Bees and nature: *Chaos, land ethic and metapopulation*

Chaos:

In the flux of time, chaos reigns. To understand this statement we need to know that flux is a continuing movement, especially in large numbers of things, time is the indefinite continued progress of existence and events in the past, present, and future regarded as a whole and, chaos, a behavior so unpredictable as to appear random, owing to great sensitivity to small changes in conditions, especially at the edge of chaos.

Furthermore: Chaos theory is the field of study in mathematics that studies the behavior and condition of dynamical systems that are highly sensitive to initial conditions — a response popularly referred to as the butterfly effect. Small differences in initial conditions (such as those due to rounding errors in numerical computation) yield widely diverging outcomes for such dynamical systems, rendering long-term prediction impossible in general. This happens even though these systems are deterministic, meaning that their future behavior is fully determined by their initial conditions, with no random elements involved. In other words, the deterministic nature of these systems does not make them predictable. This behavior is known as deterministic chaos, or simply chaos. The theory was summarized by Edward Lorenz as: *When the present determines the future, but the approximate present does not approximately determine the future.*

Chaos theory helps us to understand patterns in nature. It has been used to model biological systems, which are some of the most chaotic systems imaginable. Chaotic patterns show up everywhere around the world, including cloud patterns, the currents of the ocean, the flow of blood through fractal blood vessels, the branches of trees, astronomy, epidemiology, and the effects of air turbulence.

Oh dear, now we have fractals. A fractal is a never-ending pattern. Fractals are infinitely complex patterns that are self-similar across different scales. They are created by repeating a simple process, over and over, in an ongoing feedback loop. Driven by recursion, fractals are images of dynamic systems – they are the pictures of Chaos.

Through the work of Mandelbrot and others, were have been shown the great beauty of fractals, not only in living systems, but also in conservation, especially in terms of Biological Conservation, where we are continuously working on the edge of error, simply because there can be beauty and lessons in error.

My interest in chaos also led me to thinking about the dynamics of vision, especially in terms of assimilation and understanding. Nowhere is this more touchingly illustrated than in the allegory of Plato's Cave, which goes thus:

The dialogue between Socrates and Glaucon is probably fictitious and composed by Plato; whether or not the allegory originated with Socrates, or if Plato is using his

mentor as a stand-in for his own idea, is unclear.
In the dialogue, Socrates asks Glaucon to imagine a cave, in which prisoners are kept. These prisoners have been in the cave since their childhood, and each of them is held there in a peculiar manner - they are all chained so that their legs and necks are immobile, forced to look at a wall in front of them. Behind the prisoners is a fire and between the fire and the prisoners is a raised walkway, on which people can walk.
These people are puppeteers, and they are carrying objects, in the shape of human and animal figures, as well as everyday items. The prisoners could only see these flickering images on the wall, since they could not move their heads; and so, naturally enough, they presumed the images to be real, rather than just shadowy representations of what is actually real. In fact, Socrates claimed, the images on the wall would be so real that the prisoners would assign prestige among each other to the one who could recall the most detail about the shapes, the order in which they appeared and which might typically be found together or in tandem. Of course, Socrates would point out, this was hollow praise, since in fact the images were not real.
Then Socrates offered a twist in the plot - what if one of the prisoners were to be freed and made to turn and look at the fire? The bright light would hurt his eyes, as accustomed as he was to the shadows, and even in turning back to the wall and its flickering images (which would be only natural), the prisoner couldn't help but notice that they weren't real at all, but only shadows of the real items on the walkway behind him.

If the prisoner was then taken from the cave and brought into the open, the disorientation would be even more severe; the light of the sun would be much more brilliant than the fire. But as his eyes adjusted, the newly freed prisoner would be able to see beyond only shadows; he would see dimensions and reflections in the water (even of himself). After learning of the reality of the world, the prisoner now sees how 'pitiable' his former colleagues in the cave really are. If he returned to the cave and rejoined them, he would take no pleasure in their accolades or praise for knowledge of the shadow-figures; for their own part, the prisoners would see him as deranged, not really knowing what reality is and would say of him that he left the cave and *returned with corrupted eyes.*

The point of departure of my talk thus rests on two assumptions, namely, that we are living in beautiful chaos which we are only beginning to understand, and that our eyes and senses have been corrupted by having forgotten the realities of the ecologically functional world. Needless to say, this must lead us to attempt correction and deeper understanding. The chronicle of the very recent past offers us salutary counsel and pointers to exactly this kind of understanding.

The land ethic

Published posthumously in 1948 by Oxford University Press, Aldo Leopold's lasting classic *"A sand county almanac"* has not only endured, but has become one of the cornerstones of modern conservation concepts. He states in the introduction: *"There are some who can live without wild things, and some who cannot. These*

essays are the delights and dilemmas of one who cannot." and herewith anchored a phrase which is becoming prophetically relevant today.

This is what he had to say:

"A land ethic, then, reflects the existence of an ecological conscience, and this in turn reflects a conviction of individual responsibility for the health of land." and:

"We can be ethical only in relation to something we can see, feel, understand, love, or ***otherwise have faith in****."*

In 2003 the Australian philosopher Glenn Albrecht coined the term *solastalgia* to mean a "*form of psychic or existential distress caused by environmental change*". A mere glance at any ranked refereed journal in earth science is enough evidence to immediately raise concerns for conservation, not only at the international scale, but also at the local and landscape level. We *know* that natural capital is the very foundation of our sustained existence, we *know* that more than destruction, the biosphere of the planet is heading for catastrophe. To you, the bee farmer, your insects have become the litmus and the indicator of change in what is currently described as the anthropocene, or the era of human influence. Robert Macfarlane, in his essay *Generation Anthropocene: How humans have altered the planet forever*, states: *The idea of the anthropocene asks hard questions of us. Temporally, it requires that we imagine ourselves inhabitants not just of a human lifetime or generation, but also of "deep time" – the dizzyingly profound eras of Earth history that extend both behind and ahead of the present.* Never, in our history, has a universal land ethic been more relevant.

Then, in 1962, Rachel Carson published possibly the most damning account of global ecological genocide when Silent Spring appeared. In the chapter "A fable for tomorrow", she says: *The "control of nature" is a phrase conceived in arrogance, born of the Neanderthal age of biology and philosophy, when it was supposed that nature exists for the convenience of man. The concepts and practices of applied entomology for the most part date from that Stone Age of science. It is our alarming misfortune that so primitive a science has armed itself with the most modem and terrible weapons, and that in turning them against the insects it has also turned them against the earth.*

Comes the year 1968, Joni Mitchell released "Big yellow taxi", clearly influenced by Carson:

"*Hey farmer farmer,*
Put away that D.D.T. now,
Give me spots on my apples,
But leave me the birds and the bees,
Please,
Don't it always seem to go,
That you don't know what you've got,

Till it's gone,
They paved paradise, And put up a parking lot".

At the time she was a friend of Bob Dylan and was most certainly familiar with his terrifying lyric from Hard Rain written in 1964:

"I'll walk to the depths of the deepest black forest
Where the people are a many and their hands are all empty
Where the pellets of poison are flooding their waters
Where the home in the valley meets the damp dirty prison
And the executioner's face is always well hidden"

Surely we owe ourselves, and the environment, an ethical response now that we have been warned and understand the outlines of the problem. I say outlines simply because that bitter old sage Mencken, also cautioned us that: *"For every complex problem there is an answer that is clear, simple, and wrong."* He also said, in 1932: *"The cosmologies that educated men toy with are all inordinately complex. To comprehend their veriest outlines requires an immense stock of knowledge,* ***and a habit of thought****."*

The Metapopulation

I speak no more as a scientist, but only as someone who has had wide exposure to the ecological ravages of economic growth, man's insensitivity to man and his fellow creatures and, perhaps most importantly, having seen the gross excesses produced by greed and corruption in a time calling for compassion and altruism. The tipping points sorely needed to remedy this tragedy will be achieved, not in the laboratory, but in the mind.

Is there hope in such bleak land- and mindscape? Methinks yes. Let me offer you a small example of how my remedial thinking about managing threatened and dwindling resources works. Table Mountain holds one of the rarest frogs on earth, the Table Mountain Ghost Frog, a particularly dull and ugly amphibian, existing only in a handful of streams. There have been endless attempts to safeguard these breeding streams from pollution, disturbance and fire, whilst the general surrounding habitat has been steadily trashed. Would sound management at the landscape level not produce much better results? Look after the mountain and the frogs will look after themselves.

We have glorious technology at our fingertips to begin addressing metapopulation management, not only at the regional, but perhaps the continental level. Remote sensing has produced spectacular results, not only in real time, but in conservation tools such as Muchina and Rutherford's "*The vegetation of South Africa, Lesotho and Swaziland*". The application of such data has furthermore produced world-leading research and publication in the field of demographics, where the Animal Demography Unit at UCT, established by the visionary Prof. Les Underhill, has become justifiably famous. Our research into habitat fragmentation management

has made huge strides in modeling and planning, where it has been clearly shown that in order to effectively bridge habitats through corridors, where these connections need not be linear and substantial, but will function even when in the shape of Lady Gaga's bra.

The future of pollinating insect management will *not* lie in remedial action of commercial, captive and mobile populations but in the robust genetic engine of wild and unmanaged populations. Remember what happened in the late 1990s when bovine tuberculosis nearly wiped out the entire population of lions in the Kruger National Park? Wisely it was decided not to intervene, not to inoculate, not to isolate. The population paid a substantial price in a catastrophic decline, but has now robustly rebounded. I believe that our bee population will show much the same response to metapopulation management. The true engines of remedial genetic flux lie "out there" and not "here". Let us acquire a *habit of thought* when we think and act on the looming crisis in insect pollinators, and paint with big brushes. Much as in a large work of art, the picture will become clear when we step back.

Using GIS it would be very easy to superimpose carefully selected and filtered criteria such as agricultural edge, distance from edge, management unit size and drainage systems into a predictive visual guide at the landscape level. Next, using the highly sophisticated but simple criteria and indicators prescriptions used in certification by the Forest Stewardship Council, the connectivity dynamics, especially in terms of shortfall at landscape level, will immediately become apparent.

The current crisis in global pollinator declines needs a new habit of thought, mostly due to the fact that familiarity has become the our greatest obstacle to accurate observation. The future of apiculture should begin in our cities and towns, as has been successfully shown in large metropolises such as New York and London. Only by extending a planned and managed set aside connected by corridors and refugia across entire landscapes will sufficient genetic and adaptive resilience be integrated into our precious pollinator fauna. The benefits of such resilience outweigh the input and establishment costs by immeasurable amounts.

Ladies and gentlemen, give me spots on my apples, but leave me the birds and the bees

I thank you