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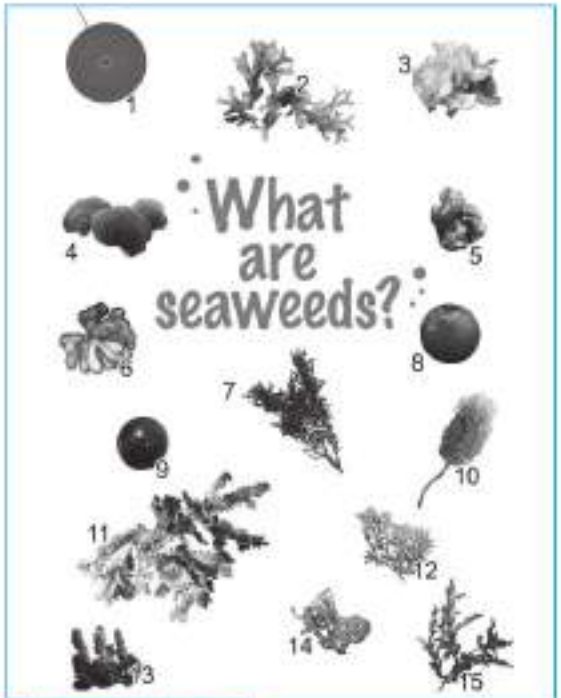

Seaweed list of cover

1. *Acetabularia ryukyuensis*
2. *Dichotomaria* sp.
3. *Padina melemele* Abbott et Magruder
4. *Chlorodesmis fastigiata*
5. *Colpomenia sinuosa*
6. *Gibsmithia hawaiiensis*
7. *Sargassum* sp.
8. *Boreletella sphaerica*
9. *Ventricaria ventricosa*
10. *Struvea okamurae*
11. *Bellaphycus gelatinus*
12. *Portieria hornemannii*
13. *Turbinaria ornata*
14. *Hydroclathrus clathratus*
15. *Hormophysa cuneiformis*

What are seaweeds?

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Okinawa Churaumi Aquarium


Which foods use seaweed?

See page 15 for more details.

Body structure of seaweeds

Some characteristics of seaweeds

In general, seaweeds are marine algae that can be seen by the naked eye. They come from three distinct groups of organisms that can photosynthesize, and can be found in the relatively shallow areas of the sea. Some seaweeds look like plants found on land. However, they have no specialized organs, such as roots and leaves. This suggests that they can absorb nutrients and photosynthesize on all parts of their surface.

Seaweeds have been divided into three distinct groups based upon color (the red, brown, and green algae), but there are many exceptions to this rule. Presently, there are more than 10,000 species of seaweeds known in the world.

Undaria pinnatifida (Harvey) Suringar

Undaria pinnatifida is not distributed in Okinawa.

Body structure of seagrasses

Some characteristics of seagrasses

Seagrasses are angiosperms that live in the oceans. For common species, such as *Zostera marina*, the leaves are long and narrow blades, which appear like grass, and hence the name "sea-grass". Since seagrasses are angiosperms, they are related to land plants, and can produce flowers.

They also have distinct organs such as roots, stems, and leaves. They can be found throughout the world, and about 60 species are known.

Thalassia hemprichii (Ehrenberg) Aschers

Common names in Japanese

What do these names mean?

Mizu-tama

"Mizu-tama" means "ball of water", and often there is water inside of the ball.

Rappa-moku

If you look closely, this seaweed looks like a collection of trumpets. This is why it is called "Rappa-moku", and "moku" is a term for floating seaweeds.

Maga-tama-mo

"Maga-tama" is the name of an ancient Japanese stone ornament, and "mo" is the Japanese word for "seaweed".

Ya-bane-moku

"Ya-bane-moku" was named after how it looks like the fletching on an arrow, and "moku" is a term for floating seaweeds.

Kikkou-gusa

"Kikkou-gusa" was named because it looks similar to a turtle shell, and "gusa" is another word for "seaweed".

Hai-kona-hada

"Hai-kona-hada" literally means "creeping powder coated skin", because this seaweed can cover a wide area and deposits lime on its surface.

Kitsune-no-o

"Kitsune-no-o" was named after how it resembles a fox's tail.

Gara-gara

"Gara-gara" is the word for a baby's rattle, and I wonder if it makes a rattling sound.

Mayu-haki-mo

"Mayu-haki-mo", was named because it looks like an eyebrow brush.

Umi-tora-no-o

"Umi-tora-no-o" was named after how it resembles a tiger's tail in the ocean.

Kara-goromo

"Kara-goromo" was named because the blades looks like a dress from ancient China.

Ha-goromo

"Ha-goromo" was named after its resemblence to the dress of an angel.

Kaimen-sou

"Kaimen-sou" means "Sponge-weed".

Fude-no-ho

"Fude-no-ho" means the tip of an ink brush, the common English name is "Finger algae".

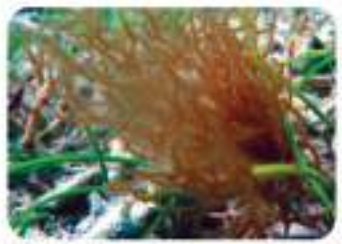
Various beautiful colors of the seaweed

In general, seaweeds can be divided into three groups that are based on color. These are the red, brown, and green algae. However, seaweeds can be very colorful, and there are many exceptions.

Asparagopsis taxiformis

Dudresnaya sp.

Trichogloea requienii



Cladosiphon okamuranus

Codium sp.

Acrocystis nana

CORALLINALES
(non-geniculate coralline alga)

Monostroma nitidum

Padina melemele

Hypnea pannosa

Dictyopteris polypodioides

Portieria hornemannii

Champia sp.

Halimeda discoidea

Unusual appearance

Seaweeds can come in many shapes and sizes.
They can look like land plants, corals, and even animals.

Monostroma nitidum

Betaphycus gelatinus

Sargassum sp.

Padina sp.

Struvea okamurae

Halicoryne wrightii

Hydroclathrus clathratus

Colpomenia sinuosa

Caulerpa racemosa var. *clavifera* f. *macrophysa*

Eucheuma sp.

Eucheuma sp. is strikingly similar to this is a real coral colony (*Acropora* sp.).

Hydropuntia edulis

Ventricaria ventricosa

Gibsmithia hawaiiensis

Avrainvillea erecta

Jania sp.

Acetabularia dentata

Some rare seaweeds that can be found in Okinawa

Acetabularia ryukyuensis

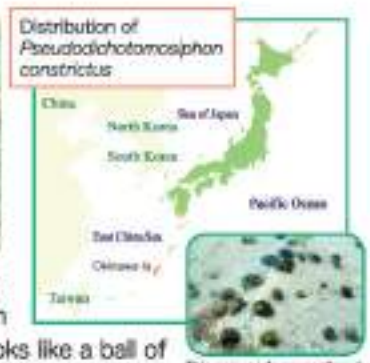
An unusual shape, but with beautiful patterns.

※This species is common in Okinawa but it has not been found in Miyako Island.

Acetabularia ryukyuensis is an endemic green alga that can be found in the Ryukyu Islands. It is also a unicellular alga, which means it has only one cell. Therefore, it is often used to study cell biology in many high schools in Japan.

Pseudodichotomosiphon constrictus

An endangered species.



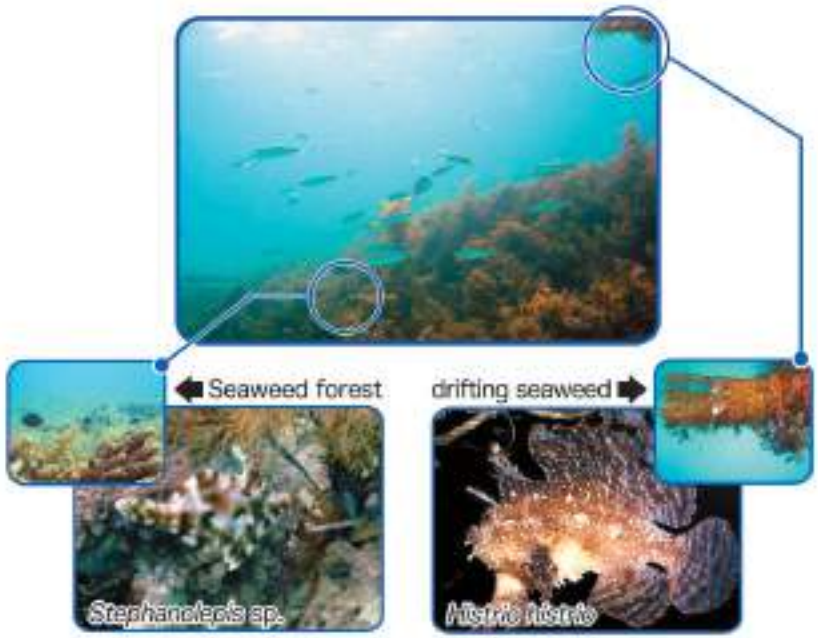
This seaweeds are scattered.

Pseudodichotomosiphon constrictus can be found only on the sandy bottom during winter and early spring, and looks like a ball of green hair. This species is endemic to Okinawa Island, and is only found in a few places of the Island. It is also listed as an endangered species by Japanese Ministry of Environment.

Interaction between seaweeds and marine animals in the coastal ecosystem

Marine animals are adept at using seaweeds for their own benefit.

Large seaweed communities, such as kelp forests and drifting seaweed rafts, create habitat that can be used as shelter and feeding areas.



Some damselfishes are known to make "seaweed garden" for food.

The many ways we use seaweeds in our lives

The many ways we use seaweeds in our lives

In Okinawa, seaweeds are indispensable to the dietary culture. Indeed,we eat many kinds of seaweed including *Undaria pinnatifida*,*Sargassum fusiforme*, *Seccharina japonica* and *Cladosiphon okamuranus*.

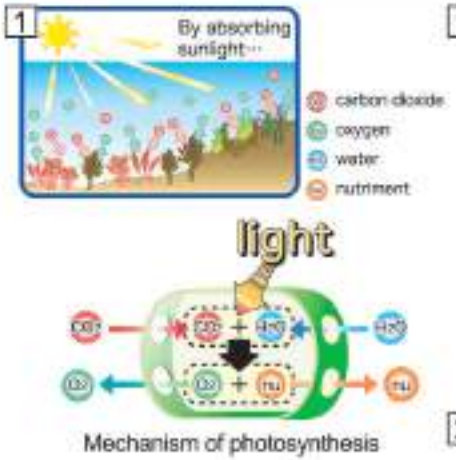
It may be difficult to imagine, but as shown in the photo above, seaweeds are used in many kinds of foods, such as ice cream and ham, and they are even used in fire extinguishers.

Products that use seaweeds as an ingredient

Ingredients	Function	Food
Carageenan (Made from *Kappaphycus* spp.)	As the thickener, emulsifier	Ham, Boiled fish paste, Noodles, Custard, Ice cream, Milk pudding, Cocoa, Sweet redbean jelly, Pet food **Medicines, Chemicals** Sirup, Toothpaste, Shampoo, Fire extinguisher
Funoran (Made from *Gloiopeltis furcata*)	Remineralization of teeth	Gum (Remineralization accelerant of teeth)
Kainic acid (Made form *Digenea simplex*)	Paralyzing parasites living in human guts	Ascaricide (deworming medicine)

In this way, seaweeds are processed in many ways to be used in many products.

Important roles of the seaweed in the coastal ecosystem



1 Produces the oxygen and nutrients by photosynthesis

Similar to land plants, seaweeds use sunlight to photosynthesize, producing oxygen and carbohydrates from dissolved carbon dioxide and water. Carbohydrates, such as sugar and starch, are the main building blocks of seaweed. So, if the water becomes murky and turbid, not enough sunlight will be available and seaweeds cannot survive.

2 Purifies the seawater

Nutrients, such as nitrogen and phosphorous, that flow into the ocean from sources on land provide nutrients to the coastal environment. However, too much nutrients can cause water pollution, therefore seaweeds help to purify the water by absorbing much of these nutrients.

3 Provides habitat for fish and invertebrates

Seaweed communities provide habitat for many marine animals, including the fish and invertebrates.

4 Provides food for fish and invertebrates

Seaweeds are a source of food for many marine animals,including the fish and invertebrates.

Distribution and taxonomy of seaweeds

General characteristics of seaweeds in Japan and the vicinity.

Distribution

Japan is an island country that stretches from the subtropical Ryukyu Islands in the south to the subarctic island of Hokkaido in the north, and is known to be one of the most biodiverse areas in the world, with the records of more than 1500 species of seaweeds.

Subarctic species including kelp (*Saccharina*) can be found along the coast of Hokkaido and the Pacific coast of the Tohoku region (northeastern part of Honshu) and are strongly influenced by the cold Oyashio current. Other regions of Japan in Honshu, Shikoku and Kyushu Islands have a temperate climate, and temperate species such as *Undaria* are dominant here. On the other hand, subtropical species including *Halimeda* and *Caulerpa* are distributed in Ryukyu Islands, which is influenced by the warm Kuroshio current.

In general, the makeup of seaweeds species differs from region to region. Green algae are relatively more common in Okinawa and similar warm waters; however, brown algae, such as kelp, often dominate relatively cold-water regions like Hokkaido. Interestingly, smaller seaweeds are common in the south, especially Okinawa, whereas larger seaweeds are more often found in the north.

Taxonomy

Unlike the terrestrial plants, seaweeds come in a wide variety of colors. This is typically due to the wide variety and makeup of pigments in the seaweeds that take part in photosynthesis. Seaweeds have been divided into three groups based on these pigments, which are found in the chloroplast.

Green algae

The chlorophyll-a and chlorophyll-b found in the green algae occur in the same proportions as the terrestrial plants. In Okinawa, species such as *Halimeda*, *Ventricaria* and *Codium* are some commonly found green algae, and edible species such as *Monostroma* and *Caulerpa* also belong to this group. The pigments in the green algae serve to absorb blue and red light for the photosynthesis and reflect green light, which is why they appear green. It is believed that the ancestors of terrestrial plants are the green algae.


Monostroma nitidum


Halimeda discoidea


Ventricaria ventricosa


Codium sp.

Brown algae

Brown algae often are brownish in color, because of a pigment of the xanthophylls, called fucoxanthin. Besides fucoxanthin, chlorophyll-a and chlorophyll-c are distinguishing pigments found in this group. In Okinawa, common edible species and *Sargassum fusiforme* and *Cladosiphon okamuranus*. *Undaria pinnatifida* and *Saccharina japonica* also belong to this group, but are found in colder waters. Unlike the green algae, brown algae are able to use green light for photosynthesis.


Sargassum fusiforme


Colpomenia sinuosa


Padina sp.


Cladosiphon okamuranus

Red algae

Red algae are often red to burgundy in color, because of the pigments phycoerythrin and phycocyanin. Unlike the other two groups, red algae only possess one type of chlorophyll, which is chlorophyll-a. Some popular edible species are *Pyropia tenera* and *Betaphycus gelatinus*. Red algae can use both green and blue light to photosynthesize, and because of this many can be found relative deep waters of the ocean, where only blue light is available.


Asparagopsis taxiformis


Gibsmithia hawaiiensis


Betaphycus gelatinus


Portieria hornemannii

Projects of the Okinawa Churaumi Aquarium

At Okinawa Churaumi Aquarium, field surveys of seaweeds are conducted around the nearby shores.

Quadrat Surveys

There are permanent quadrats (2m x 2m) on some characteristic locations of the coral reef. In these quadrats, we determine the %-coverage of seaweeds by examining how much space in the quadrat they occupy. Seasonal and annual surveys of these permanent quadrats helps us to determine how biodiversity changes over long periods of time.

We want to determine how the environment of these coral reefs is changing, and how this affects all the organisms that live in this ecosystem.

We hope to improve explanations and educational activity at the aquarium so that we can help you to better understand and appreciate seaweeds, and realize why they are so important to our daily lives and the lives of many organisms living in the oceans.

Our Discoveries So Far

Along the coastal area of Churaumi Aquarium, there are five distinct habitats: an outer reef slope, a lagoon, a seagrass bed, a *Sargassum* bed, and a coral community. Each habitat has a different makeup of species, and because there are many habitats there a diversity of species. In fact, we have found more than 150 species of seaweeds.

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List of species

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