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I: Welcome to IFLScience, The Big Questions. I'm Katy Evans, Managing Editor at IFLScience and I'll be your host. In this episode we're discussing the big question: is evolutionary biology sexist? "Science can't be sexist," I hear you cry. "Science is methodical, it's rational". Well, science is carried out by humans, who are often products of the time and place they're operating in, and we as a species generally struggle to overcome our own biases. Something my guest today discovered while writing her eye-opening book, *Bitch: A Revolutionary Guide to Sex, Evolution and the Female Animal*. I'm joined by zoologist and author Lucy Cooke to discuss how sexism has shaped our understanding of female animals, and let's see if we can debunk some myths along the way.

I: Lucy, thank you for joining me today. Can you introduce to yourself to our listeners and tell them who you are and what you do?

R: Hi there, Katy. I am Lucy Cooke, and I am as described, I'm a zoologist and author and occasional broadcaster. I'm very interested in the space where culture and science meet so a question like "is evolutionary biology sexist" is right up my street.

I: Literally the perfect person to discuss this episode's question. Do you want to attempt it in a one-word answer? This could be the quickest interview in podcast history.

R: Broadly, yes. I would say that with a caveat. I would say that evolutionary biology has a history of being extremely sexist and is becoming less sexist, would be the answer that I give.

I: I don't think that it should be in this day and age breaking news that bias and confirmation bias exists in science and that science can be and has been influenced by the people that are carrying out that science, especially because historically it's been traditionally men who are also products of the historical time period that they've been working in, and particularly in patriarchal societies. However, I was not prepared for the extent to which biases influence what we consider facts about male and female behaviour in the natural world and how much it has influenced the entire field of evolutionary biology until I read your book, *Bitch*. I do have to say I am curious what pushed you to write that particular book when you did. Was there a tipping point when you realised that no one else was addressing this massive elephant in the room and it was going to have to be you?

R: So I'd written my first book about how we misunderstand animals by anthropomorphising them. Essentially that's what *The Unexpected Truth About Animals* is about. As I said, I'm really interested in that place about where culture and science meet. And so I was sort of fishing around for a big idea for my next book, and I suddenly thought to myself, well, what about, because I love telling stories that make people look at the world in a different way and just

change the world view. I thought to myself I wonder whether females have been misunderstood, you know, whether maybe there's a big story in that. And then I did a little bit of digging and found, yeah, they have, and then discovered that there was a story there. But even I was shocked at the size of the stories. I didn't realise it was going to be so massive. The timing of it was simply that it was just when I had another book to write, so it was nothing magical about that. I wish I could say that something amazing happened that pushed me into doing it, but simply I had a book to write, and I thought that that was a good idea. But I was shocked at what a massive idea. As I started writing it, I thought this is just so huge, how come nobody's written this before? I kind of got really nervous and then I got in a real panic because I thought I've got to get this done quickly because somebody else is going to do it because it's enormous. It was actually a bit of luck as much as anything else.

I: When I was reading it, I was like "I can't believe no one has tackled this massive topic before" as well. You say that you were shocked by the scale of it, were you surprised at some of the things that you discovered? You're a trained zoologist, you trained under Richard Dawkins, did what you discover contradict what you were taught when you were being trained as a zoologist?

R: 100%, yeah. As you say, I was taught by Dawkins and was taught the standard Darwinian line of sexual selection, sperm are cheap and eggs are expensive, and males will be promiscuous, and females will be choosy and that's the end of that. That's the story, that's the universal law, that's how it works. In fact, I even quote Dawkins from *The Selfish Gene*. He says that there's no such thing as excess for a male, you know, this idea that males could just have unlimited amounts of sperm. That's exactly what I was taught and when I was at university I was fascinated by sexual selection. I loved it as a subject because I love weird and wonderful animals and adaptations and, of course, sexual selection has produced some of the maddest traits in nature, the crazy adornments of males, be they armaments or ornaments, are all down to sexual selection. I just sort of gobbled all that up and was like this is just fantastic. But god, as a female I'm on the losing team, it's the guys that have all the fun. They're the promiscuous, aggressive, competitive dominant drivers of evolutionary change, and we're just -

I: The protagonists of their story.

R: Exactly, a feminine footnote to the macho main event. It made me a bit sad. Back then I was way too green around the gills and in awe of my tutor to challenge those ideas. I did at the time think to myself if males are all promiscuous and females are all seeking chastity, then like, that just doesn't add up? Who are the males having sex with if the females are not? It did sort of trouble me, but I didn't feel at the time I was able to challenge these ideas.

I: I'm hoping that we can talk about some of the big myths that we can debunk right now. I know reading in your book you have a thousand examples of the way that female behaviour just does not fit into our very traditional idea of how natural selection in the natural world works. I'm hoping that we can kind of debunk some of the examples of sexism, confirmation bias, patriarchy that affected how we understand female behaviour, female sex, even female anatomy. I think the first one that we can go quite hard on is this idea that females in the natural world are passive and submissive.

R: Yeah, I know, that's really, really pervasive. That one goes all the way back to Aristotle, actually. Because because sperm are mobile and eggs are sedentary, females are passive and males active because of their mobile sperm. That idea is... the idea of female passivity and males being active, basically males act and females react, that still lingers in the language of papers written today. It's like it's a real sticky one and, as I say, goes all the way back to Aristotle. And, you know, it just isn't true. It just is not true. So what it comes down to a lot of it is that male tussles over dominance are really eye-catching. Males in many species will fight each other for dominance. That's really attractive, so that drew the attention of the male scientists that were in the field. They're like "oh males must all be dominant so they're dominant, and so the alpha male, he's leading the pack and he has all the power". And nobody bothered to look at the females at all. Of course, in primates, females very often have their own matriline, they have their own hierarchy and because they're very often the resident members of the group, so males literally come and go in a fist fight, they will move into a troop and then they'll fight and they'll have dominance for however long, let's say they're capuchins or whatever. But the females, they don't move, and their status is inherited. They have a huge amount of power because they're the ones who know where all the food is, where the fruiting trees are because that information is passed down the line. I think there's a really interesting discussion going on now about how we look at power within social structures, because it's been classically defined in terms of dominance and dominance has been a masculine thing that centres around males fighting one another. Actually, power resides in lots of ways. Power resides in females having the ability to say "no I don't want to have sex with you, I'm going to have sex with that male over there instead". And female choice gives females an enormous amount of power, or power that comes from knowledge. A great example are the orcas. I love this story, because everybody always assumed that orcas were social creatures and they live in these big family pods, that the males are in charge because the males are big and there's this very lazy assumption that equates size with authority and that the males, because males are bigger, they must be the ones that are leading society. Well it turns out in orcas it's not the males that are leading the charge, it's the females. Not only that it's the post-menopausal grannies because they are the ones that are the old wise ones.

I: I love the grandma power.

R: Granny power, I know. So, they have these extraordinary long lives, as we humans do as well, which is like freakishly long. Orca females have been found to live to 100 years old, as do humans. And the reason why these females are leading is because they live longer than the males and they become the repositories for ecological wisdom that keep their hunting clan alive. So the power there has nothing to do with size, and nothing to do with sex. Then you have in other groups like the bonobos where females are smaller than males again so they could be dominated by males physically as chimpanzees, the males dominate the females. But the females have formed a very strong sisterhood which is forged and maintained by having sex with each other, so that dampens the aggression that you'd otherwise find between unrelated females. They form this really tight sisterhood, and the females are more powerful than the males as a result. There are many, many examples that show that females even when they're smaller than males are not necessarily sweet and submissive. It's just a lot more interesting than that. Thank God.

I: What about parental care, Darwin's maternal instinct? I think you've got some pretty brutal examples of that not necessarily happening across all female species.

R: Yeah, absolutely. I think that this one I was really interested in because I was never interested in having kids and always felt like a bit of a freak because I just thought I apparently don't have a maternal instinct. But then my friends who actually did have babies, they were worried they didn't have a maternal instinct either because they were struggling with their babies. This chapter was really, really important to me. I wanted to investigate this. It turns out that this idea of maternal instinct, females are not born with a maternal instinct and a drive to nurture, it needs to be triggered. And Catherine Dulac at Harvard University has found that trigger in the brain. She's actually found the switch for nurturing behaviour that happens. She's found that it's exactly the same in males and females, so actually both males and females can be triggered to be nurturing in the right circumstances. She assures me that that trigger will be exactly the same in humans. So there is a sort of nurturing instinct, but it needs to be triggered, you're not born with it. Mostly being a mother is just incredibly difficult. So just to write it off as this instinct and this idea that Darwin had and everybody that followed him, that all mothers are there for the same and all females are just reproducing to capacity and there's no variation, it's nuts. It's nuts that we believe these things, but that is what everybody thought. Thankfully, people like Jeanne Altmann who was a pioneering primatologist basically completely radicalised how field ecology was done by creating a means of observation where people were actually forced to observe all the troop members, not just the showy males, and study females. Even if they don't look like they're doing much, as a data point it's worth studying. She particularly focused her attention on mothers, and she realised that motherhood, there's a huge amount of variation and definitely not all mothers are the same. We know this but amongst the baboons, it's a huge steep learning curve because basically baboon mothers are essentially single mothers and they've got to earn a living foraging whilst also looking after their offspring. And, surprise surprise, first time mums really struggle with it. They struggle with breastfeeding, they struggle with carrying the babies whilst travelling, so the firstborns have a 60% more chance of dying than subsequent babies. I think the average baboon will have seven babies in a lifetime and only two will survive, but obviously that's an average. There's like a huge amount of variance, some of them will be totally rubbish mums and just never really get the hang of it and none of them will survive, and others will be really good. There's a lot of variation. So it's a very steep learning curve and I think it's fascinating to discover, as Jeanne Altmann did, the effects of hierarchy on maternal ability. The stress of being a low-class female baboon, for example, impacts how they are as a mother and they're more likely to have post-partum depression. All of these things, they're not really surprising because we know this. Do you know what I mean?

I: Yeah.

R: But for ages everybody just thought all mothers were the same because of maternal instinct. And it's really damaging, that, it's really unhelpful for people who are struggling with motherhood. I think it's helpful to know that baboon mums struggle too.

I: Yes, I think women around the world will be sighing with relief that it's not just that and it's something that we're essentially taught by society that that's what's expected, and it

will be natural, and it will all just work itself out. Essentially, we have been listening to Darwin mansplain for 100 years about what motherhood is.

R: Yes, exactly. And then of course, in the animal kingdom being a good mother is not necessarily just like being really sweet and nice and nurturing, it's about being fierce, fierce and brutal and highly competitive. This is another one of these things that it's not considered to be feminine to be competitive and aggressive. Well, tell that to a female meerkat. There was a survey that was done that found that meerkats are the most murderous mammal on the planet. A survey of 1,000 mammals, they beat even humans. They're more homicidal than human males because their society is predicated on ruthless competition between females who want to co-opt all the resources for themselves. The females who are related to each other and live in these clans, the dominant female, she doesn't want any of her sisters reproducing and if they do, then she'll kill their babies, possibly eat them, and evict her sister from the clan. So being a good mother, it isn't just about being sweet and nice, it's about being ferocious, competitive, and quite possibly having sex with lots of males. It's not what Darwin imagined.

I: We've talked a bit about Darwin. We have these great titans of Victorian evolutionary biology, Charles Darwin, Alfred Russel Wallace, and they both put forward these incredible theories that challenge everything that we knew about nature at the time. But at the same time, they were Victorian gentlemen, and they are also responsible for solidifying some of these ideas about passive females and active males. But why do you think that this idea has gone for so long unchallenged?

R: That's like the million-dollar question, isn't it? For a start off, Darwin was challenged in his day. Antoinette Blackwell, she wrote letters to him challenging his ideas. But back then women weren't afforded the same education as men, so it was a hopeless argument to try and have because no academic man was going to engage in conversation with an uneducated woman about such things. Interestingly, the first challenges to all this came from American scientists, American primatologists, Sarah Blaffer Hrdy, Jeanne Altmann, who I've mentioned, Patricia Gowaty, who are all in their eighties now. They started challenging in the 1980s after the second wave of feminism hit, and they were able to get the same kind of education as men. I think that obviously these ideas have hung about for such a long time because it took a long time for women to be able to walk the halls of Harvard and go into the field and study monkeys for themselves. When they saw a female behaving promiscuously, didn't ignore it as an inconvenient anomaly and instead went, huh that's interesting, I wonder why that langur female is doing that, which is what Sarah Blaffer Hrdy did. You know, that was 40 years ago. What's going on? You know, like, why are we still finding this shocking? Do you know what I mean? It's 2024!

I: There was a really interesting study that came out this week that I expect you've seen about how male mammals, that traditionally we have thought that the majority of male mammals were larger than the females. This study came out this week where they had said about 400 species of mammals, completely different animals have been studied before and they found that this wasn't true. The majority size in sexual dimorphism actually doesn't occur anywhere near as much as everyone had assumed. The male mammals were the majority actually the same size as the females. What was so

interesting about this study is that the authors really highlighted that they were not the first people to say this, that was Katherine Ralls in the 1970s who had her work published who found this, but that her work was ignored. It was overlooked because it challenged what we thought we knew because she was a woman. They really made the point in this study that 100 years of bias had affected how we approached this discovery which should not be a discovery in 2024, when it was discovered in 1970. You've talked briefly about who the people are that are at the forefront of challenging these ideas now. I think one of the things that you mentioned in the book, which I think is so interesting as a reminder, that science is carried out by people and people are affected by their biases, is that evolutionary biologists may have been reluctant to challenge Darwin, especially here in Britain because he is this great titan of science, he is this national treasure for us in the UK. In the US, they have no such qualms.

R: That's definitely true. He's a national treasure and so speaking ill of Darwin is not allowed. American professors have told me that they think that our evolutionary biology is less progressive as a result. There's a couple of things that I think also... There's this brilliant quote, I can't remember who said it, but that science progresses one death at a time.

I: Oh, that's brutal.

R: It's quite harsh. I think it's true though. Because I've really noticed the difference between universities and institutions and some places are progressive and have totally taken these ideas on board and running with them, and then other places just not. For example, Oxford where I went to, when I was researching the book my researcher had a conversation with a very senior evolutionary biology professor there, whose name cannot be mentioned, asking if Patricia Gowaty's very, very thorough criticisms of Bateman's foundational fruit fly experiment from the 1940s, which is the "empirical evidence" – in inverted commas, because we're on a podcast and you can't see me doing that – to support Darwin's stereotypes that females have nothing to gain by mating with multiple males and females don't vary as much as males. Whereas males have everything to gain from mating with multiple partners and there's a huge amount of variation. That Bateman's paradigm, the graph is reproduced in every single textbook still. But Patricia Gowaty has taken apart that experiment. She's repeated it every single way. She actually found the same strains of fruit fly; she replicated the experiment. She went back to Bateman's original notes, and actually read his original notes, and saw that he collated the results in a way that means that gave him the graph that he was looking for and the other graph proves complete opposite. At Oxford when my researcher asked if they teach Patty's papers alongside teaching Bateman's paradigm, my researcher was told no because they're considered ideological, and Bateman wasn't. Bateman sought out to prove Darwin's misogynistic ideas, and yet he wasn't being ideological. I think that there is this idea that feminism breeds a kind of science that is somehow tainted by ideology. But I think we all have to be a bit more grown-up than that and recognise, well it is possible to do science without being biased, we're all biased. The one thing that Patty does which she told me which I think is really brave, is she makes sure she always writes papers with someone who's going to disagree with her to flush out the biases of her science.

I: That's a really good attitude.

R: Yeah, she's brave, fearless. Yeah, she's a feminist and she knows that, so she makes sure she keeps her feminism in check by having other readers that she works with. So if you've built a career around stating one paradigm and throwing your all into that, at the end of your career, even these tenure jobs, you have them until you die. Yeah, science progresses one death at a time. I think old heads of department... am I allowed to say that on a podcast? I don't know, maybe it's... somebody else said it, I'm just quoting it.

I: I think you'll be pleased to know that I googled Bateman's paradigm earlier and the first thing that comes up is Gowaty's work.

R: Brilliant.

I: The message may not have filtered down to all of the universities that are teaching the next generations of evolutionary biology, but we do have people like you, popular science authors, who are going on podcasts, and they are highlighting that this is an issue that is real. And also, the study authors of the mammal study, they're including the social context of what they found and how this isn't a new thing but why it's not more common knowledge. So you did touch on feminism, that is a big question that want ask, is there a place for feminism in science? Because there are going to be people that say no.

R: Of course there is. I just think we all have our own ideologies, right. Why should feminism be picked out and sidelined as something that's unacceptable? We just all have to be very open about our biases and strive to do better science. And in order to do that, we have to recognise the things that hold us back. I don't see that feminism in itself is a problem, it's only a problem if the science that comes out of it is biased and bad. But if the science is good and can't be criticised, it doesn't matter if a feminist was behind it or not. The reason why you need feminists is because they're asking questions from a different perspective to the 150 years of misogynistic questions that have gone before them. It's just about addressing the balance, isn't it. As long as the science is good, it's fine, I think.

I: I think there are a lot more conversations being had now about how we know what we know in science. Who were the people carrying it out and what biases or agendas or any kind of influence might they have had in even choosing what they're looking into, let along the conclusions that they drew from it. I think there are a lot of conversations now about a wider diversity of scientists who can bring a different perspective, which I think is really interesting. I think one of the main critiques about feminism in science is the assumption that anything that came before feminism was not bias or didn't have an agenda. So I think it's really important to kind of re-evaluate how we know what we know. Do you think in general that the field of evolutionary biology is getting better at recognising the bias that existed within it and kind of addressing the balance now?

R: Yeah, I definitely do. I've got a lot of hope actually, because I feel like this idea of cultural bias, as you say, it's not news now, whereas five years ago I think probably might have been news to a lot of people. And that makes science really exciting, doesn't it, because it means that we're able to suddenly screen for the truth in a different way. I'm working with a load of PhD students and graduates researching my new book and I'm just so excited by their world view, because they're just not as bogged down by all this stuff as I was. I realised when I was writing *Bitch* that

I assume males are dominant, I assume males are bigger, I assume males are more competitive, and I'm a feminist, just because that's what I'd been taught. You can't help it. I feel like their generation are just much more savvy and they're asking different questions. I think we're on the crest of some really exciting paradigm shifts in evolutionary biology.

I: And what do you think that this all means for trust in science? If we are more aware now that science has been carried out with a heavy bias, how do you think that will affect how people trust science and also how we can avoid this bias in the future?

R: I did wrestle with that because obviously the fact that evolution in and of itself is under trial still and increasingly so, particularly in the States, is deeply depressing, so you feel it's tricky to be criticising science because there's so much. But I don't think the fact that we're of a time when science is being criticised for all the wrong reasons is the time to pretend that everything is hunky-dory if it isn't. Do you know what I mean?

I: Transparency is actually going to make everything much more trustworthy.

R: Surely that's the only way. I think that there's just some really fantastic meta-analysis now going on of old papers and just looking at even the language that we use, as I think I mentioned earlier, even when talking about females it's couched in this passive language and males are active and females react and males act. I think that all of these things, the awareness of this is going to create better science, it just has to. I feel hopeful. I came across not just sexist bias but also heteronormative bias and geographic bias. But then there's also the fact that most science, that the leading language is English. In of itself, that's going to restrict it as well and the cultural view being predominantly from the western world and just all of these things, you realise they will also change the way we see the world because we just see your reflection from our standpoint. I think there's more work to be done but I think that it's exciting because we're heading there.

I: I think so too.

R: I don't think pretending that everything is hunky-dory is the answer. I can see that there's like a painful bump where we all have to, sort of, it's a bit of self-reflection. I found that tricky. I was quite shocked to discover that I had biases and that I'd been imprinted. And it made me uncomfortable, but you've just got to work beyond that, haven't you.

I: I felt the same reading your book and I was almost ashamed of myself that I hadn't questioned some of these things before when they seem so obvious once you highlighted it. It definitely made me want to look at science but at everything about the world and question, well, how do we know that and what's the story behind it as well. Because science is carried out by humans, it is not outside of that realm. It was a really great way of getting people to look at the world slightly differently.

R: I mean diversity is key. I know we're all striving to increase diversity, and that is the thing, that science is all about asking questions. You want questions being asked by people with different sexuality, gender, cultures, where they live in the world, languages, all working together really to flush out the truth, I think. I think as we become more accepting of people being able to be

open about their own sexuality or gender identity and ask questions from their perspective that they're interested in, then that is also going to really change things and shake up this heteronormative bias that we have about the animal kingdom.

I: Thank you so much for speaking to us today, Lucy, especially as you are so busy. You did give a little scoop to the IFLScience listeners that you are working on a new book, and I hope that you will come back on to speak to us about it when it's out.

R: I'd love to, very much. Yeah, that would be great. Thank you very much.

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