

FEATURE SMALL CREATURES BIG VALUE

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Muck diving might be about small creatures but their economic value is enormous. Joanna Lentini and Maarten De Brauwer delve into the beauty of these creatures and the value they bring to everyone around them

By: Joanna Lentini and Maarten De Brauwer

Seahorse in Lembeh Strait,
Indonesia
IMAGE: Maarten De Brauwer





Valuing Muck

By: Joanna Lentini

World-renowned as a mecca for muck diving, the Lembeh Strait in North Sulawesi sits within an incredibly bio-diverse region of Indonesia, which boasts a multitude of bizarre, alien-like macro life. Year after year, the Strait entices scuba divers and underwater photographers to make the trek for workshops, shootouts, and bucket-list ticks. Whether in search of mating mandarinfish, flamboyant cuttlefish, or pygmy seahorses, muck diving is a big deal. And while scouring underwater rubbish may not seem exciting for everyone, the pastime brings in millions of tourism dollars annually to local communities throughout both the Philippines and Indonesia.

Best known for its sandy volcanic slopes and fascinating underwater critters, the Lembeh Strait is a narrow body of water in the northern part of the country that divides the main island of Sulawesi from Lembeh. For scuba divers and underwater photographers that appreciate the smaller things in life, the Lembeh Strait is an absolute must visit. However, like many other ecosystems

worldwide, it requires passionate ambassadors, such as Belgian researcher, Maarten De Brauwer just to help maintain the status quo.

In recent years, economists have increasingly developed and refined models, which look to integrate the financial value of “natural capital” including animal species such as the manta ray or whale shark. However, at a granular level, there has not been much focus on macro subjects such as the blue ringed octopus or hairy frogfish. This is where De Brauwer comes in. The young researcher has spent a great deal of time and energy assessing the economic benefits of muck diving while residing in Lembeh for his PhD project.

Over the course of a dive trip to the Lembeh Strait, I had the opportunity to meet up with De Brauwer, and to learn first-hand about his fascinating research. He explained that by

placing an economic value on our natural resources (no matter how insignificant they may at first seem), we inherently protect both them as well as ourselves. De Brauwer provided a very compelling argument for this suggestion.

For example, his findings indicate that dive guides in the Philippines and Indonesia net US\$51 million dollars annually from guiding muck divers. This figure represents nearly three times the local minimum wage. And while this may sound impressive, De Brauwer emphasizes the true number is likely much higher. While preparing the figures, De Brauwer only accounted for dive centres that specialised in muck diving. Of course, plenty of other more generalist dive centers and liveaboards across the region frequent muck sites as well.

In his paper, *Known Unknowns: Conservation and Research Priorities*

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ABOVE: Over and under with Maarten,
IMAGE: Luke Gordon



for Soft Sediment Fauna that Supports a Valuable Scuba Diving Industry, De Brauwer presents the top ten muck diving species he derived from a method that is not yet commonly used in the conservation world. Popularized by both the Food & Beverage and Medical industries, the “Best-Worst Scaling Method” helps to identify the most popular muck diving species among divers. Such data points could prove invaluable for dive organizations and NGOs, as it provides a baseline for research, marketing, and conservation efforts.

So who is your average muck diver? De Brauwer explained the typical muck diver is someone with a good amount of dive experience that possesses an average of 580 logged dives. In his research, he also determined 73.5% of those divers are in fact underwater photographers donning expensive camera systems. Not surprisingly, muck divers are generally high-income earners with advanced level educations.

But what are the Top 10 muck diving species these well to-do divers

BELOW: Maarten smiling for the camera
BOTTOM: Maarten doing a survey underwater
IMAGE: Luke Gordon





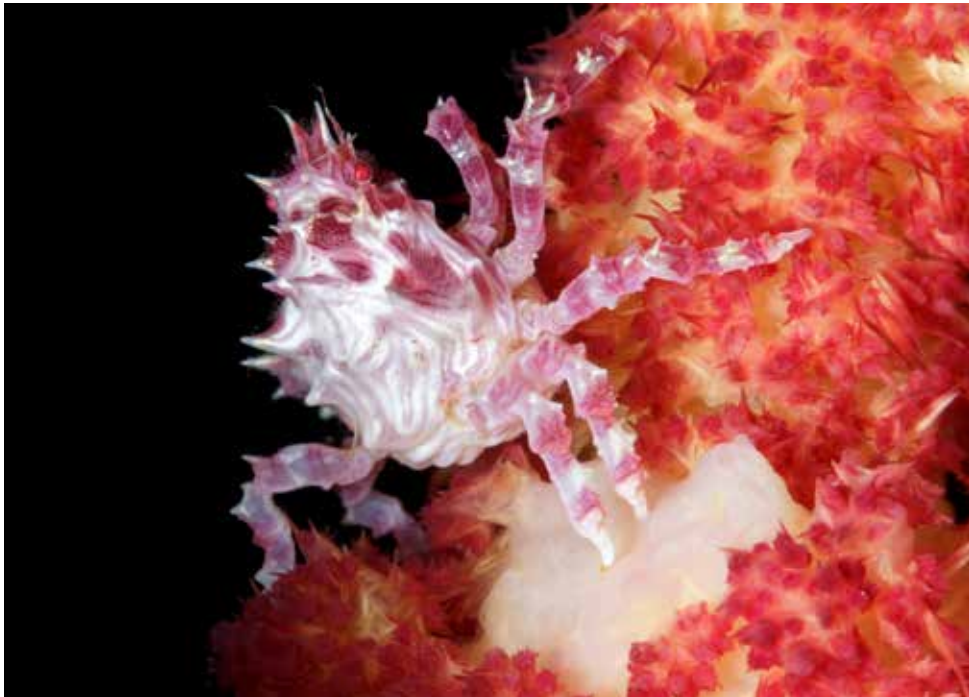
are after? Well, by comparing the results from the Best-Worst Scaling Method to a traditional survey, De Brauwer was able to put together the following list:

- 1) Mimic Octopus/Wunderpus
- 2) Blue-ringed octopus
- 3) Rhinopias
- 4) Flamboyant Cuttlefish
- 5) Frogfish
- 6) Pygmy seahorse
- 7) Other Octopus species (e.g.Mototi octopus)
- 8) Rare crabs, such as boxer crabs
- 9) Harlequin shrimp
- 10) Nudibranchs

The mimic octopus, an apparent favorite among photographers, tops the list. De Brauwer credits this to the interesting behavior they display. While the top ten results are not at all surprising, the fact that little research has been conducted on them is quite disconcerting – particularly when one considers more widely known species missing from this list (such as the ghost pipefish) are less likely to attract divers and tourism dollars without the presence of some of these less mainstream “Top Ten” species. By calculating the actual benefits of muck diving and the particular species that repeatedly bring tourists to remote regions such as Lembeh, De Brauwer hopes to get a lasting conversation going with

By conducting his research, De Brauwer hopes they will come to grasp the true economic value that their underwater ecosystems provide for their communities and ultimately protect them

ABOVE: Fervently protecting his territory, this fragile porcelain crab may very well resemble a crab, but it is, in fact, more closely related to the squat lobster
BELOW: Soft coral crab or Candy crab, Hoplophrys oatesii
IMAGE: Joanna Lentini



local governments and stakeholders. Without empirical economic evidence, it would be difficult to properly convey the true economic value that their underwater “wastelands” hold. By conducting his research, he hopes they will come to grasp the true economic value that their underwater ecosystems provide for their communities and ultimately protect them. Without research like De Brauwer’s, and passionate divers and underwater image-makers, dredging and/or other destructive activities could potentially wipe out the array of remarkable species that populate the Strait before much is even known about them. Of course, as evidenced by De Brauwer’s assessments, this would also adversely impact the livelihoods of so many locals as well as their broader economy. While marine life encounters provide relatively high-paying jobs for locals and great joy for divers, De Brauwer is concerned about the vulnerability of these highly sought-after species, especially when it comes to divers touching marine life — which is not acceptable. He took his concerns regarding the welfare of marine life a step further, with extensive research into the effects of camera strobes on fragile seahorses. While his conclusion was that the strobes were not harmful; he notes that there is always a risk to the wildlife in any marine life encounter. After chatting with De Brauwer, I headed out into the Strait to explore for myself. Equipped with my 100 millimetre macro lens, I switched on my critter radar and got to work. A great deal of satisfaction certainly comes from finding and creating images of these complex creatures. In a way, it is very much akin to a treasure hunt. Once a camouflaged, miniature subject is found in the sand, or perhaps in an old soda bottle, a great deal of patience is usually required to capture an interesting tack-sharp image. While I don’t necessarily have the greatest radar for critters, I managed to photograph a species that was high on my own list: the blue-ringed octopus. Although slightly bigger than what I had imagined, the encounter did not at all disappoint. In addition to the satisfaction that can be felt,

it occurred to me that macro subjects are much more foreign to our terrestrial brethren, making them all the more important to create and share. Documenting critters that don’t typically make it into the mainstream media can help raise awareness and appreciation for these lesser-known creatures. Of course, I felt inclined to conduct a Best-Worst Scaling survey on Maarten to find out his most and least coveted species. Here’s what he had to say: “One of my all-time favorite critters would be the flamboyant cuttlefish: the combination of cool behavior, switching from perfect camouflage to outrageous colors, and their tiny size never ceases to amaze me. While rhinopias are great critters, I feel that they offer less of the exciting behavior than some of the less gaudy colored species out there.”

FINAL THOUGHTS

As many famous muck sites, such as the Lembeh Strait, are located in remote, hard to reach areas, where locals have few choices for employment, muck diving provides a rewarding and sustainable alternative for those that may have otherwise been fishermen or factory workers. Clearly, great benefits can be derived from assigning an economic value to each of these critters. Society is fast approaching a tipping point where we are using more resources annually than the planet can replenish in a given year. It’s high time we value both big and small alike. Hopefully, with continued passion for places such as Lembeh, increasing research and reverence will continue to cultivate valuable tourism dollars providing balanced support for both conservationist’s concerns as well as more business-focused leaders.



JOANNA LENTINI is an award-winning photographer and writer based in the Greater New York City area. Joanna’s passion for the natural world and photography ignited from an early age and has led her to explore diverse environments around the planet—from the Arctic to the Coral Triangle.

TOP 10 MUCK DIVING SPECIES

- 1) Mimic Octopus / Wunderpus
- 2) Blue-ringed octopus
- 3) Rhinopias
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Things You Didn't Know About Your Favourite Critters

By: Maarten De Brauer



BLUE-RINGED OCTOPUS

Few people know that male blue-ringed octopus can't tell the difference between males and females. When it comes to sex, they try to mate with any other blue-ringed octopus they meet.



Name : Blue ringed octopus (*Hapalochlaena*)
Family : *Octopodidae*
Size : Generally measure 12 to 20centimetres. They weigh only 28 grams with bodies to five centimetres long and arms to 10 centimetres
Habitat : Often sighted in tide pools and coral reefs in the Pacific and Indian Oceans, from Japan to Australia at depths of up to 50 metres. They can also be found among clumps of sea squirts, particularly after storms
Behaviour : The blue-ringed octopus diet typically consists of small crabs and shrimp. They also tend to take advantage of small injured fish if they can catch them.

A male blue-ring will pounce on any potential partner and insert their hectocotylus (scientific slang for "penis-arm") into the mantle cavity of the other octopus. It's only at this point that the male finds out if he hit the jackpot or got himself into a rather embarrassing situation. If the partner turns out to be another male, they amicably part ways, no harm done. In case he gets lucky and their partner is a female, the male clings on for as long as possible. The male basically tries to hang on as long as possible, only breaking contact when they forcefully remove him. This strategy is not without risk, since females occasionally attack, or even kill and eat the male during sex. The actual deed can take up to 4 hours, but I think we can all agree it hugely lacks in romanticism.

ABOVE: Blue-ringed octopus in Lembeh Strait, Indonesia
IMAGE: Maarten De Brauer

SEAHORSES MAKE NOISE

Next time you encounter a seahorse, instead of just looking, you might want to listen too. One of the more quirky things all seahorses do, is make noise, quite a lot of it even. Seahorses make two distinct types of sounds: "clicking" and "growling". "Clicking" is used for interactions between seahorses, such as courtship or mating. "Growling" is a stress response when they are threatened or even captured by predators. It is thought that it might serve as an escape mechanism that startles predators. I absolutely love the idea of a growling seahorse! Maybe because those predators would be laughing too hard after hearing a seahorse growling at them? So seahorses not only serenade their partners to get them in the right mood, they also growl to chase away predators. Strange little critters indeed.



Name : Pygmy Seahorse (*Hippocampus bargibanti*)
Family : *Syngnathidae*
Size : Can grow up to 20 millimetres
Habitat : Found in coastal areas ranging from southern Japan, Indonesia to northern Australia and New Caledonia
Behaviour : Adults are usually in pairs or clusters of pairs. These groups can be as large as 28 pygmy seahorses on a single gorgonian at depths of 10 to 40 metres. As with other seahorses, the female lays her eggs in a brood pouch in the male's trunk area and he carries the young.



Few people know that male blue-ringed octopus can't tell the difference between males and females. When it comes to sex, they try to mate with any other blue-ringed octopus they meet.

LEFT: Seahorse in Lembeh Strait, Indonesia
IMAGE: Maarten De Brauer



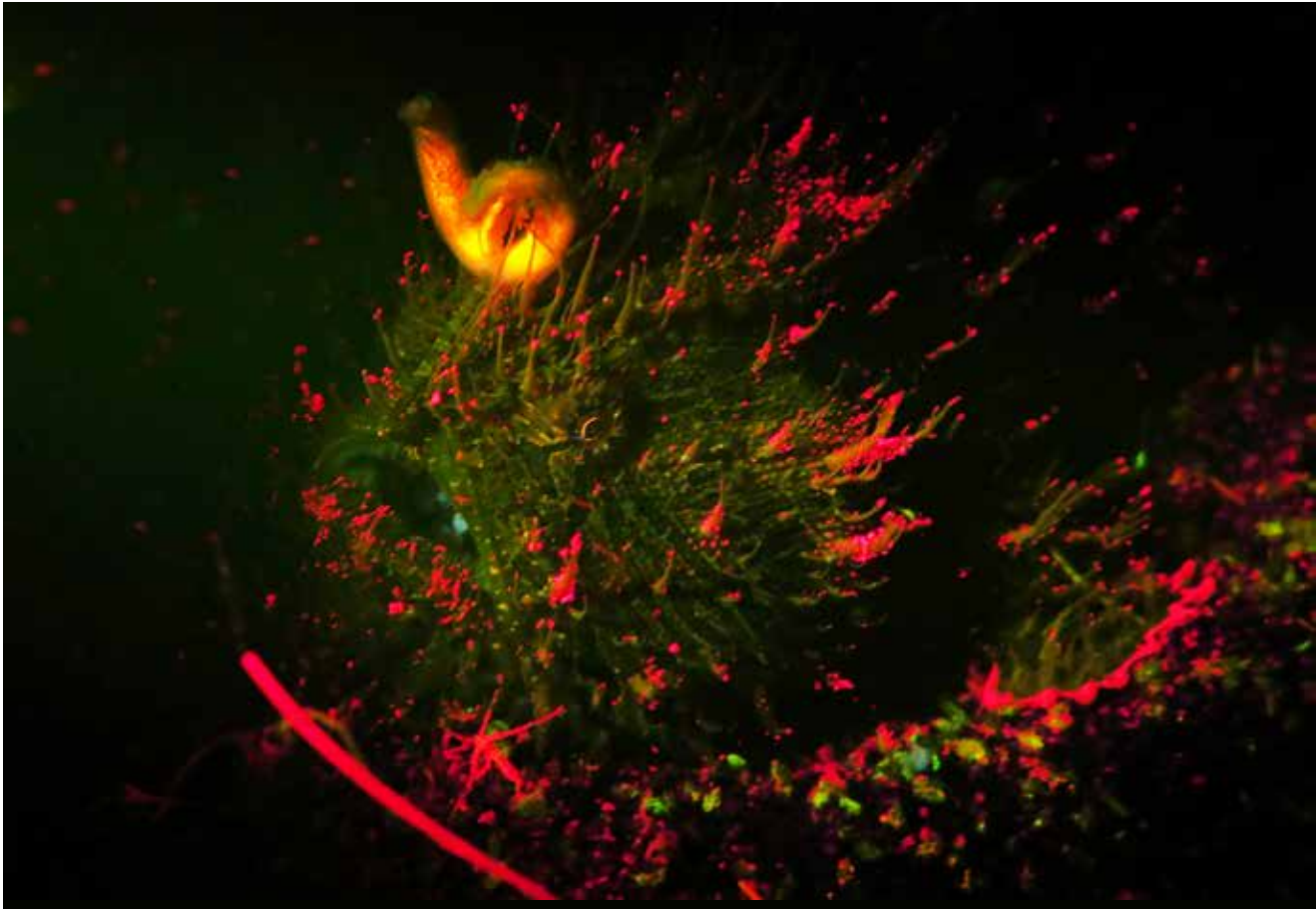
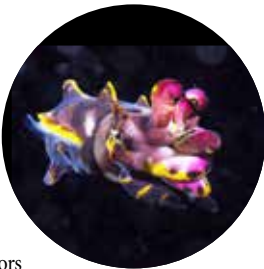
FLAMBOYANT CUTTLEFISH ARE NOT REALLY FLAMBOYANT

When hearing the words “flamboyant cuttlefish”, you are likely to picture a cute multi-coloured tiny cuttlefish, flashing its waves of colour at you. You’re in for a surprise though. Most of the time, flamboyant cuttlefish are anything but flamboyant! In their “standard” state, flamboyant cuttlefish are a mottled grey, brown, or black colour, blending in perfectly with their sandy habitat. They usually only display their vivid colours when they are disturbed, hunting, or mating. Some divers might be tempted to disturb the animal to get more colourful pictures. Clearly this will stress out the cuttlefish and should be avoided at all cost. Be patient instead. Observe it for a while and you might even be rewarded by seeing it hunt small shrimp, lay eggs, or even mate!

ABOVE: Flamboyant cuttlefish eating a Randall’s pistol shrimp in Lembeh Strait, Indonesia
IMAGE: Maarten De Brauer

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Name : *Metasepia pfefferi*
Family : *Sepiidae*
Size : Can grow up to eight centimetres in mantle length
Habitat : They inhabit tropical Indo-Pacific waters off northern Australia, southern New Guinea, as well as numerous islands in the Philippines, Indonesia and Malaysia. They are mostly shallow-water animals, and can be found at depths of three to 86 metres
Behaviour : Active in the day, it hunts fish and crustaceans. Arm tips often display red colouration to ward off predators



BUT HAIRY FROGFISH ARE (AT LEAST THEIR LURES)

You might have been lucky enough to have gone for a fluorescent night dive but few people have seen hairy frogfish while “fluo” diving. It is worth a try though, if you want to see something truly special. The bodies of hairy frogfish do not fluoresce, but their worm-like lures do. As you might know, frogfish use their lure as a fishing rod, attracting small fish closer, which are then eaten whole. The fluorescent lures of hairy frogfish might be used to increase their hunting success. They seem to mimic the fluorescence of free-swimming worms, which are often eaten by small fish like cardinalfish, which in turn are a tasty snack for the frogfish. By mimicking the fluorescence of these worms, frogfish might increase their chances of attracting and catching prey. Your next “fluo” dive

might give you an exciting glimpse into previously unknown hunting strategies in the ocean.

ABOVE: Hairy frogfish in Lembeh Strait, Indonesia
IMAGE: Maarten De Brauer

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Name : Hairy frogfish (*Antennarius striatus*)
Family : *Antennariidae*
Size : Can grow up to 22 centimetres long
Habitat : Tropical Pacific, Eastern Atlantic, Eastern Pacific, Hawaii (Kona), Indian Ocean, Japan, Red Sea, Tropical Australia, Western Atlantic, Indonesia and Asia
Behaviour : These frogfish come in different varieties, often striped or with hairy appendages. they also known as anglerfish are lie-in-wait predators. They are equipped with a specialized lure called an esca. Using its fishing rod and lure the frogfish will dangle the bait in front of its head



OCTOPUS ASPHYXIATION

Frogfish are not the only critters with special hunting techniques. Wunderpus have been seen bullying other octopus to get a good feed. In at least one case, a wunderpus tried to asphyxiate a mimic octopus to steal its food! In fact, “constricting” is not uncommon in octopuses. They will use one of their many arms to plug the other octopus’ funnel (=breathing hole). This makes it hard for the other octopus to breathe, but also prevents it from squirting ink. Not being able

to ink might seem less important than breathing, but inking is used for more than just hiding from predators. Octopus ink often contains chemicals that act as an irritant for predators, making it even harder for the predator to get a meal of octopus. Octopus not only constrict other octopus to steal their food. Females sometimes use it during mating to kill and then eat their mate. Finally, it can be used as a defence against predators, for example by blocking the gills of sharks that try to eat the octopus.



Name : *Wunderpus photogenicus*
Family : *Octopodidae*
Size : Can grow up to 30-45 centimetres from arm tip to arm tip, mantle (body) around 2-5centimetres, occasionally larger
Habitat : Lives in a burrow on the ocean floor. Found in shallow waters from Bali and Sulawesi north to the Philippines and east to Vanuatu
Behaviour : Emerges to feed at dusk and at dawn. Moves by swimming or by using its arms to perform a walking motion over ocean floor. Feeds on fish and crustaceans

BELOW: Wunderpus in Kubu Bali, Indonesia
IMAGE: Maarten De Brauer



Nudibranchs occasionally indulge in mating aggregations (a nicer word for orgies), S&M (most of their penises have backward pointing spines), mating with different species than our their own and some even practice protandry

REARING NUDI

If you thought the sex-life of octopus was special, let’s have a look at that of nudibranchs. To some extent their life is simpler. There are no males or females, instead nudibranchs are both at the same time. If that’s not special enough for you, here are some other things nudies get up to. Nudibranchs occasionally indulge in mating aggregations (a nicer word for orgies), S&M (most of their penises have backward pointing spines), mating with different species than their own (“any nudie is a good nudie”), and some species even practice protandry (adults mating with juveniles). In what is probably one of the most bizarre cases of sex on the sand, a species of Siphopteron-slugs uses a part of its forked penis to stab their partner through the head during mating! You read that correctly, they use an adapted penis to stab each other IN THE HEAD while having sex. As if that’s not enough, they even inject prostate fluid into the head as well. Researchers have suggested this process (called “cephalo-traumatic secretion transfer”) might change the behaviour of the receiving slug, go figure... [AD](#)

LEFT: Nudibranch in Lembeh Strait, Indonesia
IMAGE: Maarten De Brauer



Name : *Nembrotha kubaryana*
Family : *Polyceridae*
Size : Can grow up to 2.5 - 12 centimetres long
Habitat : Found in the tropical Western Indo-Pacific
Behaviour : It uses the toxins in its prey ascidians to defend itself against predators. It stores the ascidian’s toxins in its tissues and then releases them in a slimy defensive mucus when alarmed



MAARTEN is a marine biologist based in Curtin University in Perth (Australia). His recent research focuses on soft sediment habitats and cryptic species in Southeast Asia, but he is passionate about critters all over the world. The aim of his research, writing, and photography are to share the beauty of the ocean and help protect it for future generations.