Life zones

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Between the surface euphotic zone (above the picnocline, 0 to 150–200 m deep), and the deep disphotic zone (below the picnocline, over 150 m deep) a marked contrast exists in taxonomic families, genera, and species composition. While in the surface zone we found families of sponges, corals, crustaceans and mollusks of tropical-subtropical origin, both from Indo-Pacific and Eastern Tropical Pacific origin, the families and species in the deep zone were mostly of temperate and cold-temperate origin, reported in the deep cold water zones of Canada, Alaska, and the North Sea.

Shallow zone

Seamount communities near the surface zone do not form a gradual continuum from the surface to the 150–200 m, but rather the majority of species show a discontinuous distribution, grouping into two sub-zones: (a) a shallow surface subzone above 50 m deep, and (b) an intermediate surface subzone (or sub-euphotic subzone) between 50 and 150–200 m. Both of these habitats are biologically connected by the presence of evolutionarily related families and genera (unlike the deep zone where many groups have different evolutionary origins), but at the species level the layers are different.

Shallow surface subzone. This shallow and warmer layer is dominated by the presence of species of tropical and subtropical origins, like sponges (*Aplysina* cf. *fistularis* and

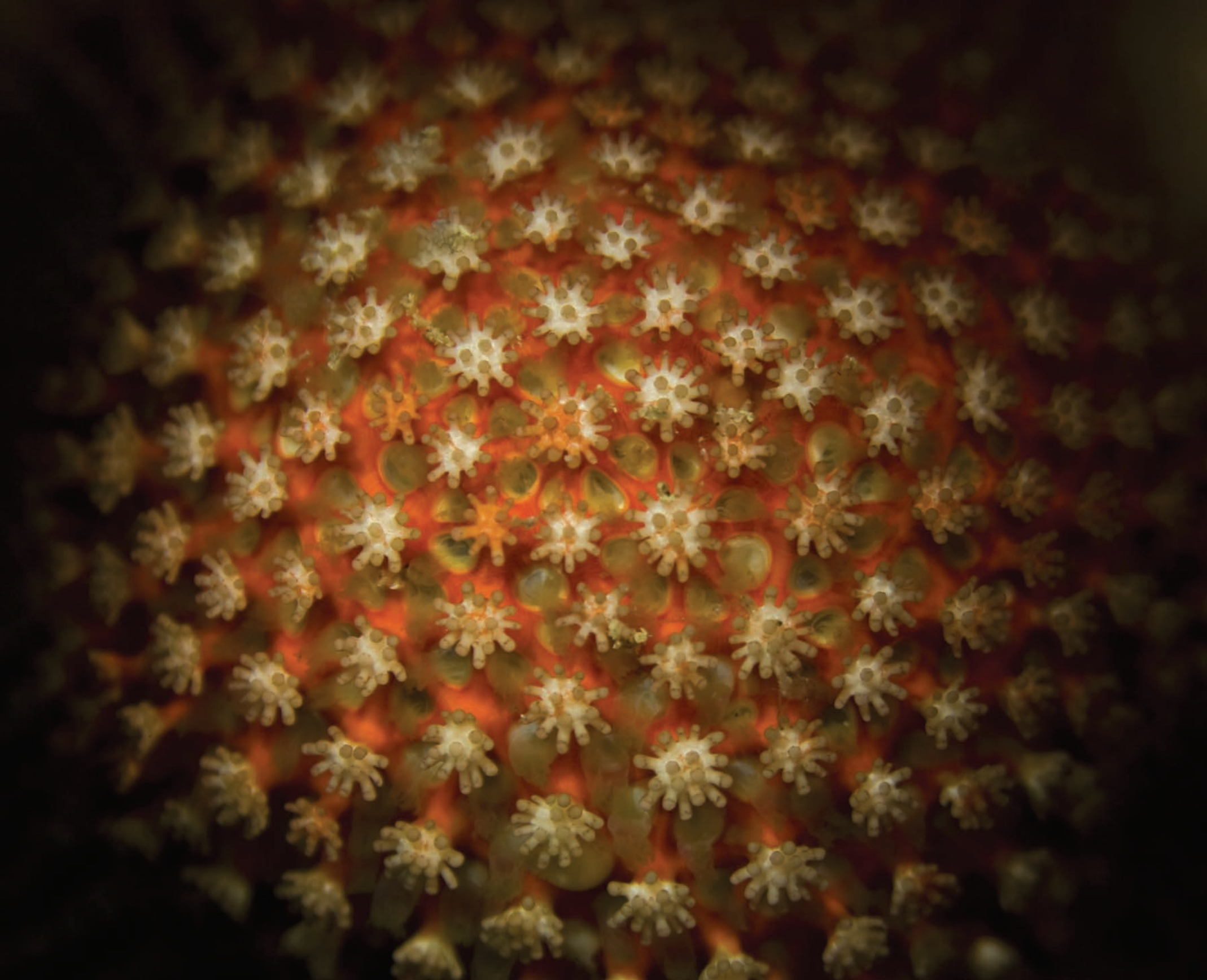
Soldier-fish *Myripristis leiognathus*, of nocturnal habits, find refuge during the day in the crevices of rocky reefs. Photo © Octavio Aburto-Oropeza.

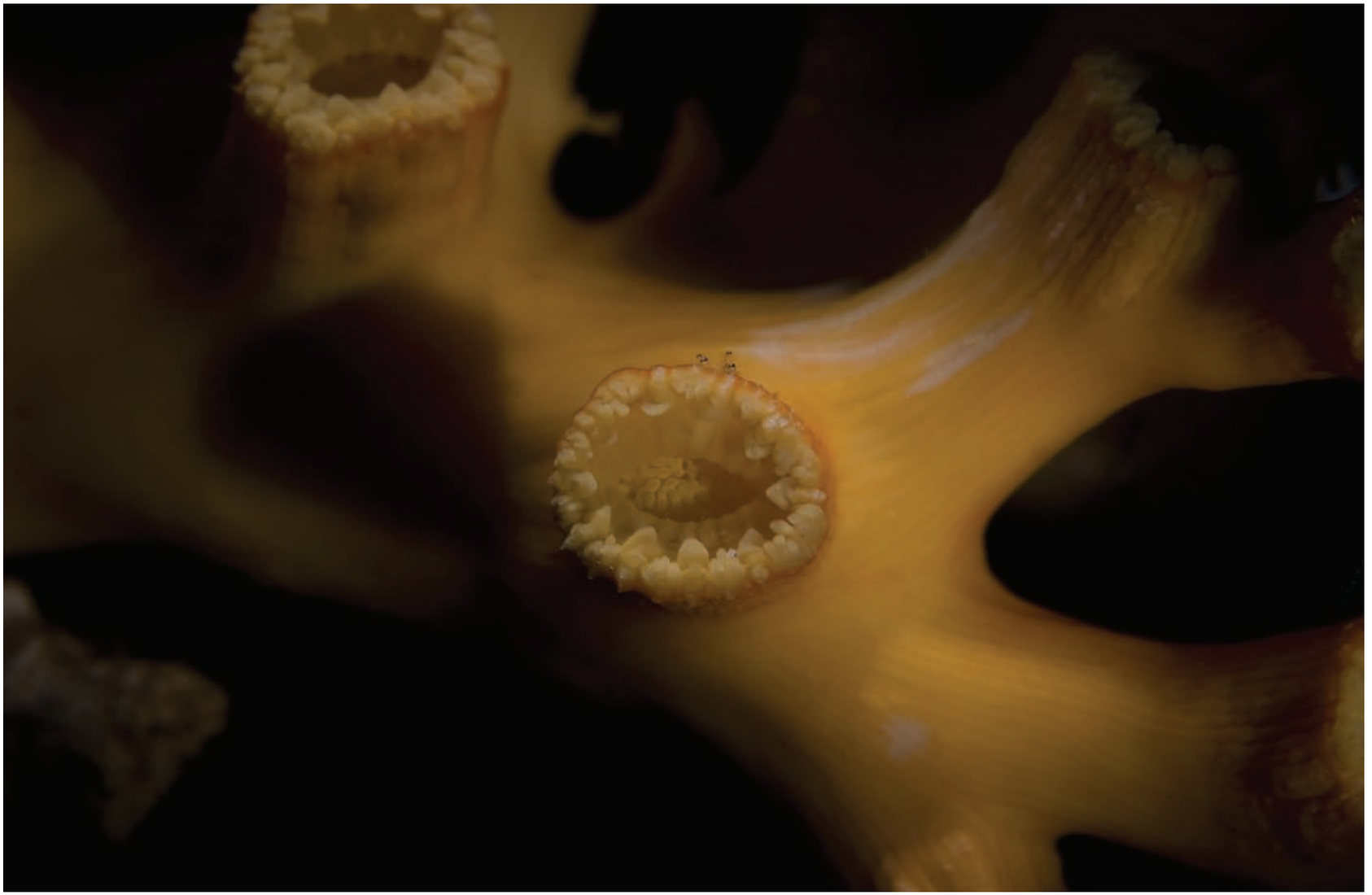
A. gerardogreeni), hydrozoans (*Lytocarpus nuttingi* and *Plumularia* sp.), seafans (*Leptogorgia rigida, Eugorgia multifida* and *Pacifigorgia agassizii*) and hard (hermatypic) corals (*Porites panamensis, Pocillopora elegans* and *Pavona gigantea*).

Intermediate surface subzone. Between the upper boundary at 40–50 and the lower one at 150–200 m, it is possible to observe some species from the shallow zone, together with (a) some species previously reported as frequent at these depths (black coral *Antipathes galapagensis*, the octopus *Octopus rubescens*, crabs *Maiopsis pamamensis* and *Stenorhincus* sp., and some species of squat lobsters), (b) species not previously reported at these depths (seafans *Leptogorgia* sp., *Eugorgia* sp., *Pacifigorgia* sp. and *Muricea* sp., sea pen *Cavernulina* sp. and several small species of crustaceans living in symbiosis between the branches of soft corals), and (c) species previously observed in the Pacific side of Baja California (giant keyhole limpet *Megathura crenulata*) and of California (*Leptogorgia chilensis*, a sea fan), but not previously recorded in the Gulf. The intermediate sub-zone proved to be an ecosystem rich in novelties, still partially illuminated by sunlight but is in the shadows most of the time, sheltering various species that belong to families or genera closely related to shallow water species, and to a lesser extent, to deep water species from the disphotic level, over 200 m deep.

Finally, approaching the 200 m lower boundary, after crossing the thermocline some 40–100 m deep, the greatest densities and cover of rocky-bottom macro-invertebrates are seen, associated with the green layer of high phytoplankton density. This group is mostly made up of suspension feeders (which obtain nourishment on the abundant plankton and organic matter suspended in the water) forming extensive "forests" of black coral and sea fan reefs, and sheltering crabs, squat lobsters, basket starfish, and fish. Undoubtedly, this layer is an important source of larval settlement and refuge for species of other water layers.

Close-up view of the epidermis (covered by paxillae) of the dorsal surface of the disk of the sea star *Tethyaster canaliculatus*. Photo © Carlos Sánchez-Ortiz.





Deep zone

The sponges in this zone belong to the class Hexactinellida, commonly known as "glass sponges" because of the siliceous spicules that make up their skeletons. The extraordinary specimens collected (*Acanthascus* sp. and *Farrea* sp.) belong to genera commonly found in deep waters in California, Canada, and Alaska. These sponges, together with the octocorals *Anthomastus* sp. and *Paragorgia* sp., had not been seen before in Mexico; they all are part of taxa typically found in deep waters of up to 2,500 m deep. In fact, there is a close phylogenetic relationship between *Paragorgia* spp. and the species of red or pink coral *Corallium rubrum*, typically found in deep zones and widely used for fine jewelry.

We also registered another group characteristic of deep zones: the Scleractinia or stony corals, which belong to a diverse group (1,300 species) that divides into two ecological groups. The first includes the corals that form reefs in surface and tropical waters (656 species), generally associated in symbiosis with microalgae (the zooxanthellae that live together with the coral polyp and give the colony a greenish hue). The second group, to which our findings belong (formed by three species of the family Dendrophylliidae whose precise identification is in process), is composed by 669 species that do not construct extensive reefs and widely distributed all over the world's oceans, including both temperate and polar regions, from near the sea surface to depths of up to 6,000 m. These corals are not associated with microalgae, because they do not depend on sunlight and can hence reach great depths. Their color is often transparent or white, but in some species it is can be bright yellow, red or pink.

Deep-water (200–400 m) azooxanthelate stony coral, of the family Dendrophylliidae, at Bajo Marisla. Photo © Carlos Sánchez-Ortiz.

Pages 112–113:
At Bajo Candeleros, a sea-cucumber *Holothuria fuscocinerea* expels a toxic, filamentose, and sticky compound as a defense against predators. Photo © Carlos Sánchez-Ortiz.

Productivity in deep water systems

The seamount region that stretches between Bahia de La Paz and Loreto maintains geo-

oceanographic processes that contribute to maintain an elevated primary and secondary production. Three species of krill (small euphausid shrimps: *Nyctiphanes simplex, N. difficilis* and *Euphausia distinguenda*) are a major component of secondary productivity. In particular, in the dominant species *N. simplex* elevated levels of larval productivity have been registered, much higher than those registered in the Pacific coast west of Baja California or the rest of the Gulf. This high productivity points to this euphausid as a cornerstone species in the trophic dynamics of the region that attracts the annual presence of blue whales (*Balaenoptera musculus*), fin whales (*Balaenoptera physalus*), humpbacks (*Megaptera novaeangliae*), whale sharks (*Rhincodon typus*), and smooth tail mobulas (*Mobula thurstoni*). Euphausids are also the principal source of food for the ocean whitefish (*Caulolatilus princeps*), the species with the highest importance for traditional artisanal fishing in the region.

During the expedition, especially during the immersions in the DeepSee at dusk, we confirmed the presence of euphausids and other groups in suspension (annelids and polychaetes, among others) over the reefs near the surface. We believe that the great density of suspension feeders like the black coral, sea fans, and basket starfish between 30 and 100 m deep is probably due to the high densities of euphausids and other small invertebrates suspended during their day-to-night vertical migration in the water column. It is also possible that the benthic organisms in the deep zone (the majority of which are suspension and detritus feeders) take advantage, in some degree, of the great production in the surface that reaches the sea bottom in the form of detritus.

Understanding these complex flows of energy between the different communities (benthonic-pelagic) will provide a complete vision of the production dynamics in the Gulf of California. Future investigations directed in this sense will support management and use strategies for these ecosystems.