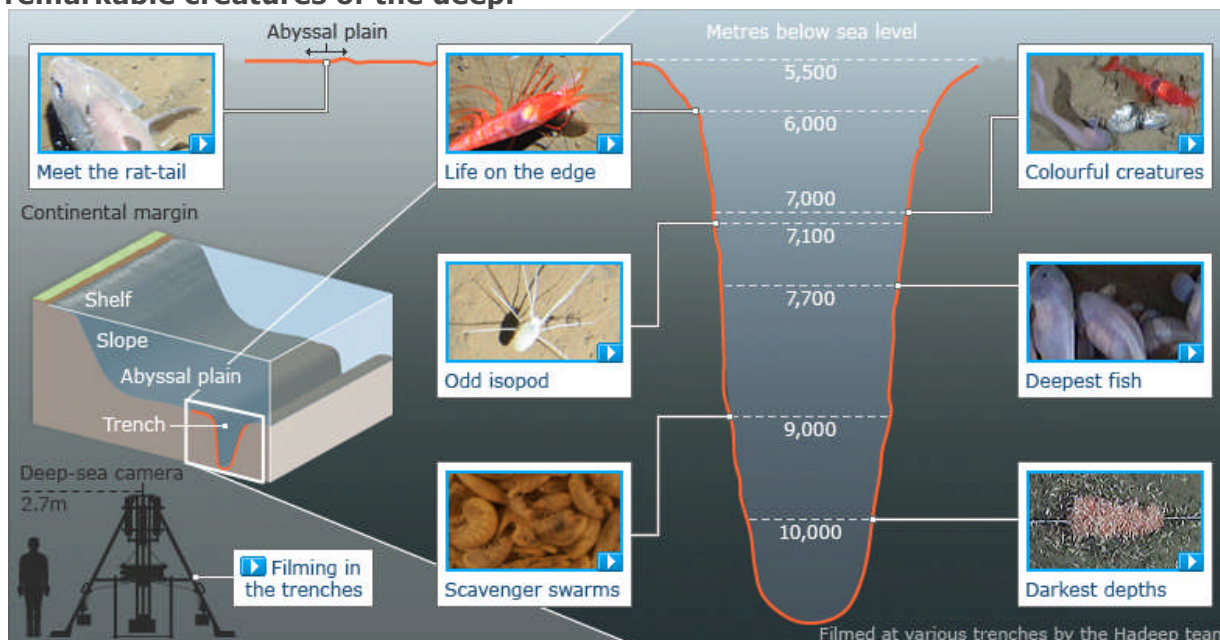


Meet the creatures that live beyond the abyss

By Rebecca Morelle
Science reporter, BBC News

It is pitch black, icy cold and the pressure is phenomenal. The deepest parts of the ocean are some of the least hospitable places on Earth - yet footage from recent expeditions reveals that life in the oceanic trenches is thriving. Click on the images below to see the remarkable creatures of the deep.



Our fascination with the deepest of the deep was sparked by an extraordinarily dangerous expedition that took place 50 years ago.

On 23 January, 1960, the bathyscaphe Trieste propelled Jacques Piccard and Don Walsh to the bottom of Challenger Deep in the Marianas Trench, which at more than 10,900m (35,800ft) down is the deepest spot in the ocean.

They were the first - and even now, the only - humans to have experienced these depths.

With the vessel creaking and groaning under an immense 1,100 bars of pressure - the equivalent of having several dozen jumbo jets piled on top of you, the explorers stayed at the bottom for 20 minutes before they began their risky ascent back to the surface. But as they neared the ocean floor, instead of finding a barren desert, devoid of life, the explorers say they spotted a fish swimming past.

Captain Don Walsh told the BBC: "The flatfish was seen just before we landed and the water clarity was still good."



Don Walsh (left) and Jacques Piccard's (right) deep-sea record still stands

"I would guess that it was less than a metre away. Jacques was at the viewport and I was looking at our fathometer calling off our height above the bottom when he saw the bottom and the fish."
The sighting suggested that even this most remote spot was habitable - and the hunt was now on for life in this mysterious underwater world.



The bathyscaphe Trieste spent 20 minutes at the bottom of Challenger Deep

The oceanic trenches - and there are 37 around the world, with the deepest found in the Pacific Ocean - are profound, narrow canyons in the sea floor.

They sit beyond the abyss, which covers a mere 3,000-6,000m (10,000-20,000ft) below sea level, and are positioned in the hadal zone, which plunges to 11,000m (36,000ft).

The fact that life can exist here is not as unlikely as it first seems.

Professor Paul Tyler from the National Oceanography Centre, Southampton, UK, explains: "The thing is animals adapt.

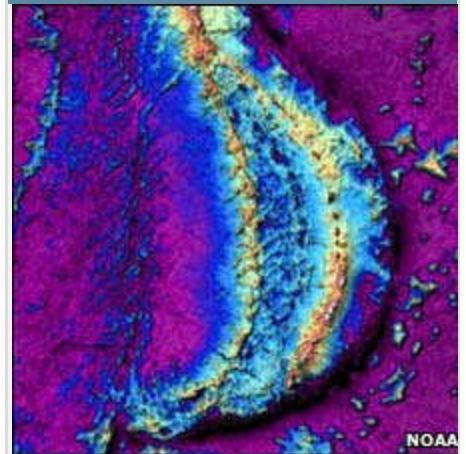
"OK, we think it is a highly hostile environment, but the animals living down there have most likely slowly penetrated the deep sea over millions and millions of years and have adapted to the pressure."

And many trenches contain an abundant food supply, especially those close to the coast. Organic matter drifts into the depressions, sinking to the bottom, contained by the steep sides.

But while scientists knew that fauna could survive here - and early trawling expeditions, during which dredges were towed across the ocean floor to collect a smattering of creatures, gave some idea of a trench's biology - a broader picture of deep-sea life has only emerged more recently.

Monty Priede, director of the University of Aberdeen's Oceanlab, says: "With new technology there is a renewed interest in the hadal zones."

DEEP SEA DIVISIONS



Bathyal zone: 1,000-3,000m
(3,000-10,000ft)

Abyssal: 3,000-6,000m
(10,000-20,000ft)

Hadal: 6,000m-11,000m
(20,000-36,000ft)

Not only is it easier to put together submersibles that can withstand high pressures, he explains, satellite navigation has also made it simple to pinpoint the spots in the trenches that you want to study. Professor Priede says: "If you go back to the 60s and 70s, you only knew roughly within a mile or so of where you were in the middle of the ocean.

"But with modern navigation, a ship can move within an accuracy of 10m (30ft) and we can send down a remotely operated vehicle and you know exactly where it is."

[Click here to see the ocean trenches in the Pacific](#)

Over the past few years, the Hadeep team at Oceanlab has been exploring trenches around the world using an underwater vehicle built to withstand the extreme conditions of these chasms.

The pyramid-shaped Hadal-Lander has high-resolution camera equipment encased in a titanium body with sapphire windows.

Dr Alan Jamieson, from Oceanlab, who designed the vehicle, says:

"The lander is lowered from the ship and freefalls, sinking to the bottom. To get it back up, you send an acoustic command, and it drops weights and shoots to the surface."

Once resting on the seabed, animals are lured over by some smelly fish bait, allowing the team to film them as they feed.

Dr Jamieson says: "The principles are simple, but the technology is not."

The Hadeep team has captured some remarkable video footage of creatures living at different depths in various trenches.

They have filmed fish called rat-tails that measure 0.5m-long (1.6ft), shrimp-like creatures called amphipods, which swarm in increasingly large groups the deeper you go, as well as a shoal of snail fish swimming at 7,700m (25,300ft) down in the Japan Trench - the deepest fish to be caught on camera.



Life in the deep evolved over millions of years



Oceanlab has used a special vessel to explore the deep



Fish from the ocean trenches like this rat-tail (left) look less strange than those that live in the mid-waters, such as this fangtooth (right)

The marine life looks less strange than you might expect - not that different to creatures that live at

much shallower depths.

Dr Jamieson explains: "It's the fish that live at about 1,000m deep in the mid-water that are really strange.

"They don't live on the surface or sea floor - which is why they have such incredible adaptations. The populations are so low that if you are going to eat something, you have to make sure you get it right first time because you won't get another chance."

Professor Priede adds that the main advantage of filming the animals is that it gives the team a chance to observe the behaviour.

"The main thing is that we can see animals in context. If you put down the dredge, you'd have no idea of where it was, how deep it was, and you brought up fragments of animals," he explains.

"Now we've been able to see that the fish are eating amphipods, and we get an idea of how fast they are moving and so on."

Other animals that have been spotted in the deep include starfish, sea cucumbers and worms, as well as much smaller creatures, including the single-celled protozoa and foraminifera.

"It's an eclectic mix of life," adds Dr Jamieson.

The recent boost in deep-sea research has revealed that many trenches contain similar animals living at comparable depths - even those in opposite hemispheres.

But while the creatures are closely related, each trench seems to have its own specific species.

Dr Alan Jamieson explains: "Take the snail fish.

"In the Japan Trench, there is that one particular snail fish, but there is another species of snail fish in the Kermadac Trench, and there is another one in the Puerto Rico Trench - and they are all very closely related, but they are all different species - but they all live at the same depth."

He explains that each species is essentially "trapped" in its own trench - to move in and out of it would require having to swim through too extreme a pressure change.

Back to the Challenger Deep

While the Oceanlab team plans to head out to the Peru-Chile trench next year, scientists in the US have trained their attention on the Marianas Trench.

At the Woods Hole Oceanographic Institution (WHOI) in Massachusetts, US, scientists are hoping their new vehicle Nereus will help to shed more light on the hadal zone.



The team filmed snail fish at 7,700m below sea level



The researchers have been able to look at the animal's behaviour

The submersible can work in two different modes. It can be lowered to the bottom of a trench while tethered to a ship using thousands of kilometres of fine fibre optic cables, which allows scientists to control it from the surface. It can also be untethered and explore the seabed autonomously.

In 2009, in a series of tests to prove that it was stable in the deepest parts of the sea, Nereus reached the bottom of the Marianas Trench.

This was only the second time a submersible had made it there since the unstoppable Trieste explorers (in 1995 the Japanese vessel Kaiko made the trip, spotting a sea cucumber, a worm and a shrimp during its stay on the sea bottom).

But next year, the team want to go back - this time to focus on science.

Andy Bowen, project manager and principal developer of the sub, says: "There is very little information about what types of life may exist there, so there have been some discussions about possibly using Nereus to contribute to that."

Last frontier

Despite the recent advances, scientists say we have still only scratched the surface of this area of deep-sea research.

Lisa Levin from the Scripps Institution of Oceanography says: "We have seen more of the Moon that we've seen of our trenches.

"Without doubt this is one of the unknown frontiers."

She is hopeful that the new boost in deep-sea research will help us to better understand this unusual ecosystem - and this could yield some astonishing discoveries along the way.

She said: "We are currently in a new era of exploration.

"When you have a unique set of conditions, you are likely to find unique organisms and novel communities and things you never knew about.

"I still believe the trenches probably hold some of that."



The sub sampled sediment from the Marianas Trench

“ Without doubt this is one of the unknown frontiers ”

Professor Levin, Scripps Institution of Oceanography

Oceanic Trenches in the Pacific Ocean

