

New Species Podcast
A New Sea Slug with Ángel Valdés
Published May 2nd, 2023

[bright, tech-y introductory music]

Zoe: Welcome to the New Species Podcast. I'm your host, Zoe Albion. On this podcast we learn about recent discoveries of species that are new to science, but not necessarily new to nature. We ask scientists how they find these new species, and why they matter. We learn what makes a new species, and hear some behind-the-scenes stories along the way. So join us as we explore the biodiversity of our planet and the scientists who help us better understand it.

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00:40

Zoe: Welcome to the New Species Podcast. I'm your host, Zoe Albion, and I'm here with Dr. Ángel Valdés, Professor of Biology at California State Polytechnic University in Pomona. He's here today to tell me about his paper in the March 7th issue of Zookeys, in which he and his co-authors described seven new cryptic species of nudibranchs, sea slugs, in the family Discodorididae. Welcome, Ángel. Thank you so much for coming on the podcast.

Ángel: Thank you, thank you very much for having me.

Zoe: So can you start us off by sharing a little bit about yourself and how you ended up working on this really interesting group of marine invertebrates?

Ángel: Sure. So I've been fascinated by natural history since I'm a little boy, and I grew up in northern Spain near the Atlantic coast. So since I was 10 or 11, I used to go to the tide pools to look for all kinds of marine life. And I remember very vividly one day I turned a rock and I found a beautiful blue sea slug. And that was the start of the love story. So since then I devoted my career to study sea slugs.

Zoe: Wow. And can you give us a little overview of sea slugs? What are they and what is your group about?

Ángel: So yes. So sea slugs is actually a paraphyletic assemblage. There are multiple lineages that are not closely related to one another, but they all belong to a group of gastropods called heterobranchia that includes marine groups and also terrestrial groups like land slugs and snails. So sea slugs are different groups that belong to that larger clade. And they're all characterized by either having a reduced shell or having lost the shell completely.

Ángel: Most sea slugs, they lay eggs and from the eggs typically a larva hatches and they can stay in the plankton a variable period of time and then they settle, become juveniles and adults. But in some groups, the development of the larva occurs completely within the egg.

New Species Podcast
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Zoe: Wow!

Ángel: So a juvenile hatches directly from the egg.

03:00

Zoe: That's so fascinating. And what are they related to phylogenetically? Where do they sit?

Ángel: So yeah, they belong to this group called heterobranchia that includes land snails, land slugs, and other marine groups like pyramidalis and some others. And again, they're not monophyletic. So they used to be considered a monophyletic group called opisthobranchia, but when we started using molecular techniques, we realized that opisthobranchia is not monophyletic. But they're all there in that area.

Zoe: I was really excited to read your paper because I'm not familiar at all with nudibranchs. Are they well studied?

Ángel: Well, not really. So we are struggling to keep up with all the new species we're discovering all the time. So no, there are some groups that are well known and easy to recognize, but for the most part there is a lot of work that needs to be done. We're constantly discovering new species, even in very well studied places like in California, we're still discovering new species.

Zoe: And so they're found in California. Where else are they found? Is it all over the world?

Ángel: They're found all over the world, from the Arctic to Antarctica, from very shallow water to the deep sea. I think the deepest record is around 4,000 meters depth. And they're all in all different kinds of habitats. Most of them are benthic. Some are pelagic.

Ángel: There is even some neustonic species that live in the interface between the ocean and the air, feeding on things like Portuguese men of war and things like that. So they're basically found all over the ocean. There are also some freshwater species of sea slugs.

Zoe: What do you think is their role ecologically? So there is a group of sea slugs or some groups of sea slugs are herbivorous. So some of them feed on microalgae. There's a group called the sacroglossans that they have a modified radular teeth, so they can use them to puncture algal walls and then suck up the contents. Some of these can take the chloroplasts from the algae and incorporate them into their own cells. So they're actually photosynthetic animals.

Zoe: That's amazing.

New Species Podcast
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Ángel: But the great majority of sea slugs are predatory and they mainly feed on other benthic organisms, mainly sponges, tunicates, and things like that. A group called the Aeolian nudibranchs, they feed on cnidarians and they can sequester their stinging cells, the nematocysts of the cnidarians, and they can use them for their own defense. And they're extremely, many species are extremely colorful.

Zoe: Your paper examines species collected from New Caledonia, which is a collection of French colonized islands in the South Pacific. Can you tell us a little bit about what that geographic area is like and why it was decided to collect there?

Ángel: Yes. So New Caledonia is an amazing archipelago, both from a biological perspective and also human cultural perspective. So it's mainly historically Melanesian land, although there's some Polynesian groups in one of the islands. The cultural diversity is unbelievable. I think there's 25 different languages, native languages, and they're different enough that people from one valley cannot communicate with people from the next valley.

Zoe: Wow.

Ángel: It's absolutely mind blowing. And the, Yes, you said that territory was colonized by France many years ago, and now French is the only language that all the people in the area can use to communicate with one another. From a biological perspective, it's also fascinating because it's a tropical area, but it's far enough from the tropics that contains high levels of endemic species, and the fauna is different. So it's very, very unique.

07:05

Ángel: It has a huge reef, a very reef parallel to the coastline and with a very large lagoon. Even you can see whales in the lagoon sometimes. And the biodiversity is very, very well preserved because of the lack of, the number of inhabitants is very reduced. So most people in New Caledonia live in this capital city, Numea, but the rest of the island is pretty much empty. Although the main problem is the mining industry. There is heavy mining for nickel and other minerals, and that has contaminated the lagoon in certain areas.

Zoe: And I briefly want to mention that these islands are in a really critical political moment. So there's a large movement among citizens of New Caledonia, and led by indigenous Melanesian people, are pursuing independence from France. So can you tell us a little bit about what's going on there? And then also how that might impact how you think about your work.

Ángel: Yeah, so that is, yeah, I'm glad you brought that up. So yeah, there's been some historic tensions between the native people who call themselves the Kanak and the French government that colonized the territory many years ago. And there's been a push for independence by the Kanak people, and they had a referendum for independence a couple of years ago, I believe, and the majority of the people voted to stay within France.

Ángel: But you know, it's controversial because there's many people who moved from the mainland, from mainland France into New Caledonia, many years ago. So, you know, everybody who has been lived in the territory for a certain period of time has the right to vote. So I think that there is still, it's still a hot political issue, yeah. Something I didn't mention is why we did the fieldwork there. So the Natural History Museum of France led by Philippe Puchet has been organizing a series of expeditions all over the world to document the biodiversity of the planet. They've been doing fieldwork in the Philippines, in Papua New Guinea, in the Mediterranean, in the Caribbean.

09:35

Ángel: They had a series of expeditions also to New Caledonia. So those are multidisciplinary, multinational expeditions. So they invite experts from different countries around the world and with the objective to document the diversity of mainly mollusks and crustaceans. So I was invited first to participate in one of these expeditions a few years ago, and then we have a series of follow-up expeditions. And they were done in mainly Kumak, which is in northern New Caledonia, in Numea in the south. And that's the reason why I was studying those animals.

Zoe: So what does collecting look like?

Ángel: So I didn't do very much collecting, actually, because there is a team of different people doing different things. So in the Kumak expeditions, there were different teams doing different things. So a team goes on boats and they do dredging. There is teams of divers. Some divers are doing direct collecting, turning rocks and looking for specimens. Other are using underwater vacuum cleaners to collect sediment. There were people with brushes, brushing rocks, and then collecting whatever debris falls to look for micro-mollusks. There were people using ARMs, which are these structures that you settle down in the reef, and then you come back later, a few months later, and then you look for the animals that settle in those structures.

Ángel: There was a group of Filipino colleagues using a technique called the lumun-lumun, which are nets, old nets that are tangled together, and they are dropped in certain areas, and then you pick them up a few months later and you collect the mollusks and crustaceans in those nets. So a huge variety of different techniques. So I spent most of the time in the lab photographing the specimens that other people were bringing to me.

Zoe: Wow. That's fascinating. I'm like really visualizing what that must have looked like to have so many people doing all sorts of different collecting.

Ángel: Not only that, it was a big warehouse with tables, microscopes, all kinds of different people working around doing different things and speaking different languages. So to my left, people were speaking Japanese. In front of me, people were speaking Russian, Spanish, Portuguese, Czech, French, English, everything you can imagine. It was amazing.

New Species Podcast
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Zoe: Aside from your specimens, were there some other interesting discoveries?

Ángel: Oh yeah, lots of new species found by different groups, endemic species of all kinds of different mollusks. They found some of these semi-terrestrial slugs that are extremely rare and they discovered two new species, lots of new crustaceans, all kinds of different things.

Zoe: That's fantastic. How did you determine that these specimens that you were looking at represented new species?

13:00

Ángel: Okay. So, the first thing we need to do is we do the molecular work. So we sequence three genes and then we determine how many species we have in our sample using different techniques. Then the next step is to dissect the specimens. We mainly look at the reproductive system and the radular teeth, which are these that they use for scraping their food. And once we have all the data, then we need to go to the literature. So dig into old books and references and make sure that none of these species were previously described by other people. And that's the tricky part because some of the old descriptions are very incomplete.

Ángel: So there was a person called Riesbeck, John Riesbeck, who worked on New Caledonia many years ago and produced several papers in which he described the species based on the external morphology with a drawing and then a short description. And sometimes it's very difficult to recognize those animals as the animals that we're finding in the field. So that is challenging.

Zoe: Especially because I imagine... So how are the specimens stored? Is it all in alcohol?

Ángel: Yes, in ethanol, yes.

Zoe: So I imagine that it might look different after a few years of storage in ethanol than when it's first collected.

Ángel: Yes. So that's why we have to photograph every single specimen individually and we had thousands of specimens collected. So it was very long hours of photographing every single specimen.

Zoe: And what are some morphological differences that you might find between species or between genera?

Ángel: So the external morphology is important, the color in some groups, but in some groups color is variable and it varies within the species. So the reproductive system is important. They are hermaphroditic, they have male and female organs that mature at the same time. So different reproductive structures and also the radular teeth are important. So a combination of all these different traits.

Zoe: Your new species actually includes some cryptic species.

Ángel: So the term cryptic is used in two different ways. So the most common ways that we use the term in systematics is to refer to species that either look identical or very similar morphologically, genetically they're distinct. So, however, the term cryptic is also used to describe species that blend in with their environment and they're very difficult to find. So in our paper, we are using the term cryptic to refer to species that blend into their environment. And that's why we put it in quotes. So it's not confused with the other term cryptic.

Ángel: So we wanted to do a paper about these species because they're so amazing morphologically how they're almost impossible to distinguish from the sponges in which, in which they're found. But as you, as I was saying earlier, in most cases, we use the term cryptic to refer to the other case. And in that case, molecular work is, as you can imagine, is extremely important. And this is something that we're finding in, in many places in the world that we have a species that varies in morphology or in color slightly.

Ángel: So we used to think that it was just part of the natural variation of the species, but then when we sequenced those specimens, we realized that perhaps there is two, three, four different species, cryptic species, and we're in the process of naming those species now.

16:35

Zoe: And another thing that your paper does is re-describe a poorly known species and also document the presence of another species which had previously not been found regionally.

Ángel: Yes. So yeah, one of those species was described by Riesbeck many years ago and it's one of those that nobody could recognize. We didn't know if that species was really properly described or it was something else. So we found one specimen that actually matches the original description. So we're redescribing the species based on that specimen. And then as you were saying, that there's another species that seems to be, is widespread in the Indo-Pacific,

but it's never been recorded for New Caledonia before. It's also cryptic because it blends in with the sponge in which it's found, and we're redescribing it as well, providing additional information and a new record.

Zoe: That's really exciting.

Ángel: Yes.

Zoe: And another thing that I want to just touch on is that in your paper, you and your co-authors highlight the lack of scientific consensus around the structure of Discodorididae, including the number of valid genera. So can you explain to us what this means? And was it a goal of your paper to address this deficit?

Ángel: Yeah, so it wasn't a goal of the paper. But we- this is something we're struggling with. We don't have phylogenies that robust enough to tell us the evolution of the different groups within Discodorididae. We recognize different groups morphologically. We have phylogenies, but the phylogenies are based on molecular data, but they're not well resolved. And this is because we don't have enough data. The genes that we're using are too variable to really tease out the relationships at the base of the tree.

Ángel: So we need to move forward to the next step and start using next generation sequencing to resolve those relationships and come up with a reliable phylogeny that can tell us how many groups we have within this color entity. But we're not there yet. So for this paper, we wanted to describe these new species, but in some cases, we don't know in which genus we need to place them because our phylogenies are not well resolved. So in some cases, we're just guessing. and we'll see if we're correct or not.

Zoe: So if there are any early career taxonomists that are looking for a really interesting group to study, this could be one of them.

Ángel: Yes, absolutely. And particularly using next generation sequencing techniques. And we're moving in that direction.

Zoe: Can you tell us how you and your team named these new species?

Ángel: Yeah, so we named the species after people who were participating in the expedition and collected the specimens. So there was a group of very enthusiastic divers and collectors that were working very hard and going in the field every day and bringing the specimens. And as I was telling you before, because these animals are cryptic in the ecological sense, they're very extremely difficult to find. So it was because of the hard work of these people that these species were actually collected. And we wanted to recognize that effort by naming this piece after them.

Ángel: I like to mention, for example, Anna Sovanova, who one of the species named after her. She's a Czech student and she was working on crustaceans and she was dissecting sponges to find little shrimp who live in the sponges themselves. And she realized that there was this soft body animal that wasn't really part of the sponge and it was moving. So she thought maybe this is a sea slug. So she brought those to me and I said, yes, this is a sea slug. And I said, I need to study them. But if this is a new species, I promise I'll name it after you. And she didn't believe me, but you know, there you go.

Zoe: [laughs] And you did.

Ángel: Yep.

Zoe: And where are the types deposited for this material?

Ángel: So because the expedition is organized by the Natural History Museum of Paris, it's all the types need to go back to France, to Paris. In New Caledonia, unfortunately, they don't have a museum for types of their own diversity, but maybe in the future they will. This is a problem that we have in taxonomy and systematics is that the type material of species from all over the world are deposited in museums in European and North American nations and we should make an effort as a community to repatriate the material or make an effort that in the future when we describe new species those types should be in the institutions in the countries where those specimens were collected.

Zoe: I absolutely agree. Why do you think it's so important to study Discodoridids and similar taxa? And why does your discovery matter?

21:50

Ángel: Well, I think we need to document the diversity of the planet to really understand how the planet works. And I get that question very often. And some people ask me, why should we care about these tiny animals that live in the ocean that nobody ever heard before? And the reason is that we don't know what ecological plays role. We don't know how the planet will work if those species are gone. And I think it's important, especially with the challenges that we have in terms of climate change, ocean acidification, and all these other problems that we have as much data as we can possibly have to be able to confront those challenges and come up with solutions to the problems. So I think every bit of information counts and it's important that we document the diversity of the planet before it disappears.

Ángel: There's another twist to the story, for a while people were investigating sea slugs, particularly Discodorididae and other groups to look for chemicals that could be used in medical research. Turns out that there was a couple of promising ones that turned out to be too toxic at the end. So they failed in clinical trials. So right now there is no drugs that were developed from

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sea slugs that are used, but there is potentially thousands of new chemicals that we haven't discovered yet. And that potentially is a source of some products that can be used in treatment of rare diseases or cancer, things like that.

Zoe: Wow, that's really unexpected. But I mean, another reason why it's so important to study and conserve all creatures, just intrinsically they have value and also you never know what significance they may hold in the future.

Ángel: Absolutely.

Zoe: Is there anything else that you feel like we didn't touch on that you'd like to add?

Ángel: No, I just think that it's really cool that you're doing this and it's important to, you know, bring to the public the work that we do in systematics and taxonomy that is often neglected and doesn't get the same attention as other branches of biology. And, you know, I'm just very happy to be here with you and thank you for these wonderful questions.

Zoe: Thank you so much for coming on the podcast.

Ángel: Thank you.

24:15

Ángel Valdés' paper "Seven new "cryptic" species of Discodorididae (Mollusca, Gastropoda, Nudibranchia) from New Caledonia" is in the March 7th issue of Zookeys. See the episode details for an open access link to the paper, and to learn more about Ángel and his work, you can visit his website.

[bright, tech-y music returns]

Zoe: Thanks for listening to this episode of the New Species Podcast. This podcast is created by Brian Patrick, and is edited and produced by Zoe Albion. If you would like to support us, please consider subscribing to our Patreon at <https://www.patreon.com/NewSpeciesPod>. And if you'd like to get in touch with questions or feedback, please e-mail us at newspeciespodcast@gmail.com.

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