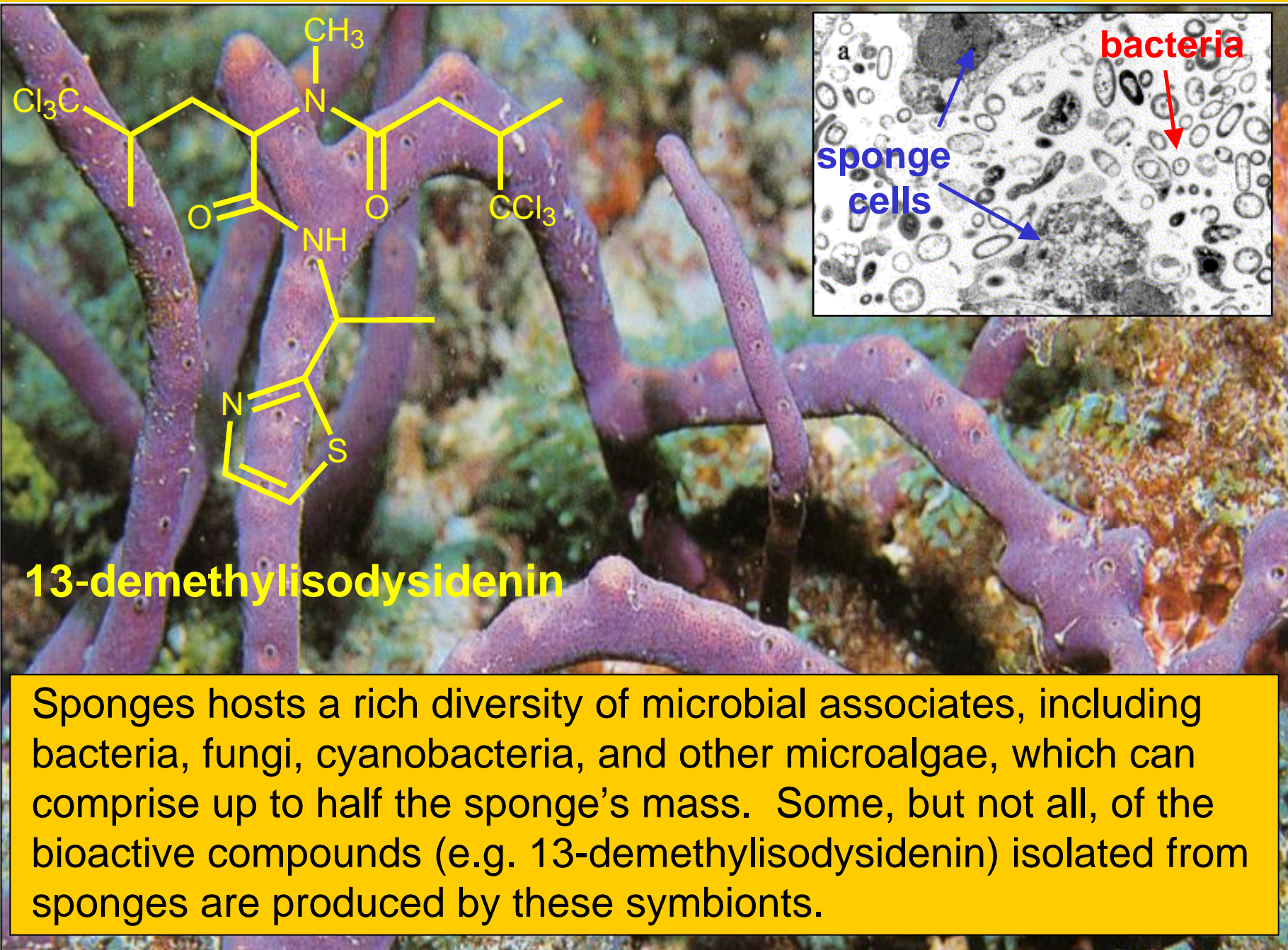


Chemical Punches in the Marine Environment

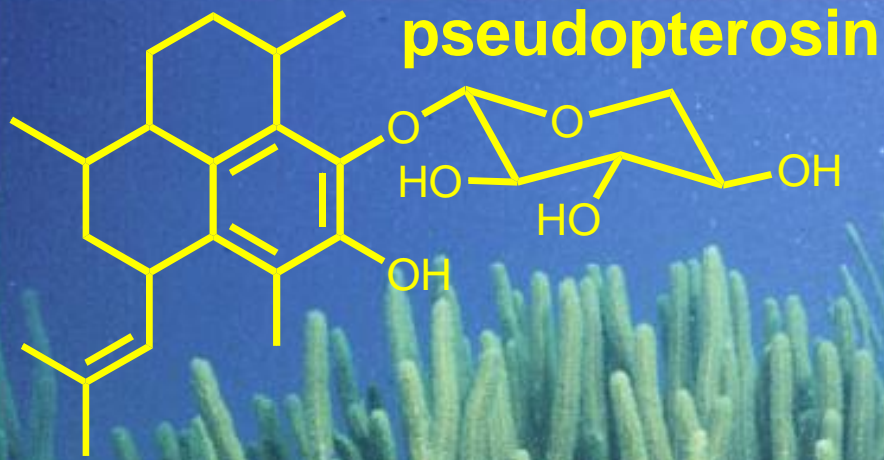
Symbioses are known to occur commonly between microorganisms and taxonomically diverse marine invertebrates, such as sponges, corals, mollusks, sea squirts, and even some crustaceans. Some of these microorganisms help their invertebrate hosts by providing a nutritional boost, while others produce bioactive chemicals that deter predators, competitors and pathogens of the host.

The following slides provide marine examples of symbiotic associations in which the symbiont is known or thought to produce chemistry that protects its host against predators, competitors or pathogens, or against environmental stresses, such as exposure to high levels of solar UV radiation. Many of these chemicals may also be useful to people as new drugs, sunscreens and antifoulants.

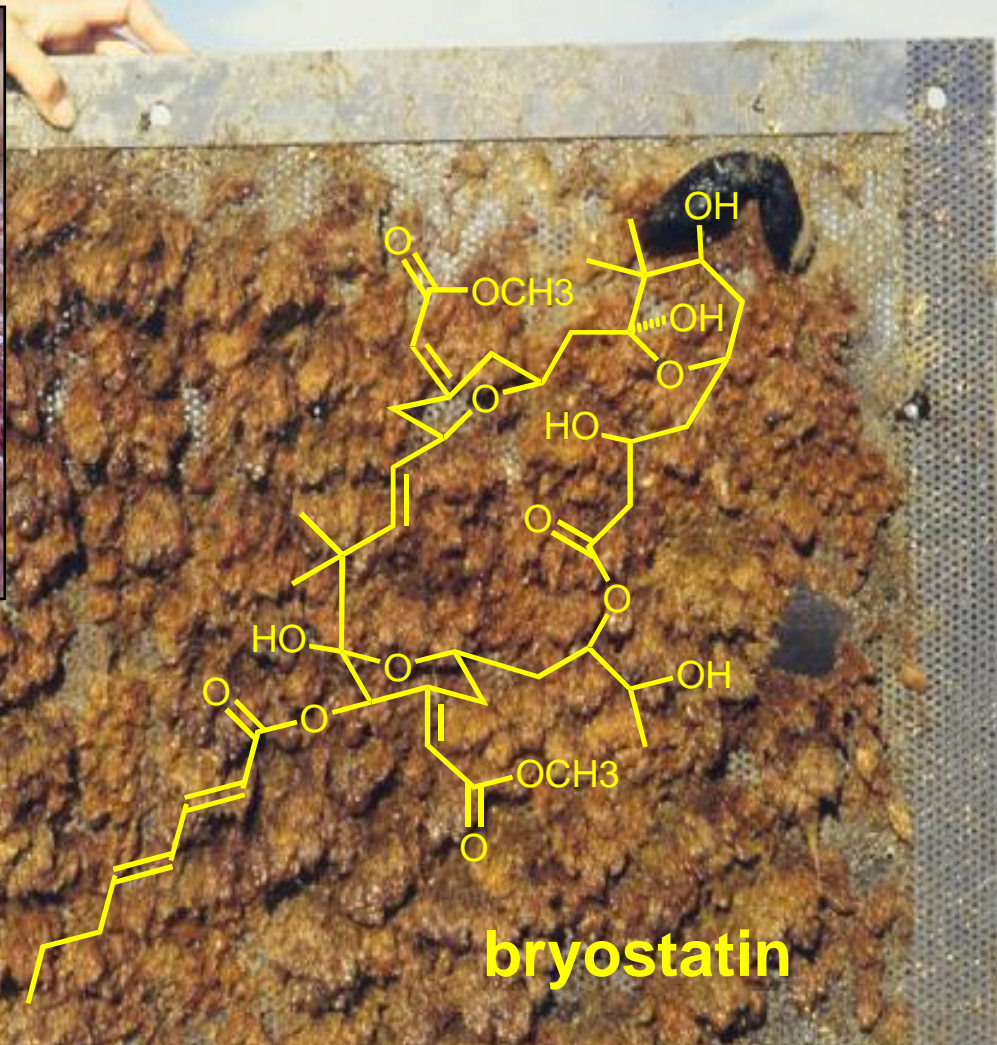


13-demethylisodysidenin

Sponges hosts a rich diversity of microbial associates, including bacteria, fungi, cyanobacteria, and other microalgae, which can comprise up to half the sponge's mass. Some, but not all, of the bioactive compounds (e.g. 13-demethylisodysidenin) isolated from sponges are produced by these symbionts.

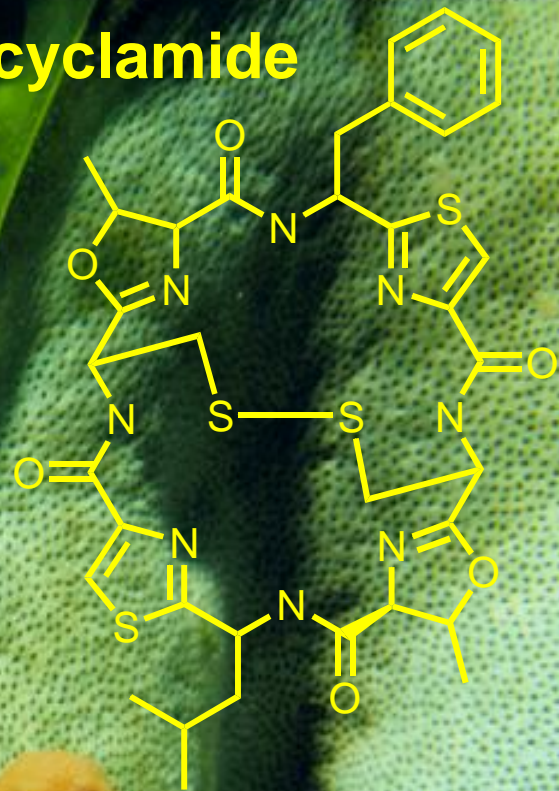


Recent evidence suggests that the pseudopterosins are produced by the zooxanthellae of a Caribbean sea whip. No ecological roles are known for these compounds.



The anticancer compounds called the bryostatins, are isolated from the bryozoan, *Bugula neritina*, but are thought to be produced by a symbiotic bacterium. The bryostatins are concentrated in the bryozoan's larvae and protect the larvae from predation by fishes.

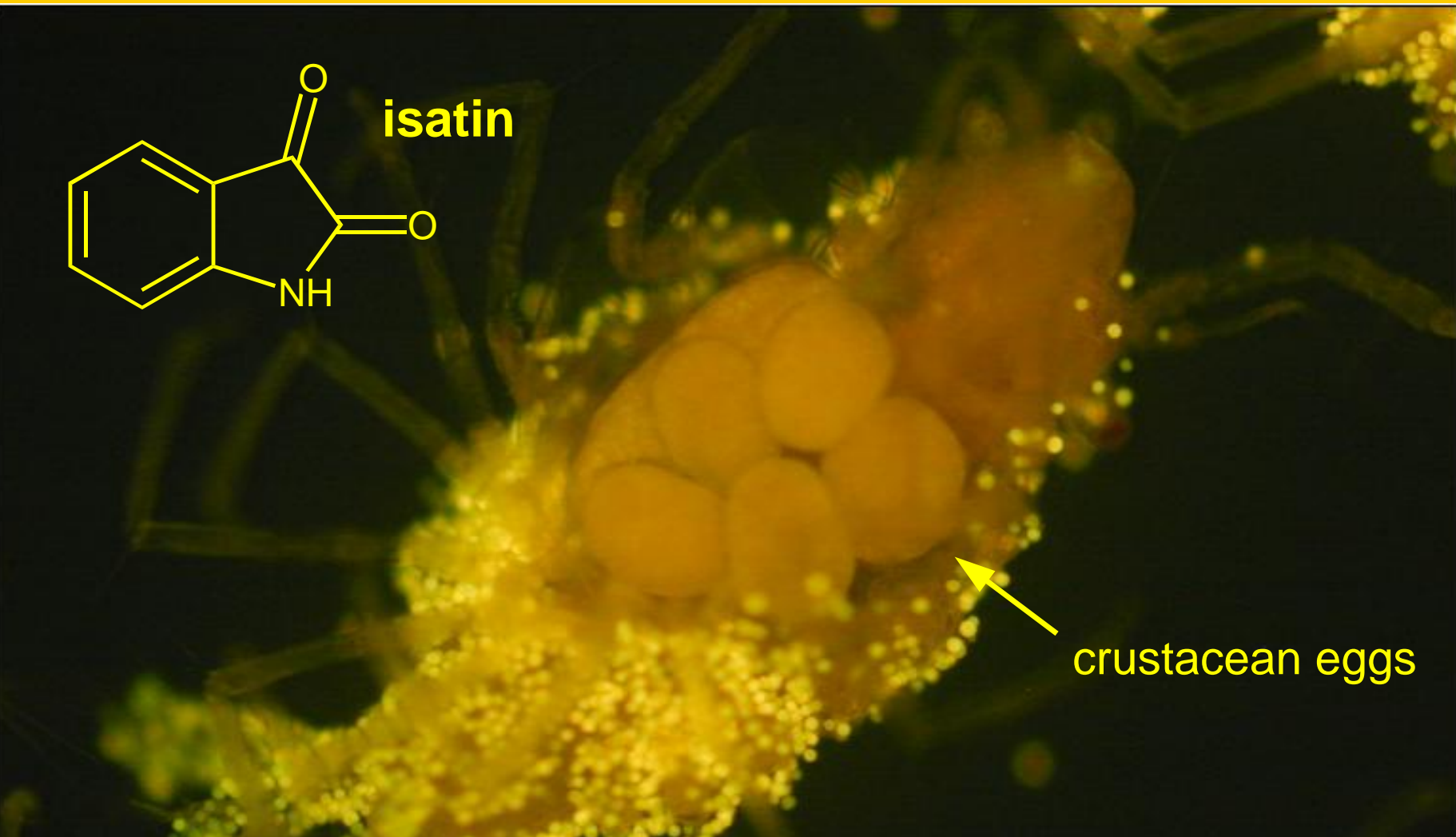
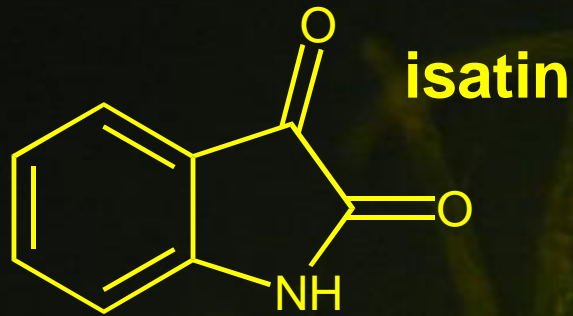
ulithiacyclamide



Sea squirts with symbiotic *Prochloron* are a rich source of pharmacological active chemicals. Conflicting reports exist about whether these compounds (e.g. ulithiacyclamide) are produced by the animals or their symbionts.



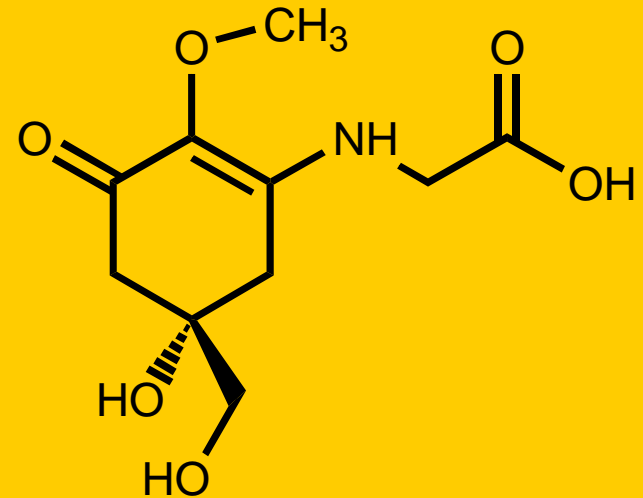
This unique marine isopod, a type of crustacean, has a thick carpet of cyanobacteria growing on it. The cyanobacteria produce a noxious compound that deters fish from eating the isopod. Because the isopod isn't eaten by fish, instead of hiding from fish, the isopods live on sun exposed substrates where their symbiont gets plenty of light for photosynthesis. The isopod also eats its symbiont.



Isatin is a compound produced by a bacterium that lives on the surface of crustacean eggs. Isatin inhibits the growth of pathogenic fungi. Without the bacteria to protect them, crustacean eggs are quickly attacked and killed by fungi.



mycosporin-like amino acids



These compounds are produced by marine plants, including the zooxanthellae of corals and sea whips. The compounds absorb solar UV radiation and act as a sunscreen that protect the algae and their host from sunburn.

This presentation has provided several examples of associations between marine invertebrates and microorganisms for which it is thought that the symbiont produces chemistry isolated from the association.

Relatively few examples are provided because only a few instances of symbiont production of chemistry are known from the marine environment, and few of these compounds have been tested for important ecological roles.

Parting Punch – How does the host of a symbiont producing a highly toxic defensive compound avoid being poisoned by the compound?