

nudibranch

The coral reef off Sulawesi, Indonesia is a kaleidoscope of colour.

The corals seem to fight for space, clamouring in a brilliant profusion of textures, shapes and sizes. I am 10m below the waves, searching for a tiny creature in an immense underwater realm. From my weightless spot several feet from the reef, it's akin to searching for a needle in a haystack.

To my right, I spot a distinct jumble of coral anchored to the sandy bottom. It's the size of a small car. To me, the isolated coral head seems a more manageable place to step up my search. I exhale a column of bubbles, kick my fins and roll to my right, gently descending until I am only inches away from the coral.

Hovering, I scan the nooks and crannies, and almost immediately, my patience is rewarded. Well camouflaged by the vivid sponges, algae and corals around it, is an aptly named *Chromodoris magnifica*. It's only 3cm long, but the magnificent pyjama-like orange, blue and white stripes that are characteristic of the species, pack a visual wallop.

I am thrilled by the find, but the *Chromodoris magnifica* is only one species of a huge group of marine invertebrates belonging to the scientific order *Opisthobranchia*. To the layperson, the finger-shaped, bottom-dwelling animals are known as 'sea slugs' or 'nudibranchs' (pronounced *nooh-dee-branks*), and they're found all over the world.



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Travel beneath the waves with The Sea's Jessica LePoidevin to discover some of the oceans' most remarkable living treasures...



*Chromodoris
kuniei*

nudibranchs



Nembrotha purpureolineata

Slug of another kind?

When I tell people I love sea slugs I often get a strange look. Most of the time the term 'slug' drums up visions of the small, mud-coloured garden variety that invades gardens across the UK. While the nudibranch's basic shell-less body type is similar to that of the land slug's (the word *slug* only refers to their body type) the marine versions are farther apart on the evolutionary scale than snails and land slugs and they couldn't be more visually different. Many are covered in such dazzling patterns and colours that they look more like undersea jewels than soft-bodied molluscs. But in fact, that's exactly what they are.

Like land slugs, sea slugs belong to the scientific class *Gastropoda*. In essence, they're in the same group. They both evolved from shelled, sea-dwelling creatures, and both share several basic characteristics. For instance, they both possess a muscular foot, which they use for locomotion, and both have a mantle, which encloses their organs. Surprisingly, they also share a fairly complex

digestive system and a rasping organ – called a *radula* – which is really a modified mouth. But that's where the relationship stops.

In fact sea slugs and land slugs belong to different scientific orders, and the biggest difference between the two lies in their evolution. Land slugs crawled out of the sea and evolved lungs and a respiratory system, whilst nudibranchs stayed in their aquatic environment. As for why both groups subsequently lost their protective shells; that's still being debated by scientists. So, while both land and sea slugs are similar in a basic way, in actuality they are quite different creatures.

Made for the sea

In the wave-dappled sunlight streaming down to my place above the coral, I have resumed my search. This time my scan reveals a multi-coloured *Glossodoris cincta* moving sedately, its muscular foot flexing rhythmically to propel it along its perch.

I wave my hand gently in the water above its head and watch as two small horn-like projections sway in the current. These are the nudibranch's *rhinophores*.

In air, chemical molecules float about and are detected by animals with scent receptors. In our case, scent receptors are found in our nose. The same scenario happens in the sea, as dissolved chemicals float

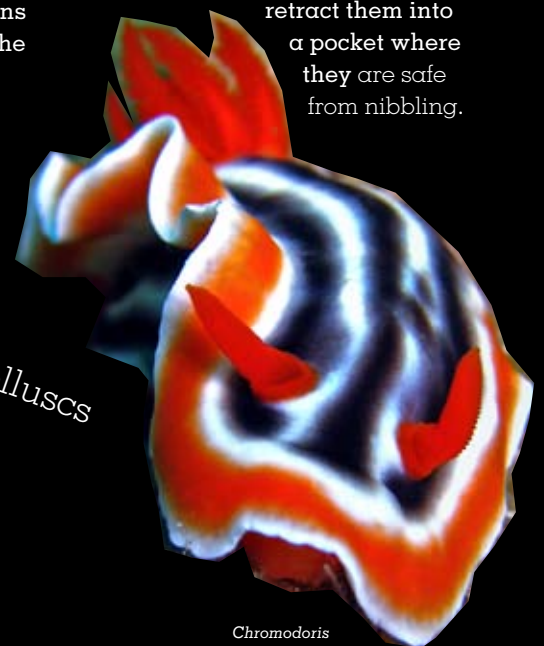
about and are detected by a variety of marine life.

In the sea slug's case, chemical receptors are located in the rod-like rhinophores that protrude from the front of their bodies. Rhinophores enable them to detect food, enemies and mates as they make their way around their habitat. This is crucial to their survival, as their tiny eyes only register dark and light.

But the rhinophores aren't the nudibranch's only marine adaptations. On the back of the *Glossodoris cincta*, away from the creature's head, is a cluster of appendages. In this species' case they resemble a small feather duster. But they can range from large tentacle-like clusters of contrasting colours, to invisible, such as in the case of *Phyllidra*.

In many instances, the appendages on some nudibranchs' backs add to their magnificent appearance, but they aren't just a pretty adornment; they're actually gills, which enable them to extract oxygen from the water around them. And because bits waving about in the current can act like a lure for curious predators, many nudibranchs with these types of gills have evolved the ability to

retract them into a pocket where they are safe from nibbling.

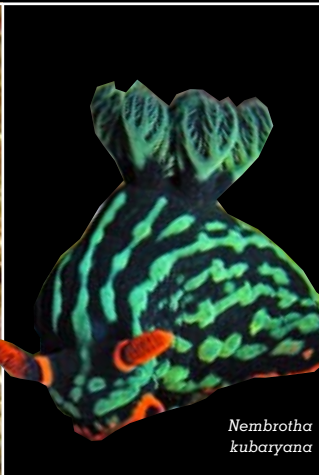


Chromodoris magnifica

Sea-slug classification KINGDOM: Animalia PHYLUM: Molluscs
CLASS: Gastropoda SUBCLASS: Orthogastropoda
ORDER: Opisthobranchia SUBCLASS: Nudibranchia



Phyllidia ocellata



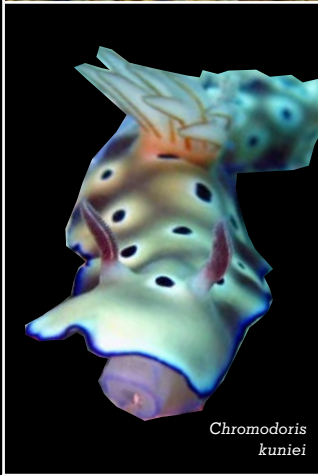
Nembrotha kubaryana



Phyllidia elegans



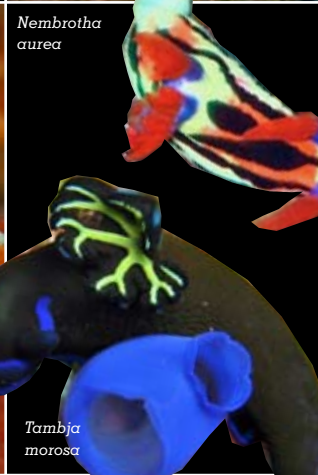
Chromodoris annae



Chromodoris kuniei



Phylloidesmium briareum



Nembrotha aurea



Phyllidiella pustulosa

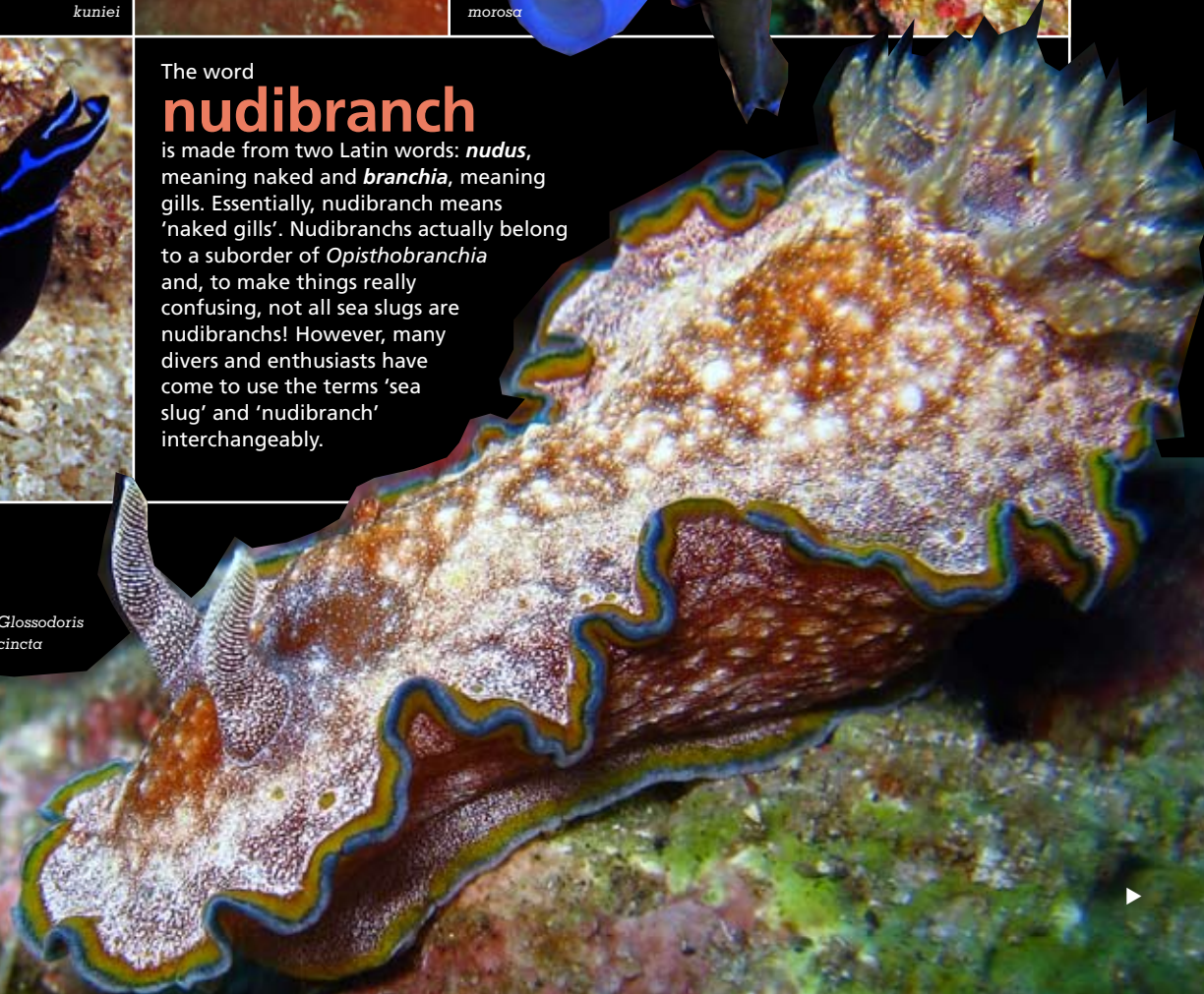


Chelidonura varians

The word nudibranch

is made from two Latin words: *nudus*, meaning naked and *branchia*, meaning gills. Essentially, nudibranch means 'naked gills'. Nudibranchs actually belong to a suborder of *Opisthobranchia* and, to make things really confusing, not all sea slugs are nudibranchs! However, many divers and enthusiasts have come to use the terms 'sea slug' and 'nudibranch' interchangeably.

Glossodoris cincta



Survival secrets

As I check my dive gauges and ascend over the top of the coral head, I can't help but marvel at how camouflaged sea slugs actually are. When gazing at photos and taking in their dazzling colours and patterns, people often assume they should be easy to spot, but amidst their natural habitat they can be nearly impossible to find, and this is one of the keys to their survival. Their colours, patterns and even shape have evolved over time to provide sophisticated protection from veritable sea of predators.

In nature, brightly coloured animals are often harmful, and this is also true of sea slugs. In many cases their brilliant display is a warning to predators to keep away from stinging flesh, foul tastes and poisonous chemicals.

Species like the *Hexabranchnus sanguini* swim. This particular species is



Ceratosoma trilobatum

Spanish dancer,
Hexabranchnus
Sanguineus, in
action!



neus, or Spanish dancer, have developed the ability to
one of the largest, measuring upwards of 40cm!

The fascinating thing about some sea slugs is that they get their harmful chemicals from the food they eat. These nudibranchs feed on sea anemones, corals, jellyfish and other stinging organisms and are able to store their food's stinging cells (*nematocysts*) and use them in their own defence.

But not all nudibranchs are brightly hued. Many temperate-water species are less lurid than their tropical counterparts, which makes sense, since their environment is generally less colourful and bright patterns would increase their visibility – think of a Hawaiian shirt in the Arctic! In fact, many Arctic and Antarctic sea slugs are snow white and unpatterned, while UK species tend towards subtle browns, oranges, peaches and whites.

While the sea slugs that rely on camouflage as a defence mechanism may not be as photogenic as their vivid counterparts, they are equally amazing in their capacity to

incorporate the pigments from their food into their skin. This results in camouflage that is so precisely matched, it can be nearly impossible to distinguish them from their background!

Besides colour and pattern, a few nudibranchs have developed the ability to cast off body parts in a process known as *autotomy*. One nudibranch is able to quickly drop its mantle, confusing predators and aiding its escape, while another species, *Phyllodesmium*, is able to cast off parts that secrete a sticky mucus. These gluey bits are left behind to wriggle and distract predators while the *Phyllodesmium* makes its getaway!

Other species, like the *Hexabranchnus sanguineus*, or Spanish dancer, have developed the ability to swim. This species is one of the largest, measuring upwards of 40cm, and is usually nocturnal. Most divers are thrilled when they catch sight of this striking nudibranch 'dancing' out of the darkness and into the beam of their torch.

HOME-GROWN NUDIBRANCHS

Fabulous sea slugs aren't just exclusive to warm tropical waters. Many interesting and beautiful specimens can be found close to home! Bernard Picton, author of 'Nudibranchs of the British Isles', shares some of his favourites...



Favorinus bilanus



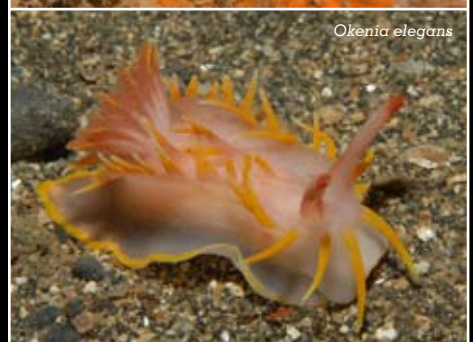
Flabellina lineata



Janolus cristatus



Rostanga rubra



Okenia elegans

nudibranchs

Upon hatching, sea-slug larvae actually have a tiny shell, which is lost as the juvenile grows

Sluggish behaviour

It's time for me to return to the boat. My air is getting low and, despite my wetsuit and the warm Celebes Sea, I'm getting chilled from inactivity. Above all, nudibranch spotting requires patience.

I'm about to turn back to the boat when I see them: two spectacular *Risbecia tryoni*, and they are exhibiting the unusual trailing behaviour that is so characteristic of the genus. They are nose to tail as they creep across a sponge; the nudibranch following the leader is actually touching its tail, ensuring that they stay in contact.

No one knows why some sea slugs display trailing behaviour, although there are a variety of theories. Some experts suggest it's a mating tactic; most sea slugs are hermaphrodites – both male and female – and keeping close tabs on mates ensures they're easy to find.

Nudibranch specialists surmise that species that do not 'trail' their fellows,

follow residual mucous trails; in essence, they use their rhinophores to follow the chemical scent left behind. What is clear is that breeding occurs in hermaphroditic sea slugs through an exchange of egg and sperm, leaving both individuals to separate and lay their eggs. It's a beneficial system, ensuring that each nudibranch creates genetically variable offspring, while laying the most eggs possible.

Upon hatching, sea-slug larvae have a tiny shell, which is lost as the juvenile grows. Like many larval marine creatures, sea slugs form part of the plankton until they reach an appropriate level of maturity, at which time they sink to the sea floor and start their lives as adults. Amazingly, it's a short process; most only live for a year or so, but like most things, there are exceptions to the rule. One Antarctic species can live for over four years, while another from Europe may only live a few months. The life of a beautiful nudibranch is fleeting, as is my time underwater!

Reluctantly I take in one last look at the companionable *Risbecia*. There will be other dives and other nudibranchs.

Tomorrow I'll don my scuba gear again to descend into the blue and search amongst the corals for the beautiful and elusive, jewels of the sea.



Tritonia diomedea

SCIENTIFIC SEA SLUGS

A species of nudibranch known as *Tritonia diomedea*, is helping scientists in the field of neuroethology discover how the brain controls behaviour. Studies show that sea slugs don't just wander aimlessly around the sea. Instead they respond to odours and other sensory cues by changing their navigational behaviour to cope with changes in their environment.

What does this mean for us? The sea slug is a favourite research model and is considered a natural gift to neurobiologists. Their relatively simple nervous system and large nerve cells are easy to study under controlled laboratory conditions. This allows scientists to study cells involved in basic behaviours that are common to all animals, including humans!

Photo: Dr James Murray

Photos, unless noted: Michael Henke



Risbecia tryoni