

**Robocrop: Seagrass Restoration with Robocean, with
Niall McGrath and Isobel Harris (S02E01)
Not Another Science Podcast
February 18th, 2021**

Introduction

[Helena] Welcome back to *Not Another Science Podcast?!*, I'm Helena

[Tom] And I'm Tom.

[Helena] For this second episode, we are careening head first into the wonderful world of engineering. Our guests are Niall McGrath and Isobel Harris, who are both fourth-year mechanical engineering students.

[Tom] Niall and Izzy are two founding members of Robocean, a team of students who designed an underwater robot to plant seagrass. Their design was selected as the wildcard winner in the 2020 Redbull basement competition.

[Helena] And no wonder, because they were so inspiring to talk to. They are incredibly passionate about their project. I had never heard of seagrass before this episode, but I am so glad that someone has and is doing something about it.

[Tom] Yeah, me too – it was such a blast recording this interview and we had such a funny conversation, so let's dive into it.

Intro music ends

[Tom] But, before we start, this podcast is sponsored by Greiner Bio-One, supplying laboratory, diagnostic and medical products to research institutions, higher education, the NHS and others across the UK. For details of the full product range, visit www.gbo.com. And now, on with the show!

Transition

Main

[Niall] My name's Niall, I'm a fourth year mechanical engineering with renewable energy {student} at the University of Edinburgh, and I'm the founder and project director of Robocean, the student startup trying to mechanise seagrass restoration.

[Izzy] I'm Izzy, I'm also a fourth year mechanical engineering student at Edinburgh Uni. Technically – what? – administrative director, but just kind of doing everything.

[Niall] All titles are made-up anyway.

They laugh.

[Tom] So Niall, how did you come up with the idea for the robot?

[Niall] I was really passionate about mixing engineering with environmental regeneration, finding the Venn diagram intersection between those two technical areas. And I came across these guys working for a charity called Project Seagrass, which is the UK's biggest seagrass restoration project, backed by WWF and Sky Ocean Rescue. They were planting these huge seagrass meadows, by hand, off the coast of Wales, and the more I started to look at it, I was like: "This is a crazy operation, everything is done manually, and the amount of prep and resources consumed by this effort, that's just insane," but what they're doing is absolutely fantastic. Seagrass meadows are amazing bastions of biodiversity, pretty much unparalleled in our cold waters. But in the last century, we've lost around a third of global seagrass coverage, and in the UK alone I think it's 92%. And one of the other positives of seagrass restoration is that they capture a lot of CO₂, so they're actually up to 35 times faster at capturing CO₂ than tropical rainforests.

So I looked at that, and as an engineer I thought: "Well, surely that can be done a lot better." And I remember just sitting in the flat, and it was a cold autumn night, freezing, blankets over us and I was just like: "Well what if we made a robot that planted seagrass?" And my friend was like: "What are you talking about?"

Tom laughs

We were all sitting there after exams with nothing to do and we thought well – with our friends – and we thought: why not give it a go? And then we've been working on it ever since, creating a robot that mechanises seagrass restoration, and we took that to Redbull Basement after seeing an Instagram ad, and it sort of skyrocketed off there.

[Izzy] I don't think we expected to get anywhere near as far as we did. Yeah, got kind of scooped up by NTT, as like a wildcard entry, and then got so much more support – marketing, branding, pitching support, business support. Yeah, it was good, it was good but it was really intense.

[Tom] I love the idea that there's just lots of engineers in Edinburgh sitting in their flat, and someone's like: "What if we just make a robot?"

They laugh

[Izzy] My friend who is an art student, she was like: "Is this all you do? You just like – shall we make a robot? You know, this would be much better with a robot."

[Helena] 'Cause I live with two computer programmers and they sit around being like: "I'm sure I could automate this." They could just do it manually, but they're like: "Well, I know how to so I just will," and it feels a similar – for you guys – "Well I know how to build a robot, so I just will!"

[Izzy] ... "I will", yeah!

They laugh

[Tom] Talk us through the design of the robot. How did the concept come together? How do all the different parts fit?

[Niall] What we're actually doing is really, really simple. It's not new technology, it's pretty well established. It's really niche, and no one has ever done it before, as far as we can see.

[Izzy] It's gone through I don't know how many design changes, we change our mind all the time, because funnily enough building a robot underwater is quite complicated?

Tom laughs

And so, the main kind of point is that we have a pump system that pumps gel suspension out in these little ploughs, and it buries it. So the seeds are suspended in effectively jelly, but because we have a pump system, it makes it all very complicated in terms of like pressure. And then we have to, obviously, waterproof the pump system, on top of electronics, batteries.. We have to drive it so we're doing like little tank tracks instead of making it swim. Because we did try to make it swim, and then everyone we took it to was like: "Nope, don't bother. You have enough to worry about." But yeah, it's very annoying. Everything is *annoying*.

[Helena] So was that, would you say that's the most challenging thing? Figuring out how to work the pump?

[Izzy] I think the most challenging thing is the fact that it's actually underwater. Because, we then have to waterproof everything. Your standard thing to waterproof is: put it in a plastic box, but then that might heat all the electronics up, and it also might heat the gel, and if you've ever tried to make jelly in the fridge, if you don't get the temperature right, it won't set.

[Niall] We were chatting to Project Seagrass, and they put their seeds in biodegradable hessian bags, and they tie up like 50 seeds inside and they drop them 1 meter apart on the sea floor. And one of the reasons they do that is that crabs can't get in and eat the seeds. And, whenever we told them that we were going to put it in a gel matrix and just pump it out, they were like: "Well, you know about crabs, right?" "What do you mean? I know *of* crabs?"

Helena laughs

"And yeah, so this other guy, he was planting seagrass by hand, and he had a big issue with crabs coming along and eating all his seeds 'cause they're so hungry all the time and they just love seagrass, it's like a crab delicacy. So just so you know, you could spend thousands of pounds building this robot, and

planting it all, and these tiny crustaceans will eat all your hard work."

I started looking into crab repellent almost? Which brings up a lot of weird Google searches, as you can imagine. So I posted on Meadows Share? Probably the weirdest Meadows Share I've ever seen. And I was like: "Hi, I have a crab problem. Does anyone know how what deters crabs in the ocean?"

And there were you know, a few guys who were like "I'm a marine biologist, and I know about crabs." And they're like, "Well, one time we were doing these fishing tests in like a field study somewhere, we used this thing called octopus gel, to keep crabs away." And I was like, "Octopus gel, what is that?"

Helena laughs

It's this gel that sort of has bits of octopus in it, and his reasoning was that because octopi are really old creatures, and crabs are terrified of them as predators, so they stay away, they don't want to go near, like they can smell it and it puts the fear of God into them, and then they scuttle away because they don't want to go near. "Maybe you could make it smell like octopus? And that would be your problem gone." How do you make it smell like octopus? Without us decimating octopus populations across the world and putting tentacles in. So now we're going to have to test it out, hope to God there are no crabs in the local vicinity. Or, then make a way to make the gel matrix taste really terrible to crabs. But then again, I don't know how you know what crabs like to eat.

We actually are pretty lucky: Scotland is really good for sub-sea robotics. So while it's not the most successful engineering field, Scotland is best of the best when it comes to that sort of sector, and within the University there's a lot of experts who we could get advice from.

[Tom] That's something we were interested in: how you guys had to tackle a lot of subjects that aren't engineering. So you've got like ecology, business strategies and things like that. How has it been just learning about all this crazy new stuff?

[Niall] The marine biology and ecology aspect is absolutely crazy. From the business side of things, that's actually been one of the best parts of this. I was in this weird position

when I was younger, when I was 17, I did like a summer accelerator, and they taught you everything about business. And reapplying that to subsea robotics that is not just for human benefit but also for environmental benefit, that is a weird thing to market. Right now, we're trying to go for like a carbon offsetting company. There's all these other benefits, you're like well, how do we sell this? I think we've got a pretty good grasp of that, and the more we keep going with it, and especially with Redbull Basement, we came to these people – experts in the field – and we were like "We're gonna try and offset carbon, but we're also gonna improve marine biodiversity and it's just really good for everyone." And they were like: "That's a really good idea! I was wondering how you were going to monetise this." I'm just so glad that it actually sounds viable and people aren't like: "This is a charity case."

[Helena] So then, so what kind of stage are you at? Do you have a prototype? Or are you just trying to sell the idea and get the prototype built later?

[Izzy] So we're getting all the parts for the prototype shipped all to my flat, annoyingly, 'cause we've not got a workspace. We can't get workshops in the Uni or anything like that, so for now it's all getting shipped to my hall, until we can get anywhere to build it, and then hopefully kind of end of March we'll start building, and then we can all see each other. We've not even all met up as a team yet, because we've not been able to, which is insane. But hopefully we can start building it, and then test by summer.

[Helena] The prototype that you're making, is it for a specific environment? Or how easy would it be to apply it to different kinds of seagrass or different types of environments?

[Izzy] Different varieties grow in different habitats. So if, for example, it was much deeper, we'd probably need to do a fairly intense redesign, for like different pumps, different waterproofing, different pressure systems and stuff like that. But it's, the kind of general idea of it is like for a different pressure we'll just change the pump, or if we need longer battery life because it grows further out, change the battery, change the treads and stuff. It's quite an adaptable design.

[Niall] So *Zostera marina* is what we're prioritising right now, also known as eel grass. Seagrass is actually a seasonal plant, it produces seeds in the summer, we would go collect them in the summer, and then plant them in the autumn and winter. Which sort of limits us for half the year. So while we're totally targeting the UK for now, it's not an environment that is totally isolated, and unlike anything else, so we can apply our current techniques to places all over the world.

[Helena] 'Cause I had sort of assumed that you would be growing the stuff... the seed collection would be done on land, from seagrass that you could grow... I don't know, I'd just assumed this. How does the collection work? Is that manual or is that automated as well?

[Niall] Project Seagrass, they do some crazy stuff where they have labs, and they try to cultivate it. They cultivate the seeds and they prepare them once they're collected. Whenever they collect it manually, they go out in wellie boots; the depth at which seagrass can be, you can go out in your wellie boots, or it can be up to 12 meters deep, and you can use divers and pick by hand. And we're sort of blessed in the fact that, as students we don't need a full scuba suit to go out and collect a few seeds. It's not something you can really farm in isolation, you can't have a huge warehouse and just grow seagrass, because the nature of the ocean is that the nutrients and stuff constantly coming in with current and things like that, and the wildlife. And trying to split that, or mimic that very delicate ecosystem is very very difficult. And then there's also biodiversity concerns as well that we are very scared to think about but we are going to have to think about at some point where, you can take seeds from Zone A, and plant them in Zone A, but if you plant them in Zone B, then there's cross-contamination potential, so you almost have to disinfect the seeds. And, from what I've gathered with my very little biological knowledge is that there seems to be this idea that that sort of disinfection of germination from Zone A almost makes it less viable to grow in Zone B, because that disinfectant takes away a lot of the valuable nutrients and stuff, and vitamins that it needs to sort of germinate initially. And so you end up with less successful planting. So it is, even more specifically you have to mix and match in the right areas, never mind the right soil conditions and things like that. Maybe making a robot to collect seeds is our next

task, maybe like some sort of subsea hoover, I don't know. The whole process is so complicated.

[Tom] I mean I think, what you've managed to do so far, considering you've just done it from your flat is pretty astounding. What do you think is lost when you don't get a chance to actually just meet up in person, and just kind of hash things out?

[Niall] It is weird because there's a few who haven't met and you know through seven months, eight months of video calling once a week, and stuff like that... We had a Christmas party as well, just like, Why don't we talk about something that's not subsea robotics, and get to know each other? So I think, it's that social aspect, like you don't really know... You know their personalities but you don't know too much about everyone. And while I have been good friends for the last four years with most of them, I think that idea of bonding over something physical, very nice and homely, and it's very wholesome, but we haven't had that opportunity. Even just going out to the pub would be absolutely class right now. And low-key I do think a lot of our technical problems could easily be solved with everyone just chatting over a pint, rather than us all sitting online for over two hours.

One half of us are on placement right now, working full time, and also we're in lockdown for the next three months, so trying to build a robot remotely across seven different flats is not going to be easy.

[Helena] When did you realise that you had to expand the team? You said you started this in your flat, but was there a point where you thought, "Okay, this is getting real, we're going to have to get more people and a bigger team, and more expertise involved"?

[Izzy] Yeah, when we started there was just, we were just a friend group from mechanical, and I think I had decided... 'cause we needed someone to kind of flesh out the control system, and I think I was doing that, and I can't design a control system for a robot! I was like: "Yeah, can we get some electrical people, I don't know what I'm doing. This robot will not work."

[Niall] Initially Izzy was looking into propellers, and {had a} general overview, kind of like me, of things like that, and

{now we have} Hero, looking after the planting mechanism, and Joe and Harry are looking after the pumping mechanism, and Anushka's looking after the motors, and the electricals are doing all the electrical control systems with raspberry pies and {arduinosaurs}. So everyone does have their special talent, but there is an awful lot of intersection. It's not like, you know, you don't just talk to each other, 'cause everything relies on the next thing. So it's all about keeping that open communication and no one getting lost in the more technical aspects whenever we delve a little bit deeper.

[Helena] We're quite interested in you guys as well: why did you get into engineering? Is this something you thought you would do? Is this... did you want to apply it to big projects? Tell me what the dream is.

[Izzy] I think this is Niall's like absolute dream, like run his own little eco company.

[Niall] 100% is. I applied for the Edinburgh Business School, and they turned me down. Unbelievable, look at me now, Business School! More or less my whole goal at the time was I want to work for myself, but I am really passionate about tech for good and positive innovation, and particularly interested in the environment. So having watched, you know, probably days of David Attenborough documentaries, I see the amazing benefits and wonders of the natural world, and then you also see what we're actually doing to it. So, whenever I see how engineering can improve the natural world, that's always where I wanted to be, so Robocean, where it is right now, is like a dream come true.

[Izzy] I think I applied to engineering, kind of out of spite? 'Cause I remember taking A level physics and stuff 'cause my, one of my teachers in school was like: "Oh, you should only do that if you want to do medicine." And I was like: "Mh, I think I can do other careers." And I remember my dad came in and was like: "She is doing this, you can't tell her no." And I was like: "Yeah, watch me do an engineering degree."

Niall laughs.

And here I am.

[Niall] We actually don't care about seagrass, we're just trying to prove ourselves to everyone else.

Niall and Izzy laugh.

20 years down the line...!

[Tom] Hopefully that clip doesn't get taken out of context somewhere.

Tom and Helena laugh.

I guess, just talking about the serendipity of lockdown coming along when it did, and giving you the chance to work on this project. Obviously, you know it's been really terrible for a lot of people but it must have been nice for you guys to actually have some just time and space to just work on something?

[Niall] So it's even better than that, in that, yeah it was brilliant that we had the time and we had, everyone needed something to do and was interested in the project, but Redbull Basement which has made the world of difference in the progression of this project, every year it's held during exams, but this year it was online, so any other year we couldn't apply, couldn't even think about it, because it's like what... Last year they flew to Toronto, and maybe the year before was to Berlin, so it wouldn't even be a possibility for us to think we'll apply for that. But because exams were online, because of the coronavirus, because Redbull Basement was online, we had this perfect opportunity to apply for it, and said: "why not chance {...}, why not go for it?" And we did, but in any other time, this would not be possible and we would not be in this position. I mean, I'm not religious or I'm not a big person in destiny but it's a wee bit creepy.

Izzy laughs

That everything has worked out far is absolutely bizarre, so definitely there has been a lot of positives, through the lockdown, for us.

[Izzy] We did the Redbull pitches, we did both pitches on the same day, one was live and one was pre-recorded, and we did them like back to back, within an hour of each other. And the

night before that, we'd had our project management exam, which I think we both spent like 10-12 hours on. I went to bed at like 2-3 in the morning, then had to get up at like 6-7 to get into King's for 8, to then start recording at half 8. It was horrific. So it's a good thing it's sponsored by Redbull.

Tom laughs

[Niall] Yeah, not Tropicana or something, we were just energised the whole time.

[Izzy] They keep going, like: "If you want any Redbull, just let us know, we will send more." I have, what like 30 cans, just on the floor of my room? Like I just, I can't get through it fast enough.

[Niall] Yeah, mine are up there. I didn't touch them until exams started, I'm very much a coffee person, and I was like: "Let's just try a Redbull, see how that goes." And then I was having two Redbulls a day to get me through – what was it 10 days of exams or something like that? And it was just... But I think once you start you get hooked on it, that's how they get you in, they sponsor startup competitions and they get you {...}. They're so clever.

[Helena] Gotta start them young!

They laugh

[Niall] That's it – marketing genius!

[Tom] It's interesting now, you're talking about using technology to fight climate change and all these other issues that we're fighting at the minute. Do you think technology alone can do that? This is kind of like a big question, but... Or do you feel like it needs to fit into a wider network of behavioural change and stuff like that?

[Niall] Oh no, 100%, everyone needs to wise up and start doing better. We can't just engineer solutions forever, although it's gotten us this far as a human race. One of the things that, with Robocean we actually called it Ecosystem Engineering, that's the sort of tagline because what we're doing is engineering ecosystems. Very quickly realised that I'm not the first one to use that term and it is actually an established

term, much to my annoyance 'cause I thought it was really original. But it's part of a wider scope of afforestation and geoengineering, which is sort of like massive engineering projects to basically save us from climate change, like last-ditch effort, last change to {...}, scary stuff. Things like spraying chemicals in the atmosphere that keep us a lot cooler. And it's like well, we could do this at a massive scale, and it would save us for X amount of years before we A) have to do it again, or perish in a climate change fiery death. So it's one of those things, there are issues that we need to come to, actually solve, eventually, and what engineering can do is be part of the solution and also buy us a lot of time.

I think recently... People consider AI one of the hottest topics in tech right now, but recently the market cap, or the investment value of green tech, is accelerating at a pace much higher than where AI was whenever it was taking off. So all the data suggests that green tech is going to take off, it has a really bright future, and it's going to be this huge sector in the future. But hopefully the rest of us as people can follow that trend and start to be better, because I think we're going to need a lot more than a few robots in the sea.

[Tom] So, looking into the future, do you have any plans for getting it to a stage where you've got the robot all over the UK, planting seagrass for people? What are the next steps in that process?

[Izzy] The plan is to have everything tested and "this is a serious idea", and viable, and prototype and everything like that, and proof-of-concept, definitely by the time we graduate so that we can get some, hopefully some very serious investment. So that we can make a proper robot that isn't just half 3D printed, like might fall apart if you kick it a bit hard.

Niall and Izzy laugh

[Niall] Yeah, we're sort of taking it a month at a time, you know, we have a one year plan to have a functional robot, that tests and validates our ideas. But I do think it's dangerous to plan ahead, and get lost in things that you haven't actually done yet. Very easy to do that, and it can be a downfall for a lot of people. But at Redbull Basement, we did set one huge goal, and this is, you know, could be 20 years, 30 years, 40,

50, {...} these robots could be going around. We wanted to plant – was it 75 000 square kilometers – I think this is a conservative estimate, it could be less, but 75,000 square kilometers of seagrass would in theory be enough to offset the European Union's carbon footprint at present. To put that into perspective, I think that's, it's been a while since I looked at the stats and stuff, but I think it was around the size of Cuba, like this is not a tiny piece of land. This is a monumental task of like 100s of robots, planting in synchronisation, 24/7 round the clock, crazy stuff, but you know you have to dream big, I guess. And we're very lucky – we have come in the right time, right place, correct everything. Project Seagrass have just planted 1 million seeds off the coast of the UK, there's this huge effort for environmental restoration and conservation. They've recently found out seagrass syphons out plastic from the ocean, that was literally last week – crazy. We were like: "Well, that's another box ticked." And the United Nations has just declared this decade for ecosystem restoration, and when you include that in with the Sustainable Development Goals, I think we're target 13 and 14, which is climate action and life below water.

Outro music starts

We're in this amazing time and place where everything is coming towards this idea, and if we can make it work, I think it can scale up in time.

Outro

[Tom] Massive thanks to Niall and Izzy for coming on the show, it was a really funny and inspiring conversation. You can find them on Twitter @robocean_eco, on Instagram : @robocean.io, and you will soon be able to check out their website at robocean.io. For any enquiries drop them an email robocean.edi@outlook.com.

[Helena] We hope you enjoyed the first two episodes of Plants and Our Health, the new series that we are hosting on our platform. It's basically a long love-letter to the many wacky and wonderful ways that plants have helped humans throughout our shared history. A new episode will air every Friday – I've seen the production schedule and I am buzzing about all the episodes that are coming up.

[Tom] This podcast is brought to you by the Edinburgh University Science Magazine. In each episode we'll explore fascinating themes and ideas, talk to awesome researchers about their work, and find out about the science being done by our very own staff and students here at the university.

[Helena] If you have any feedback for us, or if you'd like to get in touch with a question or suggestion, you can reach us on our Facebook page, Edinburgh University Science Media, or at our twitter, @eusci, that's @e-u-s-c-i. You can also drop us an email at eusci.podcast@gmail.com, and you can find the show notes and the latest issue of the magazine at eusci.org.uk. If you would like to be featured on the podcast, please get in touch, and keep an eye on our social media for more information.

[Tom] This episode was hosted by me, Tom Edwick, and my partner in crime, Helena Cornu. The podcast manager is Alix Bailie. The podcast logo was designed by EUSci chief editor, Apple Chew, and the awesome podcast episode art was designed by Heather Jones, our social media and marketing genius.

[Helena] Thank you for listening, and until next time,

[Tom] keep it science.

Post-outro shenanigans

[Niall] I don't know about you guys but if you read our name, like, does it immediately say "Robocean", or do you say one of the ten other versions that people have...

They laugh

We get, like, **Robocean**, **Robokeen**, Robocene, Roboclean? I came up with that and I was like: "I do not foresee this being an issue at all." For me, it's quite self... Robocean – the end of Robo leads into Ocean, it's not even like a stretch, it's the same 'O' sound. People just can't wrap their heads around it.

[Helena] This is like, any kind of user design, you have to assume that...

[Niall] Everyone's an idiot?

[Helena] ... {...} something stupid. It's like I love seeing the random signs when you have "Do not touch this" and you're like, you know somebody touched it, and they didn't think it would happen, but they had to put an idiot-proof sign because somebody did it.

[Niall] 100%.