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Episode 25: Abundance And Extinction: Species Under Pressure

Abundance and extinction: Species under pressure

VOICEOVER
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SHANE HUNTINGTON
Hello and welcome to Up Close coming to you from Melbourne University, Australia, I!|m Dr.Shane Huntington. And today!|s topic is the global extinction of species. Over the past few decades we have heard a great deal about species extinction rates and the effects of human activity. Global species extinction has been the key concern, long before terms such as !¢FDglobal warming!| and !¢FDclimate change!| were widespread. The rapidly changing world we currently inhabit will place many species, essentially on death row in the near future. A leader in the study of global extinction is Professor Nigel Stork, Head of the School of Resource Management, Faculty of Land and Food Resources here at The University of Melbourne, Australia. It is my great pleasure to welcome Nigel to Up Close today.

NIGEL STORK
Thank you very much.

SHANE HUNTINGTON
Nigel, how do you define a species being extinct? What does that mean?

NIGEL STORK
The definition of what is an extinct species is a species that hasn!|t been seen for fifty years. That is the classical definition. I believe those kinds of definitions are now changing because we are recognising that to wait for something to disappear for fifty years is too long a time to have to wait. But I have to say, there are some good examples of some species which were extinct for many, many years and suddenly turned up again. So, determining when a species has gone extinct is really very, very difficult to know when the last individual has actually disappeared. Or the last pair of

individuals.

SHANE HUNTINGTON
So Nigel, do we have an idea of the number of species that have gone extinct and do we have a catalogue of those particular species?

NIGEL STORK
No. Just like there is no catalogue of existing species, there is no catalogue of the species that have gone extinct. But we have to bear in mind that it is only those organisms which have hardened parts of their body which can be preserved and it is very much more difficult to preserve those species with soft body parts. What we do have though, is evidence that over the last 300 million years, there have been a number of periods of mass extinctions. Five or six really well recognised where up to 70-80% of species which were in existence !V and I!|m talking about in the sea and marine environment !V those species actually disappeared. And then you have seen a gradual recovery, as new species are created, new forms of life have been generated as well. What we do believe is that we!|ve actually probably got more species now at this point in time, more forms of organisms than have ever occurred before on earth. So, even though there have been these major crashes, there have been increases in the numbers of species, the numbers of forms of organisms as well as evolution has progressed. We also have some evidence about average existence span, if you like, of a particular species: from creation to its extinction. And it will tend to indicate that invertebrates, insects and arthropods, actually have an average life span of something like ten times vertebrates.

SHANE HUNTINGTON
That!|s quite a surprising outcome, isn!|t it?

NIGEL STORK
It is very interesting. Obviously based on a lot of good palaeontological evidence. But it is something which I think indicates that some species and some groups are much more prone to extinction than others and I believe that is what we are really seeing today. And all the concerns that you hear from scientists about mass extinctions of vertebrates, I believe are true. And in particular, large organisms. If you take South East Asia, for example, in the past there would have been a large predator !V a tiger or something, elephants and a couple of other large vertebrates !V all co-occurring in a tropical forest region. We now know from the work of Richard Corlett and others at the University of Hong Kong, that in fact there is only something like 2% of that area now which has all of those species in place.

SHANE HUNTINGTON
We have this incredible level of diversity on the planet, does that not necessitate a larger degree of extinction as well !V simply by the sheer number of species co-locating in some areas?

NIGEL STORK
I don!|t think that is necessarily the case. I just think that what is happening is that species are actually occupying more and more niches and the niches are being more

finely divided. When you actually look at a particular area of tropical forest, the number of species that actually can co-exist in any one place are really quite phenomenal. The kind of work that I was doing over the last 25 years, has been looking at insect diversity in tropical forests. And in 1982 I went into Brunei in Borneo and I took a fogging machine, insecticide fogging machine, and I hauled one of these things up on a rope into some large dipterocarp trees in Borneo !V these are very, very large, super-emergent trees !V up to 75 meters high and then I released the insecticide and collected the insects on some plastic sheets on the ground. I think it was ten trees that I sampled, I put 20 square meters of plastic sheet under each tree. You could actually then hear the insect rain as it fell, pitter-patter, onto the plastic sheets. When you actually looked, it looked like nothing. I carefully brushed these up and put them into sample pots and probably after two or three hours work, I!|d got half a cup of insects from ten trees and I thought this was really dreadful. I thought, why had a done all this work for such a small sample? I took it back to the museum in London and my colleagues !V about a dozen of us !V pored over these samples and divided them into different insect groups and then into different species. When we finished, we had 25,000 specimens, and five or six thousand species. It is absolutely phenomenal. So, on one of those trees for example, there could have been at least a thousand species of insects co-existing on that tree.

SHANE HUNTINGTON
And I assume there is a minimum size beyond which the plants themselves in that forest are no longer sustainable as a community?

NIGEL STORK
Yes, that is right. But we do have very good examples of some species which have existed in very small populations, in very small areas for millions of years. And so, there is no single answer for these kinds of problems. Many years ago, the Wild Life Fund in the U.S., actually set up a minimum critical size project in Brazil !V this is about late 1970s !V to actually look at what size area of rain forest you actually need for species to survive. And the work on that is still going on. This is where they actually worked with farmers who were going to clear some of the land, but they left little patches of forest, one hectare, ten hectares, 100 hectares, 10,000 hectares. And actually I have to say that project has probably given us some of the best evidence that we have on the impacts of deforestation on biodiversity.

SHANE HUNTINGTON
You!|re listening to Melbourne University Up Close, I!|m Dr.Shane Huntington and we are speaking with Professor Nigel Stork about the global extinction of species. When we talk about !¢FDspecies!| how do you define something as a !¢FDnew species!|? How different does it have to be for you to say, !¢FDthis is another species!|? A bit of a definition there would be helpful.

NIGEL STORK
The whole definition of !¢FDwhat is a species!| is rather difficult. There is a sort of classical !V Darwin!|s definition !V that a species is something that won!|t reproduce with another group of organisms, only reproduces within itself. And that is fairly true

for a large number of organisms. But there are other things where that species definition just simply doesn!|t work. In some plants for example, species can be created simply by the doubling of the number of chromosomes that the plant has. So those things are very complex. The rate of description of new species every year, really hasn!|t changed for almost a hundred years. We are talking probably about 15,000 species of all organisms, are described each year. And at the same time, probably a third of those are !¢FDsunk!| as species. In other words, other taxonomists have recognised, that what someone had called a new species actually had already been previously described. And there are lots of examples of those kinds of things.

SHANE HUNTINGTON
Do we have an idea of how many species exist on the planet, currently?

NIGEL STORK
That is one of the really big questions. Say, for the microorganisms, we really don!|t have a clear understanding of what a species is, and whatever definition used for bacterial viruses or other microorganisms, that definition isn!|t necessarily going to be the same as for macro-organisms. But there are estimates ranging from something like two million species on earth to a hundred million species on earth. And partly it depends on, where are all those new species? If there are a hundred million species, where are they all? We!|ve actually described something like about 1.6 million species. And I am very pleased to say that about a million of those are actually arthropods. Mostly insects. And a quarter of all the species that have ever been described are beetles. So, it will come as no surprise to you that I actually work on beetles.

SHANE HUNTINGTON
Nigel, when it comes to extinction being caused by environmental factors, which I am guessing is the key reason, what kind of delay is there, so when there is an impact on the environment, what is the delay range for extinction of species? I mean, does it all happen within ten years, or are there examples where it could be a thousand years down the track?

NIGEL STORK
There is pretty good evidence now that some species have been able to hang on, sometimes for a thousand or more years, after the sort of factor that was going to bring about their downfall was actually put in place. One example is that the bear, the European bear and wolf managed to survive in places in Europe, for example in the U.K., perhaps for a thousand years after their habitat was largely gone because of the tree clearing that had actually occurred there. So species do hang on. And of course when you look at some trees, even though they may not be pollinated or their seeds are not being dispersed because there is a lack of some other organism which is needed to do that, they can sometimes, they will survive for three or four hundred years. We!|ve called those the !¢FDliving dead!|. And we don!|t know just how many species are actually !¢FDliving dead!| at the moment. There could be many, there could be just a few.

SHANE HUNTINGTON
Now, we have a scenario, where at the moment, we!|re I guess experiencing the first stages of what will probably be major climatic change around the world. You mentioned before the definition of species extinction being that it is !V well, the old definition anyway, that it is you haven!|t seen this animal or plant for fifty years !V do we need to, I guess accelerate things to start to deal with what may be, as you say, a mass extinction on our doorstep and how will we go about that?

NIGEL STORK
Well, there has actually been some terrific modeling work. Particularly in northern Australia, in the tropical rainforests. First we have to have a very good understanding of what actually makes particular plants exist in a place at a time. And the modeling that has been done in northern Australia has actually taken into account the climatic factors which allow a species to be there. And so, we particularly know that rainfall and temperature are the two major driving factors, but there are all sorts of variants on that. So, there has been some clever modeling which actually shows that they can actually work out just how important those factors are and they test that with current data on the distributions of the plants and so on. And it does appear to indicate that the rises in temperature will cause a shift in the climate envelope that the plants currently exist in. So that many of these plants will have to move up the mountain. Now, in our rainforests in northern Australia, the mountains aren!|t that tall, they only go to 1500 meters. So, these things are just going to get pushed off the top. This is probably also going to happen in other mountainous tropical forests regions around the world, when again the mountains are of a similar height. The work has then been carried on to look at the vertebrates. And we have some fabulous records for vertebrate distributions in the wet tropics of Australia. And again we find that a lot of the endemic species, in other words the ones that are only found there, are actually trapped in a cool part of the upland forest, where they actually enjoy a cooler climate. And this actually stems from the fact that Australia was probably about one third cool rainforest in the past thirty million years and as the continent has moved north it has got warmer and drier. And so then the vertebrates have been restricted to these upland forests and it looks like sort of eighty species, with current climate predictions almost all of those will go extinct in the next hundred years. Now, what we don!|t understand is just how resilient those things are. Are they able to actually survive, or are they physiologically trapped? In other words they can!|t take temperature increases. And are there other factors which are going to impact on this? One of the things that I am particularly interested to look at, is what role the general landscape plays in terms of biodiversity as well, across the landscape. And I think, importantly how plants are actually going to react to an increase carbon dioxide level. A lot of attention has been paid to the amount of rainfall and the rise in temperature, but one of the things that we have been rather ignoring is the fact that the carbon dioxide levels in the atmosphere are likely to double in the next fifty years. We are actually seeing quite substantial increases already. Plants actually use carbon dioxide to photosynthesise and make new material, but they take the carbon dioxide in through little holes in the leaves called stomata. Now these stomata actually close up once they!|ve taken enough carbon

dioxide. And it is those holes where they actually lose water vapor as well. So, plants transpire and lose a lot of water vapor. What we are finding is that because we!|ve already got increased dioxide levels is that plants are actually becoming more water efficient. So it is interesting, maybe there!|s going to be a bit of feedback here that one of the positives of climate change, if you like, and increased carbon dioxide is that plants may use less water. So, the big picture question then is, you know, we have massive run off, particularly in the wet tropics region of north Queensland in Australia and other continents have the same problem, and they take with them sediments and nutrients and so on and run off into the reefs and in our case it is the Great Barrier Reef. So, are we going to see greater run off? Or is that going to be something else that balances out these equations? So, I think one of the big questions then is how are plants and animals going to react to an increased level of carbon dioxide in the atmosphere?

SHANE HUNTINGTON
Right.

NIGEL STORK
Just one other thing that I wanted to mention is that there has actually been a lot of work done in the past on recent climate change in the last 50-100,000 years and people have actually looked at the distribution of insects during these climatic periods !V the ice ages. They found that they have moved thousands and thousands of kilometers. Thousands of miles. For example, a species that currently lives in Norway, right in the north, will be found in the Mediterranean. What was interesting about this work is that they probably looked at three to four thousand species of these recent fossil insects which were still !V you know, they!|re not extinct !V they!|re still current today. Not one of those species disappeared, became extinct because of those ice age periods. So, there is evidence that species may be able to move, we don!|t know how rapidly. What we!|ve done though of course, is, we!|ve changed the landscape. We!|ve now got very large agricultural areas, we!|ve cleared the forests. We may not have that connectivity. So, there are a lot of land management groups that are talking about creating that connectivity !V forest connectivity. And I think that is a really interesting area too.

SHANE HUNTINGTON
And Nigel, just lastly I wanted to mention, that you almost have two careers. On one hand you!|re into species extinction, but you also sing.

NIGEL STORK
[laughs]

SHANE HUNTINGTON
I know here on Up Close we!|d love to hear a tune. Is that a possibility for our listeners?

NIGEL STORK
Maybe.

SHANE HUNTINGTON
Well, I!|ll hand over to you.

NIGEL STORK
[singing] Once I knew a pretty girl,
I loved her as my life
I!|d gladly give my heart and hand
To make her my wife
Ooohhh
To make her my wife.
[talking] A very sad lament from England.

SHANE HUNTINGTON
I think it is fantastic that we have finally got some singing on one of the scientific episodes of Up Close. Thank you very much for your time today, Prof Nigel Stork.

NIGEL STORK
Thank you.

SHANE HUNTINGTON
Relevant links, a full transcript and more information on this episode can be found on our website, at upclose.unimelb.edu.au
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