Jennifer Stock: You're listening to Ocean Currents, a podcast brought to you by NOAA's Cordell Bank National Marine Sanctuary. This radio program was originally broadcast on KWMR in Point Reyes Station, California. Thanks for listening!

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Jennifer Stock: Hello. You're listening to Ocean Currents. My name is Jennifer Stock and I bring this show to KWMR listeners the first Monday of every month from Cordell Bank National Marine Sanctuary, part of the National Oceanic and Atmospheric Administration. On Ocean Currents, we talk about our blue part of the planet, talking with experts about ocean conservation, science, compatible uses, issues, health, natural history, exploration and expeditions that face hard to fathom challenges in remote areas of the ocean. My hope is that you'll become even more ocean literate and appreciate and understand how precious this vital part of our planet is and how we are extremely interconnected with its health and our health in return. Here on the west coast of the United States, we have a very special situation.

We have an incredible oceanographic system that provides for a diverse food web from the tiniest of phytoplankton to the largest animal on the Earth, which is the focus of our show today: the blue whale. In California alone, there are four national marine sanctuaries designated at different times to help add protections to vital habitats for a diversity of marine life. There are many differences between each of these areas, but one thing that ties them together is that each of them are destination feeding areas for the endangered blue whale.

Each of these areas have incredible upwelling centers where nutrients are abundant and krill abounds. My guest today is freelance writer, author, and editor, Dan Bortolotti, who is the author of seven non fiction books and has written magazines and newspapers in Canada and the US. His books for youth feature endangered species like tigers and pandas, but also exploration of planets and the sport of baseball as well as the humanitarian organization, Doctors without Borders.

Dan's most recent book is "Wild Blue: A Natural History of the Blue Whale," just published in Canada by Thomas Allen Publishers and in the US by Thomas Dunn Books. Wild Blue: A Natural History of the World's Largest Animal is the first comprehensive portrait of the blue whale, the largest creature that

has ever lived on earth. The book features equal parts science as well as history. Wild Blue offers a journey into the world of an animal that was pushed to the brink of extinction and is slowly making its way back. I was so excited to dive into this book as I am in absolute awe of this animal and have been privileged to see them in our national marine sanctuaries off the coast here in California and I was just dying to learn more about them. So, this book has definitely helped satisfy my curiosity. So, I would like to welcome Dan Bortolotti to Ocean Currents. Thanks, Dan, for coming on the show today.

Dan Bortolotti: My pleasure.

Jennifer Stock: Dan, some of your earlier books are written for younger ages of ten and up and then you jumped to an older audience in your last two books. How did you get interested in blue whales?

Dan Bortolotti: Well, as you mentioned in the introduction, I wrote a couple of books several years ago for children on endangered species. I wrote a book on tigers and another one on pandas and then the publisher asked me to edit, rather, the other ten books in the series. So, I had a chance to really get into the whole notion of conservation and the work that many scientists were doing to protect animals. One of the books that I worked on in that series was on whales in general and there was a whole section on blue whales and the author had made a comment in this section where he said the mystery surrounding blue whales still vastly outnumber what we know about them and I remember reading that and being really struck by and thinking that this is an animal that is 80, 90, the largest ones are 100 feet long, the largest animal that's ever lived, even heavier than any dinosaur that's ever walked the earth, and yet we don't know some really basic things about them and that really surprised me because I know having done writing about astronomy and other types of biology and things like that, we know what constituents are in the atmosphere of Pluto billions of miles away. We understand what the movements that honeybees make when they return to the hive, what they mean and what they indicate.

So, science understands a lot of these things and yet we don't know how many blue whales are left in the world, we don't know where they go in the winter time, we don't know how they find their food, and so, I really became interested in not only the animals themselves, but the struggles involved in learning more about them, which are legion when it comes to whales, something I came to appreciate during the research for the book.

Jennifer Stock: This is an animal of superlatives and you write some great details about their size and weight and some great comparisons and how they feed. What are your favorite details about blue whales?

Dan Bortolotti: Well, I should start by saying that a lot of the numbers that you will see in reference books and popular articles are exaggerated. I mean, the one that you hear all the time is blue whales can be 100 feet long and that is true as far as it goes, but I like to say that it's a bit like looking up human in an encyclopedia and saying that humans can be more than 8 feet tall, which is true as far as it goes, but it is really misleading. The vast majority of blue whales never even approach that size, maybe only one in several thousand would have exceeded 100 feet and even that only would have been in the Antarctic, but putting that aside, I think most people can visualize length and if we say, for example, that a blue whale can be 80 or 90 feet maximum, if you're a baseball fan you know that's the distance between home plate and first base. So, that's sort of a distance you can visualize, but the one I really tried to come up with a metaphor for was the weight of a blue whale, which can be 100 tons. The largest ones may have been up to 200 tons.

So, you know, 400,000 pounds. Well, how do we make sense of that. So, the analogy that I came up with in the book is if you imagine, and I keep coming back to sports analogies here because I think that they're things people understand, but if you imagine that there are thirty teams in the National Hockey League and there are 30 Major League Baseball teams and there are about 24 players on each team. So, if you add all of that up, that's about1440 players and the average weight of a major league hockey and baseball player is somewhere around 205 pounds. So, if you took the entire National Hockey League and every Major League Baseball team and put them on a scale, it would weigh about 148 tons, which is about...well, within the range of a large female blue whale, a single whale.

Jennifer Stock: Wow. It's amazing. How do you think they weighed blue whales? I mean, you know, we don't have scales for these things. You think it's just based on proportions?

Dan Bortolotti: In part, yeah, there are certain techniques the biologists can use, for example, if you double the weight of a whale you typically, I want to get the math right here, but it varies, if you double it you're certainly not doubling the weight you're increasing it far more than that, but the way they weighed them into past was to cut them into pieces and weigh them piece by piece. It was the only way to do it, but, of course, when you do that you lose bodily fluids so you have

to then estimate how much blood and internal organs and things like this are added to the weight and so, and that way, certainly weighing and even the length measurements were notoriously suspect during the whaling era because there are different ways to measure the length of a whale too, especially with an animal as large as the blue whale. If you were to put a tape measurer on its snout and then follow the arch of its back and measure it to the end, that would be quite a longer distance than if you were to measure in strictly straight line because the curvature of its body would add, in the case of a blue whale, as much as several feet. If you measured it from tips of its tail as opposed to the notch between its tail flukes, which is actually the zoologically correct way to measure a whale, you're also adding a few feet.

So, that's why when you read reports about whalers killed an animal that they claim was 110 feet long, you have to take that with a big grain of salt.

Jennifer Stock: That's interesting. So, where exactly do blue whales live? Do they live in all parts of the ocean as far as our entire planet or are there specific areas that they concentrate? I know we have some here in California that come up and down the coast, but that was something interesting in the book to realize, wow, they're really in different regions.

Dan Bortolotti: Yeah. That's another thing you will often read in popular articles. They'll say blue whales inhabit all of the world's ocean and again, true as far as it goes, but highly misleading and there are really only about a dozen, maybe 15 places in the world where you can reliably see blue whales at some point during the year. As you mentioned, they're quite common off of southern California. They range from about the Gulf of the Farallones area to southern California, maybe the Santa Barbara Channel and you can also find those same whales will then move south to Mexico and possibly as far as, well, we know now actually, as far as Costa Rica on the Pacific side and those whales will also range as far north as British Columbia and Alaska.

They can be found off of southern Chile as well in the southern hemisphere. In the northern hemisphere, the other places you'll find them is in the Gulf of St. Lawrence in Canada. You can find them in the north Atlantic off of Iceland and Greenland, off the Asors, and then there's a few places in the Indian Ocean where they can be found off of Madagascar, off Sri Lanka, Indonesia, and southwestern Australia and then, of course, there is a formerly enormous, but now very small population of blue whales in the

Antarctic that is rarely encountered and not studied as much as some of the other places in more accessible areas.

Jennifer Stock: Right. hard to get to those areas.

Dan Bortolotti: Yeah. It's very expensive and difficult and there has been some research in Antarctic blue whales again more recently, but it's very difficult and expensive to mount expeditions there.

Jennifer Stock: So, a lot of those places you were talking about must be areas where there are high densities of krill, at least in the feeding areas of these animals, and that was a really neat part of the book is learningmso much about their feeding strategies and some of the biologists you talked with. One of the facts that I just thought was so cool was about their buoyancy when they dive. When they dive for food going down and they become negatively buoyant and I just imagine this torpedo sinking to the bottom. How did we learn about that? I mean, how do we learn about these animals that...I can't imagine...the length of one of these whales is basically a safe scuba dive for a recreational diver. So, from head to toe, but how do we learn about their diving strategies?

Dan Bortolotti: Well, this goes back to what I was saying about how difficult it is to study the behavior of whales because they spend so much of their time underwater that what they do once they are submerged is, or at least until recently, was a mystery. So, in this case, the way they learned that was by attaching a device that they called bioacoustic probes to the back of the whale. So, this is like a small torpedo-shaped instrument maybe a foot long or so and it contains a depth sensor. So, it can tell what depth the whale is diving to and how long it stays at those depths. It's attached to the back of the whale with a suction cup, which is very difficult to do. I witnessed it several times during the research where the researcher needs to drive the boat alongside the whale, wait for it to surface, and then strap this suction cup tag onto the back of the whale and then dislodge the pole and let the whale swim away. The tag will stay on for anywhere from a few minutes to a few days, hopefully a few hours at least to get some data.

So, in this case, what they did was they attached these dive sensors to the back of the whale and then recovered them and uploaded the data on to their computers and what they were able to detect was, first of all, that the whales were diving much deeper than anybody knew. People figured that blue whales might be feeding at a depth of 100 meters or 100 yards or so. They now know that they can dive at least three times that. So, they may be feeding as deep as

1000 feet and what they are doing...what they were able to do was graph this data so you can see the whale moving up and down in a plane of the water and they found was that there was a long initial dive so that the whales could get right down and what they learned was that they went below the krill. The krill tends to aggregate at depth, right?

So, they don't like light. So, they don't like to come near the surface. So, they move at depth and then they gather into tightly knit groups, which is perfect for whales because it makes it easy for them to go after densely packed krill rather than diffuse swarms. So, what they will do is they will go right underneath the krill and then they will lunge upward towards the surface into the krill and swallow it and then go down and do that again. So, what you see when you graph that is like this saw tooth pattern of the whale lunging up and sinking a bit, lunging up, sinking a bit. They'll do this four, five, six times and then they'll return to the surface.

Jennifer Stock: Oh, that's interesting. I didn't realize that they would return to the surface at the end of a couple of dives.

Dan Bortolotti: Well, they use so much energy when they're down there feeding that they have to come back to the surface to get oxygen and this was...but, to get back to your first question about how we knew that they were negatively buoyant, it's a really interesting one and I think it ended up coming out of the book, but it was something that I learned during the research was that part of it was they attached a camera to the back of a blue whale. This is the critter cam, which a lot of people may be familiar with.

Jennifer Stock: Yes, I've seen it. Blue whale cam.

Dan Bortolotti: ...the penguins and some other films have used it, but there was a modified Critter Cam that they attached to the back of a whale and they were able to follow this whale as it dived, but because the whale is so big and the camera so small, it was very difficult to detect any movement in the whale. So, they weren't sure whether the whale was gliding down or whether it was actually beating its flukes and I spoke to the scientist who had analyzed this data and she said, "You know, then I had it's brain wave and I remembered that when we study hummingbirds, for example, nobody understood how hummingbird wings actually worked until they were able to shoot video and then slow the video down drastically so they could see that a hummingbird wing actually traces a figure eight as it moves." But, nobody was able to tell that until they

could slow it down. Well, with blue whales it was the opposite problem. They were so big and their undulating fluke beats were so slow that they had to actually speed up the film in order to notice the fluke beats.

So, what they did was they sped up the film and then that made it quite obvious and you could see that the animal would beat its flukes vigorously right after its initial dive and then that would stop and the whale would sink. So, in other words, what they seem to be doing is using less oxygen by allowing themselves to sink rather than furiously...like you can imagine if it was a highly buoyant animal, it would have to work very hard to get down to that depth. So, it has somehow adapted by at a certain depth being able to compress its body enough that it becomes negatively buoyant and it actually just sinks.

Jennifer Stock: That's so amazing. Really cool to think about and visualize.

Dan Bortolotti: Yes, and a bit scary when you...you know, it helps you understand if the animal was sick or in some way impaired. It would be very difficult for it to get back to the surface. So, those animals are going to be really impaired when it comes to feeding because the energy expenditure of sinking to that depth and then, of course, because you're negatively buoyant you've got to work extra hard to get back up to the surface. It would be very difficult and taxing for these animals and they have found, for example, that the models predict blue whales should be able to stay underwater for about 30 minutes or more, but in fact, they only stay under oftentimes when they're feeding for eight or ten minutes. The reason is just because they're working so hard. You can imagine a person trying to hold their breath. Well, it's easy enough to hold your breath standing still, but try holding your breath and running up and down the stairs. Then you get an appreciation for how difficult it must be for them and they have to get up to the surface to catch their breath more quickly than one might expect.

Jennifer Stock: Definitely. I've experienced that myself. The other thing that was really interesting was following up after they feed on the krill is...and I've always wondered this myself...we know they have their baleen feeders and they strain the water out and the krill stays behind and then the krill is trapped inside their mouth. How do they get the krill from the tips of the baleen down to their stomach?

Dan Bortolotti: It's a great question. I wish I had an answer for you, but this is one of those processes that is a complete mystery because you can imagine, how do you know what's going on inside a blue whale's

mouth, right? I mean, once it lunges and takes this enormous mouthful of water and prey, closes its mouth, well, what does it do? But, there have been three basic suggestions for how to do it and the analogy I like is you can imagine a person who uses a net to skim the scum off of a swimming pool. Well then, how does he get that scum out of the net, right? There's a couple ways.

You can backwash it by forcing water through the other way. It's not clear how exactly a whale might do that, but they might somehow be able to move water through their mouth in the opposite direction in order to dislodge the prey from the baleen and then direct it down towards their throat. They might be able to shake it and gray whales, I believe, sometimes do this, they'll shake their head or move it in such a way that the prey dislodges itself, but the leading candidate for how blue whales accomplish it is that they seem to scrape it off with their tongue and people who have been to Marine Land or Sea World and have seen, like, killer whales put their tongue out. You might get misled into thinking a baleen whale's tongue is sort of muscular like our own tongues, but in fact, they're entirely different.

A baleen whale's tongue is a really bizarre structure. The best way to imagine it would be like a surgical glove. If you put your hand into a surgical glove and then pulled it back out so that it inverted itself, that is how a baleen whale's tongue works and they believe that what goes on is when the whale opens its mouth its tongue then lines the back of its throat. It moves into the back almost like a plastic bag would and then when the animal gulps the krill, closes its mouth, and ejects that seawater.

It can then move the tongue back out like turn it back inside or from the outside inside out, right? It can reverse it and then somehow shake that krill off of the baleen and then direct it back towards its throat, somehow tip its head and then get it into its gut, but, I mean, most of that is speculation and its based on looking at the anatomy on dead whales, but no one has ever seen that action actually accomplished and one of the scientists joked with me that he wanted to build what he called a krill cam.

Jennifer Stock: I read that. I loved that.

Dan Bortolotti: I thought that was a great idea. You build these mini camera and throw them into the water and hope that the whales would swallow them and that would hold it. I don't know how he would recover the cameras, but apparently that would be able to cover the...solve the mystery.

Jennifer Stock: Who know? You know, one thing about krill is these are pretty small little animals and one thing I've read is that they have one of the largest diurnal migrations among the animal kingdom based on their body size and they come up in the water column to feed on phytoplankton, but they go down to those depths in deep areas and canyons and over the shelf and they go up and down every single day. For an animal that's only a couple of centimeters it's a pretty incredible migration. There's a lot to appreciate about krill.

Dan Bortolotti: They're fascinating little creatures and they drive so many marine food chains. In the case of the blue whale, it's kind of interesting, as the largest animal on the planet, they're exclusive prey is this tiny little animal and its a very, very simple food chain. I mean, most mammals eat a variety of foods and they change their prey depending on the season and the location where they live. Blue whales will feed on various species of krill depending on where they live, but worldwide it is virtually their only food.

Jennifer Stock: As far as your research goes, you talked about this a little bit in your book, how did blue whales and I guess it would be all baleen whales in general, evolve to become this specialized feeder eating this way versus the toothed whales, they have teeth? I'm really curious as to what you learned and wrote about as far as the evolution of the baleen whale to eat these tiny little critters.

Dan Bortolotti: I thought this was really one of the most fascinating questions, you know? You often look at an animal's adaptations and it makes perfect sense why they evolved in certain ways. You know, why birds evolved beaks that are a certain shape that allow them to feed on certain things, but one of the things I always ask is, "What evolutionary advantage could possible come from being ninety feet long and being as heavy as three professional sports leagues?" It isn't immediately obvious. I mean, you could say, well, large size you would be able to fend off predators and there would be some benefit for regulating body temperature in cold waters, but with blue whales it's so much overkill. Whales don't need to be even remotely that large to be safe from those dangers. So, the question is why did they evolve to become so big?

And this is really the answer to the question you asked. So, what I would be able to piece together was the two main families of whales, baleen whales and toothed whales, probably split off around 35 million years ago and that was about the same time that the continents had split apart in the southern hemisphere. So, what is now South America and the Antarctic continent broke apart and opened up this expanse that is now the southern ocean and the

climate began to change there. The water was a bit cooler and what it gave rise to was a lot of phytoplankton or tiny plants, which then spawned these enormous aggregations of krill and so, one can imagine in the southern ocean that...and even to this day sometimes patches of krill in the southern ocean can be absolutely huge, tens or hundreds, even, square miles. So, there was this enormous resource that was ripe for being exploited by some kind of predator, but the main thing that you have to understand about krill is that even though the patches can be huge and it can be this incredibly rich resources, it's very patchy.

So, it may appear in one area incredible density, but a few dozen miles away there might be nothing or there might be a huge, dense patch there one week and the next week there will be none and so, you have this very rich, but unreliable and patchy resource. So, you have to keep that in mind when you think about how these animals evolved. So, basically for a predator to exploit a prey like that, they needed to have three things present. First of all, the animal would need to travel great distances as it looked for food and they would need to be able to do that without it spending a tremendous amount of energy and as I said, you might have a rich food source one place, but the next one is a couple of hundred miles away. So, you need to be able to have some capacity to get from place to place and while you're travelling from place to place looking for this patchy food resource, you also need to have the ability to store a lot of energy and be able to live off your fat stores and fast for days and weeks and even months at a time, okay? So, those are two things and the third thing is once you get to that patch, you need to be big enough to ingest huge quantities of the krill efficiently.

I mean, you can imagine if you were hungry and I gave you a big bowl of rice, but told you you were only allowed to eat one grain at a time, it wouldn't be a terribly useful resource for you. You would have to be able to have a spoon or be able to grip it with both hands or whatever. So, if you look at those three things, the ability to travel a great distance, the ability to live off stores of fat, and the ability to ingest large quantities of a small creature, the common denominator there is enormous body size and that's exactly what happened and that's why the largest baleen whales seemed to evolve in the southern hemisphere where that krill population was because they were able to take advantage of that enormous, but, you know, potentially unreliable prey resource and natural selection just happened to shape the blue whales into the biggest creatures that allowed them to exploit it more than even the others and, in fact, if you look at other baleen whales, many of which are

very large, blue whales are by far the fussiest feeders of all of them.

I mean, fin whales, minke whales, humpbacks and other baleen whales have a much more varied diet. They will eat krill, but they also eat fish, whereas blue whales are not known to ever eat fish. So, they really have become the ultimate specialist.

Jennifer Stock: Very interesting. In the last few years here on the west coast we haven't had super robust krill populations and the blue whales didn't show up until the krill came back and it was really interesting. They were staying south in the southern Channel Islands area where there was krill while they were trying to feed. So, that was pretty interesting seeing that and explaining that to people. The food's not here, the blue whales aren't going to be here.

Dan Bortolotti: Well, that's the only reason that they show up in the summer is to chase the food. So, you know, as you said and that's why what we've come to understand in the last several years is that there are places where blue whales were once abundant and they're not seen anymore and initially people were thinking, "Where these animals going? Are they dead? Is the animal highly endangered? Have we wiped them out?"

But, we're starting to understand that usually the case is that the oceanography has changed in some way. There's less plankton equals less krill equals fewer blue whales and some places like, for example, off of British Columbia and Alaska and there's one place in the Gulf of Saint Lawrence here in Canada where scientists actually began studying blue whales. It was their initial study site. Well, there are no more blue whales in that area anymore and initially people were wondering, well, where have they all gone? And the answer just seems to be they've gone where the food is. We don't always know where that is, but we can at least...I mean, I think it's a good news story, right? Like, we know that while we may not be able to find them, but that doesn't mean they're not there. They're out there somewhere.

Jennifer Stock: Yeah. We have to have hope. There's a lot out there we don't know.

Dan Bortolotti: Yeah. They haven't dropped off the face of the Earth. They've just simply gone to a place where it's more productive.

Jennifer Stock: For those of you tuning in, we're talking to Dan Bartolotti, he's the author of Wild Blue: A Natural History of the World's Largest

Animal and we've been discussing a lot about the animals natural history this first part. We are just coming up on a break. So, I would like to ask you to please stay with us, Dan, and we will be back in just a few moments. You're tuning in to Ocean Currents on KWMR and my name is Jennifer Stock. We'll be back in just a little bit.

(Music)

Jennifer Stock: You're tuning in to Ocean Currents. My name is Jennifer Stock and on today's show I'm talking with author Dan Bortolotti. He is the author of a new book called Wild Blue: A Natural History of the World's Largest Animal and we're talking about blue whales, of course. So, Dan I want to talk a bit about the...actually the introduction of your book. I'll admit I'm fairly young. So, reading about this in-depth history of whaling was fairly new to me as far as the amount of details and locations. How did you find it to research this aspect of blue whales and why did you choose to start the book with this gruesome history?

Dan Bortolotti: Well, I mean, it made sense in terms of the chronology of the book, I mean, our real humans first exposure to whales was as hunter. It's only in the last couple of decades that we've come to appreciate them for their beauty and majesty and devoted a lot of scientific effort to it. For the first sixty years of the 20th century our only exposure to blue whales was in our attempts to kill then and so, it was a really fascinating, albeit, as you said, gruesome and disturbing history of our interaction with blue whales, but beginning about the second decade of the 20th century, I mean, blue whales were the single most important targeted species of whales.

There has been, of course, whaling going on for over a thousand years, but it tended to be smaller scale until the 20th century when we invented things like the harpoon cannon. That was invented in the late 1800's and then steam-powered ships and factory vessels that were able to cut up and render the whales at sea and all of this technology really conspired to outmatch blue whales who, for a long time, were able to escape whalers. I mean, whalers were never able to hunt blue whales in open boats and with hand harpoons.

They were simply too fast. They were too big. They sunk after you killed them. So, they were virtually impossible to pull to shore and they lived, in most cases, so far offshore that it just wasn't practical to take them in open boats, but all of that ended around 1904 was the first whaling expedition to the Antarctic and in the 20 and 25

years after that, blue whales died in enormous numbers. The worst year was over 30,000 blue whales killed in one season. To give you some appreciation of that, that's about three times the current world population.

Jennifer Stock: And that's just in one year.

Dan Bortolotti: Yeah. One year, one season. So, it's like, six months.

Jennifer Stock: With an animal that has, I mean, such a large...they're huge and they obviously eat a lot of krill. It almost seems like taking those animals out of the food web would have a significant impact on populations of krill, in a way. I'm wondering if people have theorized about that as far as what the ocean looked like earlier before we killed all of these blue whales.

Dan Bortolotti: Yeah, you mean like would there be more krill now? I mean, I don't think so. I think what's happened is that just other predators have been able to take advantage of krill in ways they may not have been able to when blue whales were feeding on it. I mean, one possible way of looking at that is, for example, minke whales in the Antarctic now. Well, there's been some question about whether these population numbers are accurate, but there's several hundred thousand minke whales living in the southern ocean now whereas a hundred years ago there were far, far fewer, but there were a couple of hundred thousands of blue whales. So, I think what's happened is that species that weren't targeted as heavily as blue whales have sort of moved in and been able to exploit that prey that was left available for them.

Jennifer Stock: Were blues targeted specifically because you get more bang for the buck? It's a bigger animal. It just seems like...what a huge thing to deal with and as you were saying, the technology advanced and so they were able to be able to harvest blue whales, but it seems like it's just too big of an animal to handle, but they...

Dan Bortolotti: Yeah, but, of course, the trade off is that the cost might be a little bit higher, but the payoff is so much higher. I mean, a single blue whale could yield far more oil than...it would even yield about double what a fin whale would, which is the second largest species of whale and so, it was worth it and then, in fact, I spoke to whalers who told us, "We used to shoot over the backs of fin whales to get blue whales that were farther away," because they were just so much larger and so much more desirable than any other species that they were really the focus and, in fact, in some early years when blue whales were still abundant, there were more

blue whales killed than all other species of whales combined. So, there's no question that they were the number one target.

Jennifer Stock: What were the world activities that stimulated the whaling industry or was it a product of demand and use of the meat?

Dan Bortolotti: It's kind of interesting because when most people think of whaling, they think of Yankee whaling or sperm whales were hunted for their oil which was used to make lamp fuel and things like that. We think of right whales that were hunted for their baleen or things like that or even for their meat. A lot of people are surprised to find out that blue whales were actually hunted for two main purposes and that was to make soap and to make soap and to make margarine.

They have an enormous amount of blubber and fat, of course, which in the early 20th century, we invented the process called hydrogenation, which makes your margarine a solid at room temperature rather than a liquid and before that, whale oil wasn't really practical to be used for things like that, but hydrogenation made it possible to use whale oil and other oils that were liquid at room temperature to make soil fats like margarine and also to turn them into hard soaps and there was also by the 40's and 50's and a little bit later, it was even used to make pet food in Europe.

Sometimes it wasn't even known, like, I think most people who would've bought pet food that was made from whale meat would not have known the source and probably would not have bought it had they known the source, not necessarily because they objected to whaling because in the 30's and 40's and 50's, nobody objected to whaling. It was only after the 60's and the environmental movement that the conservation ethic began to develop, but many people felt that whale meat, for example, it never really caught on in Europe outside of Norway, perhaps. People just thought it was smelly and unhygienic and a bit disgusting, but they didn't necessarily object to it on ethical grounds.

Jennifer Stock: Yeah. You write about that in the book as far as the anti-whaling era didn't really begin until the 1960's and what not. What were the things that really turned people around about whales. It just seems so late to me in the scale of conservation and awareness about animals that we didn't care about whales until the sixties and what were some of the stimulus that helped with that?

Dan Bortolotti: Well, I think really the main reason for that was that whales were simply so far removed from people's daily lives there was really no

opportunity for people to get to know whales and feel any compassion for them.

Jennifer Stock: Yeah, we didn't have the technology to see them, I guess, or get out...

Dan Bortolotti: I mean, even I think the first pandas were exhibited in zoos in the 30's, for example. People would have been familiar with exotic animals in the middle of the 20th century for sure, but not whales. I mean, remember, we didn't have Shamu the killer whale or Flipper the dolphin until the 50's and 60's and even marine biologists would not have had that much opportunity to see whales alive and certainly blue whales, you know, were...they may well have been from mars for people before the 1960's and then, of course, by the 1960's whalers had killed so many of them that there were very few anyway. Even if you wanted to see them there would be very little opportunity.

So, it's kind of interesting. I think the environmental movement that arose after Rachel Carson's book Silent Spring and Earth Day in 1970 and these kind of things, one of the things that I was able to find out I think really had an effect on people was the first recordings of humpback whale sounds, which would have been made in the late 60's and first made public in the early 70's and, of course, at the time, people didn't really make much of a distinction between humpback whales and blue whales the way that people do today.

They just thought of large whales as more or less the same kind of animal, but they started to think, "Wow. These animals are...listen to these songs. They're haunting and they're beautiful and these animals must be so intelligent," and they started to reflect on the whaling history and say, "Look. We almost brought these animals to extinction," and there was a sort of collective guilt about it and I think as people started to become more sensitive to whales, they looked for a species that they could turn into a conservation icon and so, they logically chose the largest whale. I mean, most people knew even in the 60's and 70's that blue whales were the largest animal in the world, even if they had never seen one or seen even a picture of one. They knew that and they knew that we had pushed them to the brink of extinction and so, because it was the animal with all the superlatives, it seemed to be the one that people latched on to when they began the "Save the Whales" movement.

Jennifer Stock: Now, you talk with a couple of whalers in your book and I'm curious when you talked with them, did they have a change in

opinion about whaling as we see it today that it's not necessarily sustainable. It's a very controversial issue internationally, but did any of them have any remorse or regret for doing what they did?

Dan Bortolotti: I wouldn't characterize it as remorse or regret and I took a bit of heat for this from some people when I wrote the book because I bent over backwards to make it clear that I wasn't trying to be judgmental about people who worked on whaling ships sixty and seventy years ago. I mean, it's very important that we not look at people through the moral lens of 2009, you know? The...yes, I contacted a number of whalers who actually worked in the Antarctic in the 50's and the 60's and, you know, all of them, I mean, the ones that I spoke to anyway said, we're well aware that whaling is simply no longer appropriate today and it's totally unnecessary.

There's no whale products that we can't get through other means and they recognized now that a lot of these animals are endangered species and none of them would advocate a return to whaling today, but he said to us you have to understand it was a different period and to me, it would be like a hundred years from now when it's become a societal norm for no one to eat beef to look back at butchers and say that, "How could they possibly have committed these immoral acts and do they regret it?" The consciousness was just completely different and these were just guys earning a living working very hard, doing a dangerous and adventurous job and they also told me specifically that when they watched the whales being harpooned they said everybody on the ship really did their best to make sure that the whale died as quickly and as relatively painlessly as possible.

There's no question that the whales suffered tremendously when they were shot with harpoons, but I do believe that most of them would have made an effort to try to bring about as swift of a death as they could and I just didn't find it appropriate for me to judge these people and some of them have become friends that I've kept in touch with and, you know, I feel really privileged to have been able to speak to these guys and learn a little bit more about the lives that they led.

Jennifer Stock: And we learn from history. That's how we learn for the future is we look at the past and I think that's a point well-made in this book is look at this huge period of time and what happened and what we did learn and look where we are now and I think you made that a very strong point in your book. One of the interesting points that really struck me was a comment in discussion with Farley Moe, the

conservation and you wrote, he writes that the amount of information that we know about blue whales could be summed up in a high school paper, if that, back in 1972. Do you think we've moved way past that through the last 20, 30 years or so in the research where we're filling in a little bit more of the details.

Dan Bortolotti: Well, we definitely have and the reason for that is simply that we've been able to design technologies that have taken us...I made the point in the book that these tags that I discussed earlier in the hour when we were talking about timed depth sensors and things that we've been able to attach to the back of whales in order to measure their movements underwater. Those have done for whale research what the microscope did for biology and what the telescope did for astronomy.

It's just brought that world so much closer. There's still an awful lot of things we don't know and may never know about blue whales, you know, what their vocalizations mean, how they communicate with each other, how they find their food. We still don't know these things, but we're getting closer to understanding a lot of these things because we have been able to design technologies that have allowed us to track their movements and follow them underwater and collect data about them when we can't be there to observe them directly.

Jennifer Stock: Yeah, you made a good point too as well that it's hard for people to connect with things they can't see and that's one of our biggest challenges still to this day about making people aware about the ocean and how important it is to their health and their daily lives and for people that don't interact with it it's a big challenge so I think it links the whole issue about the whaling earlier that people didn't really know about whales because they didn't see them and what not and it's the same thing today for ocean conservation. You did spend some time with Richard Sears, a biologist in the Atlantic Ocean and John Callum McKeys, a researcher here on the west coast. What were some of the things you got to do in the field with them? Did you get to go out on some of these boats to talk with them and learn? Tell us about some of these adventures.

Dan Bortolotti: Yeah, that was the most exciting part of the book is that I was able to talk both of them to taking me out on their boats for a couple of weeks. I spent some time staying with each of them and going out each day to witness their field work. So, both John Callum McKeys and Richard Sears work in opposite parts of the continent, but they have similar techniques. They go out in a small 18, 20 foot rigid hulled inflatable boat with outboard engines that can take

them up to about 50 miles offshore safely. You don't want to go too much further than that. What they do is they just kind of patrol certain areas where they know that the whales are going to be and both of them are really remarkable at being able to spot whales from a great distance. There was so many times where one of them would say, "There's one!" And I would say, "Where?"

And I would look around and, of course, it's a mile in a distance there was this very subtle blow that they happened to see. They would even hear them, like, you can hear the exhalations of the whale that were lost on me, but from all those years in the field, they had these really honed instincts and then they would pile up the boats alongside the typical thing that they do in the field is they try to photograph each side of the whale so they can identify it using the photo ID techniques which are similar to the way police investigators match fingerprints. Each whale has a unique pattern of modeled coloration on its back.

Sometimes they will take a biopsy sample because that's the only way you can determine the sex of a whale, by analyzing the DNA in its skin and they record where the whale was seen and then they have to go home and match that whale to the others in their database so they can see, well, this whale was seen in this area one year and two years later, we saw it here, and slowly they've both been able to piece together these catalogs of blue whale populations in their study areas and I think John has at least 14, 1500 whales in his catalog. Richard Sears's catalog in the Atlantic is much smaller just because the population is much smaller. It's somewhere around 400 animals.

Jennifer Stock: Oh, wow.

Dan Bortolotti: But, it was such a privilege to be able to work with these guys and I'm so grateful to them for trusting me to allow me into that world and report on their work.

Jennifer Stock: For those tuning in, my name is Jennifer Stock. This is Ocean Currents and I'm talking with Dan Bortolotti, an author of a book called Wild Blue: A Natural History of the World's Largest Animal. We're talking about blue whales. So, back to the research part and these scientists, I can imagine this is a tough life for these folks. They have to spend weeks at sea, rough conditions, and then come back and pour themselves into data and photographs. Is this a challenge for bringing more scientists in the field of marine science and marine mammals, specifically?

Dan Bortolotti: Yeah, that's a great question because, I mean, you're right. It is difficult in a lot of ways I think both Richard and John would tell you they can't imagine doing anything else. They love being out on the water like that, but that is a really interesting point you said about a challenge of attracting new scientists to the field because in my couple of years research doing this book, I did notice that most of the younger scientists you encounter tend to be much more technically oriented. So, they can build mathematical models and they can use computers to do various sort of population models and data analysis of acoustics and things like that, but the old guard like Richard Sears and John Callum McKeys are both in their 50's now who are really at the vanguard. They were the trailblazers. They were the guys who just got out in the boats and witnessed firsthand where these animals were.

I don't know that the next generation is ready to do that and maybe they don't need to. Maybe the fieldwork at some point becomes this law of diminishing returns. You can't just go out and photograph the same whale over and over for decades, but certainly those guys who were working in the field, in the small boats, and leaving much of the data analysis and mathematical modeling to their younger colleagues and students…it is a bit of a changing of the guard I think, a little bit of passing the torch and I think both of those guys have more of a romantic streak than I think a lot of the younger generations of scientists have.

Jennifer Stock: That's an interesting perspective.

Dan Bortolotti: I spoke to blue whale scientists and I'll call that…who'd never seen a blue whale before.

Jennifer Stock: Oh wow.

Dan Bortolotti: Right? And it took me a while to get my head around, but then I realized that's not their job. Their job isn't to go out and do the fieldwork. Their job is to do the data analysis.

Jennifer Stock: Well, it's true. I mean, how many of us have seen Mars and Saturn and how much do we know about those places except through pictures?

Dan Bortolotti: That's a good point because there are…just like that, there are astronomers who never look through a telescope. I mean, who do all of their work on computers and with modeling. So, it's…I would encourage almost anybody who is interested in studying the

science of these animals to get out and see them firsthand. You have to have some kind of connection with them.

Jennifer Stock: One your most recent books before this was called "Hope and Hell: Inside the World of Doctors without Borders" and you traveled in the Middle East and elsewhere profiling doctors that are traveling to help provide humanitarian aid all over the world. Did you find any similarities in the personalities of these doctors with the profiles of the researchers who are trying to understand and save these endangered species?

Dan Bortolotti: That's an interesting question. I hadn't really thought too much about the parallels between the two books, but what I did find, I think that in both cases, both people doing humanitarian aid work and scientists working in the field, one thing that I think both of them appreciate is….people from the outside who take the time to understand what they do because I would say one parallel between them is both of them are, in a lot of ways, misunderstood and I think it's because a lot of the media reports that you read both about humanitarian aid and about science are done by people who don't have much an understanding of the fields and the reporting is superficial and its full of clichés and misunderstandings and things and I don't pretend to be an expert in either field, but what I tried to do with both of these books was to really listen carefully to the people who were telling me their stories and checking all my facts diligently and making sure that I presented their work in a way that was accurate and I found I think both groups really appreciate that because it's something that they don't often get.

Jennifer Stock: Yeah. It's also a nice read for those of us that aren't scientists. It really brings a lot of science to us in a great way. So, my kudos to you as an author for translating that so well.

Dan Bortolotti: Well ,thanks. I always tell people that sometimes it helps to not have a background in the subject you're writing about because I ask the same questions that my readers will be asking and I try to answer in a way that I would understand if someone was explaining it to me. So, I don't slip into jargon and I don't have all kinds of assumptions about what people should already know and it helps.

Jennifer Stock: So, as far as the future now for these animals, I mean, we've had a hard, heavy past and we've learned a lot from that as far as the importance of preserving these animals. What are their biggest threats today now that whaling has banned hunting of blue whales?

What are their biggest threats today as far as coming back or surviving in a changing ocean?

Dan Bortolotti: Well, there's two that stand out. I would say that the first one, which will be well known…well, both of them are well-known to people in California, is ship strikes. In the summer of 2007, I believe, there were four blue whales killed when they were struck by large ships in the Santa Barbara Channel and other busy shipping lanes. What we found or what scientists have learned is that they believe that at night whales sleep, if you will, by milling about close to the surface and diving only very short distances and then popping right back up and when they are close to the surface at night, they're just invisible to ships.

I mean, even during the day, they're invisible to large ships and they are sitting ducks in a lot of ways for big ships that are coming through these lanes and the Santa Barbara Channel, which is not only a busy shipping lane, but also a hot spot for blue whales feeding and there's just so much potential for large ships to kill these animals and they're so large and we think, in a lot of ways, as them being invulnerable, but a cargo ship hitting a blue whale is like a transport truck hitting a mosquito and it would, in some cases, the whales are killed and they're found bloated and floating on the surface, but who knows how many whales are struck and sink to the bottom before anyone ever detects it and so, I think that's probably…well, that's certainly the major problem for fatalities of blue whales today. The other big concern is one that isn't killing them, per se, but we don't know the long term effect it's going to have and that's sound in the ocean.

Blue whales have these very low frequency vocalizations that they use to communicate over great distances and the ability to make those sounds evolved in a time where the oceans were silent and today with the amount of shipping traffic we have all over the world and with the great distances that those engine noises travel, it would be like people trying to whisper in a crowded room and scientists are concerned there are blue whales who probably use these vocalizations to keep in touch with each other and breed and mate…may find it increasingly difficult to stay in touch and find one another and if that's the case, it may effect their reproductive success and their population numbers might dwindle and it may go some way to explaining why, even though we banned blue whale hunting 40 years ago, the animals don't seem to have recovered to the levels that one might expect.

Jennifer Stock: It's probably hard for them to find mates at this point with hardly any around.

Dan Bortolotti: Well, I mean, even in areas where they're fairly common, we have to remember, we think of animals as keeping in touch with each other visually, but, of course, whales almost certainly do not do that. A body length for a whale is 75, 80 feet. There's no way an animal can see 75 or 80 feet underwater or at least a whale can't So, they're keeping in touch with each other through sound and if they're not able to pick up and decode those sounds because of background noise, we don't know how difficult it might be for them to stay in touch and that certainly is a danger.

Jennifer Stock: Yeah. So, as far as recommendations for readers and listeners as far as getting involved in these issues and helping to protect whales as well as the larger ocean ecosystem, are there any recommendations you have for listeners about getting involved and what's the most important thing they can do to help with the conservation of our ocean?

Dan Bortolotti: Well, I mean, specifically to blue whales I think one of the ways they can do that is by supporting and sponsoring research because…and I say right at the end of the book that I think the biggest threat to blue whales has always been human ignorance. There's just so many things about the whale that we don't understand and so many things about the ocean that we don't understand and we have to contribute to research in order to learn more and in this economic climate research funding is drying up everywhere and one great opportunity, the one up here in Canada, Qubec, are Richard Sears's work in the Saint Lawrence, he does eco-tourism and people from all over the world visit him every year and are able to go out on the boats with him for a whole week and they get to participate in the research directly and the money they pay for that privilege goes to help sponsor the research.

So, there are some opportunities to do that, but as we said earlier, it's very hard for people to appreciate the conservation issues involved and the importance of protecting animals unless they have some sort of contact with them. So, I'd encourage people, especially in California, there's so many opportunities to go out and see whales including blues and it's very moving and I think a lot of people will find that maybe they never gave a lot of thought to this issue in the past, but you see a blue whale swim underneath your boat, you can't help but be moved by them and I think getting out and having that first hand contact is really valuable.

Jennifer Stock: Where can listeners find a copy of your book, "Wild Blue: A Natural History of the World's Largest Animal?"

Dan Bortolotti: It should be widely available in bookstores throughout the state and throughout the US and Canada and, of course, it's also available online at Amazon.com and Barnes & Noble and Borders and the usual suspects. It should be quite easy to find.

Jennifer Stock: Thank you very much for joining us on Ocean Currents today and thank you very much for the time you spent writing and researching about this book. It's just a fantastic compilation of science and natural history and human history and it helps to shape the future for this incredible animal. So, thank you for joining us today.

Dan Bortolotti: My pleasure. Thanks for having me.

Jennifer Stock: We've been talking with Dan Bortolotti, author of Wild Blue: A Natural History of the World's Largest Animal

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