

in mathematics who decides to be a film maker as long as I knew that she had been well-taught in science. I am angry when I see graduate students deeply excited about studying the brain lose their joy when their laboratory environment becomes more about “getting the paper in *Neuron*” than about discovering new knowledge. I am angry when I see graduate students crying over gratuitously hostile or mean reviews of their first papers.

Many of us are struggling for resources to do our work, with a sense of frustration because today's opportunities for scientific discovery are unparalleled. It is now, when things are difficult, that we have to be mindful that the biggest asset we have is each other. Our best and brightest young scientists came to science with the greatest of fascination with the mysteries of life. We should remember it is the drive to know and wish to help mankind that brings them to science. We are right to push them hard to explore the unknown. We are wrong to allow ourselves to be petty and ungracious in the way we treat our colleagues. Almost every manuscript that gets rejected carries the hopes and aspirations of graduate students and postdocs. We should be clear in articulating scientific issues that arise in review, but refrain from the imposition of arbitrary hurdles. We should discipline ourselves to ask for more experiments only when they are required for the scientific points of the paper, but not as an automatic response to all manuscripts when first submitted.

There is no virtue in hazarding the young entering any field. They have many possible paths to follow. Extracting new knowledge is difficult enough: we should take care not to drive our best and brightest from our field for the wrong reasons. I hope that the young will join us on the long and arduous hikes to open vistas of new understanding. I hope that they will come to know the joy of seeing something or understanding something for the first time. We should take care that they avoid the paths strewn with the detritus of broken dreams. False idols often arise in troubled times. Today, more than ever, we must say that it is what the paper shows that is more important than where it is published.

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## Q & A

### Hanna Kokko

*Hanna Kokko is a professor of animal ecology at Helsinki University in Finland. She started her career studying engineering and applied mathematics, but then learned that mathematics can be applied to biology too, and switched to ecology and evolutionary biology. She is also an adjunct professor at the Australian National University.*

**What got you interested in biology in the first place?** In a sense I have always been — as a child I was allowed to roam around in the forests quite freely. When choosing what to study, however, I initially thought biology was best kept as a hobby. I had no clue that biology nowadays is quite a mathematical subject, so I believed that my mathematical skills would be best developed elsewhere. It was only when I discovered that ecology has a firm mathematical foundation that I switched universities and completed a PhD on how life history theory relates to sexual signalling and mate choice.

**Did anyone in particular influence you at that stage?** Some bureaucrats in Finland back then actively discouraged people shifting careers, which wasn't helpful! What helped was a rather forceful letter by Ilkka Hanski which explained to said bureaucrats why I should be allowed to start a PhD in biology despite not having a first

degree in the subject, and the decision of Esa Ranta to send me to Britain to work with Bill Sutherland for a few months. Bill taught me that to make an impact in an area that is new to you, common sense and curiosity work surprisingly well. These two create the necessary self-confidence together with the equally necessary willingness to learn new things.

**Where do you place yourself now in the scientific community?** I define myself as an evolutionary ecologist, but most people know me from my contributions to theory. But really I guess my career is based on being a kind of interpreter. I translate between empiricists and theoreticians on the one hand, and ecologists and evolutionary biologists on the other.

**Communication problems between empiricists and theoreticians are understandable, but surely ecologists and evolutionary biologists should know about each others' work?** Not nearly enough! Our journal club discussed a paper that addressed evolutionary effects that arise in ecological experiments. The more evolution-oriented people in my lab expressed surprise that such a paper needs to be published at all, in 2008. But to many people with an ecological training, the idea that evolution can be fast enough to alter its direction because of their experiments might very well come as a surprise.

**So what precisely have you contributed?** Well, from the above it sounds like I blame ecologists for not



thinking enough about evolution, but surprisingly evolutionary biologists don't spend enough time thinking about ecology either. My own pet topic is the feedback between the two. For example, what I'm most proud about recently is some work where we investigated population sex ratios and parental investment theory. Whether a male or a female should care for its young depends on outside options, and people have long assumed that a male has better outside options because male reproduction can be a much faster business than female reproduction. But of course, if there aren't many females to mate with, a male's sperm-producing potential remains just a potential. This really changes the way we should think about sex-role evolution: we need to quantify how the reproductive roles of the two sexes determine their mortalities and hence the population-wide sex ratio, before we can say anything about individual prospects. And when we do this, it appears that the differences between female-biased care that is characteristic of mammals and the much more egalitarian avian systems become understandable. Mammal populations tend to be female-biased so males on average really do reproduce faster than females — this in turn is not true for birds.

**How extreme can the feedback get?** A favourite example of mine is the Amazon molly studied by a postdoc in my lab. These asexual, all-female fish still need sperm to trigger embryogenesis, but they no longer produce any of it: the species has no males. So sperm has to be 'borrowed' from other closely related species. Now, asexual reproduction is twice as efficient as sexual reproduction as all offspring are egg-producers. So the proportion of asexual females in the population increases with time, and use up the donor male's sperm resources so greedily that eventually the system collapses — there are just not enough males to serve the females of either species. It can probably only exist in the longer term because of a convoluted dance of extinctions and colonizations. This is a wonderful example of how short-sighted evolution can be, and besides it is an underused one for challenging people to reject intelligent design ideas. How should you rate the intelligence of

a designer who decides to switch off sperm production in a species without first checking whether that sperm might be needed at some point during development?

***That's interesting, but aren't there bigger problems in the world?***

Good question, and there are two possible answers. Recently an Indian PhD student asked me how to tell his parents that his education hasn't gone to waste even though it doesn't seem to produce much wealth. I thought that was a really deep and good question. I believe it was Bertrand Russell who said that when so many people do something useful, somebody has to do what is important! I'm a great believer in the value of pure research. Without an appreciation of what an amazing world we live in — in other words, without science and art — wouldn't our endeavours be rather pointless?

**And the second answer?** There is always an applied side to thinking deeply. In any society there are many complicated issues that unfortunately get simplified to the point where short-sightedness wins. It's always easier to cut down funding on non-urgent medical checks even if it could lead to higher medical bills in the future. And in any conflict between short-term economic growth and a particular land-use problem, the natural habitat tends to get lost. The politician will argue that the species that live there are not urgently endangered, to which the scientist should add: *yet*. Humans often don't seem to show any more long-term wisdom than amazon mollies. Science teaches us to think more broadly than that. If we really had wise leaders, they would take the long-term perspective seriously precisely because we are so prone to ignore it. They should listen to scientists and philosophers much more than economists who tend to be interested in what happens in the next annual quartile.

**But scientists surely aren't saints themselves are they?** No, we fly too much but at least there is a certain honesty about it: we tend to admit that. We're a bit as selfish as the others, but at least we get some wicked pleasure out of saying it aloud. We ought to complain when society hasn't established sensible rules that serve the long-term interests of people.

**So how can one achieve that?** I wish I knew! But I think scientists are often not proactive enough in popularizing their work. We're perhaps afraid showing any less than 100% expertise, yet the greatest skill that a scientific training brings it that of retrieving information. My cousins recently looked at the proofs of a popular Finnish book on evolution that I've coauthored. I was perhaps expecting them to comment on my claims that evolution has something to do with our troubled relationship with the environment, or challenge my views on how we can live humanely 'despite' being products of natural selection. But what they asked me was far simpler. They were simply baffled about where I got all this information; who told me all these cool stories? As a scientist it is all too easy to forget that not everyone in the world has access to the Web of Science, or is fluent enough in English to extract the information anyway. It is a great shame if we enjoy all this access privately and don't let the public celebrate it. Likewise it's a shame if we don't teach our younger scientists to read much more broadly than is directly relevant to their studies.

**Talking to the public must require different skills than the day-to-day work of a scientist?** Yes — but it can also be so much more fun than battling nihilistic referees. A tongue-in-cheek quote is that scientific theories are never really rejected, it is just that their supporters eventually die. Twelve-year olds you can still talk to and change the way they think — in Finland a 'science barometer' published last year showed that the youngest age classes show a far greater acceptance of evolution than older ones. They are also more environmentally aware. So, I might have a high-flying career but still the best days are those where I can interrupt my work day to cycle along a river to the local science exhibition centre, to be interviewed by pre-teens. And perhaps it's also good to show to the girls in the class that professors don't always come with white hair and a moustache.

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