



The Sponge Guide: Interactive photographic online guide to the identification of Caribbean sponges

Sven Zea¹, Timothy P. Henkel² and Joseph R. Pawlik³

¹ Universidad Nacional de Colombia, Sede Caribe, Santa Marta, Colombia, email: sezeas@unal.edu.co; ² Department of Biology, Valdosta State University, GA, USA, email: tphenkel@valdosta.edu; ³ Department of Biology and Marine Biology, Center for Marine Science, University of North Carolina Wilmington, NC, USA, email: pawlikj@uncw.edu

Development

Marine sponges are one of the most important functional components of benthic marine communities throughout the world, but especially in the Caribbean Sea (Wilkinson 1987; Díaz et al. 2001). Sponges are animals living attached to the bottom, feeding by filtering small particles and organic matter from the sea water through a system of internal canals (Bergquist 1978; Simpson 1984). Owing to coral decline and overfishing, sponges are becoming dominant on coral reefs (Pawlik 2011). Unfortunately, taxonomic identification of sponges is usually difficult and undertaken mostly by experts, due to the paucity of characters and their ecological and geographical variability. This fact has hampered their broader inclusion in ecological and other studies, even though only ten or so species usually comprise more than half of their abundance at any given site (Loh and Pawlik 2014). Sponges are identified from their external morphology (shape, color, consistency, surface characteristics), and from the type and three-dimensional arrangement of their microscopic skeletal elements called spicules; the latter are analyzed through digestion of small pieces of tissue in commercial bleach, and through thick, hand-made histological sections. With the advent of SCUBA diving and underwater photography, regional monographs and illustrated printed catalogs (e.g., Wiedenmayer 1977; van Soest 1978, 1980, 1984; Zea 1987, Hajdu *et al.* 2011; Moraes 2011) became important tools for scientists, as well as for interested laymen to become familiar with the most common species. However, printed catalogs are costly to produce and distribute, limiting both their scope and access to the information. With the advent of digital technology, more extensive catalogs can be made available, and these can be updated periodically and made available to all users through the Internet or other sources.

One of the first printed monographs combining detailed descriptions, drawings of skeleton and underwater color photographs was that of Zea (1987). It was written in Spanish and only comprised 89 species (it was intended to be the first of multiple volumes), but it quickly became a useful tool that launched new comprehensive studies in reef sponge ecology (summarized in Pawlik 2011).

The Sponge Guide
a picture guide to Caribbean Sponges

Home | FAQ | Species List | Search | References | Updates | About Us

Introducing the 3rd Edition!

With this edition of the Sponge Guide, we present over 230 species morphs of sponges from the Caribbean region. Our catalog now includes over 2,100 images that have been tagged with searchable physical characteristics.

We have begun to provide complete entries for specific species, a primary tool for identification. In 49 species morphs, in addition, we've expanded the regions we've visited and subsequently catalog more of the geographic and habitat variation of these animals.

Finally, you'll notice some new search features, detailed descriptions and notes, and many other features as you browse and explore the Sponge Guide, 3rd Edition.

Just click the **Find a Sponge** tab on the right to begin. Enjoy!

Sponges are important members of coral reef ecosystems. They filter water, cycle nutrients, and provide a home to numerous cryptic organisms. With the decline of corals, sponges have become the main habitat-forming organisms on many Caribbean reefs.

Species of sponges differ in shape, color, texture. However, even individuals of the same species can differ in their appearance between geographic areas, and also between habitats.

Every image presented in this database has been examined and the species identification has been carried out using established taxonomic techniques.

Because of their variability, identifying sponges can be a difficult task. Often, microscopic examination of the skeleton, composed of organic (protein) tissue fibers and skeletal elements, called spicules, is necessary in order to distinguish different species. With this 3rd edition, we have started to include composite images of spicules and tissue sections, together with detailed illustrations and taxonomic comments, to help in the identification.

We hope that you find this tool useful and gain a better appreciation for the wonderful world of Caribbean sponges!

REEF ENCOUNTER

The News Journal of the International Society for Reef Studies
Reef Currents: On-line Caribbean Sponge Guide



The present guide was initiated in 2000 when Zea served as the sponge taxonomist on a series of research expeditions in the Bahamas led by Pawlik. Over the next 10 years, this collaboration was joined by Henkel, who added knowledge of databases and programming to develop a comprehensive photographic database of reef sponges. While the goal at the time was to develop a tool for researchers on the expedition, in 2009 we put the Sponge Guide (tSG, spongeguide.org) online for everyone to access (Zea et al. 2009). The guide was quickly welcomed by scientists and laymen alike, receiving over 10,000 visits from 125 countries during the first year. It brought interesting discussions among sponge taxonomists and has been highlighted in various venues (Internet lists, specialized workshops and courses, other online guides, e.g. Messing et al. 2009; see also Cardenas et al. 2012; van Soest et al. 2012).

Over the past year and a half, we have worked to resolve many of the tentative identifications first published in tSG, expanding the regions surveyed to the eastern and southern Caribbean, and documenting skeletal information required for more complete identification. This work was made possible by funding from the National Science Foundation, Universidad Nacional de Colombia and a Fulbright Visiting Professor scholarship. From these efforts, in December 2014, the 3rd edition of the guide was launched (Zea et al. 2014), comprising 2,152 images of 231 species, 49 of which now have a full complement of skeletal images, descriptions and taxonomic notes.

GUIDE FEATURES

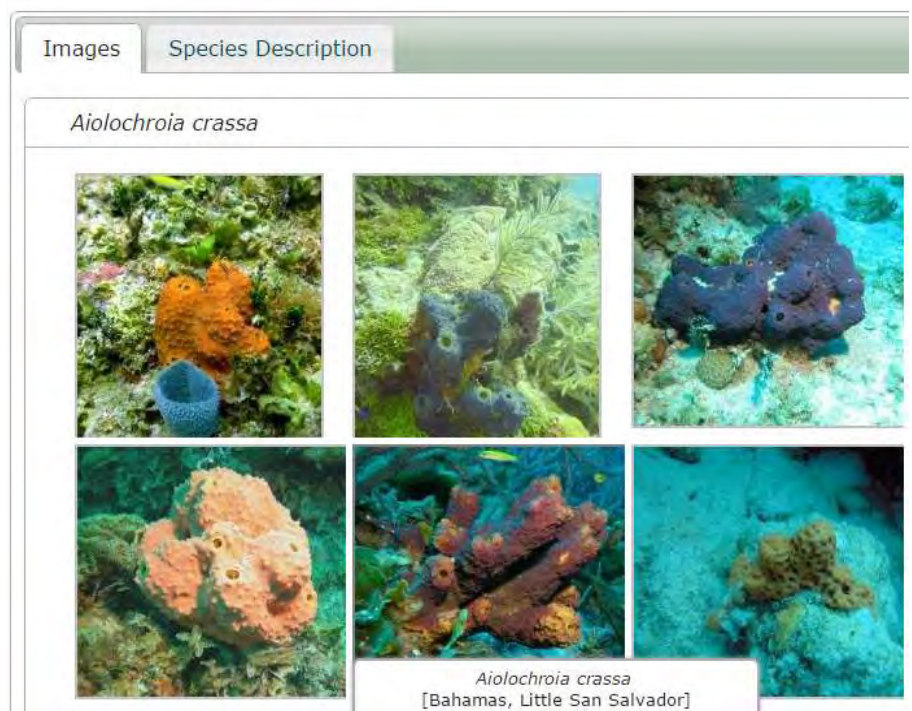
Cataloging Variability

One of the primary goals of the Sponge Guide is to capture and display morphological variation of individual species alongside their confirmed taxonomic identification. With the 3rd edition, we now have cataloged images of sponges from 10 countries in the Caribbean. In the guide, we have characterized 232 species-morphs, of which almost all have images of at least two different individuals taken *in situ*. We have recorded 5 or more specimens for 75% of the species-morphs in the guide. In each case, taxonomic identification has been verified by the guide's authors.

Within tSG, each photograph is tagged with key descriptive characteristics including color, consistency, morphology, and habitat, as well as location (the specific reef and country of origin), photographer and any specific notes of interest for the photograph. By focusing on images taken in the field, the assigned descriptive characteristics are based on the specimen as seen by a diver.

Power to Search

Tagging each specimen with key terms allowed for a searchable interface to be built around these terms. We have designed several methods for finding sponges that are accessible from every page of tSG by clicking on the Find a Sponge (FaS) tab. First, a user can filter the catalog using our predefined characteristics. The search result includes a list of names as well as images that the user can scan through. Links are also provided to view other variations of the species in question.



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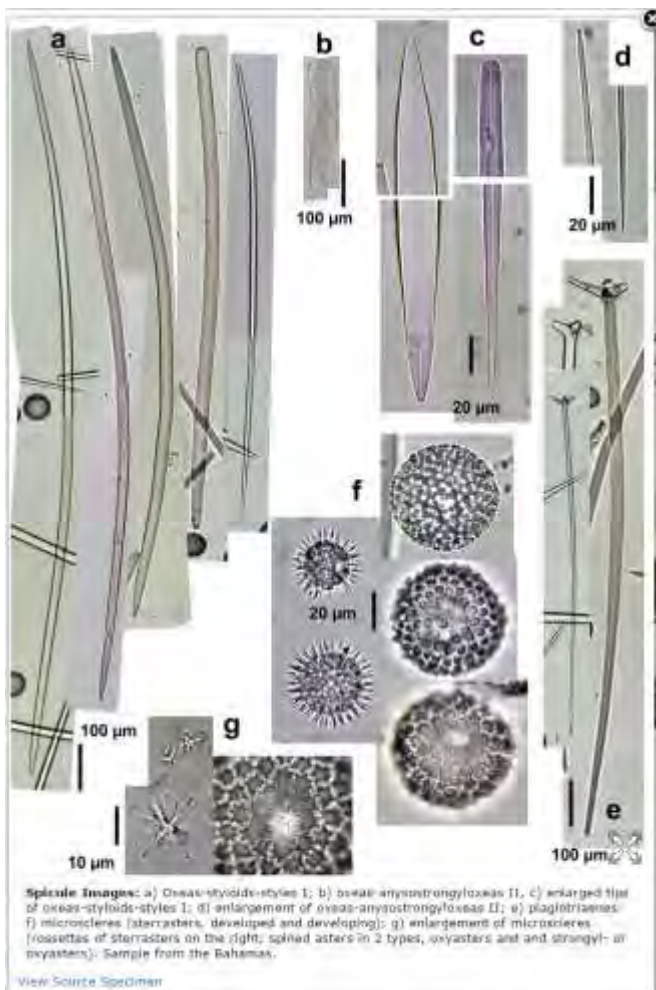


Another search option leverages a Google Custom Search Engine that has indexed all of the species and individual image pages of tSG. Thus, all of the characteristics, species descriptions, custom notes, and figure captions from tissue and skeletal images are searchable using Google's familiar interface. Within our species descriptions and notes, we include previous taxonomic classifications, so for example, if a user is looking for images of *Pseudoceratina crassa* the guide will point them to the current species page for *Aiolocroia crassa*.

From Macro to Micro Variation and Identification

The largest addition with the launch of the 3rd edition comes from extensive work processing tissue samples and cataloging skeletal structures of 49 different species morphs. Taxonomic confirmation requires analysis of spicules and skeleton, and access to specialized literature with thorough descriptions; thus we decided to bring the guide to a new level, adding composite images of spicules and tissue sections, detailed descriptions and taxonomic remarks.

Search Results for: green, branching sponges.



Users can find specimens with skeletal information in two easy ways: Using either the Search page or the Advanced Search box in the FaS tab, results can be filtered to only those with skeletal images by clicking on the "Tissue Samples" label at the top of the search results. Adding the phrase "tissue and spicules" with quotes will also only find specimens with skeletal information. Second, while viewing the Species List page (accessible in the top menu), entering an asterisk (*) will filter names of specimens that have skeletal and tissue information.

Browsing and Comparing

We have also added the ability to browse and compare sponges. Within the species list (or a characteristic search), users can click on any taxonomic level to view all specimens that belong to that group. Users can also view the thumbnails of images that match the criteria. Each thumbnail can be expanded by clicking on it, and moved around the screen. This allows for side by side comparisons of individual sponges.

Fully Referenced and Cross-listed

All of the identifications include a link to the full reference used to assign a specific identification. This allows for comparisons and historical context within the technical literature. Further, tSG is fully cross-listed with the World Porifera Database (www.marinespecies.org/porifera). This provides users easy access to even more information on the identification and distribution of any sponge of interest.

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Built for Change and Growth

Finally, the 3rd edition of tSG highlights our desire to have a resource that is able to grow and change based on both new research developments and end-user needs. The online format allows for simple changes to nomenclature based on new studies, as well as presenting the morphological diversity of each group with the large catalog of images. We have begun archiving previous editions of the database online to allow citation and for revisiting previous descriptions. Each species page includes a link to a printable view that presents all of the species information in a simple layout for printing or viewing offline. We are always looking for new ideas and suggestions for formatting and layout to better serve the thousands of sponge enthusiasts that access this resource a year (suggestions@spongeguide.org).

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