TFH E09: In the Twilight Zone Discussing Deep Coral Reefs, Ichthyology, & Biodiversity with Dr. Richard Pyle, Part 2

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SPEAKERS
Tony Vega, Dr Richard Pyle

Tony Vega 00:00
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Tony Vega 00:40
Transmissions from Hawaii! Tony Vega here and welcome to part two of our two-part series with Dr. Richard Pyle, Senior Curator of Theology at Bishop Museum here in Honolulu. If you haven't listened to the previous episode, I highly recommend you do so because we are going to pick up right where that one le feetoff. In case you don't remember though, Dr. Pyle had taken some time off from his studies at the University of Hawaii in the 1980s and he went to Palau. There he met Dr. Jack Randall, who was one of the world's leading geologists or as Dr. Pyle put it,

Dr Richard Pyle 01:23
- the grand Poohbah guru of what my own passion was, coral reef fishes.

Tony Vega 01:29
Dr. Randall also happens to have served as the senior IQ ichthyologist at Bishop Museum. So in this part, we're going to be talking about how it was that Dr. Pyle ended up at Bishop Museum, and what

kind of research he does: what does he do as an IQ theologist? Well, we're learning about all that and a few more things.

Dr Richard Pyle 01:48

After I recovered from, you know, could get walking again, was going back to school again, Jack Randall, felt guilty about everything that had happened, and he had no responsibility for it all - I was the total idiot who's doing everything I did, Jack bore no responsibility at all, but still, I guess he - combination of liked me and also felt a little guilty - so he offered me a job at Bishop Museum. So I started working at Bishop Museum only a few months after that diving accident in 1986, and I was a Collection Technician. So my job back then was to change alcohol and jars, type up new labels for specimens, that sort of thing. In fact, my main job at the time was typing labels, and we had like an old 1940s manual typewriter to type these labels. And so, I'm an okay typist, but I'm a hunt and peck with my finger typist, and so, first, it would take me a long time to type these labels, and second, we had a very high standard - so if you got one character out of place, you had to retype the entire label, it had to be perfect, essentially, and if anything was wrong, we just scratch everything I typed. And sometimes it would take me eight or nine times to get the label perfect, so I was wasting all this label stock paper, my time it was getting frustrating. And it was around that time that computers were starting to become more commonplace. And I, in high school, had learned how to use my dad's Apple2+ computer. And so at the time, the main program I used was the DOS=version of WordPerfect 5.0, not even 5.1, the 5.0 was one of the original versions of that word processing software. And I wrote some macros and scripts that allowed me to format a template that would auto format all of these labels, so that I could print them on a dot matrix printer, and not make a single mistake. So that was my early entree into using computers to serve the needs of our specimen collections. And that very quickly led me that was sort of my gateway drug into computer databases, because databases are the real way you should track this information - at the time they were just word processing files in DOS that I would run a macro on to generate the labels and print them. So basically, I became, over the course of the next several years Bishop Museum's guru on computer databases. So my job at Bishop Museum for 35+ years has been a mixture of being a fish guy and being the computer database guy, not just for the fish collection, but also all the other natural sciences collections, and even, I worked with our Archives department on their photos collections, I've worked with other departments at the museum to help them with their databases. And to this day, that's basically half of my role at Bishop Museum - is understanding how to manage information on computer systems. And even my career has head off that way - I'm very actively involved in information standards, data exchange standards in the biodiversity world, I participate in all those meetings, I led some of those groups, I've.. so it's a very big part of my life, all started because I was too sloppy and lazy to write right these typewriter written labels, mixed with a passion for technology. So the passion for technology fits in with the diving as well, because that allows me to do diving technology and computer technology, and in my mind, it all blends together, even though it seems like computer databases and rebreather diving are very different, in my mind, they actually overlap quite a bit.

Dr Richard Pyle 05:21
So what is my job at Bishop Museum now, what is it like to be an ichthyologist. So my title is, I'm the Senior Curator of Ichthyology. Now, I used to be an associate zoologist, which meant I was sort of an assistant researcher to Jack Randall, he is my mentor, he was my PhD advisor, he, you know, he was, he was my guru on everything, ever since that week in Palau out all the way up until the time of his death, which was April of last year - he died at the age of 95, lived an incredible life, just an amazing, amazing guy. And he built the collection, the fish collection at Bishop Museum that I now work in. So with his passing, I've sort of taken over the mantle. So that's when I became the Senior Curator of Ichthyology, my job now is to essentially carry on his legacy, to carry on his tradition. Whereas he spent his entire career traveling around the Pacific using scuba to find new species of fishes, cat specimens, bring them into the museum, describe them in science papers. My job is to do essentially the same, except because Jack was so successful in that top couple of 100ft, my main focus is to use this high tech dive gear to do the same thing he did, only down deeper, in the range of 300 to 500ft.

Dr Richard Pyle 06:38
So my actual job at the museum is a mixture of planning and going on expeditions, where we go out and spend a month in the field and doing diving and collecting specimens and discovering new species - that's a big part of it. And then when we come back from those, another big part of it is, is processing all those specimens, getting them in the computer databases, creating labels for them, all of that sort of stuff. And part of all of this is I'm also actively involved in the development of the diving technology we use, because the off-the-shelf stuff doesn't quite cut it, it never has, we've always had to modify it, so I've been working with the people who invented this technology to improve it. And I've been actively involved in and still actively involved - prototype testing, beta testing, coming up with new ideas, going to design meetings, whiteboarding, new concepts for how to solve old problems. So I've been doing that a lot actively as well, so that's part of my world. And then another part of my world is course traditional ichthyology, which means looking at specimens, recognizing when you have a new species that nobody's ever named before, going through the process of writing scientific papers, and describing those new species as well as other scientific papers, like when we do these long term surveys of deep coral reefs off Maui, which we published in 2016, you know, working with groups of colleagues on big ambitious projects.

Dr Richard Pyle 08:02
So, in addition to just the fish part of what I do, a big part of what I do is trying to push forward, the exploration of what we call "deep coral reefs", or the scientific term is Mesophotic coral ecosystems.

Now, most scuba divers throughout history have pretty much stopped at between 100-200 feet deep. Coral reefs turn out to go down to at least 500, maybe 600 feet deep in places, the kinds of things that we would characterize as a coral reef go much deeper than where scuba divers go. So the only way historically to gain access to that is basically submarines. Now, you could try to use traps, but coral reefs aren't really good places for traps. They're terrible places for trolls, and other kinds of technology people use to sample specimens from the bottom of the ocean. So they don't lend themselves well to collecting specimens without physically being there. So submarines is the obvious tool to try to use. Well, submarines have problems. First of all, you're inside this big metal can, you have manipulator arms, that can sort of pick up rocks and things, but you'd never be able to catch a fish with a submarine manipulator arm that way we can when we're right there in the water with them. The other problem was submarines is a very expensive, they cost $30,000 or $40,000 a day just to do one dive. Most submarines are designed to go 1000s of feet deep. So if you're going to spend that much money on a day's worth of submarine dives, you're not going to waste your time a few 100 feet deep, you're going to go deep, deep, deep and do some really deep exploration. So as a consequence, ironically, the vast majority of submarine research is done well below 500 feet, usually well below 1000 feet. So we know a whole lot more about marine environments at 1000 feet than we do in this zone that's deeper than co- than scuba divers can go, but shallower than where almost all submarines ever normally go. And we can call that the Twilight Zone, that was our original name for it. We started calling it The Twilight Zone because it's a perfect name for it, because shallower, 100 feet and shallower, in the middle of the day, you got bright sunlight. Deeper, deeper than five or 600 feet, it's really dark. It's basically nighttime down there, even in the middle of the day, it's dark, because the light's been filtered out. But the zone that we're interested, from about 100 or 200 feet down to about 500 or 600 feet, it literally is the twilight - it's the fading out of the sunlight as you go down deeper and deeper. So it was a perfect name for it, but then when I was in grad school, school and referred to it that way, all my, you know, mentors and professors said "no, that doesn't sound sciency enough, it just sounds,, you know, like you're trying to get attention, so call it deep coral reef." So for a while, I started calling them deep coral reefs, but then they discovered truly deep coral reefs in like off Alaska and Norway, places that are very deep, totally different kind of environment, so the term deep coral reef got confusing because they were using it for that community. So then I didn't know what to call it and and came up with various names, but then NOAA, the US federal agency, pulled together a workshop that I was there, and we basically brainstormed and came up with Mesophotic coral ecosystems, which is essentially, the Latinized version of Twilight Zone - it's mesophotic means middle light, twilight; coral ecosystems implies that we're not talking about lakes, we're not talking about cold water, we're not talking about open ocean, we're talking about coral reef habitat in this depth, roughly between 100 and 500 feet. And that's really what I guess my main focus is, is exploring that, and that involves developing technology that lets me go there safely, developing techniques that allow us to go there safely, doing the fish science part of that that actually recognize interesting fish, collect specimens, bring them up, process them - all kinds of things that have to do with filling in this gap of our knowledge, which turns out to be 80% of coral reef habitat, right?! What we think of as coral reefs is only that top 20%. The rest of it is the 80% we still haven't explored yet. And so there's many lifetimes worth of research that are, or need to be done until we fully understand the complexity and diversity of these deep coral reef ecosystems.

Tony Vega 12:20
Of course, the waters surrounding the Hawaiian Islands and beyond have been extensively researched over the years. So you'd be tempted to think that maybe there aren't that many new species to discover. However, Dr. Pyle's research shows otherwise,

Dr Richard Pyle 12:35
Here in Hawaii, it turns out we're probably one of the best explored shallow and deep coral reefs in the world. And it's because the University of Hawaii has a really excellent submarine program and because people have been exploring the Hawaiian Islands using all kinds of technology going back centuries. So even when I go deep, most of what I see and hear in Hawaii are known species, they're things that somebody caught before with a hook in line or a trap or trawler, found it with a submarine. We do still find new species here in Hawaii, some quite conspicuous. We found a butterfly fish, black and white stripe, we found a little pink anthias up in the northwestern Hawaiian islands that we named after President Obama because he expanded the Papahanaumokuakea monument at the same time we discovered it. So there are still new discoveries to be made even in a place like Hawaii.

Dr Richard Pyle 13:26
But the real discoveries are out there in the tropical Pacific, more southern and western Pacific Micronesia, Philippines, Indonesia, those kinds of areas. We have discovered as many as 12 to 14 new species per hour of time we spent at this step. And that's all fish, there are probably 10 or 100 times as many invertebrate new species waiting to be discovered. So the diversity of undiscovered life at these depths is just enormous, we're barely scratching the surface. And when we go on these expeditions, even with all our fancy equipment, we can only stay on these deeper dives, maybe 15, 20 minutes at the most. And that's a whole day, then we're committed to six or seven hours of decompression time. So basically, the whole day is spent just for those 15 or 20 minutes on the bottom, so we have to scramble to do everything we can. So we're looking for ways to integrate different technologies, submarines, robots, divers all together, so that each can do what it does best. Submarines can spend a lot of time, robots can go on their own without any human involvement, and divers do best which is collect specimens. So we're imagining a future where submarines are going to go do the basic exploration or remote vehicles, do these basic exploration, find all the good places, then we as divers can go exactly to where the good stuff is. We don't have to just randomly guess, let's try here, what are we going to find? Half the time we find nothing at the time we find good stuff. So we can probably ramp

up that 12 new species per hour figure quite a bit once we get there right mix of technology that lets us do it. And that's what we're sort of working towards now at Bishop Museum.

Dr Richard Pyle 15:06
My other job title at Bishop Museum besides Curator of Ichthyology is I'm the director of what we're calling Xcore, which stands for the Center for the Exploration of Coral Reef Ecosystems. Now, it's an official entity, but we haven't advertised it yet, we haven't really made a big deal about it yet. But essentially, we want to become sort of a center, a hub, of collaborating organizations, to start filling in the gaps of our knowledge of coral reef ecosystems. A big gap are these deep coral reefs, and so that's what we're really good at. And we're going to be spending a lot of time doing. But there are other gaps in our knowledge, like larval biology, almost every coral fish goes through a larvae phase, and we know almost nothing about what these larvae eat, how long they live, how, where they go, while they're drifting out in the plankton. So one of my colleagues is focused on that. And so we're hoping to set up the center at Bishop Museum to be able to do this kind of exploration at a much larger scale than what we've done before.

Tony Vega 16:05
So of course, all this begs the question, what exactly do these fish that Dr. Pyle is finding look like?

Dr Richard Pyle 16:13
So before we started doing this, seriously, only a few people had gone down to these depths with submarines or high tech scuba to look around, and they caught glimpses, but they didn't really do exhaustive surveys. So before when we started doing this, we weren't sure what we were going to find. When we got to 300 feet, were we going to see things that looked like coral reef fishes, or were we going to see things like deep water things with large fangs? And we didn't know what to expect, really, we had a little idea based on submarines, but not that much. One of the key things we discovered early on is this depth range is very much coral reef in its nature, certainly from the fish perspective. So what I mean by that is when we go now we find new species of fishes, but they're the same genus or family as the ones we find on shallow reefs, they're not the same kind of fishes you find 1000 feet deep or 2000 feet deep. And so what we're seeing are very colorful coral reef fish that look just like the colorful coral reef fish you see on shallow reefs, whenever you see pictures of a shallow coral reef, it's just that they're different species, because the ones we're finding only live down deep, and the ones everyone familiar with are up only in the shallows, and some of them live in both. So that's another thing we're discovering, is it many of the same species we see on shallow reefs, we're also finding down on the deep coral reef. So we're trying to get a sense for how many of these fishes only live shallow, only live deep, or live both deep and shallow. But if you've seen any coral reef fish on a shallow reef, you're getting a pretty good idea of what you're going to see down on the deep coral reef. I will say, the deep

coral reef fishes tend to be more colorful weirdly and more, more bold, contrasting color patterns. Now, we don't really know why that is, especially when you consider that most of the colors these fish have, which tend to be reds and pinks, and yellows, aren't visible at those depths, because those wavelengths don't make that depth. As light gets filtered out in seawater, the first color to disappear is red, by 30 or 40 feet, you can no longer see red, if you bleed underwater, it's green, you do not see red blood. And the deeper you go, the more on this color spectrum you start to lose. So why are these fish living down where there is no, no light rays, no wavelengths, to reflect off these elaborate color patterns, why do they have such color patterns? And one idea of mine is related to, remember when I told you the story of how I got the bends, I saw this fish that had black and white stripes, and when it came up in the boat turned out the stripes were red and yellow. And that's because when you take out the red and the yellow wavelengths, and all you see is black and white, you're essentially filtering it out. So my understanding is the color black, which is melanin, the pigment black, is a physiologically more expensive pigment to produce - if you want a black spot, if you're a fish that wants a black spot, it's more costly physiologically to produce an actual black spot than it is to produce a red spot, because the red pigments are much less physiologically costly. So if you want to achieve a black spot and you live 300 feet deep, evolution will drive you towards having a red spot which achieves the same thing as having a black spot, except it appears black to everybody down there, but it's actually made with red pigments. So there could be some version of that that explains why we see so many reds and yellows and pinks and those kinds of colors down at those depths even though physics doesn't even allow any fish or any-, anything to see those colors. It's not a limitation of our eyes or you know, the wavelengths simply are there and when those wavelengths aren't reflecting off those pigments, no lights being reflected, you ,what you see is black. So one of the reasons why we tend I think to see such colorful fish is, it's a less expensive way to achieve those patterns. So then the next question is, well, why bother with patterns at all. And I think that might tie in to this Twilight aspect, where it's dimmed down there, but it's not dark. So if you're in brightly lit, shallow water, you can see your mate clearly, you can see your predator's killer, you can see your prey, you know, what you're looking at. When you're down deep, if you want to be seen, in other words, if you're a kind of fish that needs to be able to keep track of your mate, you need big, bold, stark contrasting colors, so that you're more visible. Again, this is me just speculating, but I think that could explain why we see so many fish with big bars on them, or big spots, or black and white, or in some cases, red and white, which has the effect of looking like black and white - might be because it's an easier way. And that, usually it tends to happen in fish that lives socially, either as pairs, or in groups of small groups of the same species, it must have something to do with being able to see your family at those low light levels.

Tony Vega 21:16

So in a way, you could say it's a matter of perspective - what you see on the surface is not necessarily what you see down below. However, if you bring a light with you, then things get interesting.

Dr Richard Pyle 21:29
Well, we, the way we see it as when we drop down there, you know, we're looking around, everything's blue, and gray, basically, there's this blue, because that's what the watercolor is that at depth, and gray because all the colors have been removed. But then we turn on our lights and it's just this incredible rainbow as our, as our light sweep across the reef, there's like this beam of, you know, it's like magical. There's this, this, this swath of incredible diversity of colors in this otherwise drab grayish blue context. So that those lights we bring down, bring those color wavelengths with them, and so we're able to see the colors as they truly are, and that's one of the most spectacular things we see when we go down on these deep riefs.

Tony Vega 22:11
Can, can we see some of these specimens at Bishop Museum?

Dr Richard Pyle 22:15
We have an aquarium and one of our buildings, it has one of the new species we recently discovered, three of them are alive or in there, in their very bold black and white striped patterns, in that case, it actually is black, it's not red and white. But most of the ones we have are in jars of alcohol, it, preserved in our collection. And unfortunately, one of the side effects of preserving specimens and alcohol is they lose their colors, so when you look at them in the jars, you don't see the colors. But we take photographs of them while they're still alive or shortly after they've died, where we can get their natural colors. So we have 1000s and 1000s, and 1000s of color images of what these things look like when they're alive. But the specimens themselves have faded because they're in alcohol.

Tony Vega 22:58
It's clear that there's still so much that we don't understand about the ocean and the creatures that call it home, and Dr. Pyle is very much excited about all of the discoveries that are yet to come. However, things like climate change are a threat to these discoveries. So I asked Dr. Pyle about this topic.

Dr Richard Pyle 23:17
It goes beyond just these deep coral reefs. What I see us doing is a very small part, it's one part of the planet where we're finding biodiversity that hasn't yet been discovered. And often what I tell people is you can't know a species has gone extinct if you never knew it existed in the first place. And so I see our job as cataloging biodiversity before it's gone - we're losing species faster than we can document them, the extinction rate is probably is as great as, if not greater than, the rate at which we're discovering new species. And so we're losing biodiversity very quickly and a lot of people don't know this, but estimates of total number of species out there living right now on the planet, not extinct ones, but the ones still

alive today, are generally in the range of 10 million at the low end, 100 million at the high end, maybe 20 millions a reasonable estimate, depending on how broad a net you cast for what counts as life. We have only documented about 2 million of them, so at best, we're only 20% of the way there, more likely we're 10% of the way there, possibly, we're even less than, you know, we could be as little as 2% of the way there in knowing what other species we share this planet with. So in light of climate change, in light of habitat destruction, in light of pollution, in light of so many ways in which our one species is changing the planet, you know, we're having an impact that goes way beyond what you read about in the news. The news is always talking about, "Oh, the crops are going to fail" or "Oh, it's going to be a hot weather" or, "Oh, we're going to have hurricanes" and yeah, that's all true, but that's just a little sliver of the consequences of climate change and pollution and all these other things, because there are millions, literally millions of other species out there that are suffering from our actions. So I don't want to put that forward as sort of like an admonishment against humanity "Shame on you," I see it more as an opportunity to rise to the challenge. And in my mind, we want to protect biodiversity. And the reason we want to protect it is because its value to us, to human civilization, to the future of humanity is massively greater than we realize yet. And the best way to describe what I mean by that is that we're just beginning to understand the human genome. And I often use the metaphor of the library of biodiversity, the biodiversity library. So if you think of every species on the planet as being a book, it contains information just like a book, that information is encoded in the genome, and what is that information? That information has been edited and re-edited over an unbroken chain going back 4 billion years. So what you see alive around us today on Earth are the survivors of a four-year, 4 billion year process of extinction, of editing, of climate change, of all kinds of things. So what we have today on Earth is a library full of 10-20 million books, each of which has a story to tell of how you survive across billions of years, what does it take, what is that genomic information, the proteins they generate, the behaviors they have, the interactions they have with other organisms that are all encoded in the genome, and in other aspects of their lifestyle, that information is critical to the future survival of humanity. But we're burning down this library and books are being burnt up, before we even know they exist, in other words, species are going extinct. Every time a species has gone extinct, that's a book like the lib-, at the Library of Alexandria, we're never gonna know what was in there ever, ever. And so I see our job is trying to build the card catalog of this biodiversity library, at least know what's out there. We'll do everything we can to stop its extinction, but at the very least allow future generations, 100 years from now, 1000 years from now, to at least be aware of what was here, and maybe, just maybe be able to go back and resurrect some of those species. You may have seen in the news recently, resurrecting the woolly mammoth, that's been a concept that's been around for a while, it's controversial, there are ethics issues involved. But the point is, we're on the cusp of technology that might allow us to de-extinct organisms bring organisms that had gone extinct back to life, we're only going to be able to do that if we knew they existed in the first place, if we have their genomes in our collections of our museums, if we collect the specimen. So I think of biodiversity is like a library that's burning down right now, right?!

So what do you do, you've got the Library of Alexandria, it's burning down, you got 100 soldiers? Well, most of those soldiers, you put buckets in their hands, and you say, go grab some water and put out the fire. That's what conservation biology is, trying to stop the burning, trying to save the unbirth books, the unexpected species. But you might take some of those soldiers and have them run into the burning library, grab a few unburned books, and get them out of the library and put them in the vault across the street. That's what our collections represent; they represent snapshots of what did exist, at what time in history. So in case we lose more of the library, in case we can't win this fight against the library burning down, or even if we ultimately win, a lot is going to burn between now and then. We want to gather as much knowledge and wisdom and insight that evolution has produced for us in the form of all these species and get them in our vault, in our, at least so that we have that knowledge, so that knowledge isn't gone forever. And knowledge isn't the right word, wisdom is the right word, because this is evolutionary wisdom that allows us to do things like convert not us, but allows organisms to do things like convert sunlight, energy to chemical energy with 96% efficiency - no solar panel can do that, but biology can. And so you know, there are cures to almost every human disease out there somewhere, many of them already been found, most have not yet been found. There are so many things, problems that biodiversity has already solved through its multi billion year evolutionary history, that we're nowhere near solving and we can solve much more effectively for our own needs, if we can learn the lessons that they have learned over all these billion years of evolution. So that's what I see as sort of the challenge of.. We acknowledge that climate change is coming, it's happening, it's not coming, it's already here. We acknowledge that pollution, and plastics, and all these things are impacting biodiversity, not just in terms of populations, but in terms of extinctions, and every time a species is gone extinct, it's a lost opportunity to glean the wisdom that that species had somewhere inside of it. And that's what I see. It's not about saving biodiversity for its own sake, although that's what motivates me. But humans, in general, should be much more aware that this is actually a struggle to preserve ourselves. It's like, how are we going to keep humanity going beyond the next century or two. If we lose all this precious knowledge, we're going to be handicapping them incredibly in the future, and think about what they're going to look back at us. Our generation is special, this point in history right now is special, because we haven't yet lost most of it, we're just beginning to lose it. So we're the last generation to really not still be able to save it or still be able to catalogue it. And we're the first generation to recognize this problem, right?! Before us, people were mostly oblivious to what we're doing. So we're at that intersection point where there's still time to do something and we're aware that something needs to be done. If we squander this opportunity, 100 years from now, our descendants are going to look back at us, like you fools, you had a chance and you blew it. And that's what I'm hoping people will begin to understand is we have to rise to that challenge, we can't blow it, not just for ourselves or our children or our grandchildren, but for the entire future of humanity.

Tony Vega 31:07

For more information on Bishop Museum, please visit their website at BishopMuseum.org. Transmissions from Hawaii is a production of Wasabi Magazine. It's produced by me, Tony Vega, in the beautiful city of Honolulu. If you enjoy what we're doing, then please help us spread the word about the show. Tell a friend or family member or share it on social media. Also, don't forget to subscribe so that you don't miss any future episodes. And by the way, if you prefer to listen on YouTube, you're in luck, because we are releasing all our episodes to our YouTube channel. Just look us up. Mahalo for listening and see you next time on Transmissions from Hawaii.