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21 August 2010

I define myself as running Hepburn Wildlife Shelter full time now. I used to do little dribs and drabs of animation and illustration but I don't really have time now, except when I'm lucky.

I'm not going to go into great detail about endangered species or lists. The International Union for the Conservation of Nature (IUCN *http://www.iucn.org/*) has their own definitions, as do the state and federal bureaucracies, and they have that covered. The thing I really want to focus on is the nature of the issue. It's really defined as: things that are in danger of becoming extinct.

This means that, in an era of climate change, who is endangered is who is in danger of becoming extinct. So today I want to raise the concept of what are some of the causes of the endangerment of species and why is calling things endangered important in the big picture. I want get across that there is an interdependence that goes on out there and that calling an individual species endangered or just focusing on a single species isn't the kind of thing we should be most worried about.

Threatening processes

These are the main reasons I could think of that were causing threatening processes. Threatening processes are processes that put pressure on a species which leads to endangerment and vulnerability.

1. Predation
2. Loss of food source
3. Disaster
4. Isolation of population
5. Disease
6. Climate change
7. Habitat loss and alteration
8. Disturbance
9. Interbreeding
10. End of evolutionary potential
11. Alteration in community dynamic

Predation

Predation is a big one especially with changing environments.

Loss of food source

Loss of food source and this could be changing habitat or damaging the environment.

Disaster

Disasters such as the bushfires which you see from a couple of years ago here.

Isolation of population

A really good example of this is the Wombats (*http://museumvictoria.com.au/forest/animals/Wombat.html*) you see around here which are pretty much cut off from the rest of the Wombats population in Victoria. The next westerly group of Wombats is down on the south coast of South Australia, right on the border. Our Wombats are pretty much isolated from those that occur in Gippsland and up the East coast. This means there are gene pool issues because with fewer samples, it causes more pressures and boundary issues on that population.

Disease

Disease is a big one. There's increasing evidence of diseases moving south into this area. We're getting Rat Lung disease coming into our birds in this area. It was really only occurring in Queensland before but now we're getting it in Victoria. That's a worm which burrows into the lungs and gets into the spinal fluid and causes all sorts of damage. That's just one of them, but there's a whole range.

Climate change

I think we're all aware of what's happening with climate change. We don't really know the impact of that or understand the processes well enough to really know how to pick that up.

Habitat loss and alteration

Habitat loss can sometimes be as simple as a small alteration. It doesn't take much to alter an ecosystem sufficiently to put stress on a species, especially the more vulnerable and specialist species.

Disturbance

Disturbance can be from recreational activities, people being around, other animals being about, pets, new introduced species or natural movement of species across the landscape.

Interbreeding

Interbreeding is related to the isolation of populations. There are races forming all over the place in local populations. For instance the Brushtail Possum (http://australianmuseum.net.au/Common-Brushtail-Possum/) forms a line up the east coast. You can have breeding from the QLD possums and the NSW possums but the QLD possums can't breed with the Victorian possums any more. If there's not really a clear divide between one species and another, there's usually some sort of grey area, some kind of spectrum. The interbreeding is not only from isolated populations and a lack of gene pool, but it also means we're breeding out some of the less common of the races.

For instance you virtually never see the Victorian Emus (*http://www.parkweb.vic.gov.au/education/factfiles/16.htm*) that used to occur in this area. There are a lot of West Australian emus that were brought over for the commercial meat industry. When that collapsed they let them all out so now they're the ones that you see. Unless you see one on bald hill which is ours and which got out recently so if you see one up there please let us know.

The emus that are here are now interbreeding with the Western Australian ones and so they're loosing the specialist strain of genetic material that they may have developed in this region.

End of evolutionary potential

This means that some species are so specialised that they get to the end of where they could have got to given all the conditions that got them to where they are. They may have naturally died out or they may have naturally evolved into something else. An example in this region would be the Bobucks which are the Mountain Brushtail Possums. We're finding that there are a few little populations which are dotted around the edges of some of the river lines that are running through the area. Because of the dryness of the whole region, most of those populations are either interbreeding and dying off from genetic diseases or they are dying of stress. The Bobucks are getting pushed further and further into the western country. The healthy populations stop about Blackwood and maybe a few at Trentham. We know of a healthy population in Wheatsheaf which has pretty much died down in the last ten years.

I'd say that although that is a cause from life change, there is a general drying of the continent anyway so it's an evolutionary pathway that they have gotten to anyway. In a regional sense they'd die back in their local area. It's quite hard to say which species is going to die out anyway. The research isn't really clear and it's hard to know if it's coming to the end of it's time naturally.

Alteration in community dynamic

This could be one or more particular species moving into the area. A particularly good breeding season, a change to the flora or fauna within that region which changes the dynamic they live amongst. For instance this year there is a lot of water in the ground and that will change the dynamic. So we'll find that some of the species that have been more under threat won't make it. Some of the populations that have been surviving in the streams and the little billabongs or the wet soil might be flushed out of the system. We may actually lose them from our local system and it may take decades for them to creep back up the stream lines. It's just a natural flow of community change.

Some key concepts

1. Frog in hot water principle
2. Aeroplane ecology
3. Tragedy of the commons

Frog in hot water principle

The biggest problem we face is the frog in hot water principal. It's a horrible analogy but it's apt. If a frog was put into cold water on a stove and that water was heated up till it boiled, it wouldn't jump out. If you put it into hot water it will jump out straight away. What we're seeing is this gradual change. Human lifespan is longer than most species but in evolutionary terms it's incredibly short.

Humans have an incredible ability to adapt. So if we don't notice the changes that are going on around us this allows us to accept the small changes that are happening. Endangered species are a classic example of what is going on. They start out as common like they're called the Common Wombat and in a few years time there's some threatening processes going on but it's not until they tip the balance in terms of statistics or someone does some research that we realise that there's something going on. Corellas (*http://birdsinbackyards.net/species/Cacatua-tenuirostris*) are a really good example. We still get them down here quite regularly, they migrate up to NSW and they generally breed along the water lines of the Murray river and further north then come back down. But now there is concern that they are an aging population so we could have 70 year old Corellas which are no longer breeding but they come down every year so we still think the numbers are good. When those guys die off there won't be any new Corellas to replace them. There will be some a small number that are managing to find hollows but it could be the end of that species in very short terms. We don't react quickly enough to what we see and we are far too accepting of it.

Aeroplane ecology

The air plane mythology - that there is this acceptance that is called environmental triage. This is a term which they use to say that there are some animals which we just have to accept are going to die off and we will try and do our best for the ones we can save. The analogy there is that if we keep knocking rivets out of an air plane, for a while it will be fine and keep flying but one day the whole wing will drop off and we'll have a catastrophic drop.

In ecological circles the threshold and keystone species is what they relate to this problem. There are keystone species which basically support the whole ecosystem. These ideas are less influential these days. I don't hold too much that there is a specific species that holds the whole system together but I think there is a tendency for that to happen. There are some very strong important elements in a forest environment or landscape that if we lose them we are in danger of losing the whole lot and I think fungi is one of those around here.

Tragedy of the commons

This is something you would hear in economic circles. It means that there are some resources or commodities that are considered to be everybody's domain. Wildlife and the natural resources that surround wildlife is one of those. This is a really powerful concept in economics and if you apply it to ecology the tragedy is that no one takes responsibility as it is seen as everyone's responsibility. So it gets overused by everybody. The theory is that the market will decide so eventually when there is fewer and fewer amounts of these creatures, and they often use this in whaling circles, that when the numbers are so low that they become rare and their value becomes so great that it no longer becomes worthwhile to hunt them because they can no longer run an industry on them. The tragedy is that what we see now with the threats that they are facing is that no one is actually taking responsibility.

Ecology is seen in various ways right across the ecology industry

1. The systems approach
2. Population vs Community vs Landscape
3. Function vs Classification
4. Interdependence
5. Competition vs cooperation

The systems approach

I come from the systems approach so I don't tend to go into the species stuff very much.

Population vs Community vs Landscape

Most of the work has been done on population ecology which is looking at particular populations of particular species and measuring them and looking at their dynamics and that feeds a lot of our knowledge about the world. It doesn't include all the interactions that occur around that species.

Community ecology is where you look at the food web so the animals that occur around that and the plants that they feed on. That broadens it out a bit so they have a better understanding.

More recently there has been landscape ecology is coming into it. That brings in all the flows that run through an ecosystem, all the things that run in and run out. I think it's a much healthier way to look at an ecosystem is to look at it as a whole system, it is an organism in itself. There is also some debate about how important a particular species is and a particular genetic material.

Function vs Classification

My bias is on ecosystem function which is that if that function is being met by some other source then that system is still healthy. An example around around here is blackberry which forms a really important habitat. Many of the small birds and mammals live in it away from the foxes. The function of trying to find some sort of shelter for those birds and animals is still being met. It's a complicated one because there are all sorts of other issues involved. Some of the work that has been done is to look at the Victorian Mallee. This is related very closely to the tundra in North America so we can see similar kinds of multi stemmed plants growing out of that ground, very dry in terms of accessible water and extremes in their climate. We can learn a lot from researching the tundra about how the Mallee works in Victoria. Looking at function is quite informative for the science as well as thinking about what is of value to us as far as the environment is concerned.

Interdependence

The key thing is interdependence. We should be looking at what are the things around any particular issue which are dependant on those things. A good example would be that there is no point in looking at the occurrence of Lorikeets in this area if we are not looking at what are the things that that Lorikeet needs to be kept here. So if for example, someone wanted to put up a nest box and they were particularly keen to see the Musk Lorikeets (*http://www.birdsinbackyards.net/species/Glossopsitta-concinna*). They would have to consider the food sources that go with that nest box so that the animal is going to be able to stay and feed. To have mating pairs in an area requires conditions so that they can hear each other so they can flock together.

The Black Cockatoos (*http://birdsinbackyards.net/species/Callocephalon-fimbriatum*) for instance, don't like to hear other Cockatoos nesting nearby, they like to have a bit of distance. So we were having problems here when they were leaving one habitat tree in the middle of a clear felled coup because one Cockatoo pair would sit in that tree and they would be heard all around the edge of that coup so the other Black Cockatoos would have to move further out for them to be able to form their nests. So we need to be looking at all those interdependencies between the habitat and the creatures and the other creatures within it.

Competition vs cooperation

We hear a lot about the survival of the fittest and the great force in evolution and adaptation of competition. But one of the key things is cooperation and I would argue that cooperation is a more powerful force than competition.

Habitat Loss

Now I'd like to look at habitat and specifically the loss of habitat.

Complexity of habitat

1. Shelter, food, water, sex, social
2. Seasonal variation (Koalas, possum hollows)
3. Synergism (Wombat burrows)
4. Long term changes and cycles (lorikeets)
5. Quality of habitat (Koalas)
6. Quantity of habitat - contiguity (Wombats)
7. Adaptation (possums)
8. Micro habitat (hollows)
9. Animal movement (roos)
10. Implications for rescue, rehabilitation and release

Shelter, food, water, sex, social

Laslow has a hierarchy of needs and there are 5 key things that an animal needs in order to survive; food, shelter, water, sex and social contact. These are the prime things that they make their primary decisions about. That's very useful when we're looking at habitat but there are so many other things that we need to be considering when we're looking at habitat. This has real implications for us and we see it everyday. The reasons animals come into care so that they need to be rescued are often related to a lot of these things.

Seasonal variation (Koalas, possum hollows)

Seasonal variation is a big one. For example Koalas (*http://www.parkweb.vic.gov.au/education/factfiles/03.htm*) coming down for water in summer and they get into trouble by going into people's back yards. We get a lot of Koalas in dry summers, last summer was a good one for us. From ten years of drought the phenols in the leaves around here have been really high. The leaves are quite dry and they have a really big build-up of the oils and the phenols that are in eucalyptus trees and they are really toxic so the Koalas need a lot more water to flush their systems. That is a medium term cycle variation because of that drying process.

Possum hollows - if you're putting up a possum box because you've got a possum in your roof so you have decided to seal up your roof and put up a box. It will need three boxes depending on where the sun is coming from. In winter they'd rather be on the north, in summer they'd rather be on the south east side of the tree so they have multiple burrows and they will share those hollows with others. There's an interaction that goes within the population and with other species. At times of the year there will be other species that will use those hollows that they are not using. Wombat burrows are another one. They will move into an area like Lyonville in summer. When we did our research there last spring we found most of them had moved out then but come back in Summer. There's a lot of movement along the road at the moment so maybe they are on the moving at this time of the year.

Synergism (Wombat burrows)

Synergism is when they work together. There is a positive effect from having others in their area. A Wombat usually digs one primary burrow in it's life. When we're thinking about release of these animals we need to make sure that we're releasing them into areas where they are going to feed for the rest of their lives. They put a lot of energy into that primary burrow. They may build shorter ones up to two meters long for temporary habitation. The really long ones that they tend to make generational burrows that they raise their young in, there's very few of them that they can build in a lifetime. They are right on the edge of their range. They are the largest burrowing vegetarian mammal. The food they get out of their grasses, the nutrients, is only just enough for them to do a certain amount of activity.

The synergism works for them because if they live around other Wombats, there's other Wombats that are digging burrows and they can share those burrows so there's much more opportunity for them to find the shelter they need.

Animals like Kangaroos (*http://www.parkweb.vic.gov.au/education/factfiles/06.htm*) like to work with other animals like Cockatoos. The Cockatoos will have a sentinel which will let them know if something is approaching and they will all react to those bird sounds. So there is a whole lot of interaction which occurs in a positive sense. This is where I think co-operation is so important for those evolutionary processes.

Long term changes and cycles (Lorikeets)

Long term processes in cycles - talking about the rainbow , we're seeing more move up here. Some of that we think is because of the drying of this area. They're used to more low lying country but it is not so cold round here any more so they're moving up into the higher country around Melbourne. We do see these changes. Galahs (*http://www.birdsinbackyards.net/species/Cacatua-roseicapilla*) are moving down from the dryer areas down to here too. It may be water related or it may be an evolutionary process as they've been moving down for years.

Quality of habitat (Koalas)

The Koalas are finding that the leaves in the dryer times are not good for them so they tend to move down into the gullies or tend to find better trees that are more suited to them. When we have Koalas in care, we have to go out every day, sometimes every two days, depending on where the Koalas come from we have to pick leaves from very different places. The last lot we had, although they came from the Riddles creek area, they preferred the taste of the leaves from Yandoit way. Another koala we had in care at the same time, we had to go down to Muskvale to pick leaves because they were the leaves that koala preferred the taste of. They are quite particular about their leaves. The quality of the habitat they grow up in tends to be what they get familiar with. When we get these dry years, it becomes more and more difficult for us to find the right kind of leaves for them.

Quantity of habitat – contiguity (Wombats)

This is the contiguity or how connected the landscape is. This is very important for many creatures. They tend to have a tight territorial area. When people think of wildlife corridors they think a creature will go to one place then walk down the corridor to get to the next place. In actual fact they have to live along the corridor. As each generation lives and breeds it moves down the corridor. The idea is to have a corridor wide enough and healthy enough so you can have a passage of growth and full life cycles in that area rather than just to move from one area to the next. Moving along them is fine for Kangaroos as they can move large distances but not for the smaller creatures. For instance some of the smaller native rats won't cross tracks because owls will hunt along tracks. So those rats won't cross any open areas. Any new tracks that go in mean that the local population of rats will be contained within that area.

Adaptation (possums)

This is one of the difficult things and we need to be careful of how we define natural habitat. Possums are a great example. They've done really well in the city. They live in peoples' rooves and all the introduced plants and sheds, anything they can find. Their populations are booming down there but up here we very rarely see possums coming in and that's because the foxes are preying them out. There are a few that live in the trees around here but their numbers are much lower than they should be naturally before the foxes came. Although they can adapt to living in our spaces their ability to adapt depends greatly on what the stress or influence is. Trying to take account of that makes adaptation extremely difficult.

Micro habitat (hollows)

Micro habitats - when we talk about hollows we have to be aware that it's not just about having somewhere to live and that may change over the seasons as well as different animals move in at different times. Hollows also form little micro habitats of their own. They fill up with water and become water sources for a lot of the arboreal animals that live in the trees. Some of the frogs breed in them, insects will use them as weak points as the water will soften the wood so they will use them as access into the wood so it's really important that we think about habitat in a much broader sense. We don't want to get locked into thinking that a particular

habitat element like a hollow has only one role to play. Fungi is another one. They have a great de-composition role but they also provide food and all sorts of soil activity that allows other animals to survive in the forest.

Animal movement (roos)

This is a really important one. An example is the culling permits issued for Kangaroos here. There are currently 40 in operation which means that 1400 Kangaroos are allowed to be shot just within our shire this year. We can't get hold of a lot of the details of this data as it's held under the national interest, but we suspect that what is happening is that we're looking at similar mobs moving through several properties. Those properties each have a permit to shoot out 20% of the population that occurs on their property so that means that the same mob would actually be completely wiped out in one season if it is the same mob moving through these properties. No one is doing that research. People order the permits over the net, they say we have this number of Kangaroos here and they are given a permit to cull 20% of them.

Animal movement is a really big issue in terms of habitat. You'll see mobs of Kangaroos out on the plains at dusk. They'll form big family mobs and that's when they have a lot of their social time and then they'll break up into small family groups. Around 6 - 10, sometimes the females go off by themselves, the males will go into bachelor mobs and they disperse throughout the forest. You'll often hear people who've lived in the area for a long time say they've never seen so many Kangaroos but that will be because there's only one paddock left that they like to gather on rather than really understanding the actual movement of these animals and how they are surviving across the landscape.

Implications for rescue, rehabilitation and release

These are the kind of issues we try to confront when we are doing our rehabilitation. We need to make sure that the animals we have in care are being trained to survive in the wild. At the shelter we to try to give them the social context they need. For instance we give them familiar housing which may change as the seasons change, for instance in summer we might give them one type of housing and in winter another one. For bats we have to allow them their hibernation time in this area, most of the other bats would be hibernating about now.

We had a koala come in last year that was found in someone's back yard. She had been attacked by a dog. At first we thought she looked fine, just two small puncture wounds but we thought we'd better catch her just to be sure. When the vet opened her up you could see that all underneath was very badly damaged by the teeth. All her intercostal muscles were torn because when the dog shakes the animal, it tears all the flesh underneath the skin. The result of that was she was in care for 6 months and we couldn't take her back to that property as they now had a big Malamute dog in residence. So we tried to find the nearest piece of contiguous natural bushland around. It took about three days to find somewhere suitable. We had to do map searches and ground searches. We crossed two electric fences, we had to go on one side of the creek then eventually ran into blackberries before we could get to trees so we had to come all the way back again. Then we had to cross another three sets of fences before we found a tree that was linked down a creek line that we could put her in. These kinds of interferences in their habitat, they deal with them everyday, but we kind of see some of the problems that these animals face just trying to cross the landscape.

Habitat disturbance

Habitat disturbance can be a whole range of things.

1. Presence of strangers
2. Variation in populations/communities
3. Noise
4. Smells
5. Light
6. Tactile - vibration, wind, temperature
7. Alteration to structure - barriers, removal
8. Changes to health - stress, pollution
9. Variation in ecosystem flows

Presence of strangers

The presence of strangers - just hearing people's voices around the place can really upset them. You'll see Kangaroos will stand up and stop eating whenever they hear human voices or even cars passing if they are in a quiet area.

Variation in populations/communities

This can be the introduction of a range of new animals or changes to existing populations. Like a flock of Corellas or Cockatoos might move in. You'll see battles this time of year between the Choughs (*http://www.birdsinbackyards.net/species/Corcorax-melanorhamphos*) and the Currawongs (*http://museumvictoria.com.au/discoverycentre/discovery-centre-news/2007-archive/magpies-and-currawongs/*) and the magpies. In our backyard at the moment there's a big three way war going on over who's going to take the territory.

Noise

Noise is a big one. We tend to have about 80 animals in care at any one time and we're able to do this because most Australian animals don't make any noise. You bring one human child into a house and you notice the difference.

Noise is one of their primary messages for alert, it puts them on guard and they eat less and it changes their whole ability to meet their other needs.

Smells

Smells are important. If you have a Wombat in your area and put anything new into that environment then the Wombat will poo all over it that night and you'll come back and see a little pile of cubes all over it. They are really conscious of any changes to their environment. We really notice that if anyone comes in that is wearing perfume. The animals react quite differently to them and they're very alert to any changes to smells. They recognise each other by their smells too. We might have 30 Kangaroos in care but if a new one comes in they know immediately.

Light

Light is a big one and changes the way creatures like moths move. About 15 years ago all the male Bogong moths (*http://museumvictoria.com.au/melbournemuseum/discoverycentre/wild/victorian-environments/alps/bogong-moth/*) that live in the hills around Sydney flew into Sydney because there was some kind of unique light situation with the moon. Meantime all the females were sitting up in the forest in the hills so they had a really bad breeding season that year. It also affects bats and so the best way to get a bat out of your house is to turn on an outside light. They'll fly out as they know moths will be attracted to the light and so they'll go out to hunt.

They are sensitive to tactile things like vibrations. This includes cars moving around the road, wind, temperature changes that are all part of their habit. When coups are clear felled or trees are removed from their local area it changes where nesting sites are. We find we get a lot of Tawny Frog Mouths (*http://www.birdsinbackyards.net/species/Podargus-strigoides*) coming in because they build a really shoddy little nest, it's just like a little pile of sticks on a little platform. They're used to building them in very well protected forest areas and there are now so few of those. They often hunt on the edge of open plains as it's easier for them, and those trees are much more exposed to wind so the chicks tend to be blown out of the nest. So we have a lot of chicks coming into care.

Alteration to structure - barriers, removal

Alteration to the structure of the habitat. Weed removal can have a big impact. A Wombat that has anything put in their way they will really notice the difference.

Changes to health - stress, pollution

Changes to the health of the environment. Climate change, stress can be a big factor. We found that the occurrence of mange in Wombats went up quite astronomically while they did the last few years of logging. We think it's improved since but when there's disturbance going on that level of stress changes their ability to fight off disease and impacts on their ability to survive.

Variation in ecosystem flows

Variation in ecosystem flows can be a whole range of things. It's the way nutrients move in and out of an environment. There are all sorts of cycles, carbon cycles, nitrogen cycles and phosphorus cycles and they can change quite rapidly. On a year like this when there's a lot more nutrient streams going through the system it can have quite sever changes. It will be interesting to see how they adapt because their ability to adapt is affected by all the other things that have been going on for the last ten years. For some of them it will be a benefit, for others it might be a problem. I think this year the Echidnas (*http://www.parkweb.vic.gov.au/education/factfiles/15.htm*) will have a good year as all the ants have risen to the surface because their holes have all been filled with rain. They should have a really good breeding season. Probably not so good for Wombats as a lot of their burrows have also filled with water so there will be a lot more activity out there as there's a lot more of them moving around on the surface.