

21st Century Crisis Climate Change and Species Susceptibility by Dr. Wendy Foden

Reported by Dr. B.A. Daniel, ZOO

Dr. Wendy Foden, Programme Officer, Climate Change, IUCN Species Programme, Cambridge, UK, delivered three presentations on climate change and monitored country-based working groups on species susceptibility to climate change.

Dr. Foden began by describing the basic aspects of Climate Change, e.g. Greenhouse effect, climate history, future predictions of climate, etc. Regarding climate history she said that climate has always changed and it is a natural phenomenon, but in last several decades, with increasing human use of elements that increase carbon content of the atmosphere, a cycle of destruction has evolved which has to be reduced or life as we know it will not be possible. Using corals as a keystone she described the uniqueness of coral reefs as the most biologically diverse habitats on Earth and how practically useful to human beings in the hundreds of millions. She described the intensity and rate of decline of coral reefs and the impact of human use on them (over-fishing, destructive fishing, coastal pollution and sedimentation) stating that management of these stresses will determine their survival. She also spoke about Climate Change policy internationally and the failure of the UN Conference of Parties in Copenhagen to reach an agreement after much trial and debate. The meetings which will occur in 2011 may achieve consensus between countries may find their way toward consensus, otherwise the circle of destruction of habitats and species will continue and even escalate.

On the second day, after this overview and background, Dr. Foden focused on her speciality and that of our conference of zoo personnel, which is species susceptibility to climate change. It stands to reason that when temperature increases in countries and regions that ecosystems and habitats also change. Increased temperature leads to heat waves, drought, rainfall, and storms which impact life conditions for species, including human species, plants and animals. She gave examples, other than the Polar Bear that has been used as a model example of climate change impact, stating that many parts of the world have species that have been impacted. For some, the warmer climate reduces their ability to find food and by negative impact of changed



Dr. Wendy Foden presenting one of her series of talks on Climate Change

interactions between species. She named the Arctic Fox that is highly specialized for surviving in snow. When snow turns to ice from higher temperatures they are unable to find enough food. Also they become prey themselves to the larger Red Fox and are declining as a result. An example of direct effect is the White Lemuroid Possum which lives in trees in Australia and has such sensitivity to the rising temperature that they die of stress when the heat waves increase in the night. Leatherback Turtles are impacted by both raising sea levels due to weather and also due to higher temperatures. The increased heat causes their eggs to incubate at elevated temperatures which produces a skewed sex ratio that negatively affects long range population increases necessary for survival. Also the increase in weather changes result in beaches normally used as nesting sites to be washed away.

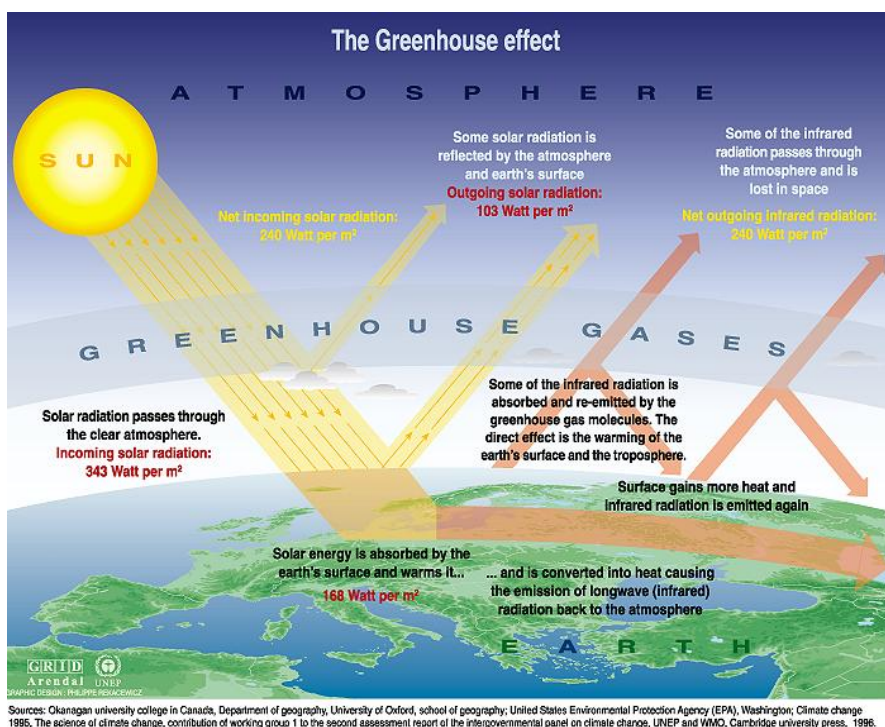
There are also species such as Koalas which have declined to less than 50% of their former numbers. Research projects that increase in Carbon dioxide in the air causes *Eucalyptus* trees to produce leaves with higher oil and chemical compound level which makes them indigestible and leads to malnourish females in particular as they have to feed their young. It is an example of plant and animal interactions following Carbon dioxide effect on plants which also impacts the

animals. The Clownfish is sensitive to an acidic ocean which occurs due to high carbon dioxide level in the atmosphere. The ability to smell and thus find their way to their normal reefs and the sea anemones on which they are dependent, and also to relocate their offspring.

Coral bleaching due to high temperatures and disease severely impacts about 160 species of Staghorn corals which account for about one fifth of reef-building corals. Southern Africa and Namibia are home to the Quiver tree, a soft wood plant species not used by humans which is sensitive to warm temperatures. Plants can't disperse the way animals can and remove themselves from the heat. This is a range restriction example.

Salmon is a freshwater fish that is familiar to most people on earth. Many countries and cultures depend on salmon for their economy and livelihoods. Increased temperatures, as well as changes in rainfall and melting ice in freshwater systems dramatically affects reproduction of salmon. Changes in nutrient content of the water also impacts salmon, directly disrupting economies in the afflicted countries also.

Beluga Whales are losing their refuge from predators, including human predators, due to melting Arctic ice. They are exposed and vulnerable



Slide on Greenhouse effect

without the ice and also suffering due to noise and pollution from ships.

Golden toad is extinct with the dubious distinction of being the first extinction due to climate change. Wild living examples have not been seen for 14 years due to a disease (*chytridiomycosis*), global warming, air pollution and restricted range.

Dr. Foden made the point that Climate Change doesn't consign species to become extinct. It is still possible to turn the tide with reduced carbon emission targets if government support and people also help by changing their behaviour to slow down climate change so that species and their habitats have a chance to adapt.

Dr. Foden reviewed a global study conducted by the Species Survival Commission which took into consideration the changing climate, increased temperatures, changes in rainfall and increase in carbon dioxide, to predict. This is to be an ongoing study and the first iteration predicted on mid-range projections that 15-37% of species in the sample studied will be en route to extinction.

Some current and/or anticipated impacts of CC on various Specialist Group's focal species from the Survey of SGs climate related activities: Less suitable habitats, shifting distribution ranges, decreasing fertility, mortality caused by physiological stress and extreme weather events, decrease in food or prey, habitats impacted by rise in sea level, Food/prey becomes less

abundant, occurrences of phenological mismatches, increase of disease, of freshwater availability, some species gain competitive advantage over others, human/animal conflict increases, uneven sex ratios, acidification of ocean impacts physiology or habitats

Assessing Species Vulnerability to Climate Change in context of zoo animals was the third days

Dr. Wendy Foden related that IUCN had been pursuing the work of special vulnerability to climate change for three years. Their conclusions so far are entirely new and, at the time of the SAZARC conference, had not been published. Thus SAZARC participants were the first group to receive and use the information.

Dr. Foden explained the objective of her group in trying to determine which species will be most sensitive to and affected by climate change globally. Information has been coming in from all parts of the world and it is very complicated to make these determinations. The goal is to convert the very complex system they have had to work with into a framework that will be immediately useful. Their group recently conceived a very simple way of thinking about CC impact:

A species is in trouble if it is (i) exposed to a lot of Climate change (exposure), (ii) sensitive to it (Sensitivity) and (iii) if it cannot adapt to the change (Adaptability). It all boils down to this: Think you are an

animal. ...how exposed are you? how sensitive are you? how can you escape the problem? For example: If it is you, and you are exposed and sensitive to climate change, you might know an area where you would be comfortable and get a ride there, take a bus or train or flight. If you are very sensitive and cannot move, you have a problem. This could be the case for the animal. So in categorizing species, remember their characters and behaviour to see which species fall into sensitivity and adaptability separately and categorize which species are vulnerable to climate change.

A group of biologists, species experts joined a workshop in Imperial College in London to discuss biological traits of species that could make them susceptible and problems with sensitivity and adaptability.

Exposure Sensitivity Adaptability

Point 1. Sensitivity to climate change – five characters needed to ascertain sensitivity to climate change.

A. Specialised habitat – eg Red Panda.

B. Narrow environmental tolerances (to) ... increases in temperature, susceptibility to disease, etc.

C. Environmental triggers. bird migration - time mismatched with habitat and availability of food; applicable to hibernating species also.

D. Interspecies interactions.

Changes in food sources and the predator prey relationship; change in the quality of food; specialized in its food sources, the food source may decline due to climate change. Also Disease, competition, mutualism

E. Rarity – population so low/no room for recovery - any disaster could wipe out

Point 2. Poor adaptability to climate change.

A. Poor dispersal (escape) ability

- Low maximum dispersal distances
- major barriers to dispersal

B. Poor evolvability.

- Low genetic diversity
- Slow turnover of generations
- Low reproductive output

Point 3. Exposure to Climate Change

How big is the problem in your area. Increase in temperature particularly in Himalayas, heat waves that will melt the snow mountains that will change the river flow, rainfall changes, drought, flood, extreme storms, Ocean acidification and sea level rise which



SAZARC Participants seriously taking in one of Dr. Foden's Climate Change Presentations

will have a big impact on mangrove ecosystem.

This can also be tried at ecosystem level like National Park or Reserve. This can be used in a range of different situation like river, protected areas etc.

IUCN worked on 17000 species that include Birds (~9,856 spp.), Amphibians (~6,222 spp.), Warm-water reef-building corals (799 spp.) and South African Proteaceae (389 spp.). We used 25 pieces of information (biological traits).

One example is Black-breasted Puffleg from South America (*Eriocnemis nigrivestis*). This has a very specialized habitat, it had a very narrow elevation range, it can tolerate only a very narrow range of temperature at high altitude, so the habitat is likely to be affected by climate change, it cannot move far away to non forest habitat and also has very low opportunity to establish at a new location.

Biological traits

Specialised habitat: Altitudinal range narrow and at high elevation
Restricted to habitats susceptible to climate change
High degree of habitat specialization

Poor dispersal ability

Low maximum dispersal distances
Limited opportunity to establish at new locations

An amphibian example is spotted Bull frog from Southern Africa. It breeds only after a particular monsoon rain. And that is likely to be disrupted due to climate change that will cause reproductive problem for the species.

***Hemiscus guttatus* (Spotted snout-burrower)**

Narrow environmental tolerance

Larvae particularly susceptible to desiccation

Poor dispersal ability

Geographic barriers limit dispersal opportunity

There are some analysis and evidence to say where are the birds, amphibians in the world that are in trouble. The results are expected to be published in early 2011.

To conclude, if a species is exposed and sensitive and not adaptive we need to help them move to some place where it can be comfortable. This is how we go about it with regard to conservation of species.

CLIMATE CHANGE SUSCEPTIBILITY **Susceptibility = Sensitivity + Unadaptability + Exposure**

SENSITIVITY

- A. Specialised habitat
- B. Narrow environmental tolerances
- C. Environmental triggers: migration times, hibernation
- D. Interspecies interactions: changes in food sources, disease, competition & mutualisms
- E. Rarity

UNADAPTABILITY

- A. Poor dispersal ability: low maximum dispersal distances, barriers to dispersal
- B. Poor evolvability: low genetic diversity, long generations, low reproductive output

EXPOSURE

- A. Sea level rise
- B. Temperature change: heat waves, ice/snow melt
- C. Precipitation change: droughts, floods, extreme storms, changing river flow, Disturbance from people

(Dr. Foden's presentations reported by Dr. B.A. Daniel, Scientist, ZOO.)

Extinct: The Golden Toad

"Its restricted range, global warming, chytridiomycosis and airborne pollution probably contributed to this species' extinction."



Monteverde Cloud Forest



Bufo periglenes

"Its entire range was protected by the Reserva Biológica Monteverde."

Pounds, A. & Savage, J. 2004. *Bufo periglenes*. In: IUCN 2007. 2007 IUCN Red List of Threatened Species