Eurythenes plasticus

QUESTIONS & ANSWERS

WITH DR. ALAN JAMIESON & JOHANNA WESTON

Q: Could you tell us a little about yourselves?

Alan Jamieson: I am Alan Jamieson, I am deep-sea scientist and I've been working in deep-sea reseach for 20 years. Since 2007 I have specialised in the exploration of the deepest places in the ocean, the place we called the Hadal Zone, which means deeper that 6000 metres.

Johanna Weston: I am Johanna Weston, a deep-sea amphipod enthusiast and passionate about the environment. Luckily, I am getting to spend a lot of the time with these amphipods as they are the focus of my PhD in Marine Science at Newcastle University! I love being outdoors and finding ways to protect it for others to enjoy. Previously, I was an environmental scientist at the state of California where I created policies that help reduce pollution, like plastics, in streams, lakes, and the ocean.

Q: When you explore the deep, do you go down yourself or do you use robots?

AJ: We typically use 'robots' although we call them 'landers'. These are camera and trap systems, sometimes with all sorts of other sensors on them that free-fall to the seabed and make observations and collect samples and then float back to the surface. I have done nearly 500 of these lander deployments in my career so far.
In the last year of so I have been involved in a project where I actually go down in a two-person submersible.

JW: I explore the deep from surface! My focus is taking care of the specimens that are collected by the robots or landers. On the ship, I work to quickly preserve the speciments. Back in the University's laboratory, I work to sort, catalogue, identify, count, and analyze the samples to answer questions like, "Who live there?" and "Who do they live in the deep?".

Q: How deep do you usually go and what's the deepest you ever went?

AJ: On a normal hadal expedition we start sampling at 4000 metres and work our way to the deepest point in that area which may be 7000 metres deep, or sometimes nearly 11,000 metres deep.
With the sub I have been to 500m in Antarctica, 1500m in the Red Sea, 2200m in the Arctic, 7180 m in the Indian Ocean, 7300m in the Atlantic and 10,710m in the Pacific.

JW: The place we study, subduction trenches, are like inverted, underwater mountains. When you hike a mountain, you always start at the bottom and then make it to the top. Along your hike, you might notice that the type of plants are changing as you get high – from trees to shrubs to small ground plants. Tracking this change in community over height is interesting! We do a similar thing at subduction trenches. We start sampling with landers at 4000 m and work our way down of the very bottom. This sampling method of a transect is important to track the change in the species and communities as pressure increase and food decreases!

The deepest I have collected specimens with a lander is nearly 11,000 m at Challenger Deep, Mariana Deep, the deepest point in the world. Amazingly, three different amphipod species were found living there!

Q: Can you give us an understanding of the type of pressure involved at the bottom of the ocean?

AJ: The way I normally explain it is at the bottom of the Mariana Trench it is nearly 11,000 metres deep. That is 1.1 ton per square centimetre. If you imagine your finger nail is about 1 square centimetre and imagine over a ton pushing down on it, that's what type of pressure of pushing down on every simgle part of the sub.

JW: It's a lot and almost imaginable! If you send a Styrofoam cup to the bottom, it will compress and shrink to a ¼ of its size!

Q: The deepest parts of the ocean are formed by trenches. Can you tell us a bit about these and how they form?

AJ: The Earth is made of tectonic plates. There are places called Ocean Ridges where we get volcanoes and hydrothermal vents bursting out of the seafloor that form the ridge, this makes two tectonic plates move away from each other as the ridge of 'new seafloor' is created. A good example is the Mid-Atlantic Ridge, where Iceland and the Azores are volcanoes of the ridge that are so big have breached the surface.

However, as new seafloor is pushed up from the earths mantle you might think ther earth is getting bigger, but it isn't, so some seafloor needs to get lost somewhere else. The opposite to the mid-ocean ridges are subduction trenches. This is where tectonic plates do the opposite, they push against each other rather than move away. As they get pushed against each other they bend downward to create really deep, long, trenches such as the Mariana Trench. The heavier plate is actually pushed underneath the lighter plate and so is pushed down back into the Earths mantle.

The other way in which the plates interact is called called 'faulting'. This is where the tectonic plates move side by side, like the San Andreas fault in California.
So, on ridges, new seafloor is created that can get so shallow they form islands, but elsehwhere the old seafloor is pushed downwards creating the deepest parts of the oceans.

Q: The Challenger Deep is the name of the deepest part of the ocean locat-ed inside the Mariane Trench. Have you been there, and if so how long does it take to get there, and how long does it take to resurface again?

AJ: I have deployed many camera systems into the Challenger Deep, and sampled many animals from there, and I have been on a few expeditions to the Mariana Trench. However, when I had a chance to dive it personally, I decided to go 'next door' to the Sirena Deep which is a little shallower, 10,710m rather than 10,925m. I did that because after all the lander deloyments we had reason to believe it was slightly more interesting, and it was!

JW: In May 2019, I was lucky enough to spend two-weeks bobbing up and down over Challenger Deep while on the DSSV Pressure Drop. During this time, I was part of the team that send landers to bottom to collect videos, specimens, and water samples.

Q: What do you do to prevent boredom when you're assending or desending for such long periods of time?

AJ: On the way down your adrenaline is going, and we are constantly checking that the sub and life supports are working, and preparing ourselves for the mission when we get to the bottom. It takes about 3 and half hours to get there.

After the mission, when we are ascending, there is not much to do and so we often relax and watch a film on our phones. It is also about 3.5 hours up so there is plenty of time to catch a movie, have a chat and eat sandwiches.

Q: Is it true that more people have visited the moon than the Challenger Deep?

AJ: Not really. More people had been very, very, very deep before anyone ever went to the moon, but the moon v.s challenger deep isn't really a fair analogy as they are very different places and very different missions. The moon is 38 million square km and the Challenger Deep is 14 square km for starters. As of June 2020, more people have been to the exact deepest place than have been to the moon.

Q: What does it feel like when you are sitting at the bottom of the ocean?

AJ: It is a strange feeling for sure, especially having filmed a lot of these environments for years, it feels different to be seeing them with your own eyes. I think you use a lot more of your senses when you are actually in a place as opposed to watching video of it.

Q: Given the darkness, the extreme pressure and the cold, is there much life living in these extreme conditions?

AJ: There is life everywhere, there are at least 60 species in or around even Challenger Deep. Often these species are living in the mud or are very small, but there are things like actinians (a type of anemone) that live on the rocks at the bottom of the Mariana Trench, and they look like really delicate and beautiful flowers. If you put some bait down you will see swarms of scavenging amphipods devour it quickly. If you glide slowly over the bottom you will see many almost-transparent sea cucumbers munching through the sediment.

JW: Life is amazing and someone can always find away to survive! One of my favorite amphipods is named Hirondellea gigas, and it is about 2.5 cm long. Their cells are uniquely adapted to resist the extreme pressures. They thrive at Challenger Deep! I bet if Challenger Deep was 12,000 m deep, Hirondellea gigas would live there too.

Q: How much of the oceans still remain unexplored and do you think there are still many new species to find?

AJ: While there are still huge parts of the oceans that remain unexplored, I think we have much better idea of what we will likely find that people think. I think we all still like to feel like there is so much more to find in terms of major huge discoveries, but I think over the last 40 years we have grown to appreciate and predict what a lot of these ecosystems are like, even before we get there. There are of course many new species to discover, there will be for a very long time.

JW: While we, as a science community, have explored so many part of the deep ocean over the past 40 years, there is still much to explore, sample, test and discover. For example, there are still some subduction trenchs that have never been sampled before! There are still many new species to discover and then describe and name. Now with new molecular techniques to examine an animal's DNA, we are start to find cryptic species. This means that what we called one species is technically two or more species!

Q: How do you make sure that a species that you discover is truly a new species?

AJ: We have to painstakingly check every part of it body to make sure there has never been anything like it recorded before, and to be sure we check its DNA against databases.

JW: This is a very important first step. We spend a lot of time making sure we are confident it does not look like a described species. Every part of the body is compared with previously described species. We compare our potential new species with either physical samples of described species or the taxonomic drawings of described species. Most of the time we don't have physical comparison samples, so the taxonomic drawings are a critical piece of information. Some time, I look at drawings from the 1800s and other times try to read Russian scientific papers about a sister species.

Q: When you find a new species you also get to name it. What factors do you take into consideration when naming a new species?

AJ: There are 'laws' to this, so you can just call it anything. Preferred names involve something on the animal being particularly distinctive, or the geographic region it was found, that way the names can also be useful. If these names are taken you can name them after other people (if they are significant to the field) or the ship that discovered them and so on.

JW: There are three main steps to becoming a new species: 1) Discovery, 2) Description, and 3) Publication. Discovery includes collecting specimens and then comparing specimens with what is already described. Desciption involves documenting the species for what makes it distinict and thus new. We typically describe a new species based on at least one individual that we call the holotype. With the holotype, we make scientifically accurate drawings of what it looks like and then write what it looks like in words. That is called a description, which is not the easiest to

JW: As part of the description, you also get give it a name. There are “rules” for names, but it is really don’t name it after yourself and pick something memorable and distinctive. Finally, the description is written as a scientific paper. This paper then gets submitted to a scientific journal and it gets reviewed by 1-3 peer-reviewers. The peer-reviewers double check our work that it is new species and we didn’t miss anything important. Once the paper is accepted by the journal, it gets published and the name is then official! Until the paper is published, there is a strict rule that you can’t publically use the name. While at times annoying, it helps from causing any confusion of misnaming or double-naming!

Q: Can you give is an idea of the process involved in naming a new species?

JW: Describing a new species is a very intimate process! You really get to know the species because you spend hours staring at it down a microscope, looking at pictures, and then drawing every hair. The process, from discovery to publication, can take a long time. It is sort of like having a child – a science child. Your parent’s probably gave a lot of thought to your name. A name is important because you will be called that for the rest of your life. I feel similar way with naming a new species. I think about what makes this species unique – how does it look, where did it come from, how does it live. I want the name to be something meaningful and memorable.

Q: Alan, you have a new species named after you. Can you tell us a little bit about that and how many new species have you found?

AJ: It was in 2008 off jaan that I found a few specimens from 7700 m deep in the Japan Trench. I didn’t know what they were and so they sat under my desk for a year. In 2009 I bumped into a German taxonomist in New Zealand who meantioned she specialised in ‘spikey amphipods’, and I thought, “Oh, I have some of those” and so I sent them to her.

In 2011 I found out she named them after me – Princaxelia jamiesoni. The genus Princaxelia ,to which the new species belonged, was named after prince Axel of Denmark who lived about 100 years ago. So I, being Scottish, have a species belonging to a group named after a Danish Prince, that live off Japan and were named by a German scientist in New Zealand. Very international.

Q: Are there rules to how a physical specimen of a new species must be kept and where it is kept?

AJ: The best of the newly found species specimens, called a Holotype, must be registered and kept in an internationally recognised museum as reference material.

JW: The main specimen that species and description is based off of is called the holotype. This is a very valuable specimen. This specimen is given to a museum for long-term curatation. This is the essential job of museums like the Smithsonian and Natural History Museum. They provide long-term storage (hopefully for forever) of specimens. They also loan out specimens to scientists to help with the discovery phase.

Q: It's a different world deep down at the bottom of the ocean. What's the crayziest thing you've seen or experienced in the deep?

AJ: Discovering a 3 km long by 2 km wide bright green slime pool full of uranium, arsenic and copper, where there were parts of it bursting with brown water, surrounded with dark green bacterial mats and the whole site underlying a 100m high dome of what looked like snow. It was in the North Atlantic, very unexpected, and still not entirely sure what was going on there!

Q: How long have you been exploring the deep. Since starting, have you noticed a difference in the amount of plastic in the ocean?

AJ: 20 years. I think we are seeing more plastic now, but when I started we weren't really ever looking for it as it wasn't a big priority like it is now. Now I see it everywhere, but maybe because it is in the forefront of our minds now.

JW: I have been exploring the deep for 3 years now, but I have been working on marine plastic pollution issues for 6 years. I think over the past 2 years we have been hearing more and more about all the remote and random places we find plastic – from the atmosphere, tops of remote mountains, and the bottom of Challenger Deep. I think we are all aware of the problem.

Q: We have all seen images of plastic floating on the surface of the ocean. Is plastic also finding its way to the bottom of the ocean?

AJ: Yes, we found plastic fibres in the guts of animals living at the deepest point in six trenches around the Pacific Rim, including Challener Deep. I have seen plastic first hand from the sub at the deepest point in the Indian Ocean, in the Mariana Trench and loads in the Puerto Rico Trench, the deepest point in the Atlantic. It is sad to say, but it is everywhere.

JW: Plastic at the surface can break down into small particles and sink to the bottom. I think the main story with plastic pollution is it is nearly everywhere! I have first hand seen plastic bottles floating at the surface in the middle of the Pacific Ocean. One day on a very calm day, Alan and I sat at the top of the boat and just counted all of the bottles we saw. There's one, then four, and so one. It's sad them at the surface, because we know some will sink to the bottom.

Q: What kinds of plastic do you find down there?

AJ: Microfibres and microfragments if you know how to look for them. Visually we see everything from plastic bags, food wrappers to large tarpaulins. Non-plastic items such as soft drink cans, beer bottles and wine bottles are also very common.

Q: Do larger pieces of plastic disintegrate into microplastics and if so are these microplastics toxic to marine life if ingested?

AJ: The pastic itself perhaps isn't 'toxic' as such, but it will certainly clog or choke animals of the right size. It may also fill the gut with undigestible mass and thus reducing their normal nutriational intake. They are however known to scavenge pollutants like PCBs from the water and therefore if plastic ends up inside an animal, the PCBs are passed from the plastic to the animals in greater quantities than the background level, which seems to affect their reproductive success in the long-term.

AJ: With sunlight and wave action, a plastic bottle can be broken down into smaller and smaller pieces. And some of those small pieces land in the sediment. Amphipods that live at these great depths are mostly scavengers eating almost anything they find. Unfortunately, they accidentally eat microplastics too. We haven't found an amphipod whose stomach is full of microplastics. So, we don't know if it is toxic or strongly harming them. However, in a very food limited environment, it is probably not helpful to have non-food in their stomachs.

Q: You have been involved with a study that has found plastic contamination in new species in the past. How extensive was this contamination and what implications do you think this has?

AJ: Eurythenes plasticus, a deep sea amphipod from the Mariana Trench, was the first new species we found with plastic already in it. Prior to this we have found plastic in many other similar, and deeper species, as well as in deep-sea barnacles, fish, and brittle stars.

As for the extent of the problem, I think we have to be worried when we pick up just 6 individuals of a tiny new species and say to someone like WWF "I am pretty sure there will be plastic in at least one of these", and there is.

JW: I lead the description of Eurthyenes *plasticus*, a deep-sea amphipod that lives between 6000 – 7000 m in the Mariana Trench, Pacific Ocean. This is first new species that has been documented to have plastic in its stomach. While we only examined the stomach of 4 specimens, we found that one individual did have one microfiber in its stomach. While it is exciting to discover new species and this species is interesting scientifically, I am also sad for two reasons. 1) Living in a remote location doesn't protect this species from human impacts. 2) Before we knew this species, this species has experienced our presence with our pollution.

Q: Together with the WWF you have named a new species of amphipod "plasticus" after the plastic found inside its body. What was the intention of this environmental statement and how would you like it to influence peoples' behaviour?

AJ: To show that we are harming species that we don't even know about yet. The worrying thing is that we have lost the window in which to study these animals in a natural setting as they are already contaminated. We did it to get that point across.

JW: I hope that Eurythenes *plasticus* helps people connect their actions on land with impacts in the ocean. Eurythenes plasticus tells us full story about how we many out trash and recycling and how it can harm the ocean. It can also teach and remind each of us that we can use and dispose of plastic responsibly and over-time stop plastic pollution. I am proud to team up with the WWF to share "The Story of Eurythenes *plasticus*".