

## Marine Sponges

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Sponges constitute the phylum Porifera, which includes nearly 5000 species classified among 4 classes (Bergquist, 1978). Two families occur in fresh water, but most sponges are marine. Sponges are distributed worldwide and occur from the intertidal to the deep sea. They exhibit a variety of shapes, textures, and morphologies. Sponges range in size from microscopic to 2 m; the largest occur in the Antarctic and the Caribbean (Bakus, 1985).

Sponges are unique animals. They lack organs, specialized cells perform body functions, and they derive nourishment by continually pumping water through their perforated bodies and canal system.

Many sponges, particularly tropical species, contain a variety of antibiotic substances, sterols, and toxins. Natural product research suggests that sponges have considerable medical, antifouling, and repellent potential.

Sponges are identified on the basis of several features of morphology including the composition and structure of their skeleton, measurements of skeletal elements (e.g., spicule, fibers), color, shape, and texture.

The taxonomic identity of sponges, however, is not always easily resolved. This is because many species are unidentified, taxonomic literature is limited for many geographic regions, and there is a long history of taxonomic problems associated with the group (refer to Bergquist, 1978).

Sponges presently are divided into four classes, as follows (from Hartman, 1975; Bergquist, 1978; Bakus, 1985):

**Class Calcarea** - skeleton of calcium carbonate spicules; spongin absent. Spicules monaxonid and/or 3- or 4-rayed. About 400 species. Common intertidal and subtidal marine habitats.

**Class Demospongia** - skeleton lacking or of silica spicules, spongin, or both. About 4000 species. Common all habitats.

**Class Hexactinellida** - skeleton consists of complex silica spicules, which basic pattern of 5-6 rays. About 600 species. Common in deep waters of continental shelf and slope.

**Class Sclerospongiae** - skeleton with calcareous base and entrapped silica spicules and organic fibers. About 15 species. Restricted to shallow, tropical reef habitats.

Three of the classes, Calcarea, Demospongiae, and Hexactinellida are represented in California. Demospongiae is the subject of the SCAMIT workshop. Features useful for their identification are summarized in the handout, and a general key that incorporates the features is presented.

## Demospongiae

Notes for SCAMIT, by Karen Green, December, 1991

### Body Regions:

- choanosome- area where choanocyte chambers found;
- endosome- inner portion of sponge;
- ectosome- superficial region of sponge;
- cortex- relatively thick external cover;
- dermis- skin-like external covering.

### Types of Skeletons (after Bergquist, 1978):

#### fiber- of spongin fiber:

- anastomosing- fibers form network with cross-connections (characteristic of order Dictyoceratida);
- dendritic- fibers branch without anastomoses (characteristic of order Dendroceratida);
- reduced- fiber skeleton reduced (characteristic of order Verongida).

#### mineral- of spicules and spongin:

- axial- often rigid with a condensed axis of spicules and spongin fibers from which diverges a softer, plumose or plumoreticulate extra-axial skeleton (characteristic the order Axinellida);
- desma- hard skeleton of interlocked desma spicules;
- halichondrid- refers to lack of skeletal organization except at the surface (characteristic of the order Halichondrida);
- hymedesmoid- spiny with spicules oriented vertically from spongin fiber mat (of the order Poecilosclerida);
- plumose- spicules arranged in tracts or columns (of the order Poecilosclerida);
- plumoreticulate- similar to plumose, except some cross-connections between spiculo-fiber tracts (of the order Poecilosclerida); *compressible, easily torn*
- radial- often rigid with spicule tracts arranged in a radial pattern (characterizes the orders Choristida, Hadromerida, Spirophorida);

reticulate- skeleton with network of spicules attached by spongin or a network of fibers cored with spicules (of the orders Haplosclerida and Poecilosclerida);

unorganized- flexible sponge without organized skeleton (found in order Homosclerophorida);

none: only fibrillar collagen as support (found in order Homoscleriphorida and Detroceratida).

### Spicules:

#### General Terms

- act, actine or -actinal: Suffix to indicate the number of rays of a spicule.

- axon: Suffix to indicate the number of axes (growth directions); rays grow from different axes.

acantho-: prefix that denotes that a spicule is rough (from spines or hooks).

centrotylote: refers to a knob-like swelling near the middle of a monactine or diactine spicule.

polytylote: refers to two or more knob-like swellings along the shaft of a monactine or diactine spicule.  
with spicules.

#### Megascleres

monactinal monaxons:

style- one end rounded (not knob-like), one end pointed;

subtylostyle- one end rounded with slight knob, one end pointed;

tylostyle- one end rounded with enlarged knob, one end pointed.

diactinal monaxons:

oxea- both ends gradually pointed;

strongyle- both ends rounded;

tornotes- both ends abruptly pointed;

tylote- both ends with enlarged knobs;

cladotylote- recurved clads (= rays) at one or both ends.

tetraxons:

- calthrops- rays of equal or near equal length;
- lopho- prefix associated with triactin or tetractin to indicate that one or more rays branched or with heavy spines;
- tetract- one ray shorter than other rays;
- triact- tetract modified with loss of one ray;
- triaenes- one ray long (rhabdome) and three rays short (clads);
  - anatriaene- clads are pointed in same direction as rhabdome;
  - dichotriaene- clads are forked;
  - diaene- triaene modified with one clad lost;
  - mesoprotriaene- like protriaene except with additional epirhabd;
  - monaene- triaene modified with loss of two clads;
  - orthotriaene- clads make an angle of about  $90^{\circ}$  with the rhabdome;
  - plagiotriaene- like protriaene except clads make an angle of about  $45^{\circ}$  with axis of rhabdome;
  - protriaene- clads point in opposite direction as rhabdome, make an angle of less than  $45^{\circ}$  with the axis of the rhabdome.

Microscleres

asters:

- euasters- multiple rays from small central point;
  - oxyasters- ends of rays pointed;
  - strongylasters- ends of rays rounded;
  - tylasters- ends of rays knobbed.
- spheraster- multiple rays from a large central sphere;
  - oxy-, strongylo-, tylo- prefixes used as above for euasters;
- sterraster- sphere covered with minute multiple rays;
- streptaster- rays proceed from an axis rather than from the center;
  - amphiaster- short rods with aster-like branches or spines at both ends;
  - discaster- rod with heavy spines at both ends and near middle of spicule;
  - sanidaster- straight, spiny rod.
  - spiraster- curved, spiny rod.

chela:

- anisocheles- ends of shaft unequal in size;
- isochelas- ends of shaft equal in size;
- anchoraes- shaft slightly curved to straight, both ends with three or more teeth that are free from shaft for most of their length, teeth thin (not as wide as shaft);
- arcuate- shaft curved, both ends with three teeth, central tooth not wider than shaft, lateral teeth attached to shaft for most of their length except at the tip;
- bipocilli- curved shaft, ends with flattened cap of reduced teeth or ends clad-like;
- birotulate (= unguiferate, brevidentate)- shaft curved, both ends with short multi-dentate cap;
- palmate- shaft slightly curved or straight, ends with three palm-like teeth, central tooth broadly wider than shaft, lateral teeth attached to shaft for their entire length;
- rosette- group of chela forming a ring-like pattern.

diactines:

- acanthoxea- spines along shaft;
- microstrongyles- both ends rounded, may be curved at both ends (= bicurvate);
- onychaete- spiny, raphide-like spicule;
- raphide- straight, hair-like oxea;
- trichodragma- bundle of raphides.

diancistras: shaft nearly straight, ends strongly recurved and hook-like.

forceps: u-shaped, ends may be straight, curve inward, or curve outward.

sigmas: c- or s-shaped.

toxas: bow-shaped.

Figure 1. Demospongiae macroscleres *or mega*

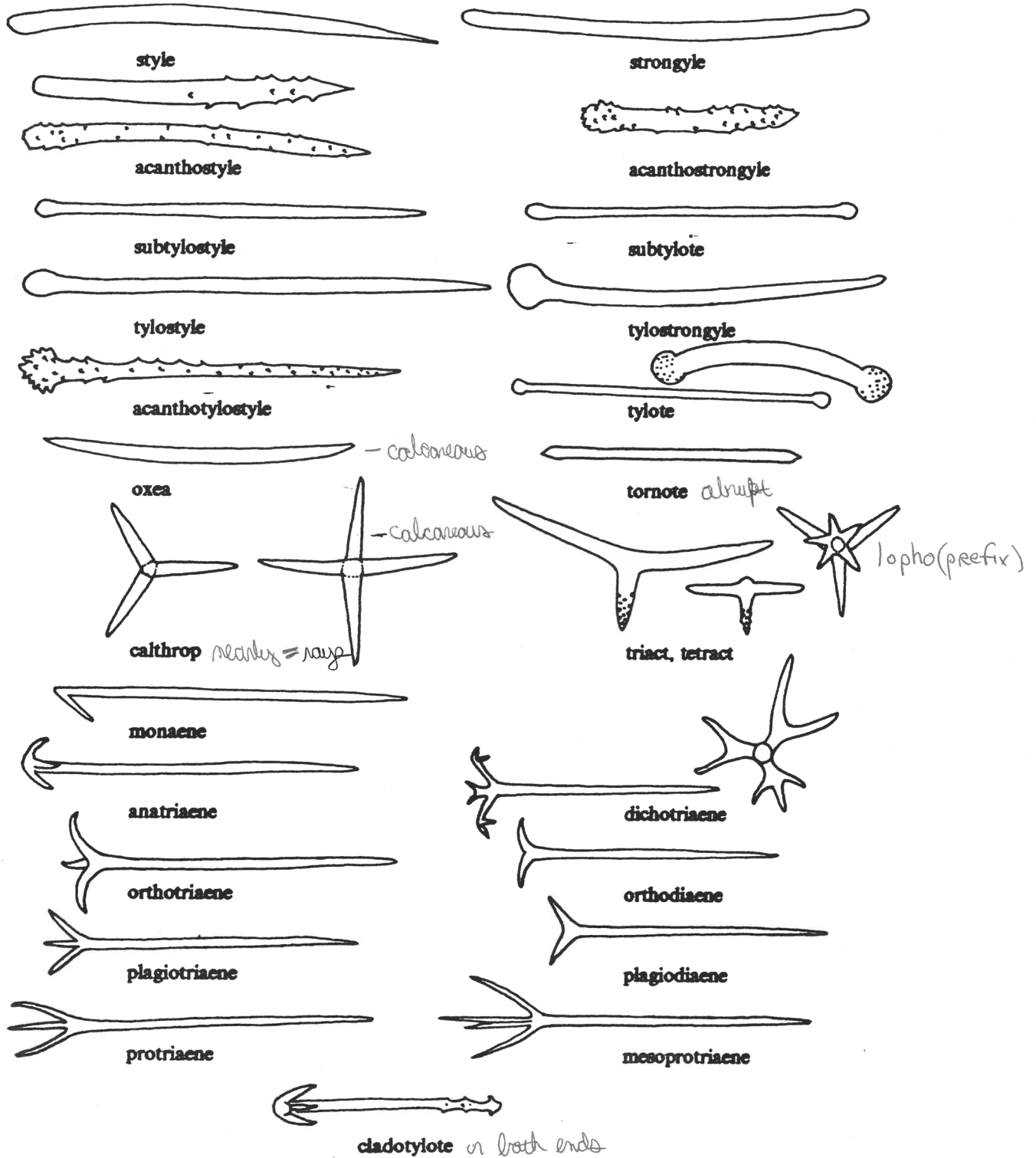
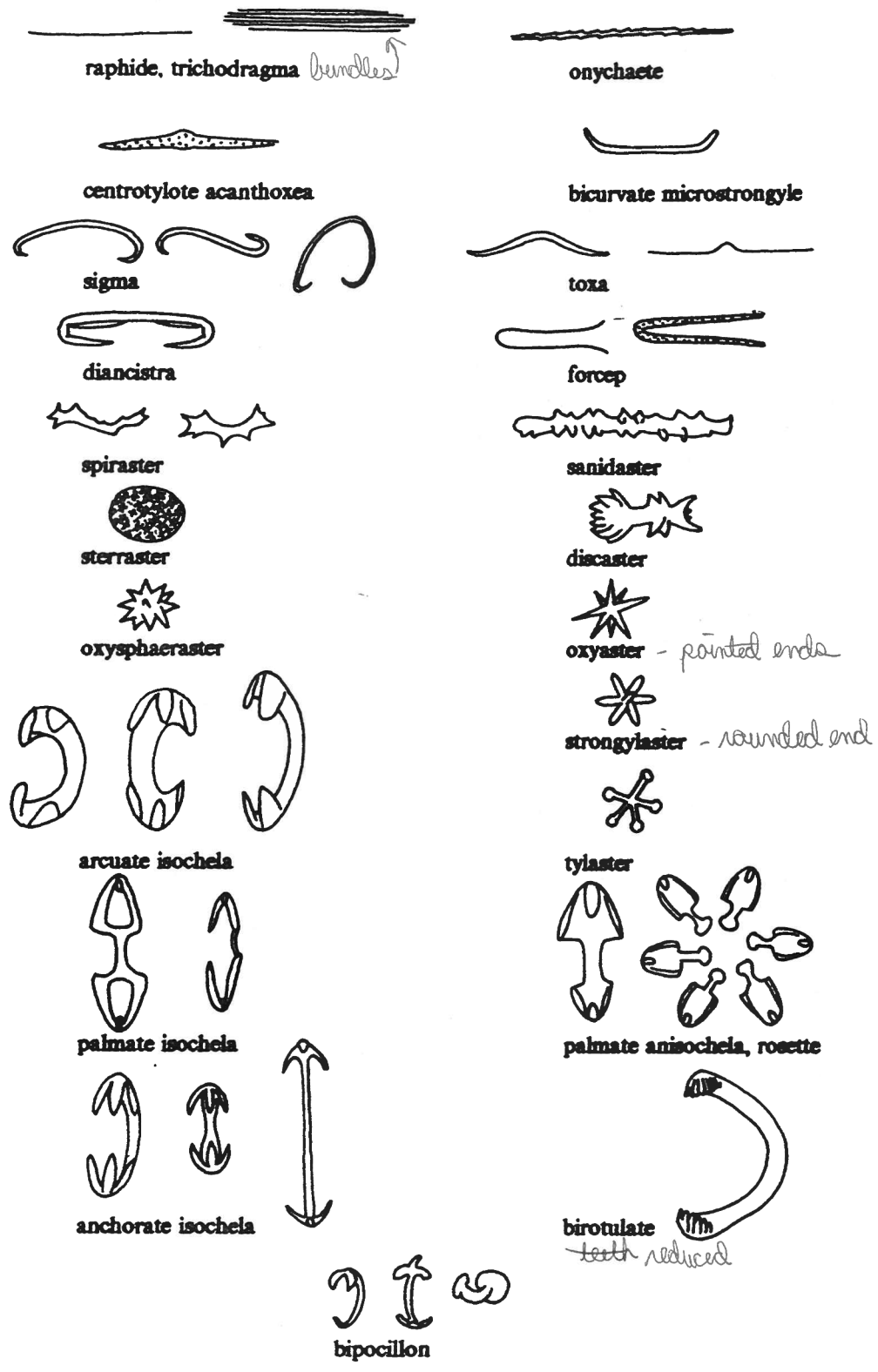


Figure 2. Demospongiae microscleres loose in between spicules



**General Key to California Demospongiae**

Prepared for SCAMIT by Karen Green December, 1991

- 1a. No skeleton.....Dendroceratida (e.g., Halisarca)
- 1b. Skeleton present.....2
- 2a. Spongin fiber skeleton.....3
- 2b. Spiculo-fiber skeleton.....4
- 3a. Primary and secondary fibers form branching network.....  
.....Dictyoceratida (e.g., Dysidea)
- 3b. Fibers arranged on a dendritic pattern, but without cross-  
connections (anastomoses).....Dendroceratida (e.g., Aplysilla)
- 3c. Fibers reduced, dense collagenous matrix.....  
.....Verongida (e.g., Verongia)
- 4a. Spicules include three or four rayed megascleres.....5
- 4b. No multi-rayed megascleres.....8
- 5a. One ray (rhabdome) much longer than other rays (clads),  
radial skeleton.....6
- 5b. Triacts or tetracts with near equal rays, various skeletons..7
- 6a. Microscleres asters.....  
.....Choristida (e.g., Geodia, Penares, Stelletta)
- 6b. Microscleres sigmoid.....Spirophorida (e.g., Tetilla)
- 7a. With asterose microscleres, radial skeleton.....  
.....Choristida (e.g., Poecillastra)
- 7b. Without microscleres, with lophate multi-rayed spicules,  
unorganized skeleton.....Homoscleromorpha (e.g., Plakina)
- 7c. Without microscleres, triacts with spines on one ray,  
axial skeleton.....Axinellida (e.g., Cyamon)



- 8a. Skeleton without organization, or organized only at surface, megascleres monactinal (styles) or diactinal of various sizes, no microscleres.....Halichondrida (e.g., Halichondria, Hymeniacion)
- 8b. Skeleton organized.....9
- 9a. Radial skeleton of monactinal spicules (tylostyles, substylostyles), microscleres absent or asters.....Hadromerida (e.g., Cliona, Polymastia, Suberites, Tethya)
- 9b. Axial skeleton of monactinal (styles) and/or diactinal (oxeas, strongyles) spicules, microscleres absent, microxeas, raphides, or asters.....Axinellida (e.g., Axinella, Hemectyon)
- 9c. Skeleton reticulate, plumose, or plumoreticulate.....10
- 10a. Microscleres absent, sigmas, toxas, and/or microxeas.....11
- 10b. Microscleres include chela or diancistras and additionally may include other types.....12
- 11a. Skeleton reticulate, megascleres diactinal (oxeas or strongyles) and uniform in size, microscleres absent, sigmas, or toxas .....Haplosclerida (e.g., Haliclona, Sigmadocia)
- 11b. Skeleton plumoreticulate, megascleres monactinal (styles, subtylostyles), microscleres- sigmas, toxas, or microxeas.....Poecilosclerida (e.g. Biemna)
- 11c. Skeleton plumoreticulate, megascleres include diacts (tylotes), microscleres- onychaetes.....Poecilosclerida (e.g., Tedania)
- 12a. With diancistras.....Poecilosclerida (e.g., Zygherpe)
- 12b. With anisochelas.....Poecilosclerida (e.g., Asbestopluma, Mycale, Iophon)
- 12c. With isochelas.....Poecilosclerida (e.g., Acarnus, Hymedesmia, Lissodendoryx, Microciona, Myxilla, Ophlitaspongia, Plocamia)

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