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OPINIONS AND PERSPECTIVES

Advocating for the Love and Protection of Soil Animals through Photography: The Work of Frank Ashwood and Andy Murray

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Abstract

For most people, the world of soil organisms is an unknown realm of darkness and decay, not, as soil ecologists know, a lively place filled with majestic animal and microbial life. Macrophotographers, Andy Murray and Frank Ashwood aim to change this apathy, even distaste, into joy, wonder, and, foremost, a motivation to protect soil biodiversity. Murray and Ashwood explain how they each have made their individual journeys through the fantastical world of macrophotography of soil organisms, what motivates their work, and their process. Their hope is to inspire others to visit their own backyards and natural spaces to visualize soil fauna themselves. Through their imagery, Murray and Ashwood not only to raise awareness of the vast diversity of soil life but encourage the love of mesofauna and its protection through conservation of soils.

Keywords Macrophotography | Collembola | Soil Biodiversity | Mesofauna | Science Communication

Introduction

For most people, the world of soil organisms is an unknown realm of darkness and decay, not, as soil ecologists know, a lively place filled with majestic animal and microbial life. Macrophotographers, Andy Murray and Frank Ashwood aim to change this apathy, even distaste, into joy, wonder, and, foremost, a motivation to protect soil biodiversity. Murray, a copy editor on the topics of water and soil for the Food and Agriculture Organization of the United Nations (FAO) for the past five years, works remotely from his home in Yorkshire, England, UK while pursuing his passion for artistically documenting the presence and behaviours of Collembola and other fauna through macrophotography. Since 2015, Murray has maintained the well-known website A Chaos of Delight (https://www.chaosofdelight.org/), which features meso- and microfauna photographs curated to educate and transport the viewer into the lives of minute soil organisms. His work can also be seen on his Instagram and Bluesky accounts by soil animal aficionados.

Ashwood, a soil ecologist and lecturer in the department of Pest-Management and Conservation at Lincoln University in New Zealand, regularly takes advantage of his recent move to New Zealand to

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highlight the country's vast, and mostly undocumented, soil life. His previous positions include Lecturer at the University of Canterbury (New Zealand) and Soil Ecologist at Forest Research in the UK. His research focus is the use of soil invertebrates as indicators of ecosystem condition, and he too has a website (https://www.frankashwood.com/macrophotography), as well as maintaining a social media presence on Instagram and Bluesky where, among other highlights, he campaigns for exciting soil animals for New Zealand Bug of the Year.

Monica A. Farfan: How did you both come to be fascinated by soil organisms, and the photography aspect of soil organisms, and how you came to this nexus, this meeting of the two?

Frank Ashwood: Oh, well, I've always been interested in soil invertebrates, I guess. I remember early memories of going into my garden with my mum and her showing me the creatures living under all the rocks when I was a kid, but it was never a plan of mine to be a soil ecologist. I didn't know you could be a soil ecologist, I didn't know that was a thing. It wasn't really until after university and going to work for a bit in the real world, that I went back to university again to do a PhD around ecological restoration of landfill soil, and that had an earthworm component, because the lead academic at my university was an earthworm specialist. And then I realised, hey, I could get into this, and I really enjoyed it. I had the really lucky opportunity to stay doing that kind of research, in soil ecology, and so I carried on researching earthworms And then through that, I got into other soil invertebrates, because while earthworms are good indicators sometimes, they're not always. So, I started looking at springtails and mites and all these other things. On the macrophotography side, I didn't really have a photographic bone in my body back then. There was a COVID-19 lockdown in the UK and I had very little to do and a lot of time on my hands. I saw Andy's work, and I thought, oh, I wonder if I could give that a go, because that would be really good for science communication. And I reached out, and he guided me a bit, and the rest is kind of history, but I'll save that story for now.

Andy Murray: Yeah, it's obviously very different for me, I'm not a scientist, never went to university, but I've had a lifelong interest in science and the natural world. So, I spent a lot of my childhood learning about wild flowers, doing nature diaries, watching spiders, the usual sort of kid stuff, but it kind of stayed with me.

I'd always intended to get into macrophotography, so one day I just went out and bought a camera, and spent a few weeks photographing flowers, beetles, bees and woodlice. But I just wanted to get smaller and smaller and it wasn't good enough. So I ended up buying a proper macro, and pretty much first thing I saw when I was really, really zoomed in was a springtail. I didn't have any idea what it was at the time, but I looked it up and fell in love immediately. And that was it. Everything else went out of the window, and I was then singularly dedicated to springtails and then other soil organisms. Because of their small size, I found it miraculous that a whole world existed that I didn't know anything about. Not a shred. And it was this beautiful secret which not many people knew about at the time (obviously science did, but the general population didn't). And, so, I had this amazing secret I could explore myself and it was wonderful. And then, thanks to Flickr (a photo-sharing website) and Franz Janssen, that started my training and just continued from that.

MAF: And, also, you have this beautiful website, A Chaos of Delight, which is very well-known. A lot of your images are there. It's educational. When did you realize that this was also sort of a vehicle for that work?

AM: So, that was in 2015. I was traveling Australia and New Zealand at the time, photographing springtails, and by then, I had amassed a massive amount of work documenting springtails, mites and other interesting invertebrates. And I began to realize that there really wasn't a resource out there which suited me or anyone else with the same interests. And so, over the next year, I just compiled this ridiculously big website. I did so much research, learned so much, read so many papers. I built the website with the prime intent of showcasing and advocating for soil animals to a normal audience but have it be scientifically accurate and be a resource for everyone, from scientists to the general population.

MAF: So, in the insect world, there are also these charismatic macrofauna but at the insect level, so why something like springtails and mites, not butterflies?

AM: Because (butterflies) are beautiful, but boring. Everyone photographs them, everyone knows all about them. There's nothing there for me, nothing new to discover. Whereas in this soil world, it's still very much unknown. I've found so many new species, photographed new behaviour; it's an expanding world you can just keep exploring. It's so different.

FA: Yeah, it's the same for me. I like to march away from the sound of drums and go towards the stuff where there are few people doing work. We don't need more Lepidopterists. We need more Collembologists. There's

plenty of people already doing the bigger, charismatic stuff, and arguably, ecologically, I think the things that we're photographing are just as if not more important than quite a lot of the things that get a lot more of the money and the attention.

The other thing for me is it's really informed my research. I've learned a lot from observing these organisms in life, which you don't normally get to do, you know? Most researchers look at specimens down the microscope and they're already pickled. You can't really infer much beyond that, as for example, the colors have been lost. But if you actually get down with a camera and you zoom in on these creatures, you realize how beautiful they are, how charismatic and interesting they are, and you see all their ecological interactions (Fig. 1). I've learned so much about the behavior of these animals that it's improved my understanding of my research field in no small amount. So, the macrophotography and the research is kind of iterative for me; they just go hand in hand so nicely.

MAF: I met a molecular ecologist once who didn't know what a fruit fly was. They dealt with the genes, but they didn't ever watch the actual insects.

AM: But this is also why things like habitat is really important. It's good to have your context. You know, when you study Collembola, if you're not going to a forest, or into caves, or wherever it may be, how can you really understand what they are and how they work? You have to be immersed.

FA: And I would just add, also, there is this opportunity to make new scientific discoveries with macrophotography. Like Andy was saying, he's found loads of new species when he was traveling around Australia and New Zealand. I saw a defensive behaviour of the giant springtails here, from a photograph that I took. I didn't see it when it was happening, and then later on I noticed it when I was looking at the photographs, and I spoke to Andy. He went through his vast library of images of giant springtails and their relatives and saw something similar. So now we've got a research project, a paper that we're working on together that is based off of a discovery from macrophotography that no one else has seen before, which is amazing, really.

MAF: So, when you make a plan to go out into the field to take photographs, what decisions are you making out there? Is it, I'll set up here, and I'll wait and see what comes? As people who are used to looking at small things quite often, are you able to look at a small patch of, I don't know, moss or leaves, and say, okay, something is going on here, I need to set up here?

Figure 1. (**A**) Two juvenile *Podura aquatica*, going about their lives on a pool surface in Shapwick Heath, Somerset. 2021. Photo credit: Andy Murray. (**B**) A phthiracarid mite navigating a slime mold forest on a decaying log. Photo credit: Frank Ashwood.

AM: I don't know if you can actually use this, but (I've heard) it's a bit like looking for magic mushrooms as a teenager. You get a feeling for the right place. It feels like that to me. You go into some places, and you just know it's going to be good. There's something about how the forest floor is, or how the cave just feels rich and alive. Obviously, it's just picking up microsignals from lots of different things and compiling them, how the logs are on the ground, or the look and dampness of the leaf litter, or whatever it is. There's a qualitative difference and it just feels magical. You think, oh, it's going to be a good day. And it very often is. As far as focus goes, yeah, I've got huge focus, so I can go out for 8 hours, 10 hours a day. I can forget to eat. I just want to explore. I can spend 2-3 hours on a single area. Or if it's a dead area, I can spend 3 or 4 hours looking without finding anything. But the focus is there, because it's a treasure hunt. You're excited. And it's always the excitement of seeing new things, seeing some new behaviour, or taking a photograph you haven't taken before that's better than what you've done before.

There's an excitement. And then it's basically you and nature combined. And, without being too esoteric, when it works, you feel very much at one with that world. You disappear, and you become an observer with an ability to preserve moments with a camera. And that's amazing, being able to capture these moments because you built up the skill set that enables you to do it. That's lovely.

You know, the amount of times I go back over the years of photos and go, god, that was a good day. I love it. I have the same joy that I had 15 years ago. It's the same excitement and passion and love for the world I've had since I was little.

FA: Yeah, I feel very similarly. I suppose one thing that I've found is that having an (undiagnosed) attention-related disorder has been very helpful for this kind of thing. That degree of hyper-fixation that you can get once you get into something, when you find something novel, or you find something that stimulates you, or that you're passionate about. And especially if you are into biology or natural history, and you go out with the camera, it's addictive, that first time you get a good photo, or the first time you see a springtail, or you see a mite, and you just want to do it more. When you get out into the field with your camera, like Andy was saying, you need to plan to go out for a day, really. I've had times where I've had an hour or two to go and do it, and it feels very stressful and very rushed because I'm up against the clock, and I'm trying to get a good shot, I'm trying to find something, and I'm not enjoying it in the same way. I think it's nice if you can just give your day over to it, if you have that luxury or privilege, which obviously not everybody has. Yeah, for me, it's kind of that same excitement of treasure hunting, as Andy said. And sometimes you get a great photo, and, like Andy said, you've improved upon your previous work, captured a behaviour, or you've captured an angle in a way that you hadn't before. And for me, now, it's also thinking about the application of those photographs. How can I bring the passion that I have and try and spread that, to encourage more people to get out as well, because it's not just about us, you know?

It's nice to try and encourage broad communities and people to go out and actually get out into nature and do some of this, see things from their perspectives, and from different angles, and in different parts of the world, because the more people that could do this kind of thing, the better it is, I think. I've seen the benefits as a scientist in being able to communicate my research through that, but also Andy and I have been contacted by many academics as well as artists, science communicators and storytellers who want to use our images to help convey their stories.

AM: Unless someone's doing a field project in New Zealand on Stewart Island, when they're absolutely not allowed to take their own photographs and they have to employ me to come over and do it.

FA: Yes, Andy's angling for another free trip to New Zealand. I don't know if you know Stewart Island, but it's a very special place. It's a little island that's set off from the south coast of the Southern Island, and it's full of incredible biodiversity, incredible springtails, incredible mites. You have to get a little plane and fly there. You see Kiwi walking around over the fields at night. I've never been, I'd love to go, it is an incredible place, apparently. But yeah, to just get lost in the forest there for a couple of days with a camera…the stuff you'd see would be incredible.

MAF: Yeah, I can only imagine the new species and the behaviors that no one's captured before that you guys would see.

FA: I think moving to New Zealand's actually been incredibly good for my passion for macrophotography as well; going where people aren't, not just in terms of subject matter, but also geographically. A lot of Europe's been categorized now, even from a soil invertebrate perspective, so it's nice to go to places where you've got a chance of seeing something new or incredible that is new to science, or just something you hadn't seen before. Yeah, it's a bit of a gift being here at the moment.

MAF: So, you both have huge communities of fans who follow your work and you both have this talent for really capturing a world that nobody either knows about or rarely sees, because we're big, the soil world small. When you are taking photos, do you think of your work in an artistic way? Do you also think about the educational possibilities of your work when you are out in the field? Would you guys be able to talk a little bit about that?

AM: I think artistically now, but when I started, I didn't. For a lot of amateur macrophotographers, the tendency is to photograph soil animals from weird angles, but with a bit of effort and practice, you can come down and photograph them at their level. The angles are really important, as are colors. So, you have to think of all this sort of stuff when you're doing it, because no one wants to look at a photograph that's not visually stimulating. At the end of the day, I do want to excite people about this amazing world. So, the photographs have to tell as much of the stories as they can and drag people in. My best photographs are often very brightly colored, well-lit, and hopefully look natural (Fig. 2). They have to feel dynamic, whether that's through color, movement or just something happening. Hopefully it's not static and boring. But it's hard to achieve.

FA: I started out with my biologist/scientist/researcher hat on, so my early stuff was just not particularly artistically interesting at all. I was more going for biological accuracy or identification of the organism. I was just taking a recognizable photo of the thing. Over

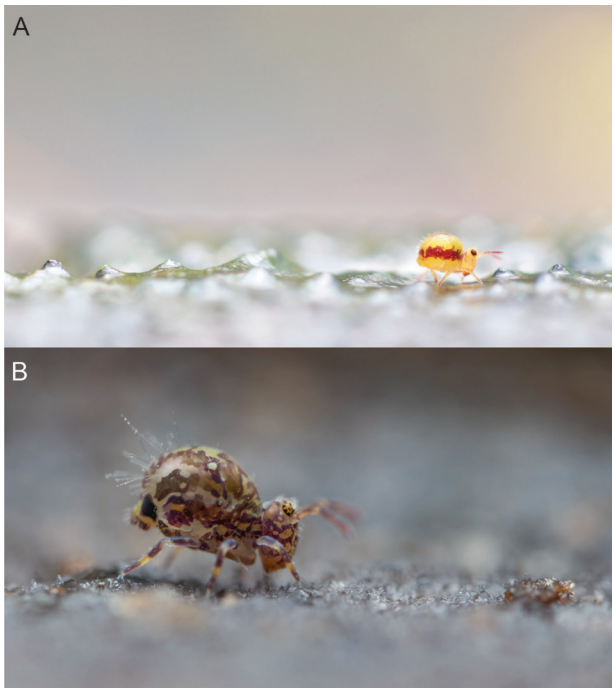

Figure 2. Two approaches to photographing globular Collembola. (**A**) *Sminthurides malmgreni*, 2020, Dundon, Somerset UK. Photo credit: Andy Murray. (**B**) *Calvatomina superba*. Photo credit: Frank Ashwood.

time, I've learned to try and be a lot more creative and artistic with the compositions. It's always a toss-up, but for me, it's the challenge of parking my scientist brain a little bit.

At the same time, I often do a lot of things for platforms like iNaturalist, keeping biological records and observations. I will always try and get a few photographs at the same time that are useful from an identification perspective, that won't necessarily be beautiful compositionally, and I won't use those on social media, or on my website.

Hopefully this article can be of similar use for people who are getting into macro photography, and I hope they take Andy's advice of coming down to the animal's level. Getting as low as you can was the most useful thing Andy taught me. If you've got a springtail on a leaf, you need your camera to be horizontal to the surface of that leaf, basically. It's humbling, I guess. A lot of people have never seen these creatures in reality, and maybe never will, and so being shown not only, hey, springtails exist, but they are incredibly beautiful, and this is what they look like, and if you were a mite, if you were tiny, this is what you'd see. There's this whole micro-world playing out underneath your feet that you have no idea about. I mean, what could be more grounding than that?

MAF: So, one thing I wanted to bring up is that, in this same issue of Soil Organisms, there's an article written by Leandro et al. (2026) that is on how people feel about different kinds of images of springtails. And in particular, people were reacting to body shape, but also, the artistic choices of background color. As Frank mentioned before this interview, seeing lots of Collembola in a photo was distasteful to people, because they got this kind of swarming feeling. It was really interesting to see, from a public perspective, what components of a springtail image were more or less attractive. I think this is kind of an amazing tie-in to exactly what you guys have been talking about.

AM: I have a couple of things that I can add. When I do public talks, which isn't very often, because I don't like them, it becomes obvious that I'm obsessed with how cute springtails are. They're the gateway animal into the macro-world. They're colourful, they're cute, they've got big eyes, big heads, they hit all the things that babies do of every species. And people's reaction when they see a springtail is 'Oh my god, it's really cute!'

Mites can be a harder sell. But there are some obviously very cute mites. And, also, very much so with *Forcipomyia* the fungus gnat larvae, they can be very, very cute. Like revulsion, finding things cute is a very human response, right? It's not scientific, it's just that built-in response we have. And I think it's very useful to have it, because it means people are able to break down those barriers that make them think, 'oh, this looks icky', or 'they're too small','they look like little creepy bugs', or 'they've got too many creepy legs'. As soon as they start thinking 'actually, they're rather cute and sweet', people's defenses are down, and they start thinking, "oh, maybe these things are actually interesting". So, that's always been my way in to teach people about these amazing animals, and Frank will tell you, I often talk about how cute things are. It's a genuine response, too. I genuinely find them cute, and I absolutely love them. I have such a deep love for them.

MAF: And viewers also like to see eyes.

FA: We all do, yeah. Get the eyes in focus, and that's most of the work done.

AM: It is because we're built to have pattern recognition, and we're built to find big eyes appealing. And if you can look at someone's eyes, you can kind of read them better, and we apply it automatically to everything else. As soon as something's got eyes, we immediately feel an affinity, I think, more so than not.

FA: Which raises an interesting challenge when you're photographing things without eyes, because a lot of the animals that we photograph actually don't have eyes. So, the question is then, what do you do? Instead, you

look for trichobothria on an oribatid that are in the same place, or post-antennal organs on a symphylan. You have to try and find something that's an eye surrogate.

AM: I do exactly that with the oribatids. If those are in focus, I treat them like eyes, absolutely. Other animals such as proturans (coneheads), don't have eyes, just a smooth, tiny head, so I try and get that in focus instead.

FA: And then sometimes it's more interesting when there aren't eyes, because, for instance, with the proturan, if there just aren't eyes, then that's so weird-looking that it, in a way, is impressive in itself.

AM: I'm still really shocked at myself, after all these years, to be so deeply in love with these animals. It's beyond anything else. And it's such a funny thing to be in love with something you can hardly see, that aren't aware of your existence. And yet, they consume so much of my life. I was saying to Frank another time, that I can't do talks without getting emotional. As soon as I start talking about them, I well up and my voice cracks and I can't speak because they're so incredible to me and I feel so passionate about them. I just want everyone to know about these amazing animals too much. Another reason why I can't really do public talks! Frank is so much better at that kind of stuff than I am.

FA: (Jokingly) Oh, yeah, I'm dead inside.

AM: No, not true! But when it comes to soil animals and springtails in particular, my emotions are on the surface and I have no barriers at all anymore. It's like showing something profound at the heart of me that's beyond precious.

FA: I've had the privilege of doing macrophotography with Andy in the field, and it is really inspiring. His passion's very infectious, and I think you find this with anyone who's passionate about their subjects, when they start talking to you or showing it to you. It really was nice going out with Andy in the field, both here in New Zealand, but also down in the southwest of England. I think that really helped my own passion for the subject, being exposed to someone who is so deeply passionate about it.

AM: But it's also an essentially human thing as well. I'm really glad that I can connect in that kind of way. And Frank, for all his being dead inside, he's not, obviously. Connecting with nature, knowing you're not at the center of all things but you're a part of everything is a really important and profound thing that humans need. And to get there by looking at soil and soil animals is amazing, and that there's a world going on you have no idea about. And then beyond that, it carries on at an even tinier level that you can't even perceive without high-powered microscopes. It's turtles all the way down. A bit like your book, Frank.

FA: Thanks for the plug.

MAF: Yeah, can we touch upon that?

FA: We can, yeah. It is quite a privilege that we have, I think, to be able to bring this world to people, and hopefully try and encourage people to do it themselves as well. My book is another way to communicate the importance of these animals, and the importance of this world that most people have never even heard of. Because it is important to us. Whether we know about it or not doesn't change the fact that most of what we do on Earth is supported by the activity of the life in the soil, and we only can really live on this planet because of what's going on in the soil. It's nice to have the chance to broaden people's horizons and bring that sense of importance to them, so that hopefully more people can protect the soil themselves. That's the idea of my book. It's called 'The World Beneath Our Feet', and it's being published at the end of August 2026 in the UK, Commonwealth and across Europe, and at the start of September in North America. Ultimately, it's a love letter from me to soil and its biodiversity, written as a popular science book. It's my own effort to try and encourage people to fall in love with soil and soil animals in the same way that I've come to love them. And by the end of the book, I hope that people will feel a need to, and a *want* to, get involved and protect the soil in their own little corner of the world, as much as I want to do. I've put a lot of what I know about soil life into the book. Hopefully it will, in its own small way, bring all the love we share for soil organisms to broader audiences. Because we need as many people on board as we can get in order to protect soil for the next generations. So, yeah, it's a small contribution, but a real privilege to be able to have done that, and thank you, both of you, for helping me along on that journey: Monica as an interviewee, and Andy as an unofficial copyeditor. Oh, and it's got lots of my photographs in it, of course.

MAF: So, what materials do you consider critical to taking the photograph? And after you take the photograph, without getting into specific brands or software packages, are there specific tools that you use in post-processing?

AM: So, I have a few criteria. You've got all the usual things, like waterproofs, good boots, and a head torch. I

always work with a torch on a little tripod because you need to illuminate what you're photographing (Fig. 3). Diffusion is king. So, with flash photography, which at that level of magnification, is essential, the better diffusion you have, the better your photograph is because you're basically wanting to emulate a natural light.

Figure 3. (**A**) Ashwood photographing springtails on a decaying branch on a farm in Hobart, Tasmania in 2023. Photo credit: Chris Wieffering, Soils for Life. (**B**) Murray taking photography on the Yucatán Peninsula, Mexico in 2017. Photographer unknown.

You don't want specular highlights or over-expose your image. This still happens of course, but you try and avoid it. I would say that diffusion is the top priority. And bug spray.

It is possible to do springtail photography without a flash using natural light but they have to stand still for a very long time and you would need a tripod. With a flash, the photo is immediate and you can photograph fast-moving tiny animals relatively easily. Because of the high magnification I have, my setup is getting on for half a meter.

I often stack, which means taking a succession of photographs at different points of focus, and then putting the photos together with stacking software. The results can be fantastic. If an individual is standing still, you can take shots at f4 or f5, and then put 3 or 4 photographs together, and have a more in-focus photograph with fine details, often making a better photograph. A case in point is my main photograph on the website, which is a pink *Pseudachorutes* species of springtail (Fig. 4) eating a slime mold fruiting body with its two front legs balancing on top of the fruiting body, with its four legs stabilized on the ground.

FA: An incredible image.

AM: I'm really proud of it, and I knew it was going to be good when I was taking it. I was just so pleased it worked out, as it was stacked from around 7 or 8 photographs put together. I was just really lucky that it didn't move. It was wandering on the ground, before it stood up, and as soon as it did that and balanced itself on the fruiting body, I could see that was a potential dream photograph. I took a few stressful minutes to get the camera position and lighting right. It was a fight against time, but it was worth it in the end.

FA: So, my setup is a little different to Andy's, as I realized when we were out doing photography together for the first time. Your setup, like you said, Andy, is quite substantial, and geared, primarily, towards photographing very small springtails and mites and can be a bit of a faff to photograph anything larger. With my setup, I'm not going out specifically looking for anything in a particular size range most of the time, so my setup is much less powerful than Andy's, but it's a bit more flexible in the moment. I use two lenses that I can swap over if I need to. One's got quite a wide range, so I can photograph quite big things, down to two times magnification and outwards up to landscapes. If I want to get something smaller and I see something, I can quickly change lenses and go down to five times magnification on a different lens, so I can do the small stuff, or I can do the big stuff, and it's quite reactive. I'm not locked in like Andy is, but then sometimes I can miss a photo, because I'm busy changing lenses, and it's very frustrating. So, I've always got that kind of tradeoff going on, but I like having that flexibility, because I like to photograph lots of different things. So,

Figure 4. A *Pseudachorutes* species on a slime mould fruiting body in Cape Tribulation, Australia, 2016 is an example of "stacking", of putting together multiple photos to get a sharper image. Photo credit: Andy Murray.

the kit that you take will be just based on and informed by what you really want to achieve and what you set out to do. Andy's setup is really incredible, but, yeah. I also don't know enough about photography, technically. I could learn, but I'm too busy and lazy to sort of jerry-rig my own really impressive kit like Andy's one, so I just go with off-the-shelf stuff.

There's a series of camera lenses by a Chinese manufacturer called Laowa, who make very affordable, but very good, macro lenses, and I tend to lean on those. And, like Andy said, the flash and lighting is so important. When I'm out in the field doing my photography, quite often, people will come over and talk to me when they see me taking photos (which Andy would hate completely, but I quite like it) and they are like 'oh, what are you doing?'. Because it does look weird. I look a bit like an insect, or like a giant version of the things we photograph. I've got a twin flash and diffusers on the ends of two bendable arms that look like antennae that flash. But it's a really nice flash, because you can get light from two different sides, or you can bend them around, and you can change the intensity on the fly. I guess my entire setup is designed to be in the moment, and very changeable. Which means I probably miss as many good shots as I take, but I quite like having that flexibility available to me. I can't really add a lot more to what Andy said. The kit's important, light's really important, and patience, like we touched on earlier. Being willing and able to just lay down on the forest floor, or whatever, and just sit there hyper-focused on something for a long period of time with no promise of reward is key. And, I don't know if you said it, Andy, but also having a little hand lens with you, a little magnifying glass or a loupe.

AM: Oh yes, good point.

FA: I'm short-sighted, so I benefit from that. I can see the tiny things on the logs quite well. I can't identify birds, I can't see them, they're a silhouette, and that's why I'm not an ornithologist. But I can see springtails, and I can see little the mites. It's really helpful for most people if you have a little loupe on a lanyard around your neck, so that you can just pull up times 6, or times 10 magnification is ideal, I guess, depending on what you prefer. And then you can see a lot of these things before you photograph it, so you're not committing to taking a photograph of something you don't know is there.

We touched on it earlier, but in post-processing, just to add to what Andy was saying, a lot of people think, oh, you're amazing at macrophotography, you must take such great shots straight away. But it's really about the scattergun approach, it's throwing mud at the wall and seeing what sticks. You know, for every good photo I take, there's 10 probably, easily, that weren't very good that get binned. And so it's just being willing to sort of kill your darlings and sacrifice the ones that aren't great. Just know that people aren't going out there and taking perfect macro photography images first time. There's a lot of really bad photographs and you just don't get attached to those, and you drop those, and you're looking for the diamond in the rough. So, that's patience as well, in going through and doing that. And I never stack. Things move too fast. I don't know how you stack, Andy. I never manage to get multiple photos.

AM: It's just more about patience. And I was just gonna add that as you get better, what you throw away increases. Because your standards keep on going up. And so, what was acceptable to you a year ago is now no longer acceptable. Stuff I would have been getting excited about when I started, now I would just delete it straight off my camera, I wouldn't even bother getting it on the computer.

And just going on from that, there was a funny story after I had decided to go to Australia and New Zealand to see the giant springtails, leaving my job and home and UK life. While I was totally obsessed and hugely passionate about springtails and macro photography, I was honestly still stuck at the standard of someone who was taking endless out of focus holiday snaps until about 3 months before I left. I was gambling everything on getting good in time. And it's still very strange looking back at the photos from that time, as there's a moment where my photos drastically improve, on the same day I started using a new flash unit and actually took my first photograph using it. It was of a 1mm big springtail- a female *Smithurides aquaticus*, sitting on a strand of pondweed. It turned into a really beautiful picture, and everything clicked into place. I gained confidence and my photos began looking professional from that moment

The only other thing I was going to add is that while Frank isn't diagnosed with ADHD, he definitely feels neurodiverse, in my opinion! I'm autistic, with Tourette Syndrome and OCD, and most of those can be very useful combined with macro photography. And me and Frank have talked about this quite a lot. In the scientific field, and especially in more obscure niche areas like soil animals, I suspect that there are a lot of people with autism making use of this sort of focus we often have- the sorts of people who obsess about stupid, obscure things, and make them their life. It's very much part of the autistic experience. When I first got into soil animals, it was very much a feeling of finding my people for the first time. I've met people all over the world with mad interests in millipedes or mosses or slime moulds or Collembola. It's all the same passion, the same obsession. And those people are often neurodiverse and using those traits to a really positive extent. You know, it's the best placing of someone who struggles with being around people,

maybe, or doesn't like talking so much. It means those people can expand into this amazing universe instead, where you don't need to talk so much or interact so much with others. And that provides a way into society if you want. Because you love it enough that it breaks down the boundaries. So, it's been very, very good for me to actually have this passion because I think without it, I would be far less communicative around people. It's given me a really interesting life because of it.

FA: And it was very well said.

MAF: Fabulous. That's fabulous. Well, so the next question I want to ask you both, and you can be as specific or as nonspecific as you want: What are your favorite organisms to photograph? But also, what are your most challenging?

AM: Well, Frank knows my answer. So, do you want to tell her?

FA: No, no. I'm not gonna put words in your mouth, Andy, go on.

AM: Yeah, well, it's obviously springtails beyond anything else, because they're my first love.

MAF: Do you have a favorite family that you like?

AM: To be honest, and Frank will probably agree, it tends to be globular springtails. They're just so photogenic. Obviously, the giant springtails, the *Holacanthella* (Fig. 5), are stupendous. And that's kind of a separate thing, but as an overall group, it has to be globular springtails, with an addition of cave springtails. My completely perfect scenario is sitting in the dark, in a cave, watching cave springtails subsist. And they're often very unusual, because they've got adaptations. All these boxes are ticked, and you've got this slow drip on the cave walls, the dampness, the quietness, and all the echoes. It's such a nice experience. It's a sensory enveloping of everything. That's my favorite place to photograph anything, with rainforests as a close second. The hardest to photograph are animals that are fast-moving, like diplurans, with long antennae and cerci. I've been trying to get decent photographs of them for 15 years and in that time, I've probably taken about 5 decent pictures, because they're so fast. Yeah, I would say above and beyond anything else, I think those are probably the hardest for me.

FA: I'll work backwards, and start with the hardest, I'll build off what Andy's just said. Anything not fast, but also anything that's also long and thin. So, like Andy was saying with the Diplura, and it's the same with symphylans, and the same with tiny centipedes. Anything that's long and thin, because in the photograph, you want to get the whole thing in focus, and so if that entire body isn't all in the same plane as your focal point on that shot, then the photo's no good. And that's basically impossible to achieve. Especially when you add that diplurans have got two-pronged tails going off in different directions. How can you photograph that? So, yeah, they're eternally frustrating.

Figure 5. *Holacanthella paucispinosa*, a giant springtail of New Zealand. Photo credit: Frank Ashwood.

I really love photographing pauropods, because I don't see them very often, but every time I manage to get one of their little biramous antennae in focus, it's a joy to me, the incredible complexity of their little antennae. Proturans as well, because I rarely see them, and I have Andy to thank for showing me most of the proturans I've ever seen, especially the big ones. And giant springtails, of course, because I'm obsessed with them, as Andy well knows. They are quite difficult to get a really good photograph of, because they've got so much going on in so many different directions, and you want to get the eye in focus, but then you've got all of the digitations, and it's actually surprisingly difficult. One of my favorite photographs of a giant springtail was actually face-on, and it was coming at the camera, and I managed to just get enough of the head in focus with the eyes and the antenna, that it just looked like it was kind of coming out of the mist. It was really cool.

Going back to where I started in soil ecology, with earthworms: I don't do enough earthworm photography, and I really must get back to it more, and show how surprisingly beautiful earthworms are. They're not just useful ecologically, they are actually quite stunning in their own way. They've got iridescence to their skin and the muscles underneath. They've got these tiny little backwards-pointing setae running down the lengths of their body, like little teeth. They've got really inquisitive, curious minds, almost, where they reach out with their little prostomia (their noses), and sort of tentatively pat things, and they're beautiful colors as well (Fig. 6). They're quite good to photograph as they're not fast moving, they're meek, and so they're quite patient subjects. So, I really need to get back and take some more photographs of earthworms, because they really need a lot more love and a lot more representation, and they are quite a joy to photograph, actually. I don't know if you've ever done that, Andy, have you photographed an earthworm?

AM: They're too big. I photographed some, but I'm not set up for doing big photos as you mentioned. And, actually, I'm not very good at it. I've got no feel for anything much bigger than a millimeter, really. You know, obviously, giant springtails aside, that's at the limit of what I enjoy. Anything bigger than that, it's not fun for me, really.

I was also just gonna add that the taxon that I'm most proud of having photographed are the proturans, even though proturans are so obscure, and hardly anyone cares about them. They're really wonderful. They're very hard to find, as they're very small and thin, colorless, and very weird looking. Basically, I somehow managed to photograph this enormous species, which was a millimeter and a half, two millimeters big. And I think I got some very cool pictures, and I still can't believe my luck. I was shooting at 12 times magnification, my limit and the photos still work as actually beautiful, nicely framed photographs. I thought at the time- I can't do better than this! I was so pleased, especially, because I think that's the ultimate of what my setup can achieve. So, I think that's a really good end point for that.

Figure 6. The prostomium of earthworm *Aporrectodea longa*. Photo credit: Frank Ashwood.

FA: Yeah, I would add just mine, as you've inspired me there, Andy, and it reminded me. I photographed a tardigrade with my setup. People only look at tardigrades down microscopes, for obvious reasons, sanity being one of them, but I thought, what if? And so, I bolted on all the extension tubes, got as much exterior lighting as I could, and managed to pipette out a single tardigrade and then I photographed it going into its tun state. I also had some swimming, which was a nightmare, trying to navigate the reflection off water and all that kind of stuff. But I managed to push my photography setup to its absolute limit, and I was quite proud of that. I think I'm still one of the few people mad enough to attempted to actually use a DSLR camera to photograph a tardigrade. It was a good challenge. I haven't tried it since, and I won't do it again, but it was a good proof of concept.

MAF: You've both shared some pro-tips and advice already, but there are many people who are thinking of alternative career choices outside of academia, maybe adjacent to their research. What do you all think of macrophotography as kind of a burgeoning career choice for someone who maybe doesn't see their future in research but really wants to maintain their relationship to the organisms that they love, soil organisms in this case.

AM: It's not a career choice, but I would say it's super important to follow it if you have even the slightest urge, even just using a macro clip-on on your phone so you can get in close. Do it, because it does nothing but add to your wonder of the world. You're not gonna make much money from it. I've got a very good profile online, I've got a few jobs out of it, but I'll never make enough to survive just taking soil animal photos. It's a passion project and I'm driven to do it. But yeah, I think you'd be foolish to think you could make a decent living. I've done better than most. I've had some years where I've made £7,000 out of my photography, including being paid for going on field work and stuff like this, but it's very unusual. Get a clip-on for your phone camera, and just do anything that gets you out there, looking at stuff, and enjoying the quiet of being out in nature. I think it's of benefit to everyone. It's a wonderful thing.

FA: Yeah, I would second that and just say, the added value that it's brought to my career or to my life has just been incredible. I got a trip around Australia, touring farms out of having a little bit of a profile as a macrophotographer to go and look at soil life, and probably never would have gone to those parts of Australia otherwise. And you get these opportunities that come out of it that you never would have expected, and collaborations, and you make friendships, you know? I got to make friends with Andy. I don't know if our paths would have crossed otherwise. I wouldn't go into macro photography looking to make your millions, because that's not going to happen, but you gain a sense of joy, of exploration, and an understanding about the world and your place in it. Also, the community and the friends and the things that you can get out of it are much more than I would have expected. I didn't have any expectations going into it, I just picked it up because I liked it, and I enjoyed it, and it's led to so many other opportunities in my life that I never could have predicted just by getting known for my photos. It's really helped my research and academic work, as well. I look at macrophotography really as a way to help communicate about the subject I love with people, and I think that's a very good way to spend my time.

In terms of getting started, my first kit (and Andy gave me advice on this) was a second-hand DSLR camera, nothing fancy. I think I spent about £100 on it. And I got a second-hand macro lens, a Sigma lens that probably cost about £50 or £100. And I bought a clip-on macro lenses called a Raynox DCR-250, which basically turns any lens into a macrophotography lens. I think that cost less than £100. Pop that onto a lens, and you've got two times magnification. Bingo. You've got a macrophotography set up. That's how I started. You're not gonna get incredible photographs of mites and springtails with it, I know I didn't, but it's a start. And you can definitely photograph bees and beetles and woodlice perfectly serviceably with that. And then you'll get a handle on if you like it. So, for a relatively small outlay, you can just get something to practice with and find out if macrophotography is for you. But I would encourage anyone who's got a passion for natural world, or anyone who's doing soil ecology, or any kind of ecological science to just get out there, and you can do it on the cheap. I will warn you, if you get obsessed with it, which you probably will, you will end up pouring a lot of money into it that you probably don't have. It can be a bit of a financial trap with lenses and cameras and things. But you can improvise your diffusion. I made my own first flash diffuser out of a sheet of A4 paper, so you can do things on a budget. Just get out there and have a go. It may not be for you, but I think it can only bring good stuff to your life, if you give it a try. And, certainly, for any academics who are passionate about a particular taxon, you could email Andy and me for a photograph, and I'm sure we'd be very happy if you did. But I'd actually be happier to know that you went out and took your own photograph, and share it, show us what you've done. I'd prefer that than you using my photograph. I'd like to see what you can take and for us to build up a soil animal macrophotography community.

AM: I think it's very important to factor in macrophotographers into any grant application or

project. For field work this is something I think should be a regular thing to happen. A bit like when you do a housing project and you always have to have an archaeology survey done first. That would be very nice.

MAF: So, what is next for the both of you? Are there animals that you are looking forward to photographing that have eluded you that you want to attempt to find? Frank, you've just completed a book, but are there projects that you are thinking about for the future?

FA: Well, I can predict what Andy's answer's gonna be, and that's to get back over to New Zealand with his camera ASAP. And I think we've got a plan potentially in place in the not-too-distant future, hopefully. For me, I really want to get over to Tasmania, and I want to photograph some of the dragon springtails they have there, because I still haven't seen them. So far, I've only been to Tasmania briefly once, and I went looking, but they eluded me. So, I really need to get over there and photograph these, because they are incredible creatures. That's my number one bucket list item. And yeah, I've been very busy lately with the book and becoming a father, so I feel like I've done enough for a little while, and I kind of want to rest for a bit. But, also go to Tasmania and photograph dragon springtails.

AM: I would say apart from getting back to New Zealand, which is my favorite place in the world, (apart from Yorkshire, obviously), I would say I'd like to get to places that are disappearing, like Madagascar and actually photograph some of those amazing springtails that must be there that I don't know anything about. Things like that. And more caves. I'd love to get into some karst systems that haven't really been explored. But apart from that, no, I don't really have any bucket list things. I'm inquisitive, so I like finding out new stuff, so I would say anything that piques my interest is going to be good. It doesn't really matter what it is.

FA: I think that's the nice thing about macrophotography, is because you never know what's under the next log. You can go to the same place you've gone for 10 years and something new might be there that you just never saw, and that's the wonderful thing. You don't have to travel the world, you can do it where you live, and you always have the chance of seeing something new and exciting. And I'm not sure what other hobbies you can say that's true for, really.

AM: Yeah, no, I don't think there is anything else for me. Macrophotography has kept me interested longer than any other of my many varied interests over the years. It's very much a gift that keeps on giving, I think. And the fact that it's so useful - you're providing information for science, helping understand biodiversity and soil health. It's useful, and wonderful and expansive. And it's full of nerds and unusual people, and people that give a crap. And that's delightful, to find people that are passionate. There's nothing worse than being around people who are dead inside - not like Frank, who isn't at all. It's awful, because they're missing out, and they don't realize what they're missing out on. Life can be rich, and passionate and full of joy, not grey and boring. Life can be horrible as well, and the world isn't great at the moment, but within that, there's some fabulous stuff still there to be found.

To concentrate on the small things is really important, because it's all about perspective. Those tiny lives go on no matter what. You know, we'll all be gone and these things will just carry on, as they have done for hundreds of millions of years. And we just have this wonderful little window into this amazing world. And, you know, it's so transient. I don't believe life has any particular point, other than we have the chance to be alive, and that we should make our own reasons for being here. In the end, of course, our photographs won't matter at all. In the grand scheme of things, it means nothing. But at the same time, it means everything. For me, exploring and photographing this incredible hidden world is how I experience love, passion and joy for the world. So, that's enough. I don't need anything else. I don't need magic or fairies at the bottom of the garden or anything else to make life more wonderful, because it's already about as wonderful as it can get.

MAF: Boom.

FA: I'm not gonna top that.

Aside from the website, A Chaos of Delight (https://chaosofdelight.org), Andy Murray also works as a freelance copy editor and maintains active Instagram (@soilanimals) and Bluesky (@mesofauna.bsky.social) accounts.

Frank Ashwood also highlights the lives of soil animals on his website, FrankAshwood.com (https://www.frankashwood.com/macrophotography), and active Instagram (@frank.ashwood) and Bluesky (@frankashwood.bsky.social) accounts. More information on his new book 'The World Beneath Our Feet: The Hidden Life of Soil and Why It Matters to Us All' can be found at Penguin Random House (U.S.) and Waterstones (UK, Commonwealth, and Europe).