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SPONGES

- Prepared in the Division of Fishery Biology

Sponges are aquatic animals that live in the ocean, except for a single group that inhabits fresh-water ponds and lakes. Most of the marine sponges live in comparatively shallow coastal waters, from the tidelines out to depths of several hundred feet. Some kinds, however, are able to live in the greater depths of the sea and have been taken from bottoms lying as much as 3 miles deep. Although all commercially important sponges grow in warm tropical or sub-tropical waters, other kinds are found in colder waters, even in the polar seas, so that the distribution of the group is world-wide.

In addition to these differences in habitat, sponges are extremely varied in appearance. In life some appear as inconspicuous patches of slimy, grayish material, while others have large spherical, vaselike, or branching bodies and may be brightly colored with red, violet, yellow, or black. Some are so small that they must be examined with a hand lens before any details of their structure can be made out; others, like the loggerhead sponge of the Gulf of Mexico and the sponge called Neptune's goblet, may grow 6 feet high.

CLASSIFICATION

Sponges represent one of the simplest and least specialized forms of animal life, being only a step advanced beyond the one-celled animals or protozoa. Early naturalists were uncertain whether to classify them as plants or animals; and even when men of scientific standing, like Linnaeus, Cuvier, and Lamarck recognized the animal nature of sponges during the late 1700's, they mistakenly placed them in the same group with jellyfishes. Not until 1836 were they classified (by R. E. Grant) in a separate phylum called Porifera (the pore-bearers).

The separation of the phylum into classes is based chiefly on differences in the chemical nature and general structure of the supporting skeleton. This skeleton is composed, in many sponges, of crystalline bodies called spicules, which may be either limy or flinty. In other sponges it is composed of organic fibers called spongin, which in its chemical structure is somewhat like the horn, nails, and other protective structures of higher animals, and like the chitin that forms the hard shells of insects and crabs. In still other sponges the skeleton may

contain a combination of spicules and spongin.

The following classification of sponges is widely accepted, although specialists disagree as to the placing of certain groups:

Class I-- Calcarea or Calcispongiae, in which the skeleton is composed of limy (calcareous) spicules which may have one, three, or four rays. Most of the sponges of this group have an elongated, vase-like body and are rough and bristly to the touch. All of them inhabit ocean waters, and are largely confined to the shallower coastal areas.

Class II-- Hexactinellida, or glass sponges, in which the spicules are composed of hydrated silica, a flinty substance, and are typically six-rayed. The glass sponges are deep-sea forms. The beautiful Euplectella, or Venus's flower basket, is the best-known example.

Class III— Demospongiae, which may have any of the following types of skeleton: Flinty spicules, spongin fibers, or a combination of spicules and spongin. In some Demospongiae the skeleton is lacking. All sponges of commercial importance belong to the group that has a horny skeleton of spongin. Most of the horny sponges inhabit comparatively shallow tropical or sub-tropical waters of full oceanic salinity. About 12 species, belonging to the genera Spongia, and Hippospongia, are used by man.

The class Demospongiae includes also the single family of fresh-water sponges, the Spongillidae. Another well known family of this class is the Clionidae or boring sponges, which do considerable damage to oysters, clams, and other mollusks where they are abundant.

STRUCTURE

The typical sponge structure is most easily understood by examining one of the simpler forms. These are like a vase in shape--elongated, attached at one end to some submerged object, and at the other end having an opening called the osculum. In addition to this single large opening, the sponge body is perforated with a large number of minute pores, the ostia. These pores communicate with a system of canals that run through the body wall and open into the central cavity. The canals that are most directly in communication w ith the central cavity are called radial canals. These are lined with cells known as choanocytes or collar cells, each of which has projecting from it a hair-like flagellum, which is set in a base or "collar" of protoplasm. The beating of the flagella in the radial canals draws water in through the surface pores and causes it to circulate through the canal system and eventually to leave the body by way of the central cavity and the osculum.

In most sponges the vase-like shape is obscured, the body wall is much thickened, and the canal system is exceedingly complex. Instead of one opening for the exit of water these more specialized sponges have many. While all sponges belonging to one species have the same fundamental structure, they show the effect of their enviroment in a striking way. For example, sponges living in a current constantly flowing in one direction may have the pores for the intake of water on the side facing the current, while the oscula are confined to the downstream side.

LIFE ACTIVITIES

In spite of its simple structure, the sponge performs many of the life processes of higher animals. Its whole body might be thought of as a sort of net-work or sieve designed to strain minute food organisms out of the surrounding sea water. Even a small sponge strains a considerable amount of water, although the currents pass slowly through the many canals of its body. A sponge only about 4 inches high and less than half an inch in diameter has been estimated to pass nearly 24 quarts of water through its body in a day. The water brings the sponge food and oxygen, and presumably carries away carbon dioxide and nitrogenous excretory products. The food is picked up by the collar cells lining the canals and digested in food vacuoles within these cells, or perhaps within the large wandering cells called amoebocytes.

The ability of sponges to react to touch or other stimuli is very limited. The osculum appears to be the most sensitive part of the body. Since they have no nerve cells, their limited responses to stimulation must be of the same order as those of protozoa, and depend on the reactiveness of all protoplasm or living substance.

Sponges reproduce both by asexual and sexual means. They are capable of many different forms of vegetable reproduction. For example, any piece that contains some of the flagellated cells and a part of the canal system is able to regenerate an entire sponge. Because of this fact, growers are able to propagate sponges by cutting them into pieces with a sharp knife and attaching them to cement discs or to stones. Attachment protects the cuttings from injury by silt or sand, and keeps them from being swept away in the currents.

Even when a sponge is experimentally crushed by passing it through a fine screen, some of the cells are able to come together again and form a complete animal. All fresh-water and some marine sponges regularly form asexual reproductive bodies, called gemmules. These are thick-walled spheres containing specialized cells from which a new sponge may be formed. Gemmule formation by fresh-water sponges takes place in the fall, and since the gemmules can survive freezing, drying, and other unfavorable conditions, they produce a new crop of sponges in the spring.

All sponges at times reproduce sexually by forming egg and sperm cells. Most individuals are capable of producing both male and female cells, but apparently form only one type of reproductive cell at any given time. Sperm produced by sponges functioning as males is carried by the water currents into other sponges to fertilize the egg cells produced within their tissues. In time the fertilized eggs hatch into larvae equipped with thread-like processes or flagella for swimming. The larvae work out of the tissues of the parent sponge into the canal system and leave the parent by way of the osculum. They swim freely about in the sea, and after a time (the length of the swimming period is not known) they attach themselves to some hard object and grow into adult sponges. There are surprising differences in the life-span of sponges. While some, especially those that live in fresh water, die off each autumn as annual plants do, others, like some of the large bath sponges, are believed to live as long as 50 years.

RELATIONS TO OTHER ANIMALS

Since their lives are spent attached to the bottom or to some hard object like a wharf pile, or a rock, sponges do not prey actively on any of their neighbors on the sea floor. Sometimes, however, they may smother other sessile animals such as shellfish by forming a dense growth over them. One type of sponge kills oysters, clams, barnacles, and certain other animals by boring into them and gradually destroying their shells.

The rough exterior of most species, and the unpleasant odor or taste of the slime exuded by others, serve to repel a great many animals that might otherwise eat sponges. Some shell-less mollusks and perhaps some crustaceans feed on them, but fishes seldom if ever do. For this reason the cavities of sponges form excellent hiding places for many small animals. Probably every sponge has its share of inhabitants. One large loggerhead sponge at Tortugas was found (by Pearse) to contain 16,352 shrimps of a noncommercial species.

One group of sponges usually grows on snail shells occupied by hermit crabs. In time the sponge grows completely around the shell, except for its opening, and eventually dissolves it, so that the crab lives in a smooth, coiled cavity within the sponge. This strange relationship probably benefits both crab and sponge, for the crab is protected from fish and other enemies, while the sponge receives whatever benefit may result from transportation from place to place.

THE SPONGE FISHERIES

The United States occupies third place among the countries of the world in total production of commercial sponges. Cuba is the largest producer, while the Bahama Islands rank second, Italy fourth, Libya fifth, and Greece sixth. Egypt and Turkey produce smaller quantities. The sponge fisheries of the United States are centered at Tarpon Springs and Key West, Florida. Most of the United States catch is sold at auction at Tarpon Springs. The accompanying table lists the quantity and value of the four principal commercial species sold at Tarpon Springs during certain years during the period 1913-1940. Between 1913 and 1934 more than 90 percent of the total United States production was sold at Tarpon Springs, and between 1935 and 1940, 95 percent.

Although sponges are, perhaps, best known to the general public through their household uses, they are vastly more important in the arts and industries. They are used in applying a glaze to fine pottery and in the dressing of leather; they are used also by jewelers, silversmiths, cane makers, hatters, lithographers, painters, bricklayers, and tilelayers. The qualities of softness, durability, resiliency, and absorptiveness which make the sponge peculiarly valuable for such uses are found in no other natural or synthetic product.

The chief commercial species of sponges are sold under the common names "sheepswool," "velvet," "yellow," "grass," and "wire" sponges. These species differ considerably in texture, softness, elasticity, and durability. These qualities, in addition to the color, determine the market value. Even within one species there are marked differences in quality, depending on the locality in which the sponges grow.

Weight and value of sponges sold at Tarpon Springs, Florida, during various years from 1913 to 1941

Year	Wool		Yellow		Grass		Wire		Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1913	362,481	$586,362	65,204	$46,947	56,551	$39,931	29,198	$11,679	513,434	$684,919
1914	332,497	515,289	64,868	25,947	41,881	16,752	29,211	7,790	468,457	565,778
1917	332,313	785,097	76,486	45,892	49,922	27,457	29,222	11,689	487,943	870,135
1918	272,693	554,165	57,400	27,522	17,028	8,574	8,574	2,517	355,695	592,778
1919	363,957	639,608	60,876	39,161	25,019	25,171	6,706	4,024	456,558	707,964
1920	308,314	601,571	60,540	43,499	37,152	29,722	6,591	3,417	412,597	678,209
1921	306,998	491,875	58,515	30,428	26,298	12,623	12,918	5,167	404,729	540,093
1922	418,343	638,485	96,212	37,637	33,957	20,379	7,585	2,588	556,097	699,089
1923	394,814	664,064	73,231	46,868	35,509	15,979	16,028	7,480	519,582	734,391
1924	429,571	671,874	67,850	37,996	5,959	2,661	5,574	2,230	508,954	714,761
1925	368,796	654,345	100,624	48,300	11,449	8,014	13,314	4,438	494,183	715,097
1926	355,273	628,869	46,004	22,682	19,693	13,441	2,091	1,101	423,061	666,093
1927	388,861	814,408	54,524	32,714	20,198	14,139	10,617	4,249	474,200	865,510
1928	358,834	674,392	51,131	28,633	29,879	20,925	11,190	5,968	451,034	729,918
1929	321,507	655,796	57,314	32,096	23,882	14,329	11,060	4,424	413,763	706,645
1930	402,788	750,576	47,532	33,083	21,683	17,346	3,291	1,931	475,294	802,938
1931	267,185	546,826	81,451	39,096	25,193	18,895	12,390	4,956	386,219	609,773
1932	274,592	430,654	75,120	44,437	51,741	29,273	29,188	13,291	430,641	517,655
1933	259,496	352,498	80,164	51,487	20,105	9,494	13,413	7,002	373,178	420,481
1934	350,586	572,574	105,572	70,650	29,391	19,503	14,086	7,806	499,635	670,533
1935	270,179	527,969	80,311	67,027	21,660	15,600	16,738	9,560	388,888	620,156
1936	468,532	937,754	122,352	73,839	26,134	17,254	11,208	6,582	628,226	1,035,429
1937	398,747	976,700	130,562	96,536	16,954	11,807	15,680	12,258	561,943	1,097,301
1938	420,638	893,261	92,146	46,460	9,755	6,229	7,644	6,308	530,183	952,258
1939	325,475	916,298	60,474	79,250	23,840	24,491	13,893	15,515	423,682	1,035,554
1940	212,336	826,123	6,324	8,566	13,504	12,521	--	--	232,164	847,210
1941	167,290	1,244,161	6,164	23,658	27,672	97,051	--	--	201,126	1,364,870

Sponge fishing is a very ancient occupation. Probably it began in the Mediterranean, for it is often mentioned in early Greek literature. From the islands of the Aegean Sea it spread westward to the northern coast of Africa and into the central Mediterranean area. The history of the American sponge fisheries dates from about 1840, when a French sponge merchant, shipwrecked in the Bahamas, noticed the quality of the native sponges and sent a shipment to Paris. In 1849 the first sponges were shipped from Key West to New York. At first the United States fishery was confined to the Florida Keys, but about 1870 it spread into the Gulf of Mexico, and by 1900 Tarpon Springs had become established as the center of the industry.

The best grades of American sponges are obtained by divers who descend in diving suits to depths of 100 feet or more. Sponges in shallower waters are gathered from boats by pronged hooks on the ends of long poles and with drag nets. Some are gathered by naked divers. The use of drag nets does a great deal of harm to the sponge beds, because it uproots small sponges as well as those of marketable size.

The sponge of commerce is merely the skeleton of the animal, composed of the elastic fibers of spongin that remain after the living parts have been destroyed by exposure to air and sunlight and separated from the skeleton by thorough washing. After this treatment, sponges are sometimes bleached or dyed. The ability of sponges to absorb water is the result of capillary forces in the meshes of the spongin network. The finer and closer the meshes are, the more water may be taken up and retained. Although the fibers themselves absorb a small amount of moisture, this is released only by evaporation.

REGULATION OF THE FISHERIES

The commercial sponge resources of the United States are protected both by an Act of the Congress of the United States and by the laws of the State of Florida. The Act of Congress (Public No. 172, approved Aug. 15, 1914; 38 Stat. 692) prohibits the capture in waters of the Gulf of Mexico and the Straits of Florida, outside of the limits of territorial jurisdiction, of sponges measuring less than 5 inches in diameter when wet. The Act also forbids the landing, curing, possession, or sale of sponges less than that size and provides penalties for violation. The Laws of Florida (Chapter X, Art. 27, Sec. 8084) establish parallel restrictions with respect to sponge fisheries conducted within the limits of territorial jurisdiction.

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* Out of print; consult in libraries that receive Government publications.