Hey to all you fish enthusiast out there. Whether you're an avid angler or just curious about fish, we'd like to welcome you to Fish of the Week! your audio almanac of all the fish. It's Monday, January 24 2022. This year we're excited to take you on a week-by-week tour of fish across the country with guests from all walks of life. I'm Katrina Liebich with the US Fish and Wildlife Service in Alaska,

and I'm Guy Eroh, and you know, I'm thinking about becoming a crypto guy. I got my eye on this new crypto. You heard about it Katrina?

Nope.

Called crypto benthic. You should get in now because there's nowhere to go but up.

Okay, so we're talking about a beautifully colored and curious fish and a great ocean dad from what I understand - the scalyhead sculpin. Our special guest is a diver, sculpin enthusiast, researcher, and 3d sculpin skeleton reconstruction is Dr. Thaddeus Buser, who's a postdoc at Rice University, and based in Seattle, so welcome.

Thanks. Happy to be here.

Okay, so first question. You know, this is a marine species found as far north as the Aleutian Islands, and Kodiak Island, and Alaska, from what I understand all the way down to California. And we'd love if you can really just kind of take us down to the sea floor, help us get a feel for what this fish looks like, if you were to dive down and come face to face with one of them.

Yeah, so the great thing about these fish that they are highly variable in their coloration. Now they're small, they're in a kind of ecological classification that fish biologists like to call a crypto benthic species. So they, they sit on the bottom, and they're hard to see. And that's kind of their, how they live their lives. So if you dive down, they're very abundant, but you often don't see them unless you really know what you're looking for. And you're capable of sitting still, for long periods of time. I did my master's degree in Fairbanks, Alaska. And so I did almost all of my scuba diving in south central Alaska. And I actually did a study looking at the color variation in intertidal and, and shallow nearshore sculpins, generally, and I looked at *Artedius harringtoni*, in particular, the scalyhead sculpin. And it turns out that not only are they super variable when you just kind of find them, but they can actually change their color to match the background that they're sitting on. So sometimes they're pink, sometimes they're all black, sometimes they're black and white, they're usually some combination of colors that range from very deep red and bright pink to browns, and blacks and greens.

I noticed that in some of the photographs online, they kind of have a pinkish color and like a fleshy looking thing on their head, What's all that about?

The little doodad on their head is only really enlarged in males. And it's not really clear what they're doing with it, it's very sexually dimorphic. And so it probably has to do with part of the breeding display of a, you know, large and in charge, sexually mature male. And it's associated with exaggeration of

other features that you find in males. So in males, the mouth is really, really big, the lips are really, really big. They have this bright yellow coloration on the skin of their throat, which in technical terms is the branchiostegal membrane, it's kind of the fold of skin that seals the gill plate to the rest of the body when they're breathing or section feeding, they'll actually be they can actually flare that out, like one of those Australian lizards or you know, the Dilophosaurus in Jurassic Park. They can flare it out and show this bright yellow membrane.

Dang.

And they will do it to other males like I mean, it looks like you're looking at, you know, an anolus lizard or some other lizardy thing that you think of. So they use color in all kinds of interesting ways, not only for camouflage, but also for getting attention. And what's cool is all of the bright stuff is basically hidden on the underside of them. And so they can preferentially show it when they want to. And so they're not constantly advertising, "hey, I'm this big, beautiful fish." They only really do it when they want to get somebody's attention on purpose.

And that's probably...Yeah, from predation, right? You don't want to get eaten if you're selling your colors all the time. That's cool. So yeah, so what can you tell us about their skulls? What are you learning about their skulls and their horns through your research?

Yeah, so in terms of the scalyhead sculpin, and one of their kind of reproductive biology, ecology, behavior, things is that, in addition to kind of flexing out that branchiostegal membrane, they flare out parts of their gill plate, in particular, this bone called the preopercal, and it has these spines that come off of it. And if anyone has ever encountered a sculpin in real life, the spines are probably the one thing they remember about them, because they're very sharp, and they poke you really well. And scalyhead sculpins use it to intimidate other scalyhead sculpins. One of the questions that I'm looking at in my research is whether the shape of the spines that come off of these bones basically evolve the way that deer antlers and cow horns evolve, or whether they seem to evolve more for just protecting them from being eaten by another fish. And I use the CT reconstructions of their bones to get at that question.

Yeah, that really gives kind of an interesting view, if you can look at a skull, they're quite fascinating looking.

So I was looking at some of your work before we jumped on here. And you're seeing a lot of CT scans with the skeletons of these fish and got me thinking I was back in ichthyology conference earlier this year, and seeing that there was actually more and more people kind of looking at the skeletons. And I was curious if this is a trend that you're seeing out there.

So the CT scanning stuff that I've done is part of kind of a bigger movement among researchers who study you know, anatomy and compare anatomy across species, to basically CT scan individuals of every genus of every vertebrate, and put it online for free, so that anyone who's interested can access it and download it, and ask questions that they want to with it, or, or teach or whatever.

That's cool.

And all the CT scanning that I've done has been kind of part of that. And so I have like 600 CT scans that are up on this website called morphosource.org. They're freely available for anybody to access and download and do what they will with them. It's part of kind of this movement of trying to make science accessible to anybody. I've had messages from like, teachers in Spain who have downloaded the scans and made visuals for their, you know, like high school classes and things like that. And so it, it appears that some people, some people are in fact taking advantage of it.

You already did a fabulous job of describing what these fish look like. But I was wondering if there's any key characteristics that someone could use to identify a scalyhead sculpin? And if they come across one in its range?

That is kind of the number one question that I get. Sculpins, as anyone who's ever seen them knows, are very difficult to tell apart if you haven't, you know, dedicated years of your life to that task. So like the kind of new trend of microfishing, where people it's like birding, but they're catching small fish or fish in general, and kind of making lists of all the species they've caught with the intention of having a really big list. I get a lot of sculpin ID questions like on Twitter, from people that are doing that. If you come across a sculpin and a tide pool, or, you know, if you're fishing off the jetty or something and you come across a sculpin and you want to know what it is, the most important things you can look at are whether it has scales on it. Most sculpins don't have a lot of scales. And when they do, they tend to be in these very distinct patterns. And so if it has single row of scales on each side of it, that tells you that that you're looking at, usually a fish in the genus *Artedius*, which is what the scalehead sculpin is in. And the other really big thing to look at is the shape of the spines that come off of its gill plates, those preopercular spines. The shape of those spines can be unique to that species in particular, or at least gets you close. So between the scales and the spines, you can usually get down to one or two candidate species just on those two traits. A scalyhead sculpin they only have really one distinct spine that comes off of their preopercal and forks at the very very end of it, this kind of subtle split that happens. And so between that and the shape of their scale pattern, that's usually enough to get you very, very close to scalyhead. It's a male, it'll have these big canine teeth that are not like the teeth of other sculpins, especially sculpins that size in this area, or where scalyheads occur. They also have that big supraorbital serus that looks kind of like a deer antler almost in some of them. And that yellow throat, they're the only ones that have that it's much more pronounced in the males, though. So if you get a male, it's usually pretty obvious, you get a female or immature male, you have to look a little closer to make sure that the shape of the preapproval spine is what you're looking for. And if you really want to get really specific, you can actually look at the number of scale rows that they have in that little scale band that they have on their sides. Yeah, that's, that's basically it.

So it sounds like these fish can be somewhat territorial. But you also said that there's a lot of them down there when you get to look and form. So I'm just curious, what kind of territory do these fish operate in? And then how do they just protect them and live down there?

Yeah, so I had a kind of an accidental experiment happen with precisely that question. I do all of my CT scanning I do at this research facility in the San Juan Islands in Puget Sound. And I was out there and had a tank full of a bunch of different kinds of sculpins live sculpins. And I had made, you know, this

nice little habitat for them. I had like all these rocks, and I have little gravel and plants and stuff like that in there for them to kind of hang out. And, and what I noticed is that there were, by happenstance, an equal number of male scalyhead sculpins and rocks that were the size of cobbles. And each one of them sat underneath its rock. And if another male of its species had to be at species and had to be male, if another male, that species came close to its rock, it would chase it away, and get all up in its face, and you know, chase it around the aquarium and then go back into its little hole. And I noticed that because at feeding time I drop a bunch of food in and they all kind of congregate where the food was. And if that happened to be by somebody rock, that individual would get really upset. One morning I came in, and I noticed that someone else had set up a tank in that room, and they had taken one of the rocks out of my community. Oh, and there was a dead sculpin in there, there was a dead scalyhead sculpin. And I was like, "Whoa, that that's interesting." So I dissected it, and it had all of these like stab wounds all over its face, we'll never know the truth. Truth is always unknowable. But it appears to me that that fish either lost its rock, or somebody bigger lost their rock, and that this individual who died, died fighting basically for territory.

Oh man.

So I think that the territory can be rather small, cobble sized rocks, or the equivalent area there of some big rocky reef. And if you go to some, you know, rocky reef habitat, you'll find sculpins hiding out. All they need is a little cave that they can hide. And that's what they what they breed in, the males will find a little cave and attract females to come into the cave and the female likes the cave shall lay her eggs in it, and then let the male mate with her. And it's not totally clear how territorial they are outside of the breeding season. So depending on where you are, the breeding season can basically be constant or narrow. And that might have a big impact on how territorial these fish are.

Can you talk a little bit about their breeding strategy? I mean, it sounds like they're territorial, is it just during the breeding season or you know, you know, just location based?

as far as I know, no one has investigated whether they are territorial outside of the breeding season. What's neat, though, is sculpins are really, really fascinating in terms of how they reproduce and what they do with their eggs. It's highly variable, but they have a fertilization mechanism that is unique to sculpins. In a normal fertilization event, you know, the sperm travels down this, this tube goes into the center of the egg and fertilizes it and the egg starts dividing. In sculpins, the sperm will travel down this tube and right at the point where it's about to cross the ooplasmic membrane which is the thing that once it crosses that fertilization happens and it will sit there you know pause, and then freeze like that. And it will remain in suspended animation indefinitely until the egg moves from ovarian fluid to seawater and it's thought that the change in salinity and other kinds of you know chemical attributes of the seawater causes the sperm then to complete the mission and fertilize the egg. And it's at that point that they said that fertilizes and starts dividing, the female doesn't have internal fertilization, she has internal insemination, but not fertilization. And she will then travel around with these eggs that are ready to be fertilized. And because they're not fertilized, though, she doesn't have to have any of the biological means of removing biological waste products and giving them nutrition or anything like that she basically has the ability to choose very specifically, where she wants to lay her eggs without a male

having to be there for that moment but doesn't have to do any of the metabolic kind of care for them, while she's deciding where they're going to go.

Do the males then help guard the eggs? Is it the same male that initially fertilized?

So does the really neat thing, it's not the same male that fertilized. The female is laying eggs that were fertilized by her previous partner. And then once she lays those eggs, she's receptive to mating with the male that is, you know, where she lays her eggs from the previous male. And so what you get as you get all of these males who are guarding nests that they are not the father of any of the eggs. And which doesn't make any sense in terms of the male's commitment to parental care, because he's not getting anything out of these eggs. Except that he gets opportunities to mate with females depending on how nice his nest is. And so if he has a bunch of eggs that he's neglecting, or if he has no eggs in his nest, females don't want to mate with him. You end up with a point where the breeding season is over but there's still some eggs that haven't fully developed yet. And the males will just abandon all of them. Because they're, there's no reason for them to keep caring for them, because they're not the father.

Oh, bummer.

I'd be a little curious to hear more about some of the work that you are doing and finding these sculpins. And what kind of special gear you might have had to have that, you know, go scuba diving in the frigid waters of Alaska. And then also how you collected those ones for like, say the aquarium that you're talking about. We're using like a trap or a dip net, or are you using?

Yeah, so scuba diving in Alaska is if you can do it there, you can do it anywhere. It's dry suits. It is usually multiple layers of either specialized or like military thermals that you wear underneath the dry suit to keep yourself warm because the water is 37 degrees, usually, we would go diving in the early spring. And so the air would usually be below freezing, sometimes way below freezing. If you spit into your mask, your spit just instantly freezes up like that. It's all basically dealing with stuff that freezes the second that you put any kind of moisture on it and having to adapt everything that you do around that kind of limitation. But catching sculpins is, you know, if you liked going out and flipping over rocks as a kid, which I confess I did.

I did too.

I did too.

It's very fun, because it's basically all of the skills that you developed as a kid being put to, you know, a more formal kind of application. So, like, one of the main ways that I collect sculpins is going out at very low tides with some dip nets and a bucket and chasing them around in tide pools. That's extremely effective, especially if you get you know, some of the really really low tides in the early summertime. You can get some real weirdos in the low tide pools. They live in these kinds of nooks and crannies, you know, that they hide out in during the day they'll live, you know, anywhere from like 60 feet to low intertidal, when they do come out. They're very, very curious. And you can dive down to these rocky reefs. And if you just come crashing down and kind of make a bit of a scene, but then you just kind of

sit there, all these little heads will slowly start poking out from like, you know, the nooks and crannies and they'll slowly start kind of hopping out towards you.

They don't have swim bladders. So they're negatively buoyant. And so they literally do I kind of hop out. It's really funny. They use their pelvic fins and their pectoral fins and hop around like that. So they'll all come and check you out. You really don't have to go looking much further unless you want to start flipping over rocks. If I'm having tides, like low tides that happen at night like in the wintertime, I will go around in shallow areas because when it's dark out there not worrying about birds coming after them which is like a major source of predator For shallow water fishes. And so they're much more just kind of out in the open and you just take a light around and you walk around in knee deep water. And you can find fishes that are usually strictly subtitle cruising around, and they're looking for amphipods and things like that and scoop them up with a dip net. When I'm scuba diving, though, dip nets are great if I'm doing kind of like highly invasive methods where I'm flipping rocks over and trying to like, find them and catch them before they realize that they've been found kind of thing. But if you are doing the technique where you go down to the reef, and you kind of stir up some stuff, and then you sit there and wait for their curiosity to get the best of them, the dip nets are very ineffective.

And actually I was taught this when I was an undergraduate, a professor at the University of Washington who basically he was my sculpin guru and showed me the ways of finding them and, and a lot of tricks for identifying them and things like that. He just takes a big gallon Ziplock bag and puts it near the scope and because they're very well camouflaged, and they assume that you can't see them, unless you make it very, very obvious that you can by like staring at them or doing something weird, if you kind of if you can notice it, and then kind of like pretend like "Oh, I'm looking over here like don't worry about me, buddy." You know, it was really works. They really know when you're looking at it's weird. I can't I mean, it's something about the eyes or something, I'm not sure what it is, but they really seem to know when you're locked in on them. So you just kind of act all nonchalant, and you put an open Ziploc bag in front of them. And then you take your other hand and you just kind of slowly kind of move it towards them. And they'll nine times out of 10 Just go straight into the back. And then you just walk back. And so when I'm scuba diving, that's basically the that's the main way that I'm catching them is just by getting them to go into an open bag, that then I close up and put in my my diaper bag, right on

If you could give an elevator pitch about why people should care about sculpins get interested in sculpins what would you say

Sculpins are one of the most dominant intertidal groups of fishes. And so for a marine fish, they are extremely accessible to anybody that can go to the coast. And you don't even need a really low tide to be able to find them and the diversity of colors and shapes and weird aspects of their biology and ecology like that, you know, unique form of fertilization. And so to have such a evolutionarily, ecologically, biologically important and interesting group of fishes that are also very important for like the biology and ecology of lingcods and other game fishes. To have something like that, that is so close and so easy to go out and look at for yourself and be able to appreciate there's just nothing like that around here. They are the thing. The most accessible, I'm a little biased. But there's nothing bid as as diverse for species and ecology and biology that is so abundant and accessible that's around here.

Sweet. Well, thank you Thaddaeus. This was a fascinating discussion about these sculpin. So thank you.

Yeah, thanks for having me. It's always fun to talk about sculpins especially with fellow fish enthusiasts, such as yourself. So my pleasure.

All right, well, we hope everybody gets out there and enjoys all the fish including all the sculpins.

Thanks for listening to Fish of the Week! My name is Katrina Liebich. And my cohost is Guy Eroh. Our production partner for the series is Citizen Racecar. Produced and story edited by Charlotte Moore-Lambert. Production management by Gabriela Monteguin. Postproduction by Alex Brower. Fish of the Week is a production of the US Fish and Wildlife Service, Alaska Region Office of External Affairs. We honor thank and celebrate the whole community: individual tribes, states, our sister agencies, fish enthusiasts, scientists and others who have elevated our understanding and love as people and professionals of all the fish.