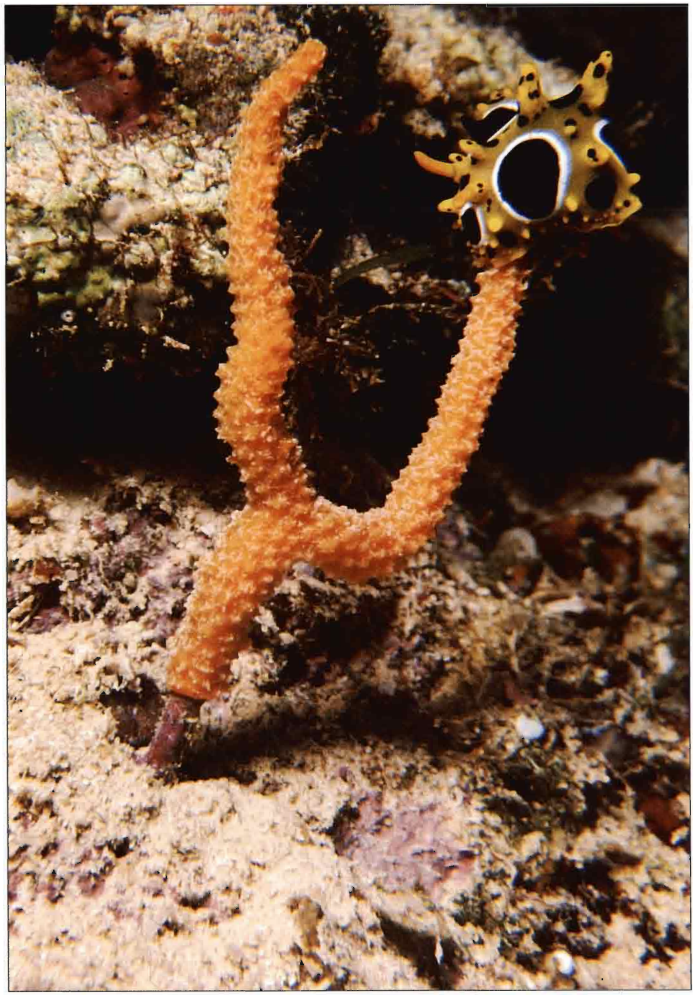
Distribution
Central region of the Great Barrier Reef and exterior of outer reef, southwest lagoon of New Caledonia.

Possible Confusions
Aulospongus clathrioides, *Ceratopsion clavata* from the New Caledonia lagoon.

Order
Poecilosclerida

Family
Raspailiidae

Ceratopsion clavata Thiele, 1898



Ceratopsion clavata Thiele: Récif Ana, 35 m (photo P. Laboute)

External Characters
Branching, digitate, bushy or whip-like sponges with a variable number of elongate, bifurcate, more or less cylindrical branches, and short cylindrical basal stalk with enlarged basal holdfast. Surface is usually prominently conulose but this varies between specimens, and conules are close-set, irregular, sharply pointed, and shaggy.

Dimensions
Sponges range from 60-360 mm high, 25-115 mm maximum breadth (lateral extent of branching), basal stalk 5-28 mm long, 2-11 mm diameter, branches 25-125 mm long, 5-12 mm diameter, surface conules are up to 5 mm long, 3 mm basal diameter.

Colour
Yellow alive, pale beige to light brown when preserved.

Skeletal Characters
Ectosomal skeleton with subectosomal auxiliary spicules protruding through the surface and sparse tangential tracts of ectosomal auxiliary oxeas dispersed around the vicinity of larger subdermal spicules, although not producing a specialised raspailiid skeleton. Skeleton divided into three distinct components: compressed axial core with tightly meshed spongin fibres cored by sinuous choanosomal principal spicules; radial extra-axial skeleton with subectosomal spicules, singly or in bundles, embedded in and standing perpendicular to axial fibres; and plumose extra-axial skeleton composed of very large plumose or plumo-reticulate tracts of subectosomal auxiliary spicules intermingled with sinuous principal spicules (this part of the skeleton is most prominent and the large spicule tracts correspond to the surface conules). Megascleres consist of: choanosomal principal spicules, in axial skeleton, sinuous or slightly curved, ranging from strongyles with evenly rounded ends, strongyloxeas with telescoped ends, to anisoxeas with a combination of rounded and telescoped ends (251-912 µm x 1.5-9 µm); subectosomal auxiliary spicules in extra-axial skeleton, straight, symmetrically or asymmetrically curved, rarely sinuous, ranging from small wispy oxeas, anisoxeas or styles, to large thick styles and anisoxeas, usually with telescoped ends, sometimes evenly rounded (171-590 µm x 3-13 µm); ectosomal auxiliary spicules, wispy oxeas, slightly curved, usually asymmetrical, fusiform points (126-302 µm x 1-4 µm); echinating megascleres are absent. Microscleres are absent.

Ecology and Habitat
Although in Japan this species was collected from deeper waters (130 m depth), the New Caledonian populations are known from 25-40 m depth, dispersed on coral rubble, coral reef and soft substrates.

Distribution
Known only from Sagami Bay, Japan, and the southwest and southeast lagoons of New Caledonia.

Possible Confusions
Raspailia wilkinsoni and *Aulospongus clathrioides* from the New Caledonian lagoon; also *Ceratopsion dichotoma* from eastern Australia.

Order
Poecilosclerida

Family
Raspailiidae

Aulospongus clathrioides Lévi, 1967

External Characters
Branching, bushy, with short woody stalk and enlarged basal attachment; branches are prolific, usually repeatedly bifurcate and rejoining (anastomosing), together producing a reticulate bushy clump. Branches are thinly cylindrical or slightly flattened, tapering to rounded bifurcated tips. Surface has a thin translucent skin-like dermal membrane stretched between adjacent surface conules. On the branches the surface is uneven, shaggy, prominently microconulose and hispid, whereas the basal stalk is more woody and more darkly pigmented, and the tips of the branches are more even and only hispid. Sparse oscules are scattered on lateral sides of branches, between surface conules. Texture of branches is soft, flexible, spiky, whereas the stalk is firm and flexible.

Dimensions
Sponges range from 55-180 mm high, 40-110 mm maximum branching width, basal stalk 22-40 mm long, 2-8 mm diameter, branches up to 6 mm diameter, oscules are up to 2 mm diameter.

Colour
Yellow orange alive, khaki brown when preserved.

Skeletal Characters
Ectosome without specialised spicules, but with plumose brushes of choanosomal principal styles protruding slightly through the surface. The peripheral skeleton is dominated by swollen spongin fibres, which also protrude through the surface and form the surface conules. Choanosomal skeleton plumose, with only a slightly compressed axial skeleton, and both axial and extra-axial skeletons dominated by the well developed spongin fibre system, whereas the spicule skeleton is proportionally reduced. Axial fibres are small, close-set, with a vestigial core of choanosomal principal styles. Extra-axial fibres, occupying most of the branch diameter, with both primary and secondary spongin fibres: primary ascending fibres cored by plumose tracts of choanosomal principal styles; secondary fibres are short, thin, uncored or with only sparse tracts of choanosomal styles. Echinating acanthostyles sparse, evenly dispersed on both primary and secondary fibres, but more abundant in extra-axial skeleton. Megascleres consist of: choanosomal principal styles, long, slender, slightly curved, occasionally sinuous, smooth, rounded bases, sometimes anisoxeote, fusiform points (145-454 µm x 3-7 µm); subectosomal and ectosomal megascleres are absent; echinating acanthostyles long, slender, slightly curved towards base, smooth, rounded or slightly swollen bases, pointed or slightly swollen tips, evenly covered with small granular spines except for base (58-82 µm x 1.5-4.0 µm). Microscleres are absent.

Ecology and Habitat
Usually found in areas of high current, flat bottom, on coral and dead coral substrates, 25-40 m depth.

Distribution
Known only from the southwest New Caledonian lagoon.

Possible Confusions
Ceratopsion clavata, *Raspailia wilkinsoni* from the New Caledonian lagoon.

Aulospongus clathrioides Lévi: Chenal des 5 milles, 25 m (photo G. Bargibant)

Order
Haplosclerida

Family
Chalinidae

Haliclona cymaeformis
(Esper, 1794)

These sponges have their main skeleton formed of simple diactinal spicules, usually oxeas of one type and size, although thinner developmental forms may occur. Spicules can be modified to strongyles or strongyloxeas.

In the Families Chalinidae, Niphatidae and Callyspongiidae, spicules are often embedded in spongin fibres in uni- or multispicular tracts. The skeletal arrangement is neat and regular, not dense or crowded. This skeleton often forms an isodictyal triangular reticulation but spicules and fibres also form triangular, rectangular or polygonal meshes. In some groups spongin fibres are well developed whereas in others they are less well developed, where spicules are bonded together by variable quantities of collagenous spongin. Microscleres may include c- and s-shaped sigmas, frequently with a central (or centrangulate) kink, and sometimes smooth toxas or microxeas. Where known, species of the families Chalinidae, Callyspongiidae and Niphatidae are viviparous, incubating their young.

Sponges belonging to the Families Petrosiidae and Oceanapiidae are typically massive, vase-shaped or volcano-shaped, sometimes repent, or bulbous, and fistulous. Their texture is characteristically stony, brittle, reflecting that in most species siliceous spicules are dominant over spongin. The external surface has a smooth appearance where the surface skeleton is an isotropic reticulation of single spicules or spicule tracts forming a crust. The main choanosomal skeleton is more or less a regular isotropic reticulation composed of multispicular tracts bound together with minimal collagen or light spongin fibres, usually forming large oval meshes. Microscleres may include microxeas, microstrongyles, sigmas and toxas but they are not common. Reproduction is oviparous, where eggs and sperm are released into the water and larvae develop externally to the parent.

Haplosclerida are particularly abundant on coral reefs, including those of New Caledonia and the Great Barrier Reef, living in full light amongst hard corals as well as in many cryptic habitats and in between the reefs on the seabed. They generally do not attain massive proportions, except the Petrosidae and are frequently fans, tubes, branches or ramose morphology. The genera *Callyspongia*, *Haliclona*, *Niphates* and *Gelliodes* are common.

Order
Haplosclerida

Family
Chalinidae

Haliclona cymaeformis (Esper, 1794)

External Characters
Sponge symbiotic with a macroalgae, *Ceratodictyon spongiosum*. Individual sponges consist of ramose flattened branches that anastomose and the branch tips are usually bifurcate. The red algae tissue dominates the branches' structure, and the sponge forms a thin encrustation that completely surrounds the algae. The surface is microscopically hispid and porous. Small oscules are up to 2 mm diameter and flush with the surface. Texture coarse and stiff, firm and incompressible.

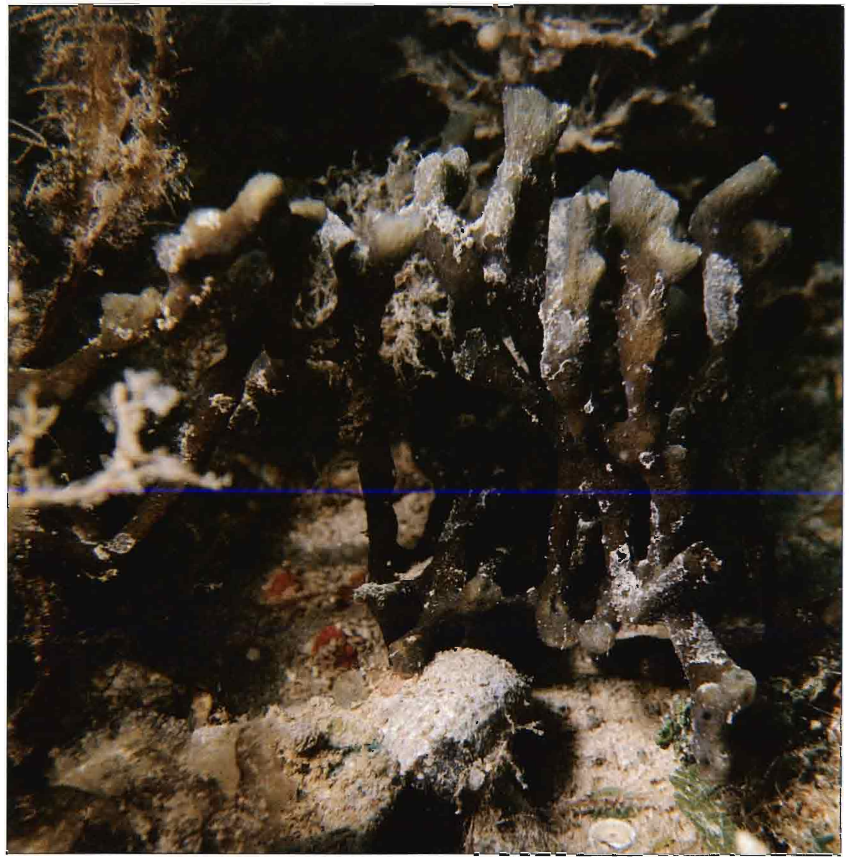
Dimensions
Can form large spreading mats up to 30 cm across. Branches to 2 cm wide.

Colour
Dark green, red-brown or purple throughout alive, fawn in alcohol.

Skeletal Characters
Sponge skeleton lies between algal fronds which form an anastomosing network of thalli. The sponge skeleton is a spicule and fibre reticulation. Spicules are thin, curved, sharply pointed oxeas 99-160 µm x 0.8-11 µm, average 130 µm x 4 µm, and microscleres are abundant sigmas 14-20 µm long, average 17.5 µm.

Ecology and Habitat
Very common species on sandy substratum attached to coral rubble or shell. Specimens may not be attached to the substrate. Found in full light with a depth range between 0-15 m.

Distribution
Southern part of New Caledonia lagoon; Papua New Guinea. Torres Strait, Australia (Great Barrier Reef, Darwin), Madagascar (Tulear).



Haliclona cymaeformis (Esper): I. Mbe, 18 m
(photo P. Laboute)

Haliclona olivacea Fromont, 1995

Haliclona olivacea Fromont (holotype): I. Maître, 20-22 m (photo P. Laboute)

External Characters
Large ramose or branching sponge with one or several points of attachment, can be found rolling around unattached to the substrate. Branches laterally compressed with rounded apices. Surface smooth, shiny and opaque with underlying pore pattern visible. Oscules at sides and tops of branches, flush with surface, up to 0.5 cm diameter. Texture very soft, limp, compressible.

Dimensions
Overall size: largest specimen 23 cm tall, 14 cm wide. Thickest branches 4 x 2 cm, smallest branches 1.5 x 0.5 cm.

Colour
Commonly olive green but some specimens are grey with faint red tinge alive; brown in alcohol.

Skeletal Characters
Spicules are small hastate oxeas some with telescoped or mammillate ends. Range: 117-140 µm x 3.3-5.1 µm, average: 130 µm x 4.3 µm. Very close meshed, compact, plumo-reticulate and isodictyal skeleton of spicule tracts with spongin fibre development at the nodes of the reticulation. Primary fibres dendritic, 14-37 µm wide, cored by 2-8 spicules. Meshes between primary tracts 96 µm wide. Secondary tracts form an isodictyal reticulation with primary tracts, especially towards the surface. Secondary tracts 5-9 µm wide, unispicular. Large internal spaces 570-1800 µm diameter, form a canal system throughout the sponge. Skeleton more irregular in the centre of the sponge with abundant interstitial spicules. Surface skeleton a single isodictyal reticulation with neat triangular meshes 1 spicule length long. Meshes 60 µm wide. Very fine spicules found between surface reticulation.

Ecology and Habitat
Found on coarse sand amongst *Halimeda* in the lagoon, in full light. Some specimens are not attached to the substrate. Depth range between 18-25 m.

Distribution
Common in front of Noumea, found in the Southern parts of New Caledonia. Presently known only from New Caledonia.

Possible Confusions
None.

Order
Haplosclerida

Family
Chalinidae

Haliclona sanguinea Fromont, 1995

Haliclona sanguinea Fromont (holotype): I. Rédika, 20 m (photo P. Laboute)

External Characters
Small branching sponge. Erect and ramose anastomosing branches form a cluster with one or many points of attachment. Branches are laterally flattened and terminally rounded. External surface faintly hispid, shiny, smooth and reflective. Oscules on slight mounds at sides and tops of branches, small to 0.2 cm diameter. Texture extremely soft, collapsed, limp.

Dimensions
Overall size: 10 cm long, 4 cm wide. Single branch: 0.8 x 0.2 cm diameter.

Colour
Maroon to dark red-brown alive; brown in alcohol.

Skeletal Characters
Spicules are thin, small, hastate, brevipointed oxeas. Range: 84-103 µm x 2.3-4.7 µm, average: 91 µm x 4 µm. Close-meshed plumo-reticulate and isodictyal reticulation of spongin fibres centrally cored by spicules. Primary fibres 19-37 µm wide, cored by 2-5 spicules. Secondary fibres 12-19 µm wide, unispicular. Meshes triangular or polygonal, mesh size 360 µm. Skeleton less regular toward the centre of the sponge body. Interstitial spicules most abundant toward the centre of the sponge. Surface skeleton tangential, irregular isodictyal skeleton with meshes 48 mm wide and 1 spicule length long. Single spicules extend beyond the surface, thin spicules found interstitially at the surface. More dense pigmentation at the surface than internally.

Ecology and Habitat
Occurs on coarse sand attached to limestone substratum in full light. Depth range between 18-20 m.

Distribution
Uncommon in southern parts of the lagoon. Presently known only from New Caledonia.

Possible Confusions
Haliclona tyria because of the similar small branching habit of the two species and similarity in colour. However *H. tyria* is always deep purple and *H. sanguinea* is always dark red-brown or maroon. Once examined microscopically it is easy to see that the species are different. *H. tyria* has a unispicular, isodictyal reticulation while *H. sanguinea* has multispicular fibres in its skeleton.

Haliclona tyria Fromont, 1995

Haliclona tyria Fromont (holotype): I. Maître, 20 m (photo P. Laboute)

External Characters
Branching sponge with single, central, basal attachment. Branches solid, ramose and erect, round or laterally compressed in cross-section. Tallest erect branches taper towards apex, other branches lobed. Smooth, shiny and opaque surface with underlying skeletal pattern faintly apparent. Oscules 2-4 mm wide, with slightly raised rim, are abundant and regularly distributed on the uppermost face of branches. Texture very soft limp and fragile and sponge falls apart when handled.

Dimensions
Branches 15 cm long and 1-2 cm wide, 10-15 cm maximum spread.

Colour
Purple throughout alive, beige to fawn in alcohol.

Skeletal Characters
Spicules are slightly curved or straight oxeas with brevipointed fusiform or stepped ends. Range: 75-121 µm x 0.9-4.7 µm, average: 91 µm x 2.6 µm. Skeleton generally isotropic with some organisation into a square meshed or isodictyal reticulation of unispicular primary and secondary tracts. No multispicular tracts. Spongin occurs at the nodes of the reticulation. Interstitial spicules abundant and without order. Surface skeleton is a continuation of the choanosomal skeleton; no tangential surface layer.

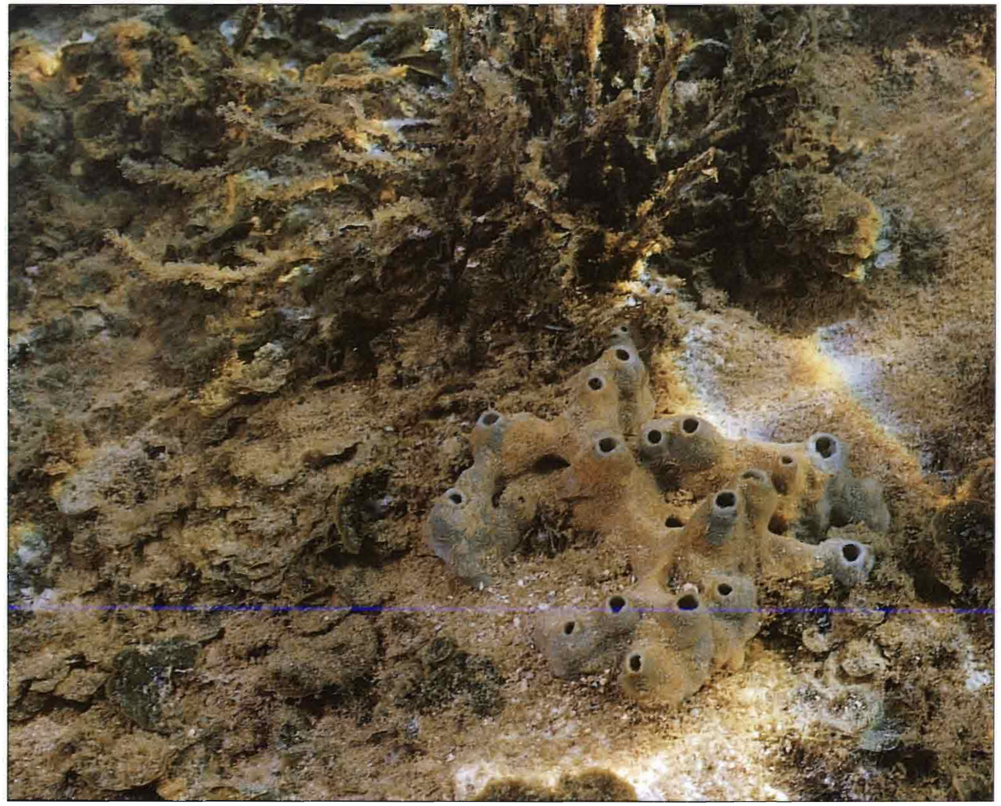
Ecology and Habitat
Occurs amongst coarse sand in *Halimeda* beds attached to large, stable limestone fragments, in full light. Some specimens are not attached to substrate. Depth range between 18-22 m.

Distribution
Common in front of Noumea, found in the Southern part of the New Caledonia lagoon. Presently known only from New Caledonia.

Possible Confusions
Haliclona sanguinea but this species is dark red-brown or maroon, not purple as for *H. tyria*. In addition the skeleton of *H. tyria* lacks multispicular tracts while the skeleton of *H. sanguinea* has them.

Family
Niphatidae

Gelliodes carnosa
Dendy, 1889



Gelliodes carnosa Dendy: Magenta, 1 m
(photo P. Laboute)

External Characters
Medium-sized sponge mound or erect lamella from which arise various sized tubes, singly or coalesced, with walls of variable thickness, thinnest apically 0.2 mm thick. Apical oscules 0.5-0.8 cm wide. External surface smooth, very finely hispid, like velvet, covered by transparent membrane hence skeletal patterning visible beneath. Texture tough, resistant, slightly compressible.

Dimensions
Overall size 5-8 cm tall, 6-8 cm wide, 2-5 cm thick. Single tubes 1-6 cm tall.

Colour
Light grey-blue to pale sky blue alive; fawn, orange or red brown in alcohol.

Skeletal Characters
Spicules fat, hastate oxeas, may have telescoped or truncated ends, some strongylote and stylote modifications. Range: 98-149 µm x 5-9.8 µm, average 129 µm x 7.4 µm. Microscleres c-shaped and faint centrangulate sigmas. Range: 21-24 µm, average: 23 µm. Dense reticulate spongin fibre skeleton. Primary fibres 36-96 µm wide centrally cored by 2-4 spicules. Meshes rectangular, mesh size 120-240 µm diameter. Secondary fibres 12-20 µm wide centrally cored by 1-3 spicules. Internal fibres brown with discrete pigment cells. Interstitial spicules occur. Internal skeleton may contain distinctive "growth rings" *i.e.* lines of condensation within the skeleton. Surface skeleton an isodictyal (triangular) network with abundant sigmas.

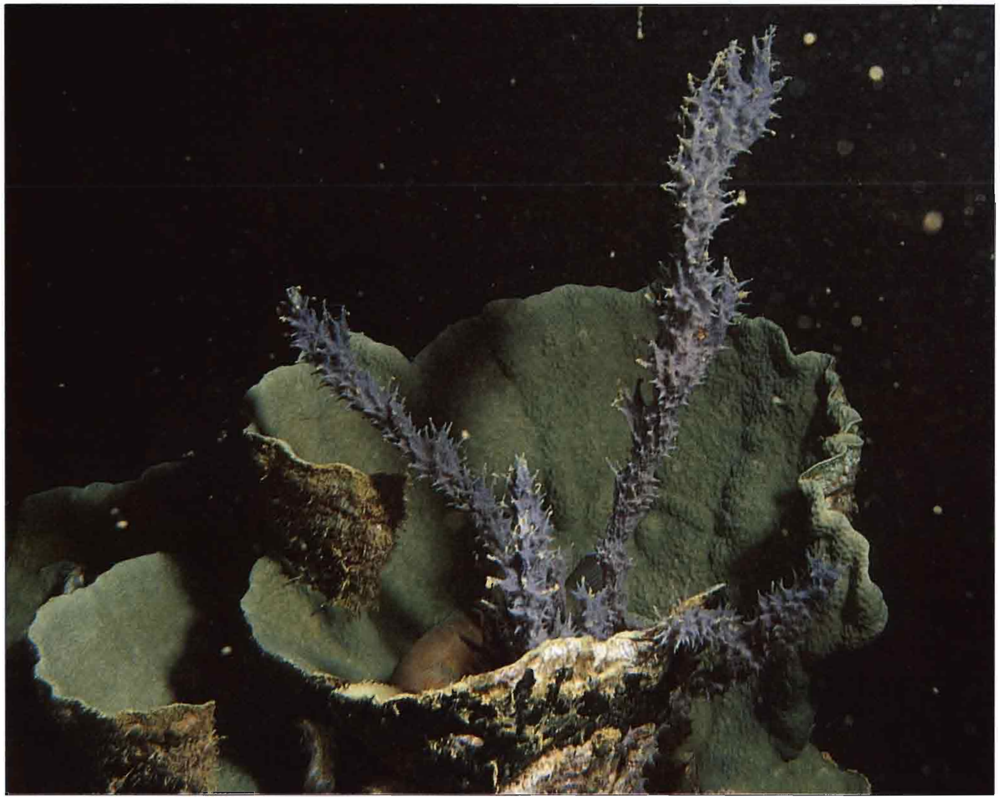
Ecology and Habitat
Amongst algae in intertidal areas, with high sediment loading, attached to limestone substratum. Found at the edge of beaches. Depth range between 0-5 m.

Distribution
Common in front of Noumea, New Caledonia; Indian Ocean.

Order
Haplosclerida

Family
Niphatidae

Gelliodes fibulata (Carter, 1881)



Gelliodes fibulata (Carter): E. Coast, Noumboue 20-25 m
(photo G. Bargibant)

External Characters

Large, erect or ramose branching sponge. Single, long branches anastomose and attach to substratum at one or many basal points. External surface of branches very spiny. Spines long, sharp, rigid spikes 0.5-1 cm in length, closely spaced at intervals of 0.4 cm. Primary spines extend from the sides of the branches and are covered in smaller secondary spines, up to 1 mm in length, giving the sponge a characteristic "prickly" appearance. A transparent membrane is visible between spines. Surface shiny. Texture rigid, slightly compressible.

Dimensions

Branches up to 12 cm in length, 5 x 4 cm wide.

Colour

Blue, grey-blue or mauve alive, spines with white tips; uniform ochre in alcohol.

Skeletal Characters

Spicules long, hastate oxeas, some truncate, curved or straight. Range: 219-276 µm x 3.7-8.4 µm, average: 253 µm x 5.6 µm. Microscleres c-shaped sigmas. Range: 12-21 µm, average: 16 µm. Plumo-reticulate skeleton of spicule tracts. Primary tracts branch dendritically, up to 150 µm wide and 450 µm wide at nodes prior to branching, cored by approximately 20 tightly packed spicules. Secondary tracts thinner spicule tracts parallel to primary tracts, 24-48 µm wide, cored by up to 9 spicules. Abundant interstitial spicules form an irregular reticulation with primary and secondary tracts. Surface skeleton a continuation of internal skeleton. Internal primary fibres support surface spines.

Ecology and Habitat

Grows on limestone substratum such as coral plates and among branching corals in calm bays with turbid water. Depth range between 10-30 m.

Distribution

Common but with a localised distribution on the East Coast of New Caledonia in the lagoon; Indo-west Pacific, South Australia, Torres Strait, North Australia, North East Australia; Indonesia; Vietnam.

Gelliodes persica Fromont, 1995

Gelliodes persica Fromont: S. Nouméa: Banc Gail, 33 m (photo P. Laboute)

External Characters
Tall, erect branches of variable diameter extending from a mound or stalked attachment. Surface conulose in most parts covered with a parchment-like thin skin firmly adhered to the underlying skeleton. Underlying spongin fibres visible as translucent lines. Conules low, 0.2 cm tall, and distributed at regular intervals of 0.3 cm. Oscules large, prominent with underlying canal system visible within, 0.5-0.7 cm wide, not numerous, present along edges of branches. Texture firm, compressible, easily torn longitudinally, not elastic.

Dimensions
Branches up to 21 cm tall, 6 cm wide, 4 cm thick.

Colour
Peach or salmon pink alive; dull fawn or brown in alcohol.

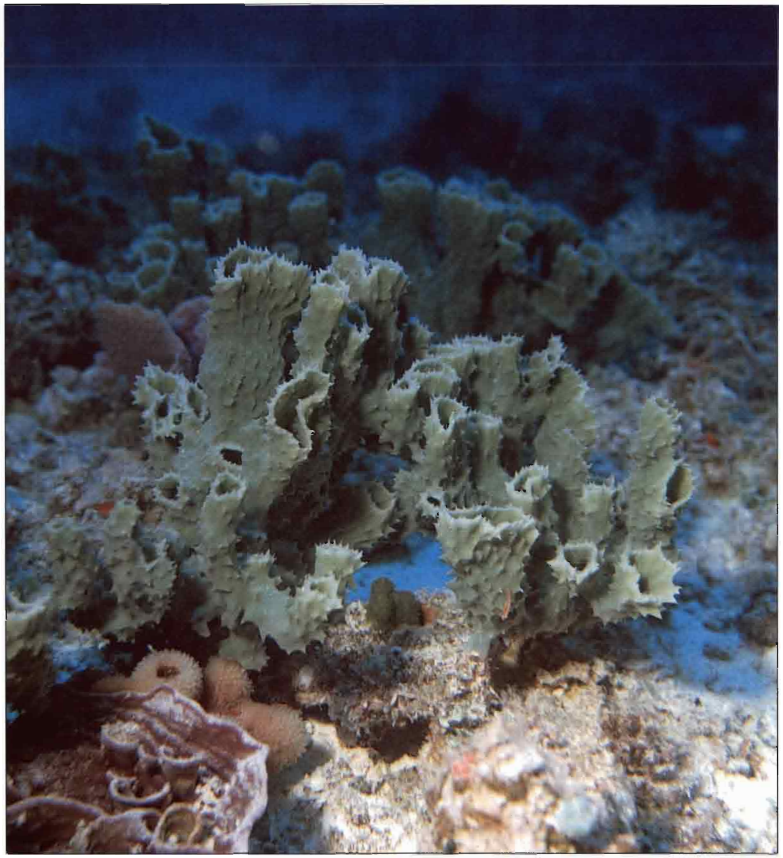
Skeletal Characters
Spicules long hastate oxeas with pencil points or telescoped ends, curved or straight. Range: 241-304 µm x 8.5-11.7 µm, average: 269 µm x 9.9 µm. Irregular plumo-reticulate fibre skeleton. Primary fibres very thick with well developed spongin, 180-360 µm wide, fully cored by 15-20 spicules. Meshes rectangular and very large 0.5-1 cm. Secondary fibres 60-120 µm wide, cored by 5-10 spicules, meshes up to 300 µm across. Interstitial spicules occur. Surface skeleton a continuation of the internal skeleton with dense pigmentation. Mesh spaces 100-150 µm between the surface spicule reticulation. Spicules at ends of primary fibres protrude at right angles beyond the surface and form conules.

Ecology and Habitat
Occurs attached to limestone substratum in muddy sediments in turbid water within calm bays. Depth range between 25-40 m.

Distribution
Baie de Prony, uncommon and dispersed in Southern parts of New Caledonia lagoon; Great Barrier Reef, Australia.

Family
Callyspongiidae

Callyspongia aerizusa
Desqueyroux-Faundez, 1984



Callyspongia aerizusa Desqueyroux- Faundez: Nouméa, I. Rédika, 20 m (photo P. Laboute)

External Characters
Sponge consists of a cluster of erect tubes gradually dilating towards the apices which are open and oscular. Tubes attach to the substrate by a common base. Internal surface of tubes smooth, with fine patterning produced by numerous small pores. External surface shiny, covered in soft tapering spines obliquely angled from sponge wall and distally directed, 0.4-0.9 cm high, 0.2-0.5 cm wide basally. Upper end of tube has uneven palisade of spines. Texture soft, compressible, easily torn.

Dimensions
Sponge can attain large size, tubes 2-2 cm tall; 1.5-3.5 cm diameter; apical openings 0.4-2 cm wide, tube walls 0.15-0.25 cm thick.

Colour
Turquoise, grey-green or blue-green alive; fawn in alcohol.

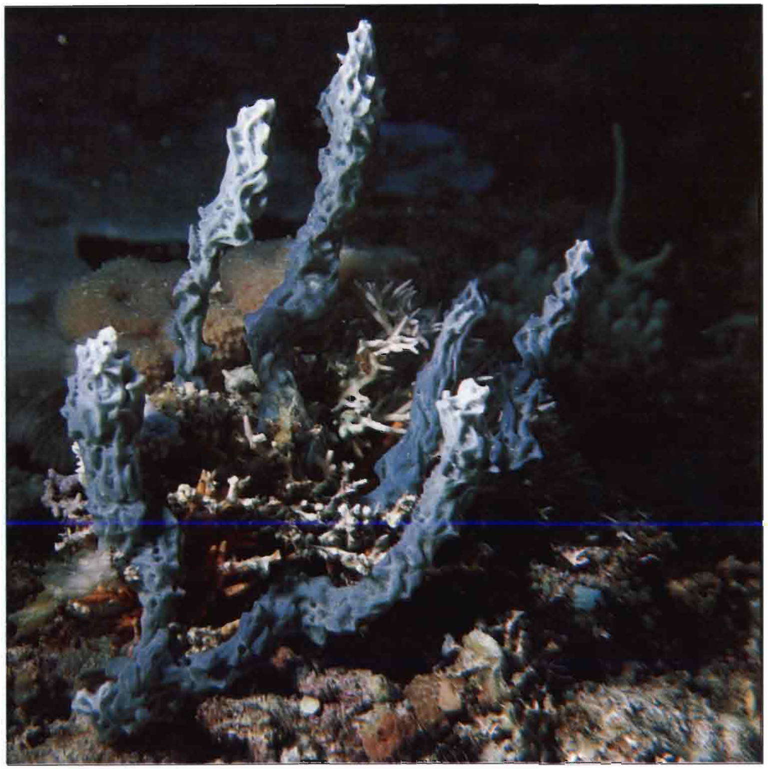
Skeletal Characters
Spicules are small, thin, hastate oxeas or strongyloxeas, curved or straight, with short blunt ends that can resemble a sharpened pencil. Size range 65-79 µm x 1.9-2.5 µm, average 74 µm x 2.1 µm. Compact regular reticulation of spongin fibres cored by loosely packed spicules, spongin obvious around spicules. Primary fibres, cored by 6-10 spicules, 23 µm thick, wider if fasciculate, up to 200 µm. Secondary fibres 14-50 µm wide, cored by about 4 spicules.
Thin tertiary fibres 5-5 µm wide, uni or paucispicular. Meshes triangular or polygonal between 50-100 µm diameter. Spicules also found interstitially. Surface skeleton supported by internal primary fibres which core external spines. Primary, secondary and tertiary fibres at the surface similar to the internal fibre reticulation.

Ecology and Habitat
Found in coarse sand attached to coral rubble, some specimens are found unattached. Always found in full light. Depth range between 10-33 m.

Distribution
Common in the Southern part of the New Caledonia lagoon, Great Barrier Reef, Torres Strait, North East Australia.

Possible Confusions
Callyspongia azurea which is distinguished by having upright or repent lobes or cylinders with elongated ridges and closed ends, and no spicules.

Callyspongia azurea Fromont, 1995



Callyspongia azurea Fromont: I. des Pins, N.E. I. Gie, 20 m (photo P. Laboute)

External Characters
Variable growth form. Often spreading mat or repent lobes, occasionally erect hollow cylinders. Characterised by its surface which tends to be clathrate *i.e.* irregular meandering ridges interspersed with elongated depressions. A fine transparent membrane joins the ridges in parts, which are raised by up to 0.2 cm and are 0.4 cm wide. Depressions are 0.1-0.3 cm wide. The surface is smooth, shiny, refractive and microscopically hispid. The tops of the lobes or cylinders have soft spines which anastamose and form a network. The apical spines are hispid while some specimens have curved, finger-like processes to 10 cm long projecting at an oblique angle to vertical. Oscules, 0.1-0.2 cm diameter, occur between ridges but are difficult to distinguish from the "holey" surface of the sponge. No apical oscules. Texture firm, compressible, resilient.

Dimensions
Cylinders up to 21 cm tall, 4 x 3 cm wide. Cylinder walls 0.3-0.5 cm thick.

Colour
Bright sky blue or steel grey alive; cream or fawn, occasionally with an orange tint, in alcohol.

Skeletal Characters
No spicules. Dense, compact, reticulate spongin fibre skeleton without coring spicules. Primary fibres, centrally fasciculate, do not form a regular mesh. Single primary fibres 30-84 µm wide, difficult to distinguish from secondary fibres not normally at right angles to primary fibres. Secondary fibres 18-30 µm wide. Tertiary fibres present and 8-12 µm wide. All fibres have parallel spongin bands. Large subdermal spaces occur, up to 1500 µm, beneath the surface membrane. Surface skeleton is a condensed form of the internal skeleton. The surface fibres have abundant spongin, primary fibres have dark pigmentation and are 48 µm wide. Secondary fibres 18-24 µm wide, tertiary fibres 6-12 µm wide.

Ecology and Habitat
Occurs on coral reefs attached to limestone substratum in full light. Depth range between 10-25 m.

Distribution
Uncommon in Southern parts of New Caledonia lagoon. Presently known only from New Caledonia.

Possible Confusions
Callyspongia aerizusa but that species has upright, open-ended tubes with soft spines, a less vivid blue colour alive, and the skeleton has spicules.

Order
Haplosclerida

Family
Callyspongiidae

Callyspongia communis (Carter, 1881)

External Characters
Small sponge with a spreading base of attachment from which arise short, erect, apically open tubes. Tubes coalesce or partially join by lateral projections. Internal and external surfaces similar, smooth and shiny with pore patterning visible beneath a superficial membrane. Tubes of variable width with periodic slightly raised bands where increases in thickness occur.
Texture firm, compressible, resilient, easily torn.

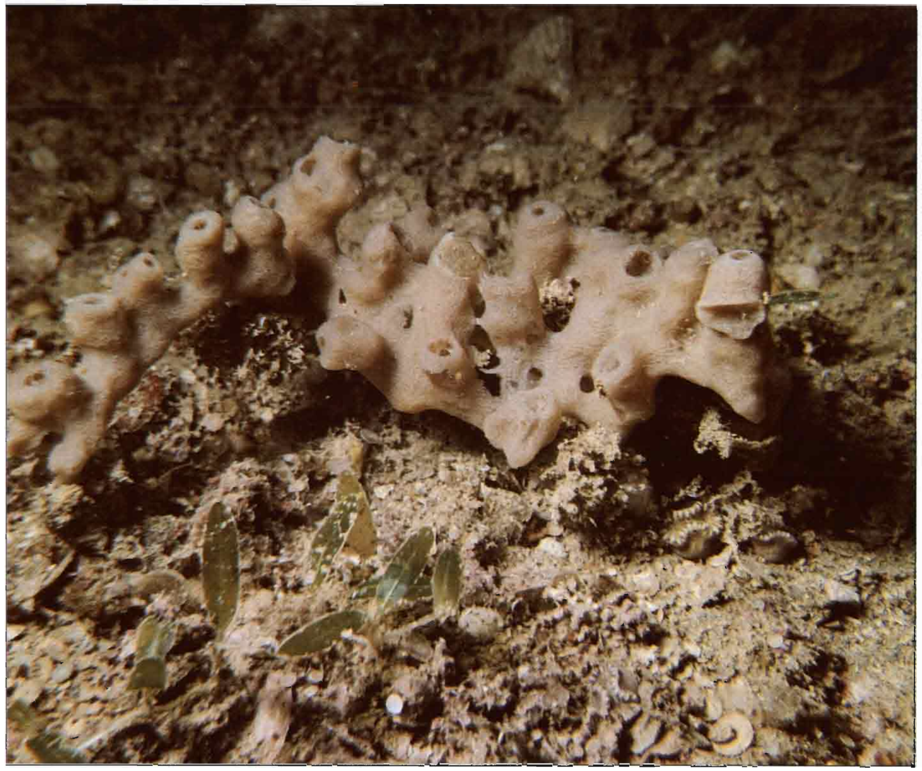
Dimensions
Overall size small, 4 cm tall, 8.5 x 6.5 cm spread. Individual tubes: 3 cm tall, 1 cm wide, tube walls 0.2-0.5 cm, apical oscules 0.8 cm diameter.

Colour
Cream-fawn with grey blue tinge alive; light brown in alcohol.

Skeletal Characters
Spicules small, variable shape, strongyloxeas, oxeote with short points or stepped ends. Range: 56-70 µm x 1.4-3.7 µm. Average: 64 µm x 2.6 µm. Skeleton a robust spongin fibre reticulation. Primary fibres loosely cored by 0-4 spicules, width of fibres up to 90 µm and 180 µm at the nodes of the reticulation. Meshes oval, up to 55 µm wide. Secondary fibres up to 40 µm wide cored by 0-3 spicules. Tertiary fibres up to 20 µm wide occurring within primary meshes, cored more visibly by up to 4 spicules. Primary and secondary fibres have spongin bands within fibres obscuring the spicule core. Surface skeleton the same as the internal skeleton except all fibres appear more heavily cored. Distinctive skeletal character is the presence of echinating spicules on surface side of secondary fibres *i.e.* spicule clusters protruding from one side of fibres at right angles.

Ecology and Habitat
Found on coarse sand in *Halimeda* beds or growing over Pecteniidae shells; in full light. Depth range between 10-25 m.

Distribution
Common in the lagoon in front of Noumea, New Caledonia; Red Sea; Indian Ocean; Pt. Jackson, Australia.



Callyspongia communis (Carter): Nouméa, between I. Canard and I. Maître (on *Chlamys*), 15 m (photo P. Laboute)

Callyspongia flammea Desqueyroux-Faundez, 1984

Callyspongia flammea Desqueyroux-Faundez: S.E. I. Ua, 20 m (photo P. Laboute)

Callyspongia flammea Desqueyroux-Faundez: Kouaré, 30 m (photo P. Laboute)

External Characters
Foliaceous or lamellate sponge with lamella usually joined to form an open funnel or bowl.
A short stalk at the centre base of the bowl attaches the sponge to the substrate.
The internal surface, with numerous oscular pores up to 1.0 mm in diameter, displays concentric bands or slight ridges at regular intervals towards uppermost edge of bowl.
External surface porous with irregular low tapering conules 2.0-3.0 mm high.
Upper edge of bowl hispid.
Texture soft, compressible, easily torn.

Dimensions
Specimens can be large, attaining 18 cm in height, basal stalk 1-2 cm in length, width of bowl up to 22 cm, lamella 0.1-0.5 cm thick, thinnest at upper edge of bowl.

Colour
Pastel pink or mauve with some blue colouration alive, fading to pale tones or white at top edge of bowl; uniform ochre in alcohol.

Skeletal Characters
Fibres lack spicules.
Dense spongin fibre forms an irregular reticulation.
Primary fibres may ramify and range in width from 40-100 µm.
Secondary fibres slightly smaller 20-70 µm wide.
Some thin tertiary fibres, up to 20 µm wide, occur.
Square or rectangular meshes between fibres are 60-90 µm diameter.
Surface skeleton identical to internal skeleton with a slightly smaller, regular mesh and very rare vestigial spicules.

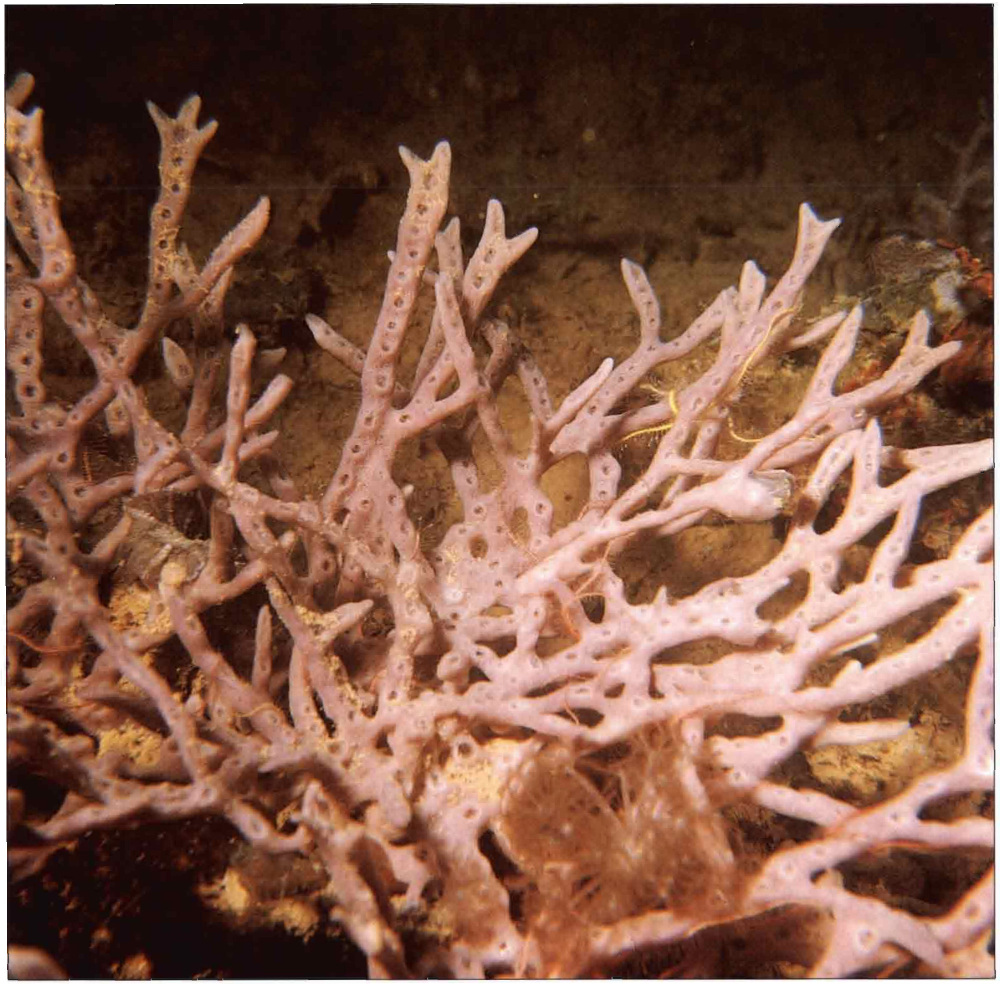
Ecology and Habitat
Attached to coral on hard substratum in full light.
Depth range between 16-25 m.

Distribution
Common but with localised distribution in the Southern part of the lagoon, New Caledonia.

Order
Haplosclerida

Family
Callyspongiidae

Callyspongia fruticosa Desqueyroux-Faundez, 1984



Callyspongia fruticosa Desqueyroux-Faundez: Banc Gail, 30 m (photo P. Laboute)

External Characters
Arborescent, ramified; branches subcylindric, sometimes anastosomed. Oscules on one side of branches, slightly proeminent, 0,3 cm wide. Surface smooth, parchment-like, but rather transparent for aquiferous system to be visible.

Dimensions
Branches 20 cm long x 0,4-0,8 mm thick.

Colour
Pinkish ochre or brownish ochre olive; light ochre or whitish ochre in alcohol.

Skeletal Characters
Spicules very thin; strongyloid oxeas, with very few silica. Range 75-85 µm x 0.5 µm. Skeleton a reticulation of spongin fibres. Meshes rectangular 150-400 µm wide. Primary fibres 56-110 µm wide cored by 6 to 10 spicules; secondary fibres 20-30 µm wide; meshes triangular subdivided by tertiary unispicular fibres.

Ecology and Habitat
Depth range between 10-38 m, Noumea lagoon.

Distribution
New Caledonia.

Order
Haplosclerida

Family
Callyspongiidae

Callyspongia hispidoconulosa Desqueyroux-Faundez, 1984

External Characters
Small sponge with spreading base of attachment from which arise erect, short, fat and rounded, apically open tubes. Tube walls may completely coalesce. Internal surface porous; external surface bristly, covered by short, tapering, blunt conules. Conules 2 mm tall, 2 mm wide basally, 1mm wide apically. Surface shiny. Texture firm, compressible, resilient.

Dimensions
Small overall size: 4 cm tall, 7 cm long, 3.5 cm wide, apical oscules 1 cm diameter, tube walls approximately 1 cm thick.

Colour
Orange, orange-pink or salmon alive; yellowish ochre in alcohol.

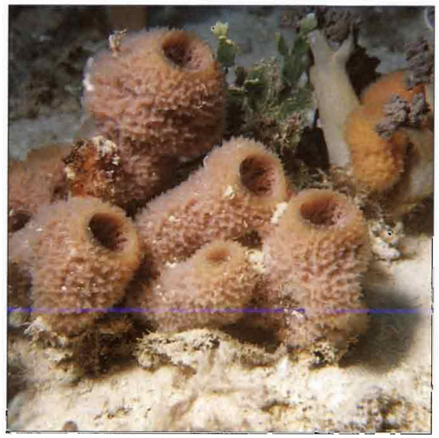
Skeletal Characters
Vestigial spicules rare, small, very thin. Size range: 37-79 µm x <1 µm, average 63 µm x <1 µm.

Skeleton a robust, irregular, spongin fibre reticulation. Primary fibres fasciculate, single primary fibres 60 µm wide, fasciculate primary fibres 180-300 µm wide, meshes between primary fibres rounded or quadrangular, 360 µm diameter. Secondary fibres 45 µm wide. Primary and secondary fibres have numerous spongin bands. Tertiary fibres rare, wavy, 20 µm wide, meshes between tertiary fibres 120 µm diameter. Surface skeleton supported by internal primary fibres. Tertiary fibres form a condensed reticulation tangential to the surface.

Ecology and Habitat
Found on hard substratum attached to coral in full light. Depth range between 5-30 m.

Distribution
Common but dispersed in front of Noumea and in Southern parts of the New Caledonia lagoon.

Callyspongia hispidoconulosa Desqueyroux-Faundez: Récif Ua, 20-25 m (photo P. Laboute)



Callyspongia hispidoconulosa Desqueyroux-Faundez: I. Ua (photo P. Laboute)

Order
Haplosclerida

Family
Callyspongiidae

Callyspongia subarmigera (Ridley, 1884)

External Characters
Small string-like sponge. Long, thin branches are compressed at intervals, tapered to spines at ends, and branch dichotomously. Surface smooth, shiny and sufficiently transparent for skeletal network beneath to be faintly visible. Texture soft, compressible, resilient. Oscules comparatively large, 0.2 cm wide, on one side of branches, regularly spaced at about 0.3 cm intervals.

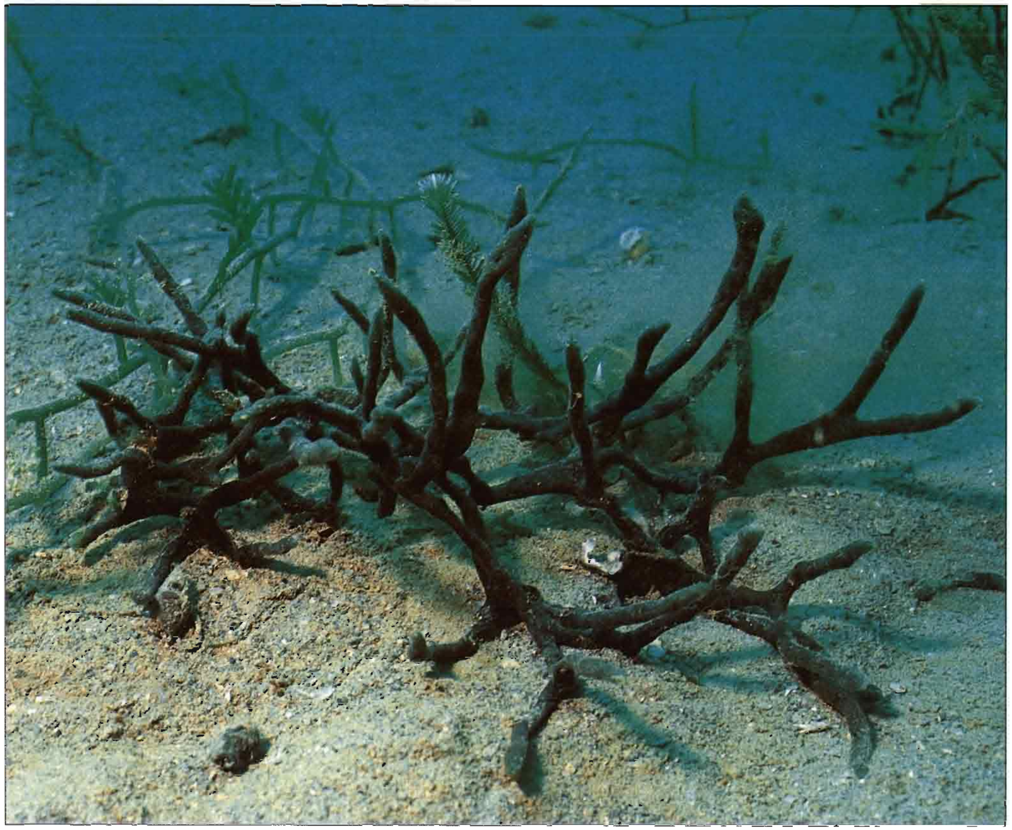
Dimensions
Branches 14 cm long, <0.5 cm x 1 cm thick.

Colour
Deep olive green or bright green alive; light ochre in alcohol.

Skeletal Characters
Spicules small, vestigial fusiform oxeas. Range: 65-93 µm x 0.9-4.7 µm, average 79 µm x 1.7 µm. Skeleton a compact rectangular reticulation of spongin fibres cored by loosely packed spicules, spongin apparent around the spicules. Primary fibres thin, 24-36 µm wide, cored by up to 30 spicules. Meshes rectangular 240-360 µm wide. Secondary fibres, 12-24 µm wide, cored by up to 15 spicules, meshes 180-300 µm. Tertiary fibres 7-12 µm wide, cored by 1-3 spicules, meshes 36-84 µm diameter. Interstitial spicules occur. Surface skeleton tangential, peripherally condensed, consisting of fibres thinner than in the internal skeleton. Primary fibres cored by 6-8 spicules, secondary fibres by 3-4 spicules, tertiary fibres by 1-3 spicules.

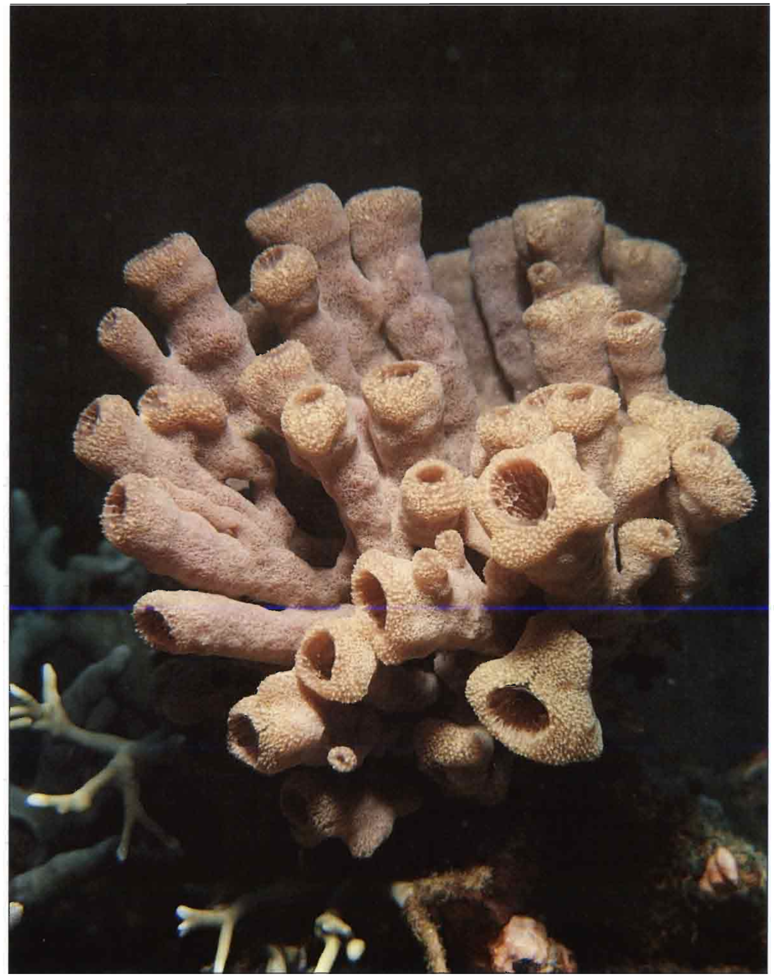
Ecology and Habitat
Found on coarse sand in *Halimeda* beds in full light. Usually attached to coral rubble or shell but can be found unattached to the substratum. Depth range between 8-15 m.

Distribution
Common but localised distribution in front of Noumea, New Caledonia; North East Australia, Philippines, Tulear.



Callyspongia subarmigera (Ridley): Baie de Ste Marie, 12 m (photo P. Laboute)

Dactylia delicata (Pulitzer-Finali, 1982)



Dactylia delicata (Pulitzer-Finali): Canal Woodin, 20-30 m (photo P. Laboute)

External Characters
Sponge consists of erect, straight tubes joined by a spreading basal attachment. Tubes are tall and thick, grow singly without coalescence, and do not taper at the apex. Surface smooth, minutely porous, with faint skeletal pattern. Microscopically a dense sandy surface network is clearly visible. Apices of tubes can be membranous but this is not seen in preserved material. Internal surface of tubes has longitudinal skeletal tracts. Texture very soft, limp, fragile, and sticky when collected.

Dimensions
Single tubes 4-25 cm tall, 0.5-2.5 cm wide. Thickness of tube wall 0.3 cm. Whole sponge can cover a 15 x 9 cm area of substrate.

Colour
Salmon pink or peach alive, fawn in alcohol.

Skeletal Characters
No spicules. Skeleton is a reticulation of thick, sand-filled fibres and long, thin fibres clear of foreign material. Primary and secondary fibres are cored with sandgrains and form a plumose to plumo-reticulate skeleton. The secondary fibres are reduced or sometimes absent from the skeleton. Tertiary fibres are fine and clear of sandgrains. They form a dense network, without regular meshes, between the primary and secondary fibres. Primary fibres up to 150 µm wide; secondary fibres up to 90 µm wide, tertiary fibres 7-24 µm wide. Surface skeleton a continuation of the internal skeleton but more compact.

Ecology and Habitat
Occurs on hard substratum attached and growing between coral branches and coral rubble in areas with current and in full light. Depth range between 8-25 m.

Distribution
Common in Canal Woodin, found in southern parts of New Caledonia lagoon, and southern region of the Great Barrier Reef, Australia.

Family
Petrosiidae

Petrosia capsa Desqueyroux-Faundez, 1987

Petrosia capsa Desqueyroux-Faundez: N. Ile des Pins, outer reef slope, 38 m (photo P. Laboute)

External Characters
Large sponge with massive spreading base from which arise erect, solid lobes, with central apical cavities, or a thick walled bowl. Flat, smooth surfaces due to thick superficial skin 0.5 cm thick. Texture firm, slightly compressible, resilient.

Dimensions
Compact thick walled bowls or 1 to 4 chimneys from an encrusting base. Overall size: 18 cm tall 11 cm deep 15 cm wide. Dimensions of cups or depressions: <5 cm deep up to 8 x 7 cm across.

Colour
Red-brown and cream brown alive, individuals may have both colours; chocolate brown in alcohol.

Skeletal Characters
Spicules predominantly strongyles with some strongyloxeas, long, pronounced curve, flexuous or straight, some with lumpy ends. Range: 144-228 μm x 6-10.8 μm; average 196 μm x 8.3 μm. Robust reticulate skeleton of spicule tracts without spongin fibre development. Distinctive thick tracts of spicules, 0.5 mm wide, occur at intervals of 1.5 mm parallel to sponge surface. Primary tracts 130 μm wide, and up to 420 μm wide where tracts are thickest before bifurcating. Primary tracts densely packed with up to 30 spicules. Meshes between primary tracts large, up to 1200 μm diameter. Secondary tracts 90 μm wide packed with at least 10 spicules. Interstitial spicules abundant. Dense mesohyl contains numerous dark brown pigment cells. Large canals internally. Surface skeleton as for internal skeleton with thinner tracts, 36-48 μm wide, and small, round meshes 108 μm wide.

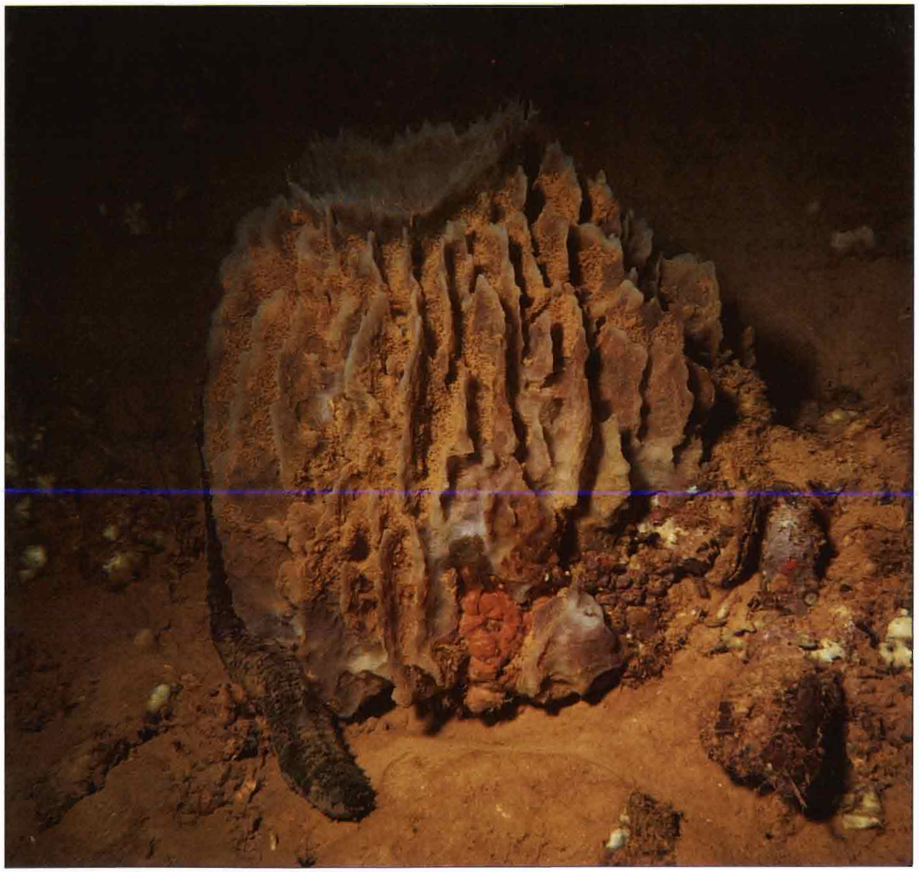
Ecology and Habitat
Found well attached to limestone substratum on vertical slopes and in shadow. Depth range between 35-50 m.

Distribution
Uncommon and localised on the Ile des Pins and outside the barrier reef on the outer slopes, New Caledonia.

Order
Haplosclerida

Family
Petrosiidae

Xestospongia bergquistia Fromont, 1995



Xestospongia bergquistia Fromont: Baie du Prony, 20 m (photo G. Bargibant)

External Characters
Massive volcano or barrel-shaped sponge. Surface of deep internal crater smooth and porous, externally large ridges or flukes, up to 6 cm long by 5 cm wide by 2 cm thick, perpendicular to surface. Oscules visible on internal surface. Texture slightly compressible, almost stoney, not resilient.

Dimensions
Overall size: up to 100 cm, radius 30 cm. Thickness of wall: 0.5 cm at upper edge of cup, to 14 cm at base of cup. Crater approximately two thirds height of sponge.

Colour
Externally red-brown or maroon alive, internal surface of cup maybe paler shade of exterior, flukes or ridges may have white ends; ochre in alcohol.

Skeletal Characters
Spicules strongyloxeas or strongyles, curved or straight of variable width, most thick. Range: 108-396 µm x 9.6-14.4 µm; average: 283 µm x 11.8 µm. Strongly developed reticulate skeleton of spicule tracts, no spongin fibre development visible. Primary tracts 300 µm wide, packed with up to 20 spicules. Meshes rounded, up to 720 µm diameter. Secondary fibres 120 µm wide, packed with 10 spicules. Interstitial spicules abundant, large internal canals up to 2000 µm diameter. Surface skeleton an extension of internal skeleton; meshes rounded, 180-480 µm diameter. One or two spicules extend beyond the surface at the ends of the primary tracts.

Ecology and Habitat
Occurs attached to dead coral or limestone substratum in calm bays and in turbid water. Depth range between 30-40 m.

Distribution
Localised only in Baie de Prony, New Caledonia lagoon; North East Australia.

Possible Confusions
Xestospongia testudinaria. Identical gross morphology but *X. testudinaria* has much more resilient texture, and spongin fibre development around spicule tracts.

Order Haplosclerida

Family Petrosiidae

Xestospongia exigua (Kirkpatrick, 1900)

Xestospongia exigua (Kirkpatrick): Baie du Prony, 10 m (photo G. Bargibant)

External Characters
Irregular massive, lobed, or erect branching sponge. Short lobes or erect branches extend from a mound-like base. Surface smooth, sticky, opaque, microscopically hispid. Underlying skeletal pattern faintly visible. Oscules small <0.2 cm diameter on upper surface and lobes. Texture firm, slightly compressible, crumbly, friable.

Dimensions
Overall size: 6 cm long, 4 cm wide, 3-8 cm high. Lobes and branches are 2-8 cm high, <5 cm wide.

Colour
Ochre to chocolate brown throughout alive; cream to fawn in alcohol.

Skeletal Characters
Spicules oxea. Range: 119-159 µm x 4.2-5.6 µm, average 131 µm x 5 µm. A confused skeleton of spicule tracts without spongin fibre. The reticulation is irregular isodictyal with a very compact mesh. Primary and secondary tracts indistinguishable, 120 µm wide at widest point, cored by 1-4 spicules, no tertiary tracts. Interstitial spicules dense. Surface skeleton same as internal skeleton. Tracts at right angles to surface extend beyond to produce a slightly hispid surface.

Ecology and Habitat
Found growing between branching coral, on coral rubble and limestone substratum in calm bays on fringing reefs in full light. Depth range between 5-25 m.

Distribution
Very localised distribution in Baie de Prony, New Caledonia; Christmas Island, Indian Ocean; Great Barrier Reef, Darwin, Australia; Papua New Guinea; West-Central Pacific: Palau.

Possible Confusions
None, but the variability of morphology and wide biogeographic distribution suggests a species complex that needs genetic analyses and hybridisation studies to resolve.

Order
Haplosclerida

Family
Phloeodictyidae

Oceanapia tenuis Desqueyroux-Faundez, 1987

External Characters
Massive cup-shaped sponge, attached by large basal region to substratum. Large central cavity, decreases in radius at the base of the sponge. Surface smooth due to a thin non-detachable skin, 0.1-0.2 cm thick, not transparent. Small oscules, 0.1 cm diameter, not numerous, on both internal and external walls of sponge. Small fistules, 1 cm long and 2 cm thick, present on the external surface. Texture firm, compressible, resilient. Interior skeleton stringy.

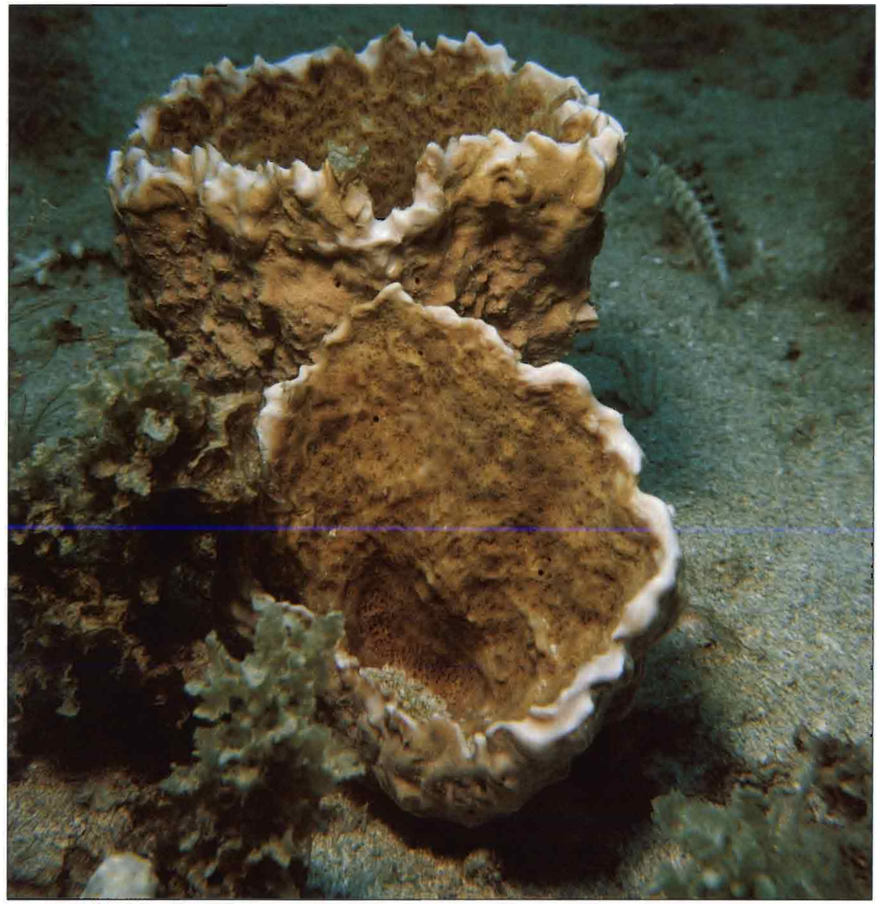
Dimensions
Overall size large: 11.5 cm tall, 9.2 cm diameter. Thickness of wall: 0.5 cm apically to 2 cm at base of sponge.

Colour
Ochre within cavity, light ochre externally alive, white apical edge; brown in alcohol.

Skeletal Characters
Small, thin spicules, strongyles or strongyloxeas, curved or straight. Range: 65-98 µm x 1.4-3.7 µm, average: 86 µm x 2.7 µm. Robust reticulate skeleton of spicule tracts without spongin fibre development. Primary tracts 90-120 µm wide densely packed with 60 spicules. Primary meshes oval or round, 240-450 µm diameter. Macroscopically stringy, internal tracts are visible parallel to the surface, and microscopically thickest tracts can be at right angles or parallel to the surface. Secondary tracts, distinguished by size, 30-60 µm wide, packed with 25 spicules, meshes 210 µm diameter. Dense mesohyl is pigmented and interstitial spicules are abundant. Two surface skeletons differ. Internal surface has a unispicular, isodictyal skeleton with very dark pigmentation. External surface skeleton is a tangential, unispicular, isodictyal skeleton without heavy pigmentation.

Ecology and Habitat
Found on coarse sand in *Halimeda* beds in full light. Depth range between 18-25 m.

Distribution
Uncommon and rare, dispersed populations found in front of Noumea, New Caledonia.

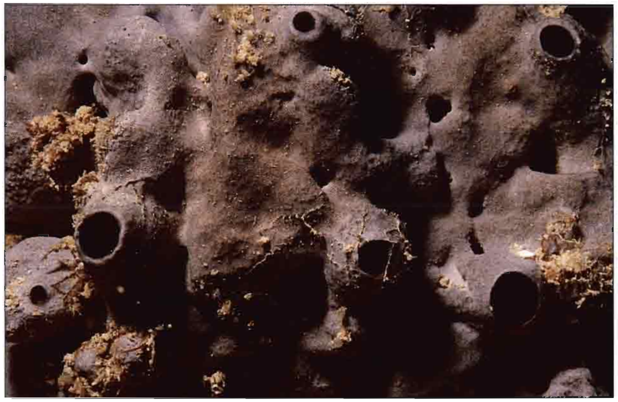


Oceanapia tenuis Desqueyroux-Faundez: Récif Croissant, 12 m (photo P. Laboute)

Order
Dictyoceratida

Family
Spongiidae

Spongia australis Bergquist, 1995



Spongia australis Bergquist (holotype): Chenal des 5 milles, 20 m (photo P. Laboute)

External Characters
A thick, spreading sponge with deeply undulating contours and randomly dispersed oscular turrets. Attachment to the substrate is at intervals across the base. The surface is microconulose, almost smooth in patches but slightly abrasive to the touch as a result of a concentration of sand in the dermal membrane. The oscules are large and elevated, the pores small and scattered and the texture is compressible, resilient but firmer than that of commercial species of the genus.

Dimensions
Covering an area 12 by 16 cm, body is 3-5 cm thick. Oscules are 3-12 mm in diameter.

Colour
Steely blue-grey in life, chocolate brown in ethanol.

Skeletal Characters
The skeleton is a dense network made up predominantly of uncored secondary fibres 5-25 µm in diameter. The primary fibres are frequent, cored, 40-70 µm in diameter and most evident in the immediate subsurface region.

Soft Tissues
The body is evenly and very lightly infiltrated by collagen with an ectosomal region differentiated only by the presence of large exhalant canals. Choanocyte chambers are small, circular, 15-20 µm in diameter.

Ecology and Habitat
Occurs on hard stable surfaces under overhangs and in crevices at 20-25 m depth. Thus far known only from the southern lagoon, where it is occasional only.

Distribution
New Caledonia.

Possible Confusions
Petrosaspongia nigra, from which *Spongia australis* can easily be distinguished by its spongy texture as opposed to the rock hard texture of *Petrosaspongia*.

This is the most diverse of the so-called "keratose" sponge orders - sponges that lack mineral spicules. The skeleton is composed exclusively of well developed spongin fibres, although detritus and contaminating spicules may also be acquired by some species. Sponges are usually tough, difficult to tear, and frequently have differences in pigmentation between the surface and interior. The main skeleton consists of a reticulation of spongin fibres, often organised into primary, secondary and sometimes tertiary networks. Fibres are usually homogeneous or lightly laminated in cross-section, with or without a central diffuse pith, and in some genera collagenous filaments are scattered within the mesohyl. Reproduction is viviparous, and larvae are large, incubated parenchymella, evenly covered with short cilia except at one pole where tufts of large flagella occur, and both poles have rings of pigmented cilia-free cells.

Dictyoceratids are a diverse and abundant group of coral reef sponges, and there are many species in New Caledonia. Included in this group are the commercial "bath" sponges. Many species are black, grey or dark brown although brilliant purple, blue or yellow pigmentation is not uncommon. Dictyoceratid sponges are found in all parts of the reef, from the reef front to the lagoon floor. Common genera are *Dysidea*, *Ircinia*, *Euryspongia*, *Hyrtios* and *Spongia*.

Order
Dictyoceratida

Family
Spongiidae

Coscinoderma mathewsi (Lendenfeld, 1889)

External Characters
A massive, hemispherical sponge with oscules located laterally and apically along low, lamellate extensions of the general body surface. The surface is remarkably regular, it is strongly conulose with adjacent elements linked by surface tracts to form an intricate reticulum. Individual conules are 1-3 mm high with rounded tips. Oscules are flush with the surface with a slightly elevated elastic lip. The texture is extremely soft and compressible indicative of spongin fibre of the highest commercial quality.

Dimensions
The sponge is known to be 10-20 cm high, 15 cm wide. Oscules are 2-6 mm in diameter.

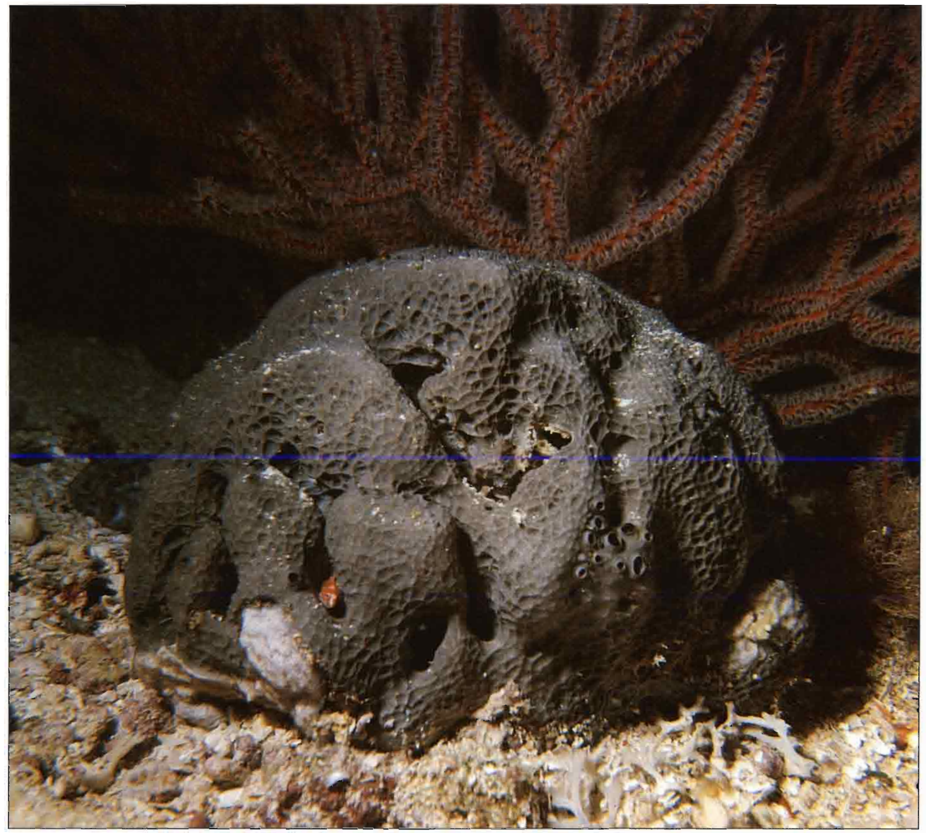
Colour
In life grayish to black externally, pale yellow-brown internally, in ethanol the same.

Skeletal Characters
The skeleton is a network of slightly trellised, thin primary fibres 40-100 µm in diameter which are cored, and secondary fibres 3-12 µm in diameter which are thin, vermiform and intertwining. The latter make up the bulk of the skeleton. There is an organised uniform sand cortex.

Soft Tissues
An ectosomal region, 250-350 µm deep is differentiated and marked by collagen tracts which run parallel to the sponge surface providing support and cohesion to the sand cortex. The choanosome, internal to this has uniform light collagen deposition and spherical choanocyte chambers 15-30 µm in diameter.

Ecology and Habitat
Occurs on coral rubble at the base of fringing and intermediate reefs and on lagoon bottoms attaching to hard basal substrate. Moderately common on the east coast of New Caledonia in depths of 20-35m.

Distribution
Micronesia, Fiji, New Caledonia.



Coscinoderma mathewsi (Lendenfeld): Passe de Yandé, 32 m (photo P. Laboute)

Leiosella ramosa Bergquist, 1995

External Characters
A ramose sponge branching in irregular fashion from a single base of attachment, the stalk and individual branches are elliptical in cross-section. The oscules are located mainly on the sides of branches rather than on the wider flattened face and lie flush with the surface. Marked exhalant canals channel the surface as they converge toward the oscules, otherwise the surface is smooth dominated by a very finely reticulated sandy crust which lies in the plane of the surface.
The texture is harsh and just compressible.

Dimensions
The sponge extends from a base, 4 cm wide to a height of 35 cm. Oscules are small, 2-3 mm in diameter.

Colour
In life beige, in ethanol brown.

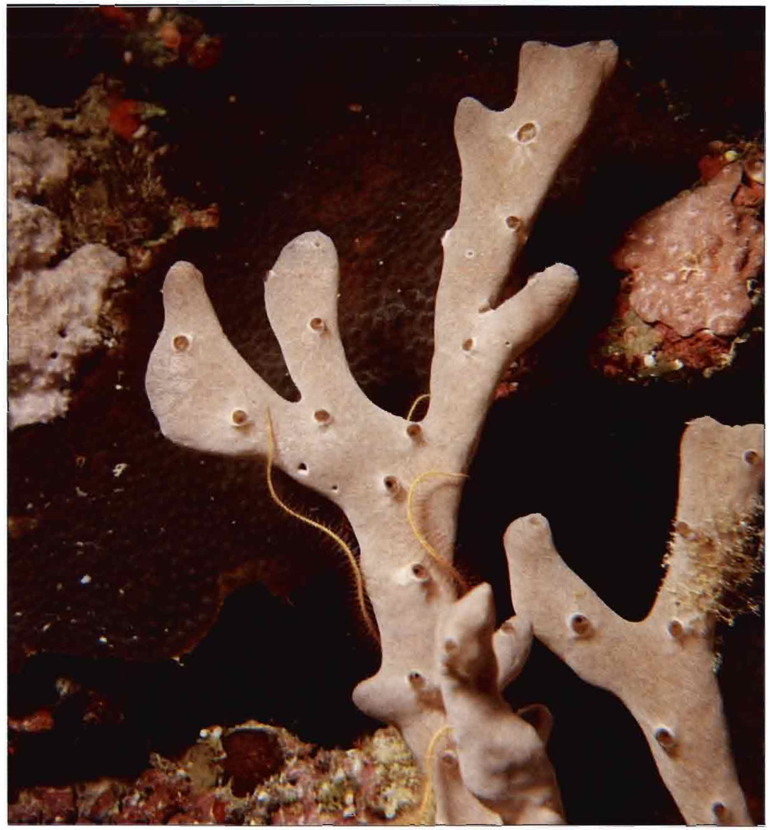
Skeletal Characters
The skeleton is a network predominantly made up of uncored secondary fibres, 10-40 µm in diameter, arranged in a very tight anastomosing pattern. Primary fibres are simple, cored, and of uniform diameter 50-70 µm wide in the deeper regions of the sponge, but become fasciculated where they converge toward the surface.

Soft Tissues
Collagen deposition is uniform throughout the sponge with no ectosomal region, other than from the surface sandy crust, present. Choanocyte chambers are spherical, 15-20 µm in diameter.

Ecology and Habitat
Occurs on the outer reef at 50 m depth, attaching to the wall of a cave. The species is not common and is known only from northern New Caledonia.

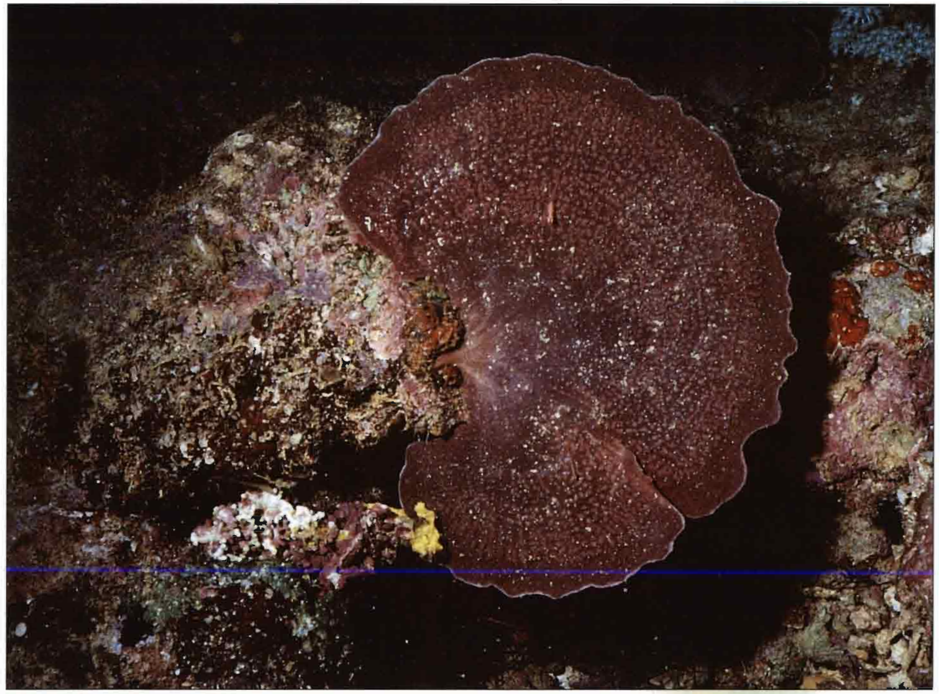
Distribution
New Caledonia.

Possible Confusions
Hyrtios reticulata which has a conulose surface and cylindrical branches.



Leiosella ramosa Bergquist (holotype): Récif des Français, 27 m (photo P. Laboute)

Phyllospongia papyracea (Esper, 1806)



Phyllospongia papyracea (Esper): Récif Doiman, 15 m (photo G. Bargibant)

External Characters

A lamellate multilobed or disc-shaped, stalked sponge with lamellae often excavated in irregular fashion, sometimes producing strap-like extensions.
The body is always extremely thin and is frequently infested with boring barnacles (*Acasta* sp.).
The oscules are small, flush with the surface and distributed evenly over one face of the lamella. The surface is smooth, never macroscopically showing any canals or organised pore areas. Microscopically tiny conules are apparent. The texture is tough, pliable and elastic.

Dimensions

Specimens can become very large, extending from a stalk approximately 20 mm in diameter to a height of 40 cm, the lamella always being 1.0-2.0 mm thick. Oscules are 0.2-0.5 mm in diameter.

Colour

The colour in life ranges from beige to pale golden brown or burgundy, in ethanol brownish cream.

Skeletal Characters

The skeleton is made up of three types of fibres. Primary fibres which are usually cored extend vertically from the attachment point and radiate to intersect both surfaces at right angles. Secondary uncored fibres connect the primary elements. Tertiary, vermiform fibres augment the skeleton in the centre of the lamella and form marked fascicles toward the base. These are never present near the growing margin and are restricted to the basal lamella and stalk in very thin forms.

Soft Tissues

The fibre reticulum is dominant. Soft tissues are very lightly collagen reinforced with only slight enhancement as an ectosomal thickening on the oscular face. Choanocyte chambers are slightly oval, 25-35 μm in greatest dimension.

Ecology and Habitat

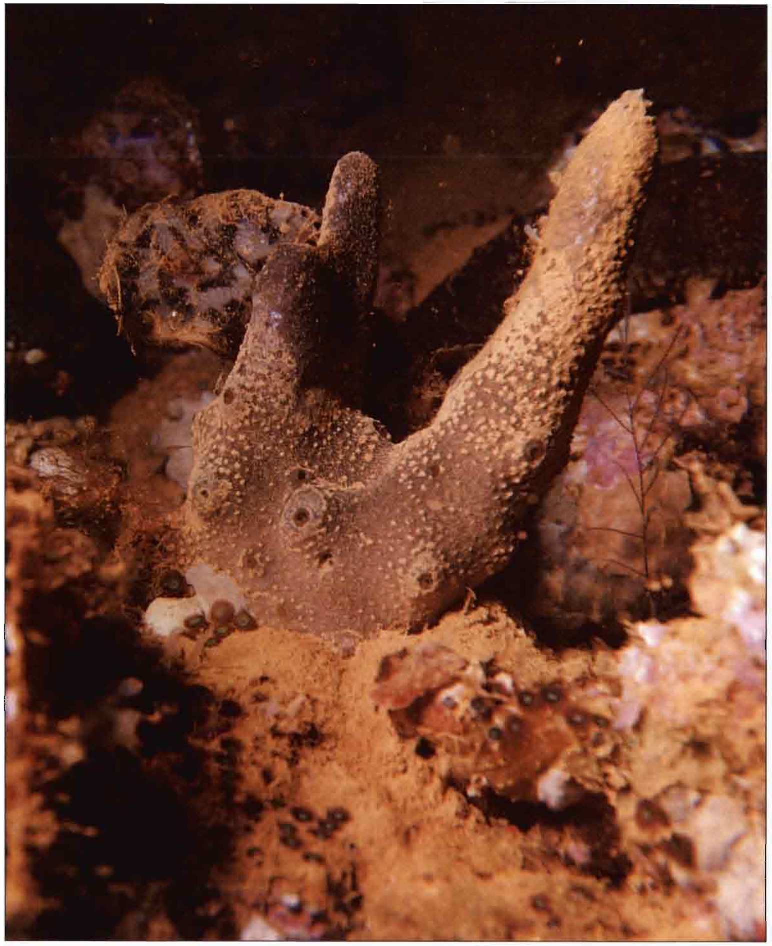
Sponge occurs on the outer reef on clean eroded coral slabs or faces, between 15 and 30 m depth. The species is not common and is present only on the east coast of New Caledonia.

Distribution

Indo-Pacific, Northern Great Barrier Reef, N.E. New Caledonia.

Family
Thorectidae

Hyrtios reticulata (Thiele, 1899)



Hyrtios reticulata (Thiele): Baie du Prony, 35 m (photo P. Laboute)

External Characters
A repent sponge with cylindrical branches extending from a somewhat flattened base which extends over coral rubble. Oscules are small, spherical, flush with the surface, and scattered over base and branches and surrounded in each case by a clear area of dermal membrane.
A dominant feature of the surface is the tracery of radiating ridges extending between the very regularly dispersed low conules (0.3-1.0 mm high).
The texture is firm and just compressible.

Dimensions
The sponge is up to 40 cm high, 15 cm wide with branches up to 12 cm high and 1.5 cm in diameter. Oscules are 2-5 mm in diameter.

Colour
In life grey to yellow brown, in ethanol the same.

Skeletal Characters
The skeleton is a compact regular network of cored fibres in which primary fibres can be identified only as short tracts which condense out of the secondary network in the immediate subdermal region. The fibres are 10-50 µm in diameter and show clear stratification.

Soft Tissues
There is a distinct ectosomal region, 1500 µm deep which is marked by the presence of a sandy layer and light collagen deposition. Except near conules, there is an abrupt boundary between the ectosome and the underlying choanosome. Choanocyte chambers are spherical, 20-35 µm in diameter.

Ecology and Habitat
Occurs on coral rubble at the base of fringing reefs and in silty bays at 15-50 m depth. Very common in the south and on the east coast of New Caledonia.

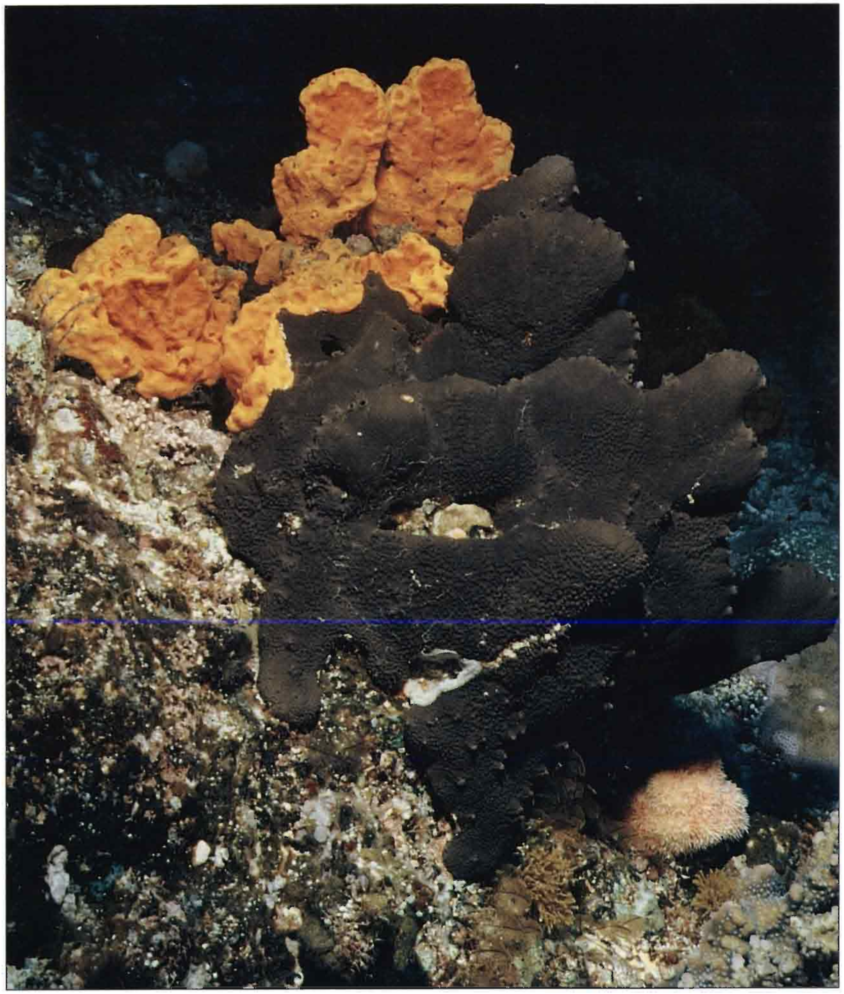
Distribution
Celebes, New Caledonia.

Possible Confusions
See under *Leiosella ramosa*.

Order
Dictyoceratida

Family
Thorectidae

Petrosaspongia nigra Bergquist, 1995



Petrosaspongia nigra Bergquist: Passe de Boulari, 15-18 m (photo G. Bargibant)

External Characters
A massive, spreading sponge with thick interlacing lobes arising from a spreading base. The surface is finely and evenly conulose with a brittle rough aspect. Oscules are small, flush with the surface and scattered over the body and the texture is extremely hard and incompressible, almost rock-like.

Dimensions
This is a large sponge covering areas of up to 50 by 60 cm and extending 20 cm above the attachment base. Conules are 0.2-0.3 mm high and oscules are 1-2.5 mm in diameter.

Colour
External colour in life jet black, internally pale yellow to beige, in ethanol the same.

Skeletal Characters
The skeletal network is extremely dense, made up predominantly of tightly interlocking, strongly laminated, uncored secondary fibres. Primary fibres are short, cored and arise just below the surface by fusion of secondary fibres to form a spongin plate from which the cored fibres extend into the conules. Primary fibres are 90-110 µm in diameter, secondary fibres predominantly 26-60 µm with some being extremely fine 8-10 µm, and almost forming a patchy tertiary network.

Soft Tissues
An ectosomal region, 200-500 µm deep is clearly set off from the underlying choanosome. It is packed with pigment cells and has light even collagen deposition as does the choanosome. Choanocyte chambers are spherical, 20-25 µm in diameter.

Ecology and Habitat
Occurs along the edges of passes in the reef and on the outer reef attached to coral formations in 12-40 m depth. The species is common around Noumea and in the south of New Caledonia.

Distribution
New Caledonia.

Luffariella caliculata Bergquist, 1995

External Characters
A shallow cup-shaped sponge of regular shape with an upper oscular surface thrown into low undulations and a smooth poral face. The surface is evenly conulose and the oscules are in oscular complexes of 3-6 which are evenly dispersed and slightly depressed below the general body surface. The texture is compressible and springy.

Dimensions
The sponge is 15 cm high, 14 cm across and the attachment base is 4 cm in diameter. Oscular complexes are 5-8 mm in diameter and conules 0.5-1 mm high.

Colour
The external pigmentation in life and in ethanol is golden brown, and the internal colouration in life is cream, in ethanol golden brown.

Skeletal Characters
The skeleton is a moderately dense network of primary fibres in which coring material is reduced to only a few scattered spicule fragments. Near the surface the fibres taper sharply to points and often divide into two or three multiple p rongs. The secondary reticulum is regular and almost rectangular, and the fibres are uncored. An extremely fine tertiary network is present. Primary fibres are 120-350 µm in diameter, secondary fibres 10-50 µm and tertiary fibres 2-5 µm in diameter.

Soft Tissues
The ectosomal region is 250-350 µm deep and mainly occupied by large canals. The choanosome is lightly infiltrated by collagen and the choanocyte chambers are spherical, 15-25 µm in diameter.

Ecology and Habitat
Occurs on the reef front attached to coral heads between 30 and 50 m depth. The species is not common and occurs only in the south east of New Caledonia.

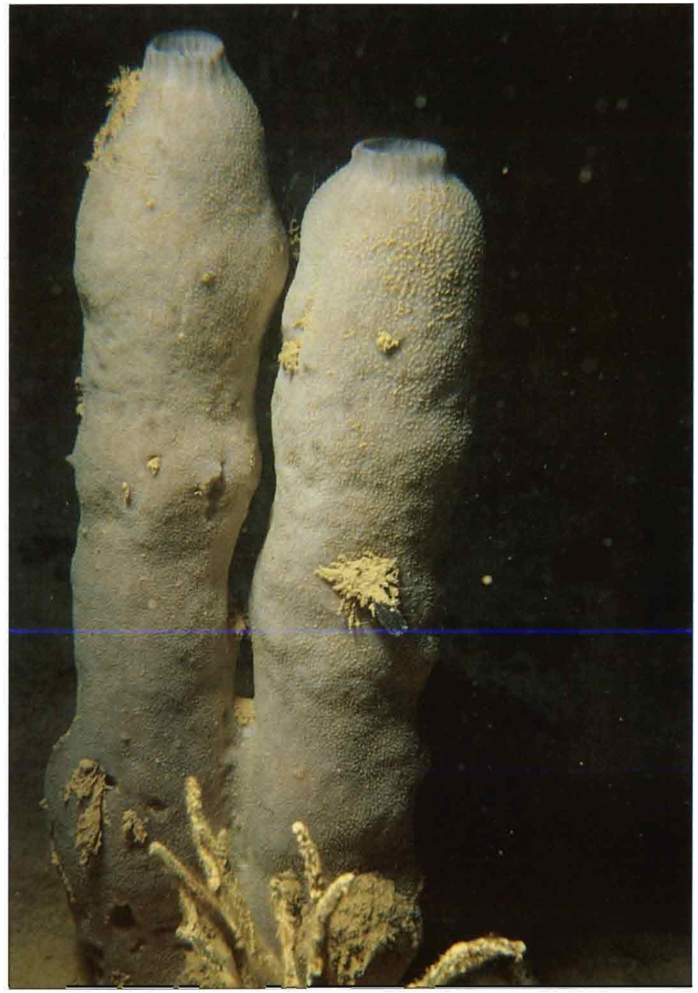
Distribution
New Caledonia.

Luffariella caliculata Bergquist (holotype): Coëtlogon-Goro, 50 m (photo P. Laboute)

Order
Dictyoceratida

Family
Thorectidae

Luffariella cylindrica
Bergquist, 1995



Luffariella cylindrica Bergquist (holotype): Banc Gail, 30 m (photo P. Laboute)

External Characters
An erect cylindrical sponge with a single large apical osculum fringed by a membrane, 1 cm high. There is a deep central oscular canal extending the whole length of the sponge into which the exhalant canals decant. The surface is covered with fine, evenly spaced low conules, each of which is supported by several prongs of a primary fibre fascicle. Texture is compressible, firm and springy, and the sponge exudes copious mucus when handled.

Dimensions
The sponge is up to 50 cm high, 15 cm in diameter arising from an attachment 3 cm wide. Oscular aperture is 1.5-5 cm in diameter.

Colour
The colour in life is gray and in ethanol the same.

Skeletal Characters
The skeleton is an open network of lightly cored primary fibres with clearly defined secondary and fine tertiary elements in an almost rectangular mesh arrangement. Primary fibres are often in a ladder-like semi-fascicular array, the elements of which divide at the surface. Primary fibres are 60-80 µm in diameter, secondary fibres 20-30 µm, and tertiary fibres 4-7 µm in diameter. In the prominent oscular membrane the primary fibres form stout palisades.

Soft Tissues
An ectosomal region, 250-350 µm deep is marked by large canals which are separated by tissue tracts. The choanosome is lightly collagen infiltrated and the choanocyte chambers are spherical, 15-20 µm in diameter.

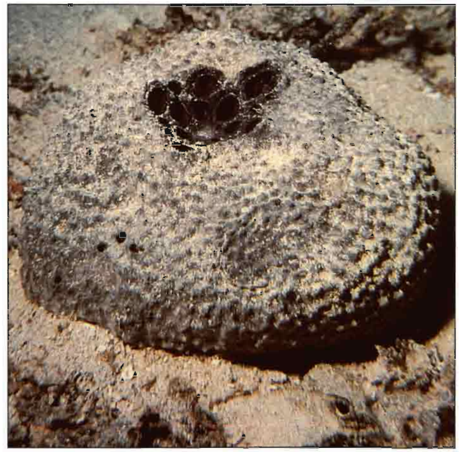
Ecology and Habitat
Occurs on the outer reef and lagoon among coral outcrops on the reef dropoff between 18 and 70 m. The species is common on the north, south and west coasts of New Caledonia.

Distribution
New Caledonia.

Family
Irciniidae

Ircinia irregularis
(Poléjaeff, 1884)

Ircinia irregularis (Poléjaeff): Nouméa, seagrass bed, West Lagoon 15 m
(photo G. Bargibant)



Ircinia irregularis (Poléjaeff): I. Rédika, 20 m
(photo P. Laboute)

External Characters
A massive, cushion-like sponge with strongly conulose surface and a cluster of apical oscules recessed below the body contour. The texture is compressible but extremely tough, impossible to tear. The surface is conulose overall and often attracts light sediment deposits. The small holothurian *Synaptula media* is always found in association with this species.

Dimensions
The sponge grows to large size, up to 50 cm in diameter and 30 cm high in New Caledonia. Oscules are 4-8 mm in diameter.

Colour
In life black externally, pale cream to brown internally, and in ethanol brown throughout.

Skeletal Characters
The primary skeleton is made up of extremely irregular intertwined fibre fascicles with all elements cored. Secondary elements are likewise cored and irregular. Individual fibres vary dramatically in dimension along their length, depending on the nature and amount of coring material present. Fine filaments 3-4 µm in diameter pack the entire body. There is a concentration of sandy material in the superficial 200-250 µm of the sponge but the layer is not a compact sandy cortex.

Soft Tissues
The body is extremely cavernous, lightly infiltrated with collagen with no distinct ectosomal thickening. Choanocyte chambers are spherical 20-25 µm in diameter.

Ecology and Habitat
Occurs on flat surfaces on the sandy lagoon bottom. Common on the west coast and in the south of New Caledonia in depths of 2-25 m.

Distribution
Torres Strait, Great Barrier Reef, New Caledonia.

Psammocinia bulbosa Bergquist 1995

External Characters
A massive repent sponge growing loosely attached to coral. It has an extremely distinctive body form, being constructed as a series of bulbous expansions from each of which one or two erect tapering oscular fistules arise. Oscules also occur flush with the general body surface. The surface is covered with regularly spaced low rounded conules 0.5-1 mm high, and has a papery texture conferred by the well developed sandy crust. The overall texture of the sponge is firm and crisp, just compressible.

Dimensions
Sponge is up to 20 cm long, 3 cm thick, 6 cm wide with oscular fistules 3-5 cm high, on which oscules 2-5 mm in diameter occur.

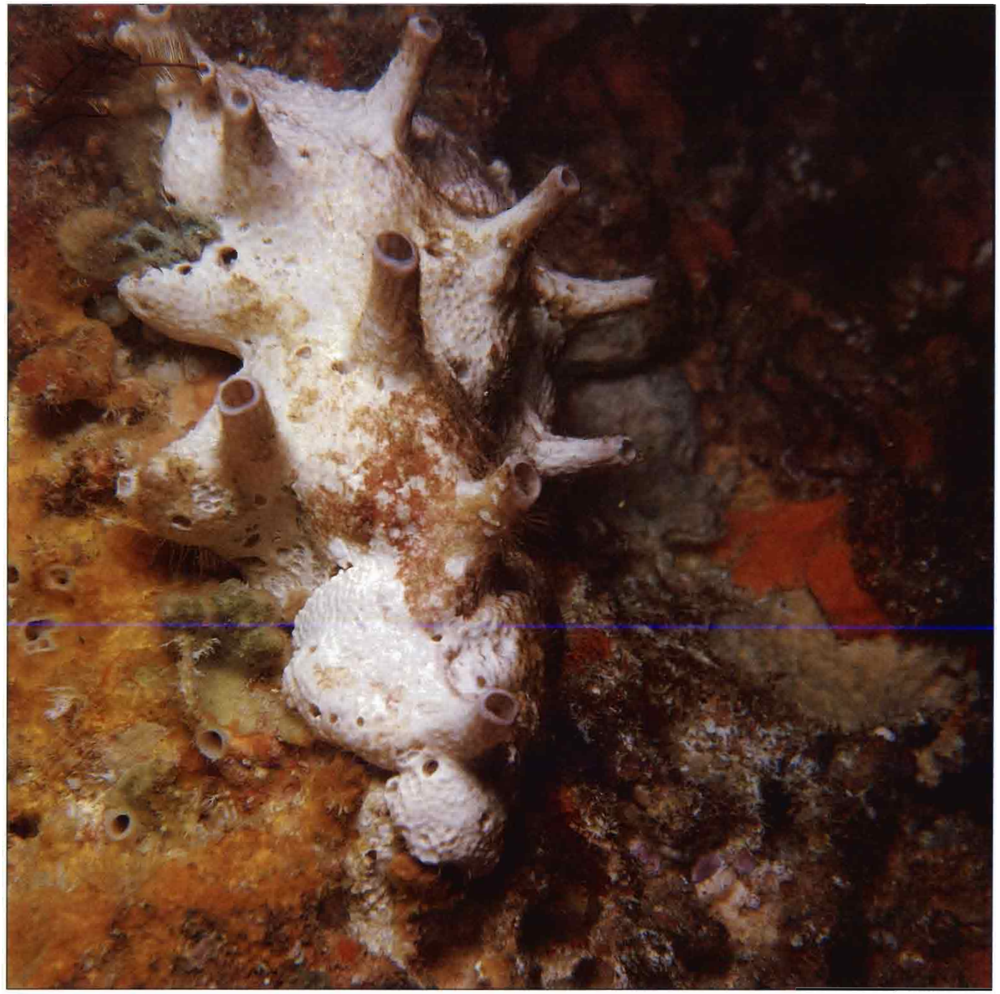
Colour
The colour in life is grayish white, and in ethanol cream.

Skeletal Characters
The skeleton is an irregular network of cored primary columns in which fibres twine and interlock to form stout fasciculate columns up to 700 µm across. Secondary fibres are also irregular, 30-50 µm in diameter and generally cored. The collagen filaments are very dense, fine, 3-5 µm in diameter.

Soft Tissues
An ectosomal region is defined by the sandy cortical crust which is up to 1 mm deep and an underlying region of lacunae formed by exhalant canals. Choanocyte chambers are spherical, 20-30 µm in diameter. Collagen deposition is light throughout the sponge.

Ecology and Habitat
The sponge occurs on the outer reef on coral rubble, mainly in crevices and under overhangs at 0.2 to 50 m depth. The species is not common and is found around Noumea and in the south of New Caledonia.

Distribution
New Caledonia.



Psammocinia bulbosa Bergquist (holotype): Barrier reef, M'Bere (photo J.L. Menou)

Order
Dictyoceratida

Family
Dysideidae

Dysidea herbacea (Keller, 1889)

External Characters
A spreading sponge with thin, digitate to lamellate extensions arising from the base which is firmly attached to the coral substrate. The lamellae may interlock in complex fashion. The surface is slimy but finely and regularly conulose. Individual conules are up to 0.4 mm high and aligned in vertical rows thus conferring in patches an almost striated appearance. The texture is soft, flexible, rather leathery. Oscules are small, flush with the surface and are most frequently located toward the upper margins of lamellae.

Dimensions
The sponge can cover areas up to 0.5 m^2 with lamellae up to 8 cm high. Oscules are 0.5-1.5 mm in diameter.

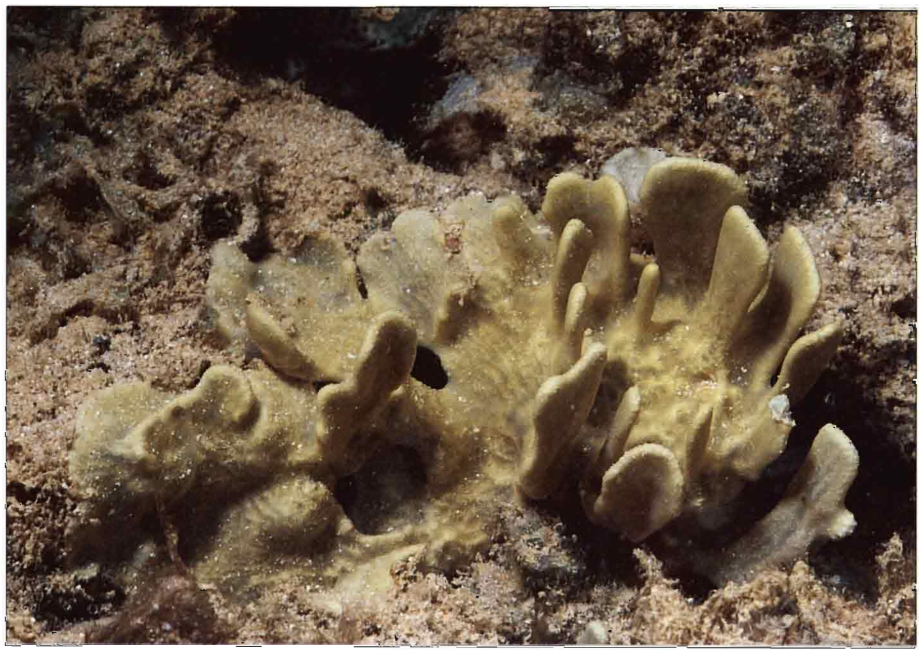
Colour
In life green to gray depending on the amount of fine sand adhering to the surface, in ethanol gray to white.

Skeletal Characters
The skeleton is an open network of fibres cored with sand grains of extremely irregular dimensions. There is no distinction between primary and secondary elements and fibres range from 50-160 µm in diameter.

Soft Tissues
The ectosomal region is thin and, on both sides of the thin lamellae, supports a fine superficial layer of sandy material.
Choanocyte chambers are oval, 50-120 µm in longest dimension and making up the bulk of the choanosomal volume. The matrix is strongly and evenly collagen reinforced and is packed with filamentous cyanobacteria.

Ecology and Habitat
The sponge occurs widely in reef habitats, occurring in lagoons, on fringing and intermediate reefs, along the edges of passes and on the outer reef. It attaches to clear hard substrate and is found from 3-15 m depth. The species is very common around Noumea and in the south of New Caledonia.

Distribution
Red Sea, Indian Ocean, Great Barrier Reef, Marshall Islands, Fiji, New Caledonia.

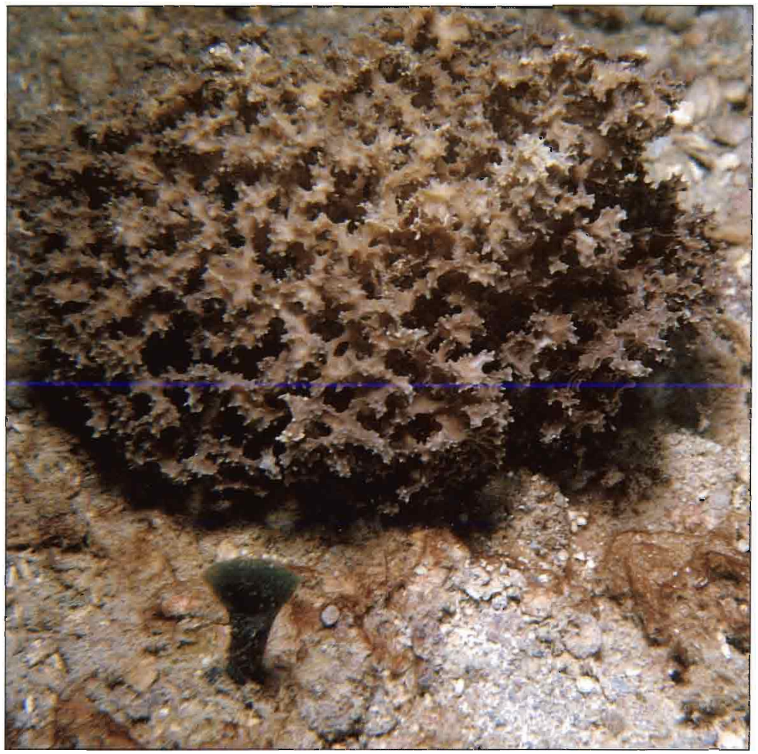


Dysidea herbacea (Keller): Chenal des 5 milles, 25 m (photo P. Laboute)

Order
Dictyoceratida

Family
Dysideidae

Dysidea arenaria
Bergquist 1965



Dysidea arenaria Bergquist: Nouméa, I. Maître, 10 m (photo P. Laboute)

External Characters
An irregularly ramose sponge with branches interlocking to form a tight but cavernous mass.
The surface is covered with prominent multi-tuberculate conules. The texture is stiff, just compressible and brittle as a result of the high quantity of interstitial debris present. Oscules are flush with the surface and distributed over the whole body.

Dimensions
The sponge is commonly 3 to 10 cm high, up to 8 cm wide with individual branches 1-1.5 cm in diameter. Oscules 0.3-1 mm in diameter.

Colour
In life dull greenish gray to pale mauve, in ethanol white.

Skeletal Characters
The fibres cannot be clearly designated as primary or secondary except in the immediate subsurface region. They are arranged in a reticulate pattern, the meshes of which are compact near the surface, open in the deeper regions. All fibres are heavily cored and the diameter is from 60-150 µm.

Soft Tissues
The ectosome supports a concentration of sand to a depth of 80-100 µm, and below that is separated from the choanosome by marked exhalant canal lacunae.
The general choanosome contains a good deal of sandy material and is only lightly collagen reinforced. Choanocyte chambers are oval, 60-90 µm in longest dimension.

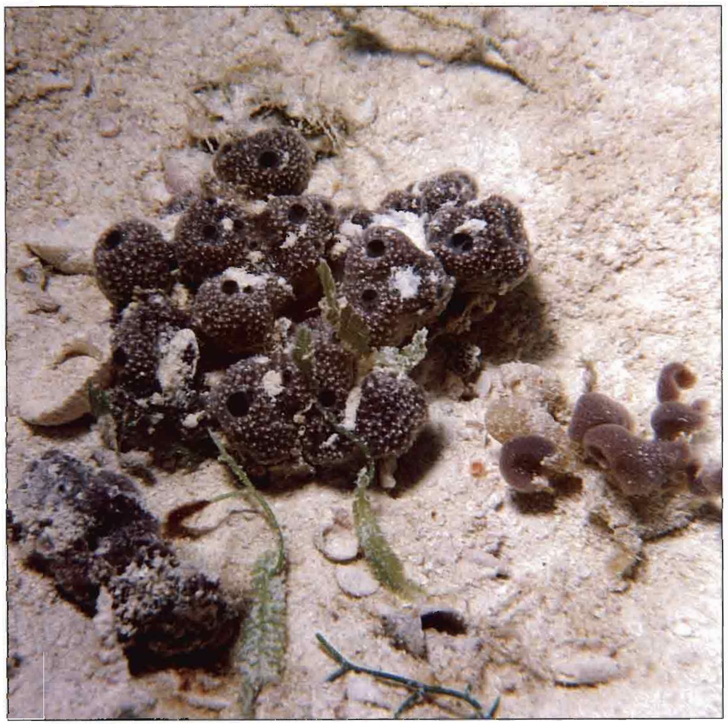
Ecology and Habitat
Common on lagoon bottoms in mobile sediment attaching to algal holdfasts or buried rubble in 8-10 m depth. Most frequent in the vicinity of Noumea.

Distribution
Palau, New Caledonia.

Order
Dictyoceratida

Family
Dysideidae

Dysidea nigrescens Bergquist, 1995



Dysidea nigrescens Bergquist (holotype): South Lagoon between I. Tere and I. N'da, 30 m (photo P. Laboute)

External Characters
A repent, massive to lobate sponge growing attached to subsurface rubble on sandy lagoon bottoms. The surface is covered very evenly with low rounded conules, 1 mm high and wide, which are connected by a tracery of fine subdermal tracts.
The apex of each conule is whitish where sand-filled fibre is exposed. This gives a regular, light spotted appearance to the surface. Oscules are situated apically on each lobe of the sponge. Texture is soft, easily torn.

Dimensions
The only specimen examined is 10 cm long, 12 cm wide, 3 cm high, but a spreading species such as this will have very variable dimensions. Oscules are 2-5 mm in diameter and flush with surface.

Colour
Deep blackish purple in life, in ethanol cream.

Skeletal Characters
The fibre skeleton has an almost perfect rectangular plan with simple, cored primary fibres 70-400 µm in diameter and secondary fibres 40-100 µm in diameter, always with some clear spongin visible around the coring material. The primary fibres are about 1 mm apart and the entire skeleton is thus a very fragile network.

Soft Tissues
The dermal membrane and ectosomal region are clear of sand and the ectosome shows only traces of collagen deposition. The choanosome is lightly collagenous, with oval choanocyte chambers 120-180 µm in longest dimension. The mesohyl is packed with filamentous cyanobacteria.

Ecology and Habitat
Occurs on shell/sand lagoon bottoms attached to rubble at 30 m depth.
The species is not common and occurs only in the south of New Caledonia.

Distribution
New Caledonia.

Order
Dictyoceratida

Family
Dysideidae

Dysidea frondosa Bergquist, 1995

Dysidea frondosa Bergquist (holotype): Nouméa: I. Maître, 25 m (photo P. Laboute)

External Characters
A repent sponge with many flattened, lobate projections arising from an irregular spreading base attached to subsurface rubble on sandy lagoon bottoms. The surface is covered with low, irregularly distributed conules 1-1.5 mm high. Sandy tracts running in the plane of the surface connect adjacent conules to give an irregularly distributed web-like appearance to the surface. Oscules are large, flush with the surface and scattered. The texture is soft, flexible, easily torn.

Dimensions
The sponge is 12 cm long, 8 cm high and 6 cm wide. These dimensions will vary according to precise location and availability of substrate. Oscules are 3-6 mm in diameter.

Colour
Dark pink to purple in life, in ethanol dark brown.

Skeletal Characters
All fibres are cored and no distinction can be made between primary and secondary elements except immediately below the surface. The fibres are thick, 120-400 µm in diameter and make up a very irregular skeletal network.

Soft Tissues
An ectosomal region is defined by superficial collagen reinforcement and prominent underlying exhalant canal lacunae. The choanosome has almost no collagen deposition and little mesohyl. Most volume is occupied by the oval choanocyte chambers 50-80 µm in maximum dimension, and canals. Dark brown pigment cells are dispersed throughout all tissues.

Ecology and Habitat
Occurs on sandy lagoon bottoms in the region around Noumea at 20-24 m depth attached to rubble and *Halimeda* stalks.

Distribution
New Caledonia.

Euryspongia delicatula Bergquist, 1995

External Characters
A massive, almost hemispherical sponge extending from a broad, continuous attachment base which is coral rock.
The surface is covered with evenly spaced, rounded conules, 1-3 mm high elevated by one to several primary fibres. Fine, subdermal sandy tracts radiate between conules and confer a regular cobweb-like appearance on the surface. Oscules lie flush with the surface and are dispersed. The texture is spongy, very compressible but elastic.

Dimensions
The sponge is up to 15 cm high, 12 cm wide, 18 cm long. Oscules are 2-6 mm in diameter.

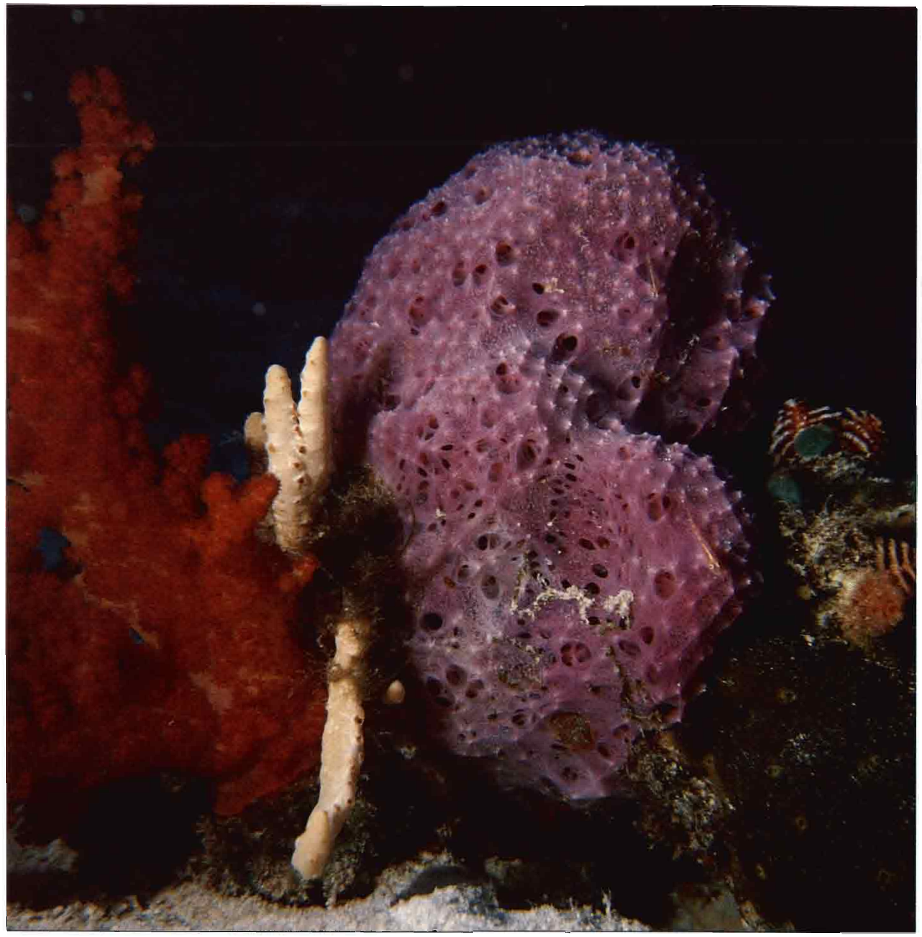
Colour
In life violet, in methanol gold-brown.

Skeletal Characters
The skeleton is composed of cored primary fibres 200-400 µm in diameter which become fasciculate just below the surface, and a loose irregularly disposed network of uncored secondary fibres 50-120 µm in diameter.

Soft Tissues
An ectosomal region is defined by a superficial collagen reinforced region overlying a region of large exhalant lacunae.
The choanosome is cavernous; it has light collagen deposition, sparse mesohyl, oval choanocyte chambers 80-120 µm in longest dimension, and many canals.

Ecology and Habitat
The sponge occurs on slightly silty or clean lagoon bottoms attached to coral rubble at 20-30 m depth.
It is not common and occurs predominantly in southern New Caledonia.

Distribution
New Caledonia.

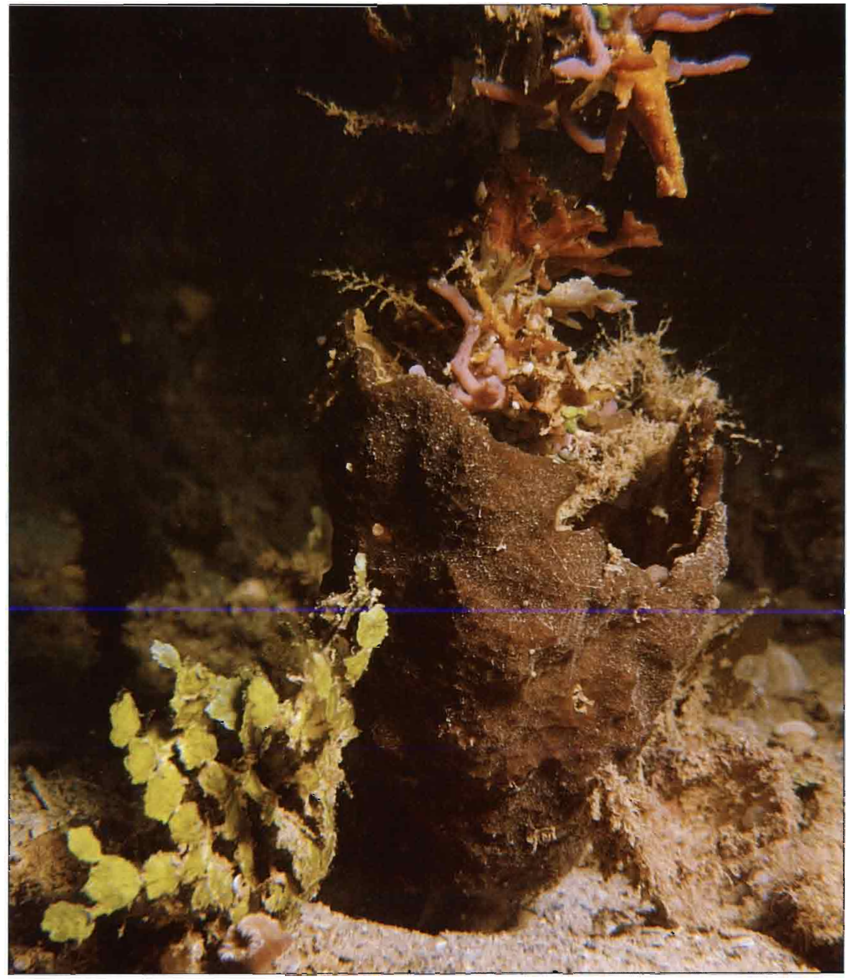


Euryspongia delicatula Bergquist (holotype): Récif Ue 20-25 m (photo P. Laboute)

Order
Dictyoceratida

Family
Dysideidae

Euryspongia vasiformis Bergquist, 1995



Euryspongia vasiformis Bergquist (holotype): Récif Tomboo, 30 m (photo P. Laboute)

External Characters
An irregular, often eroded, cup-shaped sponge which grows attached to worm tubes and coral rubble on shallow sandy *Halimeda* flats. Both internal and external surfaces are covered with closely spaced sharp conules 1-2 mm high, each supported by a single fibre and connected by a prominent tracery of surface tracts which give a web-like surface appearance. Oscules are small, flush with the surface and are distributed over both faces. The texture is soft, flexible and easily torn.

Dimensions
The sponge grows to 16 cm high, 10 cm in apical diameter, and the walls of the cup are 4-8 mm thick. Oscules are 0.5-1 mm in diameter.

Colour
In life the sponge is dark brown, in ethanol identical.

Skeletal Characters
The skeleton is composed of lightly cored primary fibres, 80-200 µm in diameter which can be fasciculate near the surface, and a loose, open reticulum of uncored secondary fibres, 40-120 µm in diameter.

Soft Tissues
An ectosomal region is marked by subdermal canals and a superficial collagen reinforced layer. The choanosome has almost no collagen deposition, little mesohyl, and a substantial volume of canals and oval choanocyte chambers 60-90 µm in longest dimension.

Ecology and Habitat
Occurs on sandy lagoon bottoms attached to coral rubble, between 8-30 m. The sponge is common in the region around Noumea, but also occurs on the outer reef.

Distribution
New Caledonia.

Order
Dendroceratida

Family
Darwinellidae

Darwinella sp.

A group of "keratose" sponges, lacking a mineral skeleton, dendroceratids are fibrous, like the verongids, but are soft, compressible, flabby and fleshy in construction. In these species the main skeleton is dendritic or reticulate, and fibres originate from a basal plate, without any obvious differences between primary and secondary spongin fibre elements. Spongin fibres are strongly laminated, with a distinct pith. Dendroceratids are viviparous, where larvae are incubated parenchymella, evenly ciliated, with or without a posterior tuft of long flagella.

Darwinella sp.: North Lagoon, I. Paaba, 27 m (photo P. Laboute)

External Characters
A complex lobose sponge arising from a single basal attachment. It has an irregularly conulose surface with individual conules 2-4 mm high and blunt terminal regions. Pores are evenly dispersed and give a fine reticulated appearance to the general surface. Oscules are large, circular, situated apically on each lobe of the body and surrounded by a transparent, slightly elevated oscular membrane. Texture is soft, fleshy, somewhat slimy to the touch.

Dimensions
Up to 10-15 cm high and wide. Oscules are 3-6 mm in diameter.

Colour
Bright lemon yellow in life, purple black in ethanol.

Skeletal Characters
The main skeleton is dendritic with large fibres of very irregular diameter arising from a spreading basal spongin plate. Fibre is sparse in relation to the soft tissue. Both bark and pith elements are present with pith making up half to two thirds of the fibre diameter. Bark is strongly laminated. Fibres range from 120-350 µm in diameter. Free fibrous triradiate spicules are present, ray length is 650-700 mm and the width 20 µm.

Soft Tissues
An ectosomal region 60-120 µm deep, which is strongly collagen reinforced, grades into the underlying choanosome. The choanosome is cavernous with collagen deposition emphasised only around major canals. Choanocyte chambers are oval, but the state of preservation of the sponge does not permit measurement.

Ecology and Habitat
Occurs on sandy *Halimeda* flats in silty sand lagoon bottom situations, more frequently in the northern lagoon in depths of 20-40 m.

Distribution
New Caledonia.

Order
Dendroceratida

Family
Darwinellidae

Dendrilla rosea Lendenfeld, 1883

External Characters
An erect ramose to bushy sponge with interlocking low lobes or with discrete branches. The surface is covered with pronounced conules 1-5 mm high, spaced 3-5 mm apart. Between conules the pores impart a lacy appearance to the dermal membrane. The sponge is slimy, with fleshy fragile texture in its soft tissues. Oscules are dispersed randomly.

Dimensions
Sponge can be up to 30 cm high with branches 4-10 mm in diameter or spreading, covering an area of 15-20 cm to a depth of 6-8 cm. Oscules are 1-4 mm in diameter.

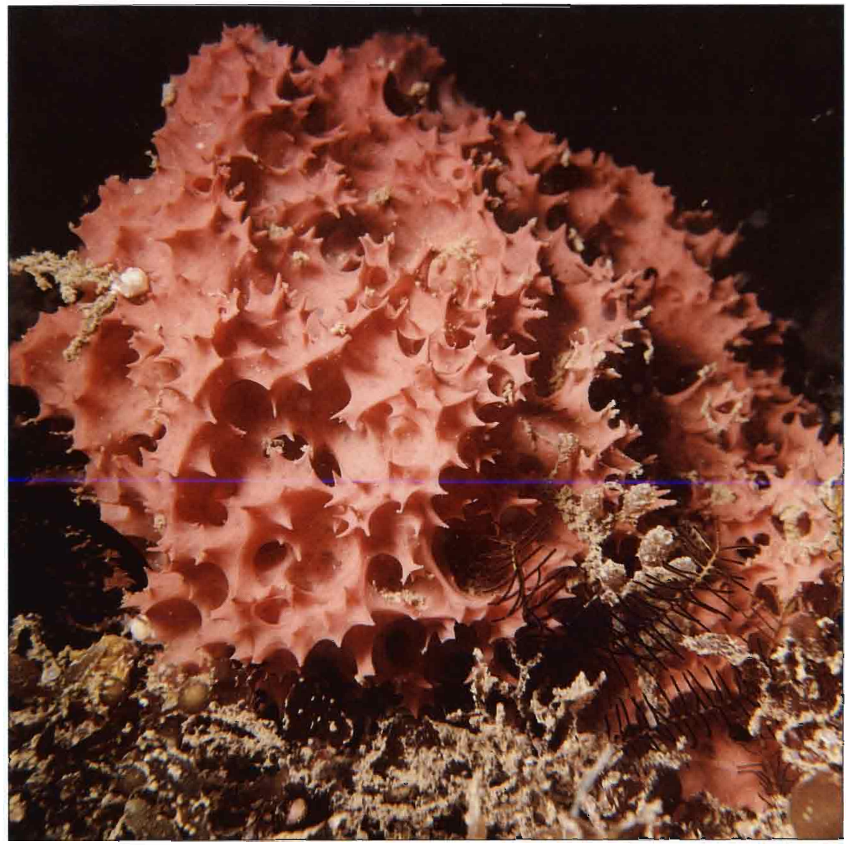
Colour
Bright rose pink in life, pale red brown in ethanol.

Skeletal Characters
The skeleton is dendritic with fibres arising from a spreading basal plate and branching toward the surface. Fibres are stout toward the base, 1.2-1.6 mm in diameter narrowing rapidly to 250-300 µm. Fibres have a central pith, concentrically layered bark with no foreign material incorporated.

Soft Tissues
The ectosome is distinct, densely collagenous 80-140 µm deep and set off from the choanosome by a system of sub-dermal canals. The choanosomal mesohyl is densely cellular with concentrations of archaeocytes and spumous cells toward the ectosomal boundary. Choanocyte chambers are oval 35-80 µm in longest dimension and evenly dispersed. Strong collagen tracts traverse the mesohyl.

Ecology and Habitat
Occurs on steep sloping reefs extending on to mobile coarse, shell gravel substrate in lagoon bottoms, where it attaches to large shells or small fragments of coral rubble. Found between 20 and 35 m depth. The species is only moderately common and dispersed in occurrence.

Distribution
New Zealand, Southern Australia, New Caledonia.



Dendrilla rosea Lendenfeld: Nouméa: I. Canard, 20 m (photo P. Laboute)

Family
Dictyodendrillidae

Dictyodendrilla elegans
(Dendy, 1924)

External Characters
A digitate to lobate sponge arising either from a single stalk or from multiple, relatively loose attachment points. The surface is strongly conulose, with conules up to 1.0 mm high and 2-3 mm apart, aligned over short distances to form marked surface ridges. Pores are evenly dispersed giving a delicate reticulate appearance to the smooth surface. Oscules are flush with the surface and dispersed in irregular fashion. The texture is delicate, soft and compressible and the general sponge construction is cavernous and fragile.

Dimensions
Individuals up to 25 cm high and 25-35 cm wide have been recorded, smaller specimens are more frequent. Oscules are 3-5 mm in diameter.

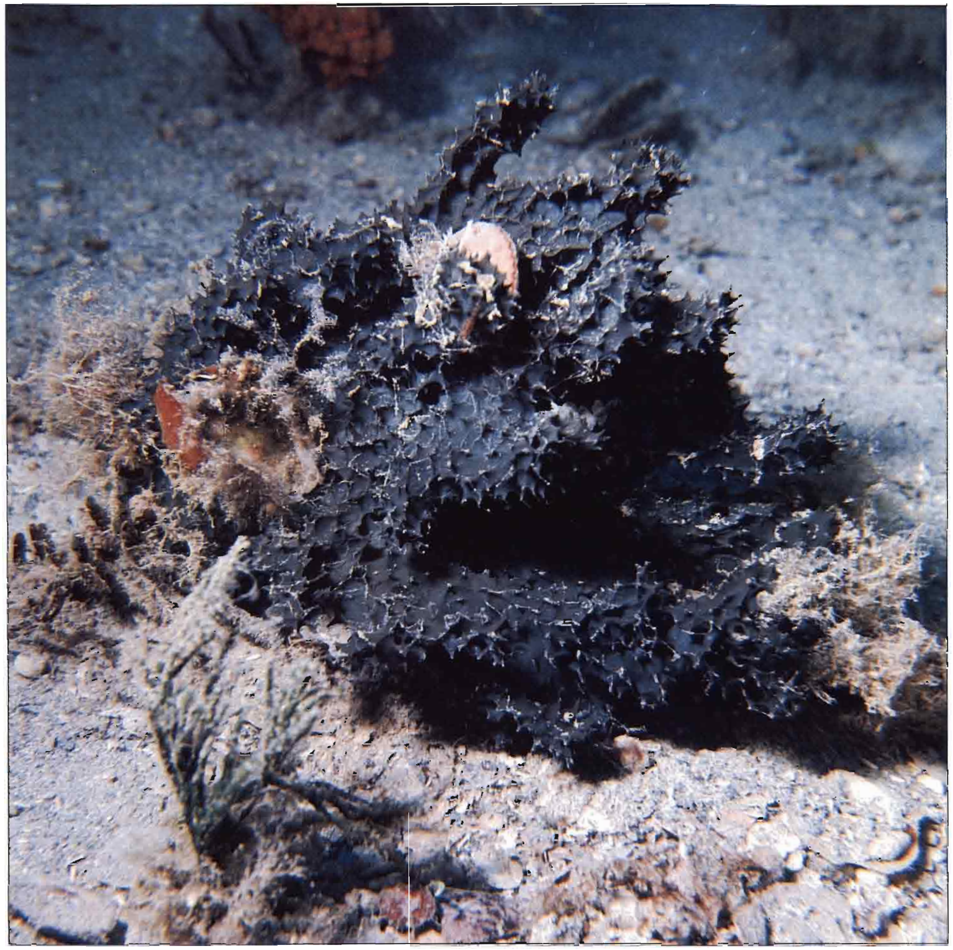
Colour
Grey to grey blue soft tissues in life, contrasting fibres are black, tissue becomes navy blue, to blue black in ethanol.

Skeletal Characters
The skeleton is a regular, rectangular reticulum with no size distinction between ascending (primary) and secondary (connecting) elements. Fibres are up to 250 µm in diameter, with concentrically laminated bark and pith which makes up one third of the fibre diameter. No coring material is present in the fibres.

Soft Tissues
The ectosome is a thin layer 90-140 µm deep, marked only by light collagen reinforcement. No particular cellular aggregations mark the ectosomal region which simply grades into the choanosome. The latter region is cavernous with large canals occupying most of the volume. Discrete groups of oval choanocyte chambers, 60-140 µm in longest dimension are surrounded by a lightly collagen infiltrated mesohyl in which cellular elements are present in low numbers.

Ecology and Habitat
Occurs attached to hard surfaces, but is most commonly found on coarse, sandy shell gravel substrate at depths of 15-23 m. Common in the lagoon habitats of south west New Caledonia.

Distribution
Northern New Zealand, New Caledonia.



Dictyodendrilla elegans (Dendy): Nouméa: I. Maître, 20 m (photo P. Laboute)

Order
Verongida

Family
Aplysinellidae

Porphyria flintae Bergquist, 1995

These "keratose" sponges also lack mineral spicules, but unlike the dendroceratids they are typically elastic. Verongid sponges also have pigments that oxidize to purple when in contact with air (aerophobic). The skeleton consists of large, widely spaced spongin fibres forming dendritic or reticulate structures, and fibres may be aggregated (fasciculated) into bundles. There is no differentiation between primary and secondary fibre elements, and detritus is only rarely incorporated into fibres. Spongin fibres have a laminated cortical (bark) region and a distinct central pith of fine spongin fibrils. The cortex may be reduced or disappear entirely in some species. The mesohyl contains abundant collagenous fibrils. All species are oviparous. Common genera are *Aplysina*, *Pseudoceratina* and *Ianthella*.

External Characters
A stalked, goblet-shaped sponge with distinct internal oscular and external poral faces. The interior surface of the vase is smooth with small regularly dispersed oscules located in slight depressions, each of which is surrounded by a membranous rim.
The poral external face is just roughened by fine low conules and can be smooth or irregular and lumpy.
The texture is firm, rubbery but compressible.

Dimensions
Individuals 15-20 cm high and 10-15 cm wide are common. The wall of the cup is 1.5-2 cm thick at its midpoint and the stalk is 0.5-1.5 cm thick.

Colour
Pale to deep purple externally and cream internally in life, in ethanol it is deep purple black throughout.

Skeletal Characters
The skeleton has a pronounced dendritic plan with slender fibres diverging from a central basal point which is a clear stalk. Fibres are cylindrical and of even dimension, 60-80 µm across, for most of their length. They taper to sharp points near the surface where they are 15-30 µm in diameter. Branch fibres arising from the main dendritic elements are short, 30-350 µm long, flexuous and sharply pointed.
Both bark and pith elements are present in the fibres, with the pith making up to a third of the diameter.
The bark is very dense and tightly laminated and as a consequence the fibres are very brittle.

Soft Tissues
The ectosome is a well marked region, 110-140 µm deep, with an outer layer 20-30 µm in extent which contains little collagen and has a high number of spherulous and other secretory cells. The deeper region is strongly collagen reinforced, but also contains many spherulous cells superficially. The choanosome is very evenly collagen reinforced and choanocyte chambers are small and spherical, 15-30 µm in diameter.

Ecology and Habitat
Occurs on the outer reef on firm hard surfaces, among coral boulders or on steep coral cliffs between 35 and 65 m depth. The species is moderately common but appears restricted to the south west coast of New Caledonia and the Loyalty Islands.

Distribution
New Caledonia.

Porphyria flintae Bergquist (holotype): Cap Boyer, I. Maré, 33 m (photo P. Laboute)

Pseudoceratina verrucosa Bergquist, 1995

External Characters
A massive repent sponge with thick branches spreading over coral substrate. The surface is verrucose, covered in abundant low conules, which are 1-2 mm high and rounded rather than pointed apically. The general body surface is thrown into low ridges. Texture is hard and incompressible and oscules are prominent, scattered over the upper surface, slightly elevated and surrounded by a pronounced contractile rim.

Dimensions
Individuals can cover an area up to 30 cm in diameter. Specimens commonly are around 10-20 cm long and wide, and 4-6 cm thick. Oscules are small, 2-3 mm in diameter.

Colour
Dull yellow throughout, sometimes yellow brown superficially in life, in ethanol deep purple black.

Skeletal Characters
The skeleton has a dendritic plan and is made up of extremely irregular fibres which are composed only of pith elements in which a small amount of sandy debris is incorporated. Bark is absent from the fibres. Large areas of the body, particularly in the deeper region of the choanosome, are devoid of skeleton. Fibres range from 220-600 μm in diameter but the irregularity makes measurements of limited use.

Soft Tissues
The sponge has dense collagen tracts deployed regionally to structure both the ectosome and the choanosome. Dense collagen depositions surround all canals and fibres, and serve to divide the choanosome into distinct islands of tissue in which the small, 15-20 μm diameter, spherical choanocyte chambers lie. The ectosome is strongly collagenous, 300-800 μm deep and made up of alternative bands of extremely dense collagen separated by areas with lower collagen density and high cell density.

Ecology and Habitat
Occurs commonly throughout New Caledonia, on lagoon habitats and on intermediate and outer reefs in depths of 10-40 m.

Distribution
New Caledonia.

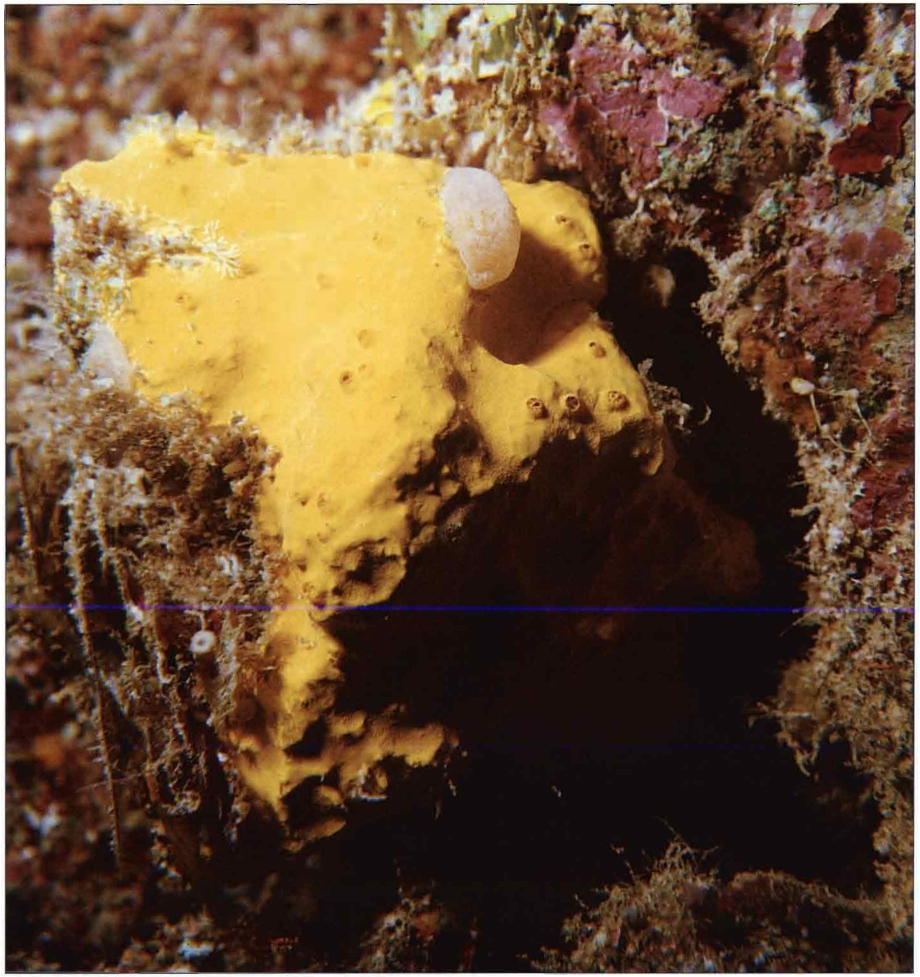
Possible Confusions
Suberea creba from which *P. verrucosa* can be distinguished by the verrucose surface and more dull yellow colouration.

Pseudoceratina verrucosa Bergquist: Baie du Prony, Rocher Auzille, 8-10 m (photo G. Bargibant)

Order
Verongida

Family
Aplysinellidae

Suberea creba Bergquist, 1995



Suberea creba Bergquist (holotype): Passe de St Vincent, 45 m (photo G. Bargibant)

External Characters
A massive, thick, spreading sponge. The surface is smooth, fleshy in appearance, and the general body is thrown into lumps and folds giving an irregular tuberculate impression. The sponge exudes purple/black pigment when damaged. Oscules are small, 2-3 mm in diameter, scattered, slightly elevated and surrounded by a marked contractile collagenous rim. The texture is firm and corky, becoming extremely hard in dead specimens.

Dimensions
Sponge covers an area 10 cm by 15 cm and is 3-4 cm thick. Clearly this spreading growth form permits larger irregular specimens to develop.

Colour
Bright clear yellow in life, in ethanol deep purple black.

Skeletal Characters
The plan of the fibrous skeleton is dendritic, fibre is sparse in relation to the surrounding soft tissue. Fibres are usually circular in cross-section and are composed of both bark and pith elements, and the pith makes up approximately three quarters of the diameter of each fibre. The bark component of the fibres is very compact and the laminate appearance which is diagnostic of the Verongida is not as marked as usual until the sponge is sectioned, when clear laminae appear. Fibre diameter falls within the range 120-250 µm.

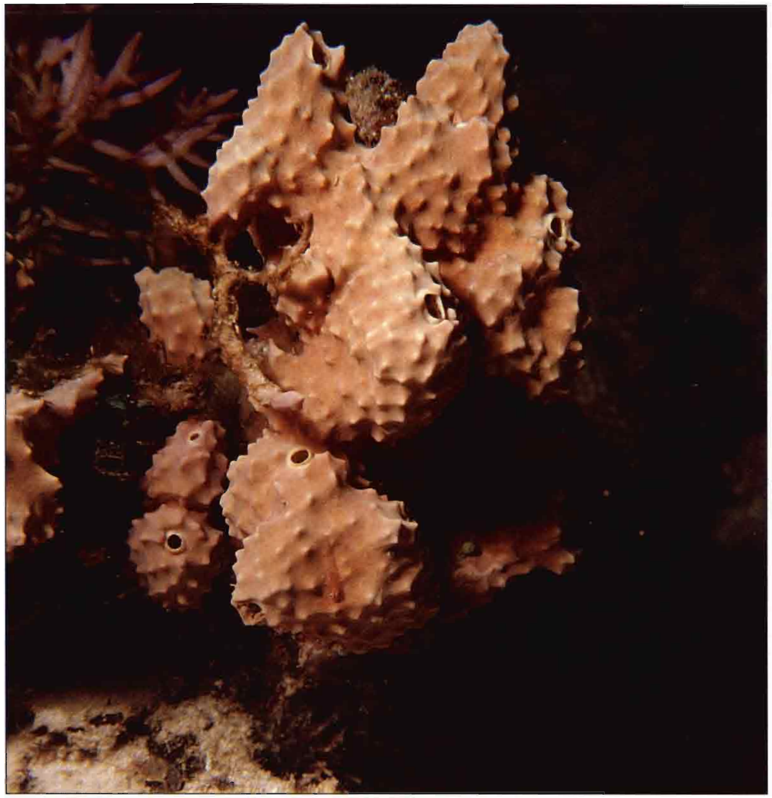
Soft Tissues
The strongly collagenous ectosomal region is 500-600 mm deep and sharply separate from an underlying choanosome which is evenly collagen reinforced throughout. Choanocyte chambers are spherical and small, 15-20 µm in diameter.

Ecology and Habitat
Sponge occurs spreading over stable coral substrates on reef fronts and on cliff walls at depths of 30-55 m uncommon on west and south coasts.

Distribution
New Caledonia.

Possible Confusions
Pseudoceratina verrucosa which has a similar growth form, colour and habitat. *S. creba* has a more brilliant clear colour, a smooth surface on a microscopic level and extremely corky texture.

Suberea laboutei Bergquist, 1995



Suberea laboutei Bergquist (holotype): North Lagoon, 18 m (photo P. Laboute)

External Characters
An erect lobate sponge, loosely adherent to coral substrate at multiple attachment points.
The surface is covered with pointed conules 1-3 mm high which tend to be aligned into short rows, thus giving the surface a slightly ridged appearance.
Surface contours are very irregular with many thin projections extending from the main lobes of the body.
Oscules are prominent, circular and situated toward the apex of individual lobes and each one is surrounded by a thickened collagenous membrane.
The texture is fleshy but easily compressible.

Dimensions
Individuals are from 7-20 cm high, lobes 4-5 cm thick.
Oscules are 3-7 mm in diameter.

Colour
The colour in life is dull brownish yellow, and in ethanol chocolate brown.

Skeletal Characters
The skeleton has a dendritic plan and fibres are relatively abundant in relation to the volume of the surrounding soft tissue.
Individual fibres are spherical to oval in cross-section and sometimes two or three adjacent fibres are incorporated within a common sheath of bark.
Both bark and pith elements are present in the fibres and the former has strongly defined, thin concentric laminae which separate and fragment easily.
Bark never constitutes more than one quarter of the fibre diameter and can be reduced to one tenth, pith is dominant.
Fibres are from 200-700 µm in maximum dimension.

Soft Tissues
A distinct ectosomal region, 250-350 µm deep is characterised by having islands of very dense collagen deposition between which lie tracts of cells, a high proportion of which are spherulous cells. The latter also are found as an almost continuous surface layer.
The choanosome is evenly collagen reinforced, but around major canals the density of the collagen is increased. Choanocyte chambers are small, spherical, 10-15 µm in diameter.

Ecology and Habitat
Occurs on hard surfaces in lagoon habitat, attached to coral formations at the base of cliffs, around 18 m in depth. The species is not common and appears to be confined to the north of New Caledonia.

Distribution
New Caledonia.

Family
Ianthellidae

Ianthella basta
(Pallas, 1766)

External Characters
A tall fan to vase-shaped sponge occasionally with multiple lamellae, but more usually a single lamella attached at a constricted base. The lamella is very thin and flexible with undulations in both vertical and horizontal planes. The surface is fleshy and marked by extremely regular radiating rows of low, sharply pointed conules arrayed to make a perfect rectangular pattern. Oscules are small, circular, flush with the surface and confined to one face of the lamella; pores are restricted to the other face. The texture is slightly harsh to the touch as a result of projecting fibre tips. The thin, two dimensional fan or vase-like form and the fine, regular, rectangular mesh of the skeleton are distinctive, striking features.

Dimensions
Sponges may reach large size, up to 1500 cm high and wide, but only 1-3 mm thick with stalk 2-4 cm diameter. Oscules are 0.5-1 mm in diameter.

Colour
In life the colour is most commonly blueish violet but bright yellow, green, orange, and vivid blue specimens occur. Deep reddish-purple fibres can be seen through the surface tissue. On exposure to air and in ethanol the sponge is dark reddish-purple.

Skeletal Characters
The skeleton is a dense reticulation of fibres with perfect rectangular meshes, oriented in one plane. Fascicles of two to four fibres aligned above each other run from the base to the edge of the lamella and are connected at intervals of approximately 1 mm by single fibres. Differential growth rates of the skeleton show up as bands of very closely spaced connecting fibres that can also be laid down in a slightly divergent vertical orientation. In cross-section the bark component of the fibre incorporates cellular elements laid down in concentric bands.

Soft Tissues
On the oscular face a collagen reinforced ectosome up to 80 µm deep is distinguished from the underlying cavernous choanosome. On the poral face there is a thin collagen reinforced layer 20 µm deep. Choanocyte chambers are oval, eurypylous and 80-100 µm in greatest dimension.

Ecology and Habitat
Occurs singly on inshore silted coral substrate or on fringing reef slopes with good current flow. Depth range between 20-40 m.

Distribution
Great Barrier Reef, Torres Strait, Papua New Guinea, Guam, Indian Ocean (Mascarene Island), New Caledonia.

Ianthella basta (Pallas): Banc Gail, 35 m (photo P. Laboute)

Order
Verongida

Family
Ianthellidae

Anomoianthella rubra Bergquist, 1995

External Characters
An erect spreading sponge, fan-like or globose, rising from a narrowed attachment base. Several intersecting fans are present in larger specimens. The sponge is cavernous with great emphasis on the fibre skeleton in relation to soft tissues. Fibres run for a considerable distance in the plane of the surface and extend into pronounced pointed conules up to 6 mm high. Brilliant pigmentation with contrasting dark-coloured fibres and compressible but harsh texture are striking features. Oscules are large and scattered over the whole surface, but most commonly are aligned along the apex of the fan.

Dimensions
Individuals reported from 5-15 cm high, 8-13 cm wide, 2-4 cm thick with attachment base from 2-5 cm across. Oscules up to 1.2 cm in diameter.

Colour
Soft tissues brilliant orange-red, contrasting fibres deep red, in ethanol uniformly purple-black.

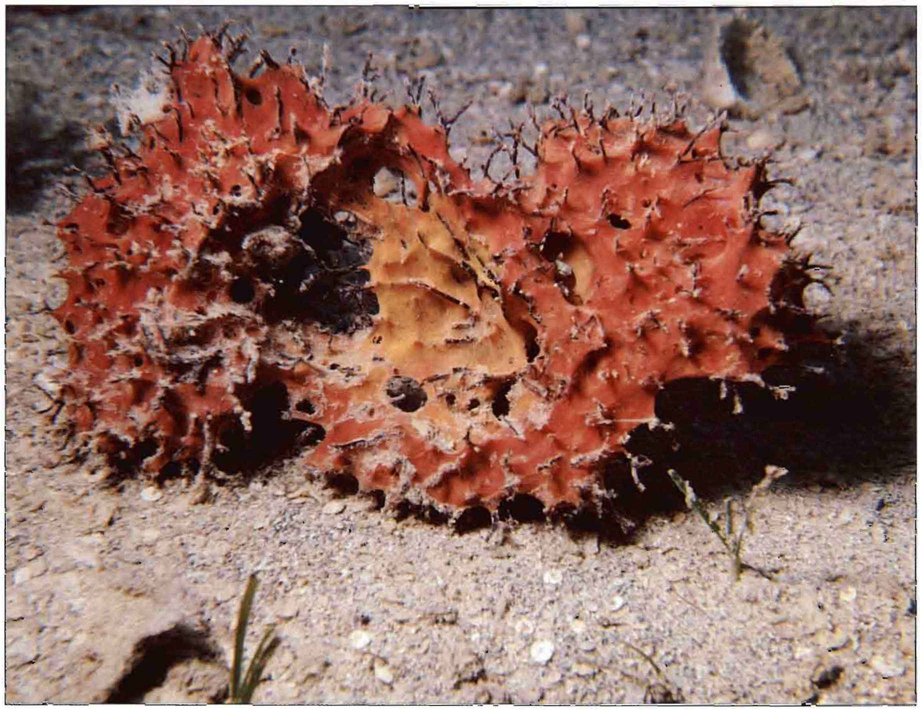
Skeletal Characters
Fibres are very thick and coarse, diverging from the base but anastomosing to form an open reticulum with irregular mesh shape and size. Individual fibres are slightly flattened, oval in cross-section and up to 2500 µm in diameter. Both bark and pith elements are present, with the pith making up about one third of the diameter in each fibre. The bark is strongly laminated and charged with cellular elements arrayed in concentric wavy rows which, on sectioning, fracture easily into strings of fibre and cells.

Soft Tissues
A collagen reinforced ectosome up to 200 µm deep is marked by strong aggregations of spherulous cells; it is set off from the cavernous choanosome by prominent subdermal lacunae. Patches of cuticle 20 µm thick are present. The choanosome has light even collagen reinforcement and large volume of canals and eurypylous oval to slightly branched choanocyte chambers.

Ecology and Habitat
Common in coral boulder habitats in lagoons 10-20 m depth. Can tolerate some mobile sand. Most frequently in the vicinity of Noumea.

Distribution
New Caledonia.

Possible Confusions
None for the living sponge; dead specimens could be confused with *Darwinella* sp. and *Dendrilla rosea*.



Anomoianthella rubra Bergquist: Nouméa: chenal de l'I. Maître, 25 m (photo P. Laboute)

Further reading

Brien (P.), Lévi (C.), Sarà (M.), Tuzet (O.), Vacelet (J.), 1973 - "Spongiaires". *In* Grassé (P.-P.), ed.: *Traité de Zoologie. Anatomie, systématique, biologie.* Paris, Masson et Cie. Vol. 3(1), 485 fig.: 1-716.

Bergquist (P.R.), 1978 - *Sponges*. London, Hutchinson: 1-268.

Bergquist (P.R.), Wells (R.J.), 1983 - "Chemotaxonomy of the Porifera: The development and current status of the field". *In* Scheuer (P.J.), ed.: *Marine Natural Products* 5, New York, Academic Press: 1-50.

De Vos (L.), Rützler (K.), Boury-Esnault (N.), Donadey (C.), Vacelet (J.), 1991 - *Atlas of Sponge Morphology*. Smithsonian Institution Press: 1-117.

Hartman (W.D.), 1982 - "Porifera". *In* Parker (S.P.), ed.: *Synopsis and Classification of Living Organisms*. New York, McGraw-Hill. Vol. 1: 640-666.

Van Soest (R.W.M.), 1991 - "Demosponge Higher Taxa Classification Re-Examined". *In* Reitner (J.), Keupp (H.), éd.: *Fossil and Recent Sponges*: 54-71.

Bibliography

Ahond (A.), Bedoyazurita (M.), Colin (M.), *et al.*, 1988 - La girolline, nouvelle substance antitumorale extraite de l'éponge, *Pseudaxinyssa cantharella* n. sp. (Axinellidae). *C. R. Acad. Sci., Fr.*, 307 (11): 145-148.

Bergquist (P.R.), 1965 - The Sponges of Micronesia. Part l: The Palau Archipelago. *Pacif. Sci.*, 19 (2): 123-204.

Bergquist (P.R.), 1995 - Dictyoceratida, Dendroceratida and Verongida from the New Caledonia lagoon (Porifera: Demospongiae). *Mem. Queensland Mus.*, 38 (1): 1-51.

Bergquist (P.R.), Kelly-Borges (M.), 1991 - An evaluation of the genus *Tethya* (Porifera: Demospongiae: Hadromerida) with descriptions of new species from the Southwest Pacific. *The Beagle, Records of the Northern Territory Museum of Arts and Sciences*, 8 (1): 37-72.

Debitus (C.), 1994 - *État des travaux SMIB 1985-1993*. Rapport Orstom Nouméa, 82 p.

Debitus (C.), Amade (P.), Laurent (D.), Cosson (J-P.), eds, 1991 - *Troisième Symposium sur les substances naturelles d'intérêt biologique de la région Pacifique-Asie.* Nouméa, Nouvelle-Calédonie, 26-30 août 1991: 438 p.

Desqueyroux-Faundez (R.), 1984 - Description de la faune des Haplosclerida (Porifera) de la Nouvelle-Calédonie. I. Niphatidae-Callyspongiidae. *Rev. suisse Zool.*, 32 pl., 91 (3): 765-827.

Desqueyroux-Faundez (R.), 1987 - Description de la faune des Petrosida (Porifera) de la Nouvelle-Calédonie. I. Petrosiidae-Oceanapiidae. *Rev. suisse Zool.*, 16 pl., 94 (1): 177-243.

Fromont (J.), 1995 - Haplosclerida and Petrosida (Porifera: Demospongiae) from the New Caledonia lagoon. *Invertebrate Taxonomy*, 9: 149-180.

Hooper (J.N.A.), Bergquist (P.R.), 1992 - *Cymbastela*, a new genus of lamellate coral reef sponges. *Mem. Queensland Mus.*, 32 (1): 99-137.

Hooper (J.N.A.), Lévi (C.), 1993a - Poecilosclerida from the New Caledonia Lagoon (Porifera: Demospongiae). *Invertebrate Taxonomy*, 7 (5): 1221-1302.

Hooper (J.N.A.), Lévi (C.), 1993b - Axinellida from the New Caledonia Lagoon (Porifera: Demospongiae). *Invertebrate Taxonomy*, 7 (6): 1395-1472.

Hooper (J.N.A.), Lévi (C.), 1994 - "Biogeography of Indo-west Pacific sponges: Microcionidae, Raspailiidae, Axinellidae". *In* Van Soest (R.W.M.), Van Kempen (T.M.G.), Braekman (J.-C.), eds: *Sponges in Time and Space*. Rotterdam, Balkema: 191-212.

Kelly-Borges (M.), Vacelet (J.), 1995 - A revision of *Diacarnus* Burton and *Negombata* de Laubenfels (Demospongiae: Latrunculiidae) with descriptions of new species from the west central Pacific and the Red Sea. *Mem. Queensland Mus.*, 38 (2): 477-503.

Lévi (C.), 1967 - *Démosponges récoltées en Nouvelle-Calédonie par la Mission Singer-Polignac. Expédition française sur les récifs coralliens de la Nouvelle-Calédonie*. Éditions de la Fondation Singer-Polignac, 3 pl., 2: 13-26.

Lévi (C.), 1979 - "The Demosponge fauna from the New Caledonian area". *In*: Proceedings of the International Symposium on Marine Biogeography and Evolution in the Southern Hemisphere, Auckland, New Zealand, 17-20 July, 1978. *New Zealand Oceanographic Institute* Special Volume: 307-315.

Lévi (C.), 1983 - *Pseudaxinyssa cantharella* n.sp., Démosponge Axinellidae du lagon de Nouméa (Nouvelle-Calédonie). *Bull. Mus. nation. Hist. nat.* (4^{e} sér.), 5 (A, 3): 719-722.

Lévi (C.), 1991 - "Lithistid sponges from the Norfolk Rise, Recent and Mesozoic genera". *In* Reitner (J.), Keupp (H.), eds: *Fossil and Recent Sponges*. Berlin, Heidelberg Springer-Verlag: 72-82.

Lévi (C.), 1994 - "Porifera Demospongiae: Spongiaires bathyaux de Nouvelle-Calédonie, récoltés par le *Jean Charcot* campagne Biocal, 1985". *In* Crosnier (A.), ed.: *Résultats des campagnes Musorstom.* Paris, Mus. nation. Hist. nat., coll. *Mém. Mus. nation. Hist. nat.,* vol. 11, tome 158: 9-87.

Lévi (C.), Lévi (P.), 1978 - *Lepidosphaera*, nouveau genre de Démosponges à spicules en écailles. *Bull. Soc. zool. Fr.*, 103 (4): 443-448.

Lévi (C.), Lévi (P.), 1982 - Spongiaires Hexactinellides du Pacifique Sud-Ouest (Nouvelle-Calédonie). *Bull. Mus. nation. Hist. nat.* (4^{e} sér.), 9 pl. 4 (A, 3-4): 283-317.

Lévi (C.), Lévi (P.), 1983a - Éponges Tétractinellides et Lithistides bathyales de Nouvelle-Calédonie. *Bull. Mus. nation. Hist. nat.* (4^{e} sér.), 13 pl. 5 (A, 1): 101-68.

Lévi (C.), Lévi (P.), 1983b - Démosponges bathyales récoltées par le N/O *Vauban* au sud de la Nouvelle-Calédonie. *Bull. Mus. nation. Hist. nat.* (4e sér.), 8 pl. 5 (A, 4): 931-97.

Lévi (C.), Lévi (P.), 1988 - Nouveaux spongiaires Lithistides bathyaux à affinités crétacées de la Nouvelle-Calédonie. *Bull. Mus. nation. Hist. nat.* (4e sér.), 10 (A, 2): 241-63.

Moretti (C.), Debitus (C.), Fournet (A.), *et al.*, 1993 - Diversité biologique tropicale et innovation thérapeutique. Les recherches menées par l'Orstom. *Ann. Soc. belg. Méd. trop.*, 73: 169-178.

Vacelet (J.), 1981 - Éponges hypercalcifiées (Pharétronides, Sclérosponges) des cavités des récifs coralliens de Nouvelle-Calédonie. *Bull. Mus. nation. Hist. nat.*, (4e sér.), 3 (A, 2): 313-351.

Vacelet (J.), 1981 - Algal-sponge symbioses in the coral reefs of New Caledonia: a morphological study. *Proceedings of the Fourth International Coral Reef Symposium,* Manila, 2: 713-719.

Glossary

Acantho-
Addition of spines to the spicule surface. With spines (prefix).

Accessory spicules
Old term referring to echinating megascleres (cf. principal, auxiliary spicules).

-actin
Designates the number of rays (suffix).

Actine
Single ray of a spicule.

Alae
Terminal or lateral "tooth-like" extensions of a microsclere.

Amoebocyte
Mobile mesohyl cells.

Amorphous
Terminology describing sponge shape; of variable form.

Amphiaster
A microsclere with spines or clads radiating from both ends.

Amphiblastula larva
Larval form which has a hollow central cavity and two distinct cell types (anterior and posterior), associated with viviparous development; has a flagella on anterior hemisphere only.

Anastomising
Reticulated, rejoining, referring to cross connections between fibres of tracts.

Anatriaene
A triaene with the clads curved backward toward the long shaft.

Aniso-
Asymmetrically-ended spicule, *e.g.* anisoxea (prefix).

Anisochela
A chelate microsclere with uneven ends.

Anisoxeote
Spicule with morphologically different points.

Anthaster
A euaster with tuberculate, denticulate, digitate or spined expansions at the ray tips.

Aphodal
(a) A small canal which joins the choanocyte chambers to an exhalant canal (cf. prosodal); (b) a condition of the aquiferous system in which the choanocyte chambers are joined to the inhalant system directly by a pinacocyte prosopyle, lacking prosodal canals (cf. diplodal, eurypylous).

Apopyle
An aperture through which water leaves a choanocyte chamber (cf. prosopyl).

Aquiferous system
The water 'circulatory' system extending from the inhalant pores (ostia) to exhalant pores (oscula).

Aragonite
A crystalline form of calcium carbonate.

Arborescent
Branching, tree-like.

Archaeocyte
A motile amoeboid or phagocytic cell within the mesohyl of the sponge, with at least one nucleolus and many phagosomes; it is able to develop into any other sponge cell type and is also known as a nucleolate cell.

Arcuate chela
Microsclere where the teeth are formed as one to three curved plates.

Arenaceous
Condition of skeletal architecture in which sand and/or foreign spicule debris partly or completely replace native spicules within the sponge skeleton.

Areolate
The surface has many circular ectosomal features, *e.g. Hamigera.*

Ascending fibre
A synonym for a primary fibre.

Asconoid
Simple tubular body-plan, without folding of the body wall, and with the central cavity (atrium) lined by choanocyte chambers; a single osculum at the apex (characteristic of primitive Calcarea, also seen in a few homoscleromorph demosponges), (cf. syconoid, leuconoid).

Aspicular
No spicules.

Aster
Star-like microsclere with more than two rays radiating from a central point.

Asterose
Star-like.

Astrorhizae
Refers to surface excurrent canal patterns seen in sclerosponges; appear as radiating or star-shaped grooves.

Atrium
Central exhalant water cavity leading to one or more exhalant canals (oscula); also known incorrectly as cloaca.

Autotrophic
Self-sustaining (cf. heterotrophic).

Auxiliary spicules
Referring to second and third categories of megascleres, other than the structural or 'principal' megascleres, usually found outside the fibres, dispersed between tracts or on the surface;

incorrectly interchanged with the terms "ectosomal" and "subectosomal spicules" (cf. accessory, principal spicules).

Axial canal or filament

Central lumen of a spicule, occupied in life by an organic filament.

Axial construction

Skeletal organisation in which some components are condensed to form a dense central region.

Axial skeleton

Organic and/or inorganic skeleton found in the centre or axis of the sponge (cf. extra-axial).

-axon

Designates the number of axes (suffix).

Bark

Outer layer of spongin fibres in Dictyoceratid and Verongiid sponges.

Basopinacocytes

Outer layer of epithelial cells covering the basal surface, at the point of contact with the substrate (cf. exopinacocytes).

Benthic

Living on the bottom of the sea; 'benthos' refers to life forms on the seabed.

Bifurcate

Divides into two forks.

Bioerosion

Chemical and physical degradation of an inorganic or organic substrate caused by an organism.

Bipocilli

Modified small chelae as found in *Iophon*; with one discoid end and the other with a toothed rim or end.

Birotula

A microsclere with a straight shaft and umbrella-shaped ends.

Blastula larva

see Amphiblastula or Coeloblastula.

Body plan

Grade of construction of sponge body based on the complexity of the aquiferous system and disposition of choanocyte chambers with interconnecting canals (see asconoid, syconoid, leuconoid, aphodal, diplodal, prosodal); (not to be confused with the terms body shape or growth form).

Bud

An asexual reproductive propagule.

Calicle

Unit of body form in a sclerosponge.

Calthrops

Megasclere with four equal and symmetrical rays emanating from a central point.

Carbonates

$CaCO_3$.

Centrangulate

Sharp bend or angular curve at the centre, centrally flexed, seen mostly in oxea megascleres and sigma microscleres.

Centrum

The globular centre of many euasters.

Chela

Microsclere with a curved axis and various cup-like or tooth-like terminations at each end.

Chiaster

A small euaster without a centrum and with truncate rays.

Choanocyte

Flagellate or collar cell responsible for generating the water current that circulates through the sponge; a flagellum surrounded by a collar of cytoplasmic microvilli, is used to produce a water current system and to entrap small food particles or colloidal material.

Choanocyte chamber

Cavity lined by spherical clusters of choanocytes with flagella directed into the water-filled lumen (Demospongiae, Calcarea) (cf. flagellated chamber of Hexactinellida).

Choanoderm

Strictly a continuous layer of choanocytes lining a single internal cavity (found only in some Calcarea); also in a generalized sense to include all internal surfaces not bound by exo- or basopinacocytes.

Choanosomal spicules

Localization of megascleres within (coring) spongin fibres or tracts (cf. ectosomal and subectosomal spicules).

Choanosome

Internal region of the sponge, containing the choanocytes or choanocyte chambers, which includes everything bounded by the pinacoderm; also known as endoderm or endosome (cf. ectosome).

Cilia

Minute hair-like appendages which vibrate constantly, serve as organs of locomotion.

Clad

Ray or branch used mainly in triaene descriptions.

Cladome

Triradiate head of a triaene.

Cladotylotes

Megascleres with a cladome at one end and a tylote extension at the other, typical of *Acarnus*.

Clathrate

Interwoven tubular construction.

Clavate

Club-shaped.

Coeloblastula larva

Simple flagellated form with a cytologically undifferentiated central region, and an even distribution of small flagella; has a central cavity; found in Calcinea and associated with oviparous development.

Collagen

Proteinaceous connective tissue, can be elaborated into a range of fibres and filaments; forms the ground substrate or matrix of the mesohyl.

Collencytes

Mobile mesohyl cells which secrete collagen filaments.

Condensed or compressed

Condition of skeletal architecture in which there is a compressed central axis of fibres and/or spicules, from which arise plumose or plumo-reticulate columns of fibres and/or spicules; also known as axinellid or axinelloid.

Conule

A cone-shaped elevation of the surface membrane of a sponge, generally appearing as the surface layer drapes over a fibre end.

Coring spicules

Spicules found inside spongin fibres, usually structural or 'principal' spicules (cf. echinating spicules).

Cortex

A layer of the ectosome supported by a special organic or inorganic skeleton; a characteristic of many Choristida and may comprise two or more layers distinguished by structure and/or localisation of spicule types.

Crenulate

Wavy.

Cribripore

A specialised structure where several exhalent systems combine (a sieve-like cluster) to empty into a subsurface cavity.

Cryptic

Hidden.

Cuticle

Superficial thickening of collagen.

Demersal

Bottom-dwelling.

Dendritic

Term used to describe a skeleton or body form that branches repetitively with little or no anastomosis between successive branches (*i.e.* non-reticulate).

Dermal

Strictly refers to any association with the pinacoderm; also used to refer to structures lying on or just below the ectosomal membrane or dermis (correct usage is "ectosomal").

Dermis

The extreme outer surface layer of the sponge, may be simply membrane but may be reinforced by spicules, sand or both (correct term is 'ectosome').

Desmas

Interlocking spicules forming a rigid skeleton.

Diactinal

Spicules with two diverging rays, representing growth in two directions, usually with bilateral symmetry; diacts may include monaxonic spicules (*e.g.* oxeas of demosponges), and tetraxonic derivatives (*e.g.* "oxea" of Calcarea; uncinate of Hexactinellida), (cf. monactinal).

Diactine

Two rays diverge from a central point.

Dichotriaene

A triaene in which the clads are bifurcate.

Digitate

Finger-like.

Dioecious

With the cells of each sex occurring in different individuals (also known as gonochoristic), but in sponges it is usual for one individual to produce eggs at one time and sperm at another times (strictly successive or temporal hermaphroditism), (cf. hermaphroditic).

Diplodal

A condition of the aquiferous system, where some sponges possess both prosodal and aphodal canals between choanocyte chambers (cf. aphodal, eurypylous).

Discorhabd

A microxea with discs or whorls along the shaft.

Dragma

Bundle of microscleres.

Echinating spicule

A megasclere which protrudes from a fibre or spicule tract; characteristic of several families of Poecilosclerida (Microcionidae, Crellidae, Myxillidae, Anchinoidae, Hymedesmiidae, Raspailiidae).

Ectosomal spicules

Condition referring to localization of megascleres to the ectosomal skeleton (cf. subectosomal, choanosomal spicules).

Ectosome

Peripheral region of the sponge lacking choanocyte chambers; the term strictly refers to the unicellular surface layer (pinacocytes), but it is also used to refer to the mineral skeleton found in the periphery; also known as cortex or dermis (cf. choanosome).

Encrusting

A sheet of sponge thinly coating the substrate.

Endopinacoderm

Pinacocytes lining internal canals.

Endosome

All except the ectosomal structures of a sponge (now correctly termed 'choanosomal').

Epitheca

A thin wrinkled layer different in structure from the normal skeleton, covering the dead basal part of a rigid calcareous skeleton.

Erect

An upright growth strategy.

Ethanol

Preserving fluid or tissue fixative (alcohol).

Euaster

Aster with a central core and diverging rays.

Eurypylous

Condition of the aquiferous system in which there are wide mouthed sac-like choanocyte chambers without any aphodal canals present (cf. aphodal, diplodal conditions).

Exhalant

Part of the aquiferous system related to the expelling of water from the sponge, and includes all water vascular structures between the apopyles and the oscula; also known as excurrent system (cf. inhalant).

Exopinacocytes

Layer of pinacocytes covering the free surface of the sponge (exopinacoderm).

Exopinacoderm

Pinacocytes lining external surface of sponge.

Extra-axial

Organic and/or inorganic skeleton arising from the centre (or axis) and ascending towards the periphery of the sponge (cf. axial).

Extra-axial skeleton

Skeleton elements surrounding or arising from an axial region.

Fascicles

Interwoven spongin fibres.

Fibre
A discrete column of spongin, one of the chief structural elements of the Keratosa, Haplosclerida and Poecilosclerida.

Fibril
A small fibre (sub-light microscopic), collagenous filaments forming the spongin ground substance (see collagen fibrils).

Filament
Thin and irregularly flexed with a small bulge at each end composed of collagen; characteristic of *Ircinia*.

Filter-feeding
Process of obtaining food by pumping water through a series of sieves of decreasing size, finally obtaining small food particles for ingestion usually less than 0.1 µm in diameter.

Fistule
Tubular structure, on the upper surface of some sponges, on which the oscule is situated, used to exhale water; frequently found on species that burrow into mud or excavate coral.

Flabellate/flabelliform
Fan-shaped.

Flagella
Hair-like projection from a cell; the central organelles of choanocyte cells, used to set up a water current via rhythmic beating and aid in entrapment of food particles.

Flagellated chambers
Cylindrical chambers lined by choanocytes, which are not embedded within a cellular matrix, and also lack any connecting canals (Hexactinellida only), (cf. choanocyte chambers of Demospongiae and Calcarea).

Foliaceous
Leaf-like.

Formaldehyde/formalin
Preserving fluid or fixative.

Fusiform
Spicule tapers regularly towards one or both ends (cf. hastate).

Gamete
Egg and sperm.

Gametogenesis
Production of eggs or sperm.

Gemmules
Asexual reproductive bodies; collections of cells and spicules surrounded by a thick wall, when released by the parent form new individuals.

Gonochoric
Separate sexes.

Habit
Term used to describe external shape of a sponge, also known as ecophenotype.

Halichondroid
Condition of skeletal structure, with megascleres arranged in vague tracts which may be reticulate or scattered in a disorganised criss-cross within the mesohyl.

Hermaphroditic
Male and female cells occur together in one individual at the same time (cf. gonochoristic).

Heterotrophic
Obligate assistance of symbionts for energy requirements.

Hispid
Projecting spicules or spicule ends form a pile.

Inclusions
Foreign material included into fibres; also a term for undefined cellular components.

Inhalant
Part of the aquiferous system related to bringing water into the choanocyte chambers, including all structures between the ostia and prosopyles; also known as incurrent system (cf. exhalant).

Interstitial
Between fibres or sediments; can also mean between cells.

Isochela
Chela with both ends identical; can be either palmate with a single flattened plate at each end, or toothed with several pointed plates at each end.

Isodictyal
Condition of skeletal architecture in which the reticulation is triangular in three dimensions, produced by single spicules joined together at their ends by an accretion of collagenous spongin (also known as 'renieroid').

Isotropic
Condition of skeletal architecture in which there is a disoriented or seemingly random reticulation of spicules or fibres without distinction between primary and secondary columns.

Keratose sponges
Collective term referring to sponges which lack a native mineral skeleton (usually only includes the orders Dictyoceratida, Dendroceratida, Verongida).

Lacunae
Spaces, usually associated with exhalent canals.

Lamellate/laminae
A thin plate or layer/s.

Leuconoid
Body-plan construction produced by complex folding of the body wall, forcing choanocyte chambers to become oval and isolated in a maze of canals within the body wall, and chambers open onto branching

excurrent canals (most Demospongiae, some Calcarea), (cf. asconoid, syconoid).

Lobate/lobose
Having lobes, rounded projections.

Mamillate
Nipple-shaped.

Massive
Term used in describing sponges which grow from a spreading base to achieve some thickness, usually in excess of 5 cm, but which can be quite irregular in overall form.

Megasclere
A structural spicule class; larger size of spicules forming the sponge skeleton; also known as structural spicules (cf. microscleres).

Meniscoid
Surface; concave depression; term usually applied to microscleres including sigmas, isochelae.

Mesohyl
The region of the sponge enclosed between the pinacoderm and the choanosome; intercellular compartment in sponges, equivalent to the mesenchyme of other metazoans.

Microcionid
Condition of skeletal architecture usually found in encrusting sponges, in which non-anastomosing (plumose) spongin fibre nodes arise from a basal layer of spongin lying on the substrate, and these are echinated by (usually perpendicular) plumose tracts of spicules; widely recognised as the subsequent stage of development from a hymedesmoid skeleton.

Micorhabd
A collective term for monactinal microscleres.

Microsclere
A packing or reinforcing spicule usually of small size frequently of ornate shape; smaller category of spicules forming the sponge skeleton; also known as flesh spicules (cf. megascleres).

Microsymbiont
Prokariotic or rarely eukariotic micro-organisms living inside sponges; maybe unicellular or multicellular; occur inside sponge cells and outside.

Microvilli
Extensions of the choanocyte cell which form an upright tube or collar surrounding the central flagellum, and used as in food entrapment and water flow.

Microxea
A microsclere in the shape of an oxea; common in Astrophorida.

Monactinal
A spicule with one ray, growing from one end only, usually asymmetrical in

geometry; monacts include monaxonic spicules (*e.g.* styles in demosponges), derivatives of tetraxonic spicules (*e.g.* "needle-eye" microxea in Calcarea) and hexactinal spicules (*e.g.* basal bidentates); (cf. diactinal).

Monactine

Spicule with a single ray or axis, thus the two ends are dissimilar.

Monaxonic

Linear spicule with no more than two rays along one axis, including both monactinal and diactinal spicules; also known as monaxonid (cf. triaxonid, tetraxonid).

Mucronate

Sharply pointed.

Multispicular

More than one row of spicules in a fibre, tract or reticulation; also known as polyspicular (cf. unispicular).

Myocyte

Mobile mesohyl cells which dictate contractions of oscules and pores.

Orthotriaenes

Triaenes with projections in a plane at right angles to the rhabd.

Oscula

Exhalant pores, through which water leaves the sponge; usually represented as the larger pores (cf. ostia).

Oscule(um)

Exhalant opening of a sponge.

Ostia

Inhalant openings of a sponge (cf. oscula).

Ovipary

Method of sexual reproduction in which eggs develop within the female sponge, are broadcast into the water, often becoming attached to a mucous layer on the external surface, they are fertilized externally, larvae are subsequently released and are free for varying periods to eventually settle on the substrate (cf. vivipary).

Oviviparous

Produces eggs.

Ovocytes

Female reproductive unicell before fertilisation.

Oxea

A symmetrical diactinal megasclere in which both ends taper to points; may be curved; asymmetrical forms are called 'anisoxeas'.

Oxyaster

An aster in which all the rays are pointed; the centrum may be small or absent.

Oxyspheraster

A spheraster with pointed rays; an oxyaster with a thick centrum.

Repent
Growth predominantly horizontal; the basal attachment area is large in proportion to body bulk, though it may not be continuous.

Reticulate
Condition of skeletal architecture whereby spongin fibres and/or spicule columns branch and rejoin (anastomose) with each other to form two- or three-dimensional meshes; any interlocking anastomosing skeleton, either fibre or spicule.

Rhabd
Oxeote or strongylote microsclere; also a term used to describe a curved end of a spicule.

Sclerocyte
Anucleolate motile secretory cell which produces spicules.

Sclerodermites
Aggregate of crystals forming a microstructural unit of the calcareous skeleton.

Secondary fibre
A fibre disposed without marked orientation to the surface; connecting primary fibres.

Secondary fibre tract
Minor fibre or spicule tract interconnecting the ascending primary fibres or tracts (cf. primary).

Sedentary animals
Animals in which the adults do not move by usual forms of locomotion (cilia, pseudopods, legs, etc.), but usually live attached to the substrate; adult sponges are typically sedentary, although their larvae swim through the water column using cilia and/or flagellae.

Sigma
A microsclere in which a single axis is curved or contorted to a 'c' or 's' shape.

Sigmaspirae
Contorted sigmas of one revolution in a spiral manner.

Siliceous
Composed of silica, a glass-like material.

Spermatocyte
Male reproductive unicell.

Spheraster
An aster with a large centrum and many short conical rays.

Spherulitic
Refers to aragonite skeleton in *Astrosclera*; globular centric or excentric arrangement of crystal fibres radiating from a common centre.

Spherulous cells
Cell filled with large round spherules which occupy most of the cell volume; secretory cells located in the mesohyl.

Spicule

Skeletal element composed of silica or calcium carbonate; discrete element of the skeleton, produced by sclerocytes; divided into two categories based on size (megasclere and microsclere).

Spinulate

Spined.

Spongin

Fibrous skeletal material; collagenous material deposited in the form of fibres or plaques which are often of large size forming the organic intercellular matrix (collagenous filaments or spongin type A), and organic skeleton (spongin fibres or spongin type B).

Spongin fibre

Macroscopic collagenous structures made up of many small microfibrils bound together, producing discrete stands or plaques; fibres may be homogeneous (*e.g.* Spongiidae), have a light central pith (*e.g.* Thorectidae) or a granular medullary portion (*e.g.* Verongida); fibres frequently contain the mineralized secreted products of the sponge (spicules) and/or foreign particles (*e.g.* arenaceous species); also known as the organic skeleton.

Spongocytes

Motile nucleolate cells that secrete spongin fibres.

Spumous cells

Secretory cells in the mesohyl; only known from the Dendroceratida.

Stellate

Star-like.

Sterraster

An aster with a large spherical or ovate centrum and numbers of fine short rays.

Stolon

Root-like processes at the base of the sponge, or filament-like attachments to the body.

Strongyle

A diactinal spicule in which both ends are rounded.

Style

A monactinal megasclere in which one end is evenly rounded and the other end pointed.

Subdermal/subectosomal

Below the dermis.

Subectosomal spicules

Condition where megascleres are localized to a region below the ectosomal skeleton but not associated with fibres or primary skeletal tracts (cf. ectosomal, choanosomal spicules); intermediate between surface (ectosomal) and structural (choanosomal) skeletons.

Subisodictyal

Partially isodictyal or renieroid; also used to describe a condition of skeletal architecture similar to isodictyal reticulation but where meshes have two or more spicules per side.

Subtylostyle

A monactinal megasclere which has a slight, or sub-apical expansion, otherwise a typical style.

Syconoid construction

Body plan produced by folding of both the exterior (pinacoderm) and interior (choanoderm) walls, such that choanocyte chambers lie within the body wall, and chambers open directly onto the atrium (Calcarea).

Symbiotic bacteria

Bacteria living within the sponge which aid the sponge in obtaining energy.

Tangential

Lying at oblique angles, or at a tangent to ascending spicules of the underlying skeleton; usually used to refer to surface spicules or fibres lying parallel to the surface.

Tetract/tetractinal

Spicules with four rays (found in some Demospongiae, some Hexactinellida, some Calcarea).

Tetraxonid

Spicule with four rays each containing a central axis; also known as tetraxonic (cf. monaxonid, triaxonid).

Tornote

A diactinal megasclere in which the shaft end is abruptly tapered to produce points.

Totipotent

Archaeocytes able to differentiate into many other cell types.

Toxa

A 'bow-shaped' microsclere.

Triact

Spicule with three rays (common in Calcarea).

Triaene

A spicule with three rays shorter than the fourth; common in the Choristida.

Trichodragma

Bundle of raphides.

Triradiate

Calcareous spicule.

Truncate

Shortened.

Tyle

Any rounded swelling or knob (other than the centrum) in a spicule.

Tylostyle
A monactinal megasclere knobbed at one end, pointed at the other; typical megasclere of the Hadromerida.

Tylote
A diactinal spicule in which both ends are knobbed.

Type locality
Original locality from which the original specimen of the species, called the holotype, was described.

µm
Micron = 1/1000 mm.

Unguiferate
Chelate microsclere with short discrete teeth, often there are more than three teeth at each end of the shaft.

Unispicular
A single aligned row of megascleres in a tract, fibre or reticulation (*e.g.* isodictyal) (cf. multispicular, paucispicular).

Vasiform
Vase-like.

Vermiform
Undulating.

Verrucose
Warty.

Verticillate
Regular rings of spines on spicules (*Agelas* species).

Viviparous
Transfer of some material from the parent to the embryo.

Vivipary
Method of sexual reproduction whereby the female sponge takes in sperm from another sponge via the inhalant aquiferous system, eggs are fertilized and the ciliated (parenchymella) larvae are brooded within the female sponge, and fully developed larvae, usually well differentiated cytologically, are subsequently released into the seawater (cf. ovipary).

Zooxanthellae
Symbiotic unicellular algae.

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140 *Haliclona sanguinea* Fromont (holotype): I. Rédika, 20 m (photo P. Laboute)

141 *Haliclona tyria* Fromont (holotype): I. Maître, 20 m (photo P. Laboute)

142 *Gelliodes carnosa* Dendy: Magenta, 1 m (photo P. Laboute)

143 *Gelliodes fibulata* (Carter): E. Coast, Noumboue 20-25 m (photo G. Bargibant)

144 *Gelliodes persica* Fromont: S. Nouméa: Banc Gail, 33 m (photo P. Laboute)

145 *Callyspongia aerizusa* Desqueyroux-Faundez: Nouméa, I. Rédika, 20 m (photo P. Laboute)

146 *Callyspongia azurea* Fromont: I. des Pins, N.E. I. Gie, 20 m (photo P. Laboute)

147 *Callyspongia communis* (Carter): Nouméa, between I. Canard and I. Maître (on Chlamys), 15 m (photo P. Laboute)

148 *Callyspongia flammea* Desqueyroux-Faundez: S.E. I. Ua, 20 m (photo P. Laboute)

148 *Callyspongia flammea* Desqueyroux-Faundez: Kouaré, 30 m (photo P. Laboute)

149 *Callyspongia fruticosa* Desqueyroux-Faundez: Banc Gail, 30 m (photo P. Laboute)

150 *Callyspongia hispidoconulosa* Desqueyroux-Faundez: Récif Ua, 20-25 m (photo P. Laboute)

150 *Callyspongia hispidoconulosa* Desqueyroux-Faundez: I. Ua (photo P. Laboute)
151 *Callyspongia subarmigera* (Ridley): Baie de Ste Marie, 12 m (photo P. Laboute)
152 *Dactylia delicata* (Pulitzer-Finali): Canal Woodin, 20-30 m (photo P. Laboute)
153 *Petrosia capsa* Desqueyroux-Faundez: N. Ile des Pins, outer reef slope, 38 m (photo P. Laboute)
154 *Xestospongia bergquistia* Fromont: Baie du Prony, 20 m (photo G. Bargibant)
155 *Xestospongia exigua* (Kirkpatrick): Baie du Prony, 10 m (photo G. Bargibant)
156 *Oceanapia tenuis* Desqueyroux-Faundez: Récif Croissant, 12 m (photo P. Laboute)
157 *Spongia australis* Bergquist (holotype): Chenal des 5 milles, 20 m (photo P. Laboute)
158 *Coscinoderma mathewsi* (Lendenfeld): Passe de Yandé, 32 m (photo P. Laboute)
159 *Leiosella ramosa* Bergquist (holotype): Récif des Français, 27 m (photo P. Laboute)
160 *Phyllospongia papyracea* (Esper): Récif Doiman, 15 m (photo G. Bargibant)
161 *Hyrtios reticulata* (Thiele): Baie du Prony, 35 m (photo P. Laboute)
162 *Petrosaspongia nigra* Bergquist: Passe de Boulari, 15-18 m (photo G. Bargibant)
163 *Luffariella caliculata* Bergquist (holotype): Coëtlogon-Goro, 50 m (photo P. Laboute)
164 *Luffariella cylindrica* Bergquist (holotype): Banc Gail, 30 m (photo P. Laboute)
165 *Ircinia irregularis* (Poléjaeff): Nouméa, seagrass bed, West Lagoon 15 m (photo G. Bargibant)
165 *Ircinia irregularis* (Poléjaeff): I. Rédika, 20 m (photo P. Laboute)
166 *Psammocinia bulbosa* Bergquist (holotype): Barrier reef, M'Bere (photo J.L. Menou)
167 *Dysidea herbacea* (Keller): Chenal des 5 milles, 25 m (photo P. Laboute)
168 *Dysidea arenaria* Bergquist: Nouméa, I. Maître, 10 m (photo P. Laboute)
169 *Dysidea nigrescens* Bergquist (holotype): South Lagoon between I. Tere and I. N'da, 30 m (photo P. Laboute)
170 *Dysidea frondosa* Bergquist (holotype): Nouméa: I. Maître, 25 m (photo P. Laboute)
171 *Euryspongia delicatula* Bergquist (holotype): Récif Ue 20-25 m (photo P. Laboute)
172 *Euryspongia vasiformis* Bergquist (holotype): Récif Tomboo, 30 m (photo P. Laboute)

173 *Darwinella* sp.: North Lagoon, I. Paaba, 27 m (photo P. Laboute)
174 *Dendrilla rosea* Lendenfeld: Nouméa: I. Canard, 20 m (photo P. Laboute)
175 *Dictyodendrilla elegans* (Dendy): Nouméa: I. Maître, 20 m (photo P. Laboute)
176 *Porphyria flintae* Bergquist (holotype): Cap Boyer, I. Maré, 33 m (photo P. Laboute)
177 *Pseudoceratina verrucosa* Bergquist: Baie du Prony, Rocher Auzille, 8-10 m (photo G. Bargibant)
178 *Suberea creba* Bergquist (holotype): Passe de St Vincent, 45 m (photo G. Bargibant)
179 *Suberea laboutei* Bergquist (holotype): North Lagoon, 18 m (photo P. Laboute)
180 *Ianthella basta* (Pallas): Banc Gail, 35 m (photo P. Laboute)
181 *Anomoianthella rubra* Bergquist: Nouméa: chenal de l'I. Maître, 25 m (photo P. Laboute)

Black-and-white photographs

27 Choanocytes *in situ* (photo P.R. Bergquist)
27 Choanocytes *in situ* (photo P.R. Bergquist)
30 Matrix cyanobacteria (photo J. Vacelet)
31 Archaeocyte (photo C. Donadey)
37 Soft parts of the sponge (photo J. Vacelet)
41 Spongin fibres some with detritus incorporated (photo J.N.A. Hooper)
41 Spongin fibre (photo J. Vacelet)
42 Perforated ostial surface of ectosome, with renieroid (isodictyal) tangential surface spicule skeleton (photo P.R. Bergquist)
42 Reticulate spicule skeleton and perforate ectosome (photo P.R. Bergquist)
42 Thick sponge cortex, with spherasters embedded in ectosome (photo J.N.A. Hooper)
43 Plumose ectosome (exterior), reticulate choanosomal skeletons (interior) (photo J.N.A. Hooper)
43 Irregularly reticulate spongin fibres and embedded spicules (photo J.N.A. Hooper)
43 Rectangular reticulate skeleton (photo J.N.A. Hooper)
43 Plumose skeleton, with embedded detritus (photo J.N.A. Hooper)
43 Radial choanosomal skeleton (photo J.N.A. Hooper)
44 Hypercalcified basal ('sclerosponge') skeleton (photo J.N.A. Hooper)

Siliceous spicules- Megascleres

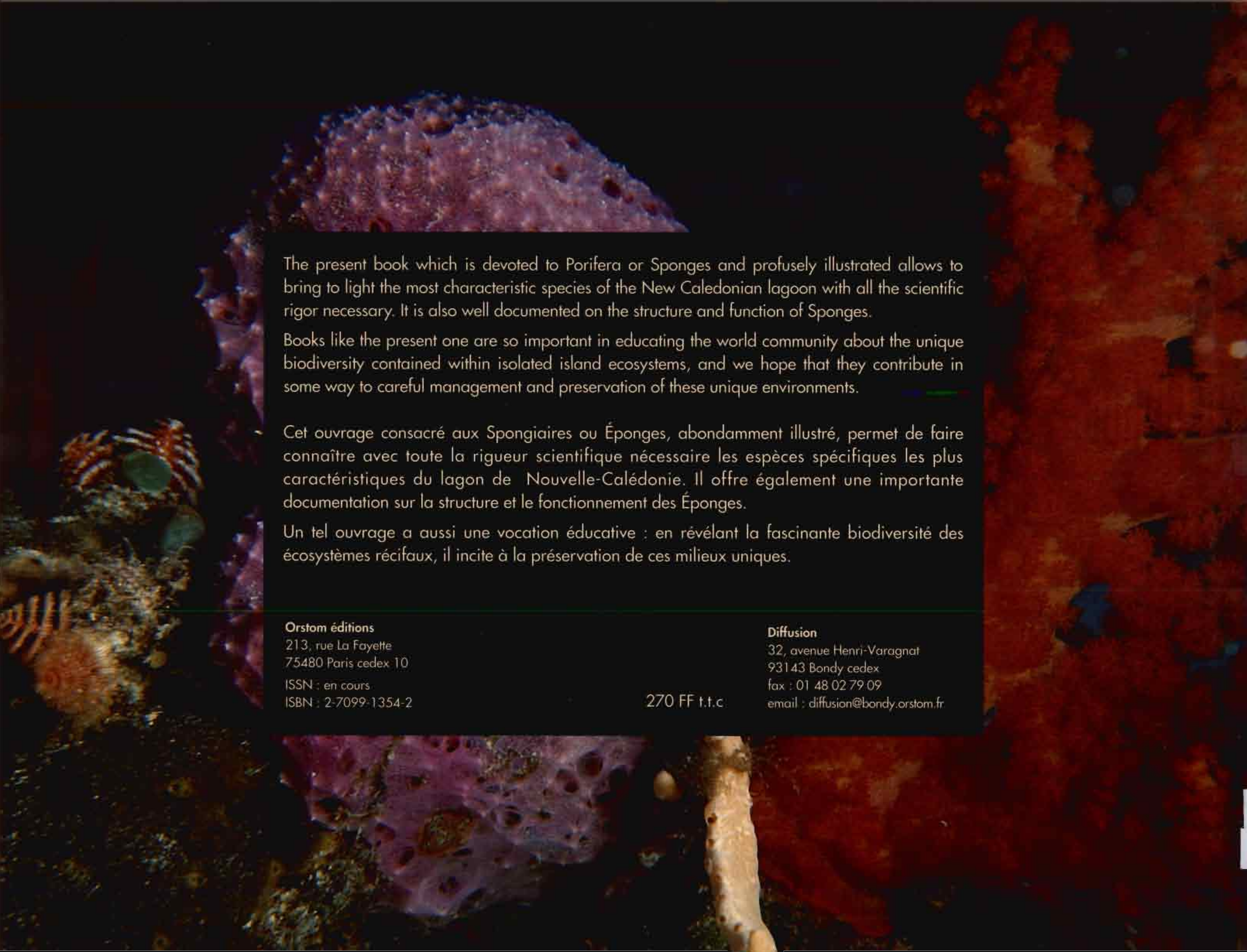
Siliceous spicules- Microscleres

Calcareous spicules

Mise en page : Gris Souris - Buzignarges
Photogravure et flashage : Atelier six - Saint-Clément-de-Rivière
Achevé d'imprimer sur les presses
de l'imprimerie SVI/Publicep à Montpellier
Reliure : Sirc - Marigny-le-Chatel

Cet ouvrage a été imprimé sur un papier job 135 g/m² couché mat

Dépôt légal : juin 1998



The present book which is devoted to Porifera or Sponges and profusely illustrated allows to bring to light the most characteristic species of the New Caledonian lagoon with all the scientific rigor necessary. It is also well documented on the structure and function of Sponges.

Books like the present one are so important in educating the world community about the unique biodiversity contained within isolated island ecosystems, and we hope that they contribute in some way to careful management and preservation of these unique environments.

Cet ouvrage consacré aux Spongiaires ou Éponges, abondamment illustré, permet de faire connaître avec toute la rigueur scientifique nécessaire les espèces spécifiques les plus caractéristiques du lagon de Nouvelle-Calédonie. Il offre également une importante documentation sur la structure et le fonctionnement des Éponges.

Un tel ouvrage a aussi une vocation éducative : en révélant la fascinante biodiversité des écosystèmes récifaux, il incite à la préservation de ces milieux uniques.

Orstom éditions
213, rue La Fayette
75480 Paris cedex 10
ISSN : en cours
ISBN : 2-7099-1354-2

270 FF t.t.c

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