When do you actually declare a species extinct?

And why does it matter? (See page 6)

Other stories
Different challenges, similar approaches  2
Bird lists can reveal underlying trends  3
Tracking crocs and birds and things (V track) 10
When is science valid  12
All species are not created equal  12
The players in the nature conservation milieu are identical. There are the managers who say the scientists are too arrogant …

the scientists who argue that the managers need more scientific training …

the policy makers complaining about scientists not doing the relevant research …

and so on”

Some of the Mediterranean scrub that forms part of the Nature Park at Ramat Hanadiv. Ramat Hanadiv’s vision is to create a balance between humans and nature. As perhaps the most researched and carefully managed open space in Israel, it serves as an outdoor laboratory for scientific research and educational projects on the environment. For more information see http://www.ramathanadiv.org.il/index_en.aspx

The workshop in Israel, which had a broad mix of participants agree that the bridge across the gap has to be built using real incentives. To expect the university sector to reward scientists who have an impact, or government departments to reward research, is a fantasy. So we agreed to formulate the A-Z of rules and incentives for engagement – some of which are found in an earlier AEDA paper (Gibbons et al, 2008). My rule ‘A’ is simple – turn up – even if you have to go to Norway (a place where the rain stops only because it starts snowing).

More info: Powerpoints and videos from the Israeli meeting can be found at
http://www.youtube.com/view_play_list?p=F4B7D36E3779A45D
http://biodiversity-group.huji.ac.il/SalitKark/sciencebasedconservationworkshop.html

Reference
What’s a bird list worth? By itself, not all that much; it’s simply a list of species spotted by a bird watcher at a particular place. Of course, some lists might hold special significance for individual bird watchers (“I saw my first pheasant coucal today!”) but traditionally they have been considered fairly useless for scientific purposes, because all they are reporting is the presence or absence of a species. And it’s very difficult to pool a number of lists because they were done by different people, over different times, in different weather conditions and often using different methods. Superficially, to an ecologist who delights in rigorous, statically-designed data collection protocols, they all look fairly useless.

However, even while they’re pretty basic, bird lists are often the only data on birds available for an area. Furthermore, we have lists for places that go back a long way, often a lot further than well-designed professional surveys. And, because bird watchers are often fairly obsessive (birders would probably describe themselves as ‘keen’), they often revisit the same areas many times over many years accumulating an impressive number of lists. So, even if a single list might be of limited value for picking up changes in the environment, is there any value in lots of lists from the same area? A new AEDA investigation has demonstrated the answer is a resounding yes.

"List Length Analysis uses presence-only data and assumes that the length of a species list is a reasonable measure of how likely any bird is to be found.”

Problems with historical data

"To detect population declines you normally have to rely on historic data,” says Dr Judit Szabo, the lead AEDA researcher on the bird list project. "Unfortunately, this data is usually of limited value because it is of such variable quality, and it’s very difficult to combine dissimilar data sets. What’s more, for most areas, the amount of historical data is very limited.

"Bird lists are a form of historical data that are often quite common for many areas and sometimes have been collected over many years. But how do you compare and combine different lists? They are produced by different people with different amounts of experience who put in varying amounts of time putting them together.

"About ten years ago Donald Franklin, an ecologist at Charles Darwin University (in Darwin), suggested that the length of a bird list can tell you something about the amount of effort that went into assembling it. He proposed that using this information you could extract valuable information from multiple sets of bird lists. Using a Bayesian modification, we developed this idea into a List Length Analysis and then applied it to several sets of bird lists to see whether we could extract any valuable biodiversity.”

List Length Analysis uses presence-only data and assumes that the length of a species list is a reasonable measure of how likely any bird is to be found. In theory, if a species is declining, its relative abundance, compared to that of other species within the community, will decline and therefore higher effort is required to find it. In other words, if a species is declining, it will appear less frequently on bird lists of the same length as time passes.

Since the dawn of time, bird watchers have been wandering around the countryside compiling lists of the birds they have spotted. Now there’s a possibility we can better harness some of their good work. Applying list length analysis, for example, the researchers found that the chance of seeing a speckled warbler in a Birds Queensland bird list declines at a rate of about 7% per year for a list of average length. (Bird image by Aviceda.)
Testing the value of list length

So that’s a neat insight, but so what? Does it hold any value for monitoring change and ultimately making decisions? Szabo and colleagues think it does. They set out to test the strength and assumptions of List Length Analysis by applying it to historical, volunteer-collected bird lists put together in southeast Queensland over the past four decades.

“We used data from birdwatching outings of Birds Queensland,” says Szabo. “It is a non-profit organisation and their bird lists are pretty typical of volunteer-collected data.

“ Their surveys were normally done in the morning and lasted around three to four hours. The number of birdwatchers varied, and was usually between 10-30 people. The locations they surveyed were described in words or with low-resolution coordinates and the extent of the area covered by the surveys was not recorded.

“Birds Queensland’s surveys covered from 1970 to 2006. Earlier surveys, from 1964 to 1970, were conducted by the local branch of the Royal Australasian Ornithologists’ Union (now Birds Australia) and were incorporated into the dataset by Birds Queensland.”

So what were they able to demonstrate working with a large heterogeneous volunteer-collected dataset? Of the 269 bird species analysed, most of the species that show substantial declines have been reported as having declined or being in decline elsewhere in Australia. For the region the researchers were considering, this was the first scientific validation of previous anecdotal claims (documented in unpublished data and grey literature).

Eleven of the 14 species showing the largest declines are insectivores, mostly inhabitants of more open woodland habitats. Their decline is not surprising, as woodlands in and around Brisbane have been replaced by suburbs to a great extent during the past half century. Among other noteworthy decliners are rainforest species, waterbirds and two introduced species (house sparrow and nutmeg mannikin). On the flip side, increasers were a mix of native parrots and introduced species, with the common myna showing the greatest increase. These results are also in accordance with field studies and the general impressions of local birders – but until now, nobody had any statistically credible proof.

“The trends picked up from the Birds Queensland data represent the only regional-scale, statistically credible change in biodiversity of a whole taxonomic group for the region over such a long time frame,” observes Szabo. “This is the kind of data one would hope that government agencies would have assembled and analysed, because it is invaluable for policy and management, and it really should form part of regional and State of Environment reports.”

For the Queensland State Government, southeast Queensland councils and natural resource managers this is signalling that action to secure viable populations of woodland birds is needed now.

Extracting value from historic data

But the analysis was possibly more important in demonstrating that a Bayesian List Length Analysis allows you to model changes in prevalence over time using species lists that were collected with variable effort.

“We’ve demonstrated that List Length Analysis is useful for modelling relative abundances from species lists, as we (continued on page 6)
were able to detect declines and increases," says Szabo. "What's more, estimating the magnitude and certainty of those changes was straightforward.

"Further, we can calculate the probability that there has been a decline of a given magnitude. The list length method proved very robust for moderately common species. We discovered that this method has the capacity to alert us to species declines and lays the groundwork for using historic datasets that previously were of only limited value.

"What's more, this method allows ecologists to calibrate more recent datasets of different quality and to plan how dense and intense future sampling networks should be in order to detect predetermined levels of decline."

These measures are useful to managers who may have to establish whether a threshold of decline has been exceeded to warrant a listing of a species as threatened.

In addition to applying List Length Analysis to 40 years of volunteer-collected data in southeast Queensland, the researchers are also analysing an 8-year dataset simplified into presence/absence lists from the Mt Lofty Ranges in South Australia and comparing the results of List Length Analysis with those of traditional trend analyses. To test the rigour of their work, they are also analysing 10,000 bird species with different initial population sizes and 'observabilities', undergoing imposed (ie, known) declines of different magnitudes. The results of these studies are now being published.

There's gold in them lists

The best way to detect changes in the abundance of birds is still through properly planned systematic surveys, where birdwatchers visit the same sites and count birds in the same way at regular intervals (such as the 20 minute/2 hectare count method of Birds Australia). But this new AEDA research has demonstrated that even the humble bird list can by useful in revealing trends over time.

"For the casual bird watcher this means that all those lists are gold, especially old lists," says Hugh Possingham, a co-author of the research. "Anybody can enter their bird lists in Birds Australia’s ongoing atlas [http://www.birddata.com.au/homecontent.do] which provides an invaluable long-term repository for future analyses. This means that the humble bird watcher may one day provide the essential data that drives environmental accounts and hence government policy!

"For governments it means that they need to hire more analysts. Megabytes of invaluable data sit unanalysed in huge state and federal government databases. Many of these data sets are not known to the public or scientists, while others are almost impossible to access (even though the Australian taxpayer paid for them). The bird list project has highlighted the fact that it is not lack of data that is our biggest impediment to delivering credible environmental accounts, but merely a lack of statisticians and modellers!"

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References


On the maven

Judit’s research has recently been given international exposure on the Conservation Maven website. An excerpt is shown below. The Maven site profiles the latest groundbreaking conservation studies, field news, books and funding opportunities.

Check it out yourself at http://www.conservationmaven.com/

Citizen science: using birder lists to detect species decline

Researchers have tested a method for using species lists collected by volunteer birders to detect avian population changes. This gets at the important issue of whether we can harness citizen science from birders and other outdoor recreationists to contribute useful data to species conservation efforts.

In the case of birds, measuring changes in species abundance has typically required systematic, rigorous data collection, which can be expensive. Therefore the need for useful data presents a big challenge for conservation given our finite resources.

Meanwhile birding lists from recreational or organized volunteer efforts are common across much of the world and can cover long time periods and large geographic areas. Unfortunately, given the lack of a systematic approach in these volunteer birding efforts, scientists have largely considered this data useless for estimating changes in species abundance.

In this new study, Judit Szabo and fellow researchers address a key limitation of birding species lists - the amount of effort spent by the birder in compiling the list is usually uncontrolled and unknown.

To help get around this problem, the researchers tested a method that uses the length of a birder’s species list as a surrogate for the amount of effort undertaken. Specifically, the method looks at changes in the occurrence of species relative to the length of lists to detect increases or decreases in abundance over time.


"This is the kind of data one would hope that government agencies would have assembled and analysed, because it is invaluable for policy and management”
Declaring extinction is a difficult decision with large risks and large uncertainties. There are many cases when species thought to have been extinct have been rediscovered — so-called Lazarus species (see the box on page 8). According to the International Union for the Conservation of Nature (IUCN), a species should be declared extinct if there is "no reasonable doubt that the last individual has died". But when it comes to extinction, what is a reasonable level of doubt?

This is far from an academic question because the answer is important to conservation management. Allocating scarce funds to manage an extinct species is a waste of resources. On the other hand, mistakenly assuming a species is extinct and prematurely cutting off management could actually lead to its extinction (a tragic mistake known as the 'Romeo Error').

A new study led by AEDA researchers Tracy Rout and Mick McCarthy (Rout et al, 2010) examines the decision to declare a species extinct. They minimise the expected cost of both types of error: mistakenly declaring extinction when the species persists, and continuing to manage and monitor an extinct species.

The optimal point at which to declare extinction depends not only on the probability the species is extinct, but also on the cost of continuing monitoring and management, the benefit of management, and the importance of conserving the species, expressed through its estimated value. To illustrate the value in their approach, the researchers carried out an analysis on three very different examples: the extinct dodo, the possibly extinct ivory-billed woodpecker, and the extant but declining mountain pygmy-possum.

Extinct: the dodo

The dodo (Raphus cucullatus) is an icon of extinction. It is thought to have been first discovered by Dutch mariners, who arrived on the island of Mauritius in 1598. The scant information on the species has been pieced together from skeletal remains, a few other physical fragments, and written accounts and drawings.

The last confirmed sighting of the dodo was in 1662. Unsurprisingly, it is extremely unlikely to be extant today (a probability of $3.07 \times 10^{-6}$ in 2009, see Figure 1).

Even so, the probability the species is extant is not the only factor that influences the cost-effectiveness (continued on page 7)
of continued management and monitoring. Part of the value of management is its expected benefit, that is, how much will managing this species increase its probability of persistence over a nominated time horizon? If management can’t achieve anything, then it is not worth investing in.

The other element to the value of management is the importance of the species being managed – expressed through its estimated value. This is a tricky point (see the box on dollars for dodos), but to allocate resources efficiently it is necessary to prioritise species. Putting a monetary value on a species at least makes these judgements explicit and transparent.

So what does this mean for the dodo? Managing now as if the dodo were still extant, 348 years after the last confirmed sighting, would only be optimal if the expected value of management were more than 17 million times the annual cost of management and monitoring (Figure 2). Even if management was absolutely effective and could increase the probability of persistence over a nominated timeframe from 0 (certain to go extinct) to 1 (certain to persist), it would appear that this is not an appropriate investment.

Possibly extinct: the ivory-billed woodpecker

The ivory-billed woodpecker (*Campephilus principalis principalis*) was thought to be extinct on the US mainland. The most recent confirmed sighting was way back in 1944. But then, in 2004, a team of scientists claimed to have discovered the species persisting in the swampy forests of Arkansas. They supplied video footage but this was challenged. And further searches failed to provide conclusive evidence of the species’ presence at the site.

(continued on page 8)

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**Dollars for dodos**

Estimating the value of a species

Methods have recently been developed to try and quantify the value of environmental goods that are not traded in any market. The most common method is contingent valuation, which uses surveys to find out what people would be willing to pay for a specified improvement in an environmental good. Contingent valuation methods have been used many times to elicit values for different threatened, endangered, and rare species around the world (though it should be noted that they are widely criticised).

The species value elicited in contingent valuation studies is an instrumental value, that is, it is a value that depends on the valuer. A species may be valuable to humans for a variety of reasons. For example, a species may have aesthetic, ecological, medical, recreational, tourism, educational, existence, scientific or spiritual value. Contingent valuation studies attempt to capture some of these values.

Some have argued against using instrumental values because they believe natural entities possess intrinsic value, a value independent of their value to humans. However, intrinsic value is a poorly defined concept and does not enable trade-offs, which are essential for management and decision-making. (For more information on intrinsic and instrumental values, see articles by James Justus in *Decision Point* 24 and 28.) Other have simply noted that contingent valuation is an expensive way of providing very poor estimates of value - at best a minimum value.

While contingent valuation is important for cost-benefit analysis (you do something if benefit minus cost is positive) it’s rarely used in AEDA research. There are other approaches to ranking options or evaluating a course of action that don’t require all attributes to be given a dollar value. For example, cost-effectiveness analysis, maximising return-on-investment for a fixed budget, achieving predetermined conservation outcomes for minimum cost (which is what Marxan does), multi-criteria decision analysis methods allow coherent evaluation of decision options, without converting everything to the same currency. For a highly readable review of such approach, see Hajkowicz 2008.


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**Figure 3: Probability that the ivory-billed woodpecker is extant as a function of years without sighting. Solid line excludes the controversial sightings (most recent sighting in 1944) while the dotted line includes the controversial sightings (most recent in 2006).**

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A hand-coloured engraving of the ivory-billed woodpecker (from *Birds of America*). The male is on the left.
‘Lazarus species’
Back from the dead

Recently there have been reports that the yellow-spotted bell frog has been re-discovered – after 30 years without being sighted! Such ‘Lazarus species’ – species that are thought to be extinct but are subsequently found to have to have persisted – drive home the level of uncertainty involved in statements on extinction.

The re-discovery of the yellow-spotted bell frog is all the more remarkable given that a recent analysis estimates the probability of the species being extant as less than 0.001 (Hamer et al., in press). So, it’s important to keep in mind that just because an event is unlikely to happen doesn’t mean it won’t!

Lazarus species are not uncommon in Australia. In fact, our third case study, the mountain pygmy-possum, is itself a Lazarus species. It was known only from fossil records and presumed extinct until found in a Mt Hotham ski lodge in 1966.

Then there is the bridled nailtail wallaby, thought to be extinct (with the last sighting in 1937) until re-discovered in 1973. After reading an article in Woman’s Day about Australia’s extinct species – including the wallaby – a fencing contractor spotted a population on a central Queensland property. The sighting was reported and confirmed by the Queensland Park and Wildlife Service, and the area is now a national park.


“A Lazarus species are not uncommon in Australia. In fact, our third case study, the mountain pygmy-possum, is itself a Lazarus species. It was known only from fossil records and presumed extinct until found in a Mt Hotham ski lodge in 1966.”

Dead as a dodo?
(Continued from page 7)

Sightings reported in Florida in 2005 and 2006 also lacked evidence, and the species’ persistence remains controversial.

The probability the ivory-billed woodpecker is extant depends on whether these recent controversial sightings are included in the analysis. Using only the non-controversial sightings (with the most recent being in 1944) makes the ivory-billed woodpecker extremely unlikely to be extant today (probability of $1.78 \times 10^{-13}$ in 2009). This probability is even lower than for the dodo. This is because the ivory-billed woodpecker was seen regularly before its disappearance, which means its probability of persistence decreases rapidly as the number of years without sighting increases (solid line in Figure 3). In contrast, the dodo was not sighted regularly, so its probability of persistence decreases slowly with the number of years without sighting.

Including the controversial sightings (with the most recent in 2006) means the ivory-billed woodpecker is highly likely to be extant (probability of 0.93 in 2009, dotted line in Figure 3).


Figure 4: The optimal year to declare extinction of the ivory-billed woodpecker on the basis of different relative management values, and using different sighting records. Solid line excludes the controversial sightings (most recent sighting in 1944) while the dotted line includes the controversial sightings (most recent in 2006).

Figure 5: The probability that mountain pygmy-possums are still present on Mt Buller as a function of the number of surveys without sighting.
Establishing the veracity of controversial sightings is obviously important to assessing whether the species is currently extant or not. But will it ultimately affect the best management decision for this species? Short answer: yes.

Figure 4 shows the optimal year to stop managing and monitoring for ivory billed woodpeckers, depending on the relative value of management. Using the different sighting records gives very different results (solid vs. dotted line).

The proposed budget for managing and monitoring this species is US$27.8 million over five years, which is an annual cost of US$5.56 million per year. To give an idea of the relative value of management for this species, we can look at the estimated value of similar charismatic North American bird species. Contingent valuation studies have estimated a total present value of US$76 billion for the red-cockaded woodpecker, US$192 billion for the bald eagle, and US$246 billion for the whooping crane. Using this range of species values and the above costs above makes the maximum relative management value for ivory-billed woodpeckers 44,245.

Using only the generally accepted sighting record (solid line in Figure 4), the maximum amount of time to manage and monitor the species (at the costs above) would be 21 years after the final sighting in 1944, with extinction declared in 1965.

Using the controversial sightings (dotted line in Figure 4), the maximum amount of time to manage and monitor the species would be 26 years after the most recent sighting in 2006, with extinction declared in 2032 at the latest if no further sightings occur.

These estimates of the maximum amount of time to manage and monitor are assuming the benefit of management is absolute – that without management the species will go extinct, and with management it will persist (over a relevant time horizon). If the benefit of management is not absolute, it will be optimal to declare extinction sooner.

The probability of persistence of mountain pygmy-possums on Mt Buller remains high, even if they are not sighted for the next 50 surveys. This is because a decline in the trapping rate means it is hard to tell whether the failure to detect possums is because of extinction or declining detectability.

If the value of management is less than 14 times the annual cost of management and surveillance, it is optimal to stop intervention immediately (Figure 6). The larger the relative value of management, the longer it is optimal to continue management and surveillance.

The annual cost of managing and monitoring mountain pygmy-possums on Mt Buller is AU$215,000. A contingent valuation study on the species found a population to be worth between AU$200 million and AU$450 million. These figures give a maximum relative management value of 2,093, which means it is optimal to conduct as many as 66 surveys without sighting before declaring the population extinct. This means that if this year's survey fails to detect possums, it could be optimal to keep managing and surveying annually until 2076. If the benefit of management is less than absolute, it will be optimal to declare extinction sooner.

More info: Tracy Rout <tmrout@unimelb.edu.au>

Reference
Rout TM, D Heinze & M McCarthy (2010). Optimal allocation of conservation resources to species that may be extinct. Conservation Biology. Early online DOI: 10.1111/j.1523-1739.2010.01461.x

The mountain pygmy-possum is in rapid decline. (Photo by Sarah Goldin)
Technology is transforming conservation biology. For example, miniaturisation of computer technology, linked with advances in sensor capability, communications, and data storage are revolutionising how we track animals. While these novel technologies are enabling us to record an animal’s every move, they are amassing data at a rate faster than policies and practices are being developed to handle those data. Consequently, we are in danger of reducing the ability to verify results and build on previous research findings, the core of good science.

To address this issue researchers from AEDA and the ECO-lab (School of Biological Sciences at the University of Queensland) have designed software know as V-track; a database management system which rapidly assimilates the vast data sets generated through long-term telemetry studies, and produces real time and distance animations in Google Earth.

The major advantages of V-track over commercial geographic information software are its simplicity and cost effectiveness. It was coded in the visual basic and keyhole mark up language, and utilises the functionality of Microsoft Excel and Google Earth. These software packages were chosen because of their popularity, enabling researchers without specialist knowledge of geographic information software to view the location and movements of their tagged animals and rapidly exchange this information with other research groups.

V-track was originally developed to manage data collected from tagged estuarine crocodiles, but is now tracking the movements of a whole range of animals including sharks, rays, water snakes, marine and freshwater turtles. Each animal is implanted with a transmitter that emits a high frequency acoustic pulse through the water. These pulses

(continued on page 9)

“T

here is a communication gap between those out in the field tagging the animals with those best suited to manage, analyse and model spatially complex datasets.”

During August 2009 the ECO-lab and Australia Zoo attached satellite transmitters to eight estuarine crocodiles in the Wenlock River, North Queensland. The transmitters record the crocodiles location through the GPS satellites and are accurate to less than 10 metres. The data is transmitted via another system of satellites back to our laboratory, and we can see where these crocodiles have been by visiting ECO-labs website.

A snap shot from a Google Earth animation, which shows the coastal route (red arrows) of a 4.86m estuarine crocodile around Cape York Peninsula, North Queensland. The yellow arrows show the residual surface currents during the period of travel. Surface current data was obtained through the Bluelink Reanalysis Version 2.1 project conducted by CSIRO Division of Marine and Atmospheric Research (Hobart, Australia).
are detected by static underwater receivers anchored to the substratum and deployed in arrays across continental ocean shelves, throughout rivers, and within bays and estuaries.

Over 15,000 of these receivers have been deployed worldwide with 63 research groups utilising the technology in Australia alone. The fact that any receiver can locate every animal that carries one of these transmitters means that by sharing data between research groups an individual project has the potential to enlarge its study area to a quasi-global scale. As with all new technology, however, researchers are still discovering the capabilities and intricacies of the data they are collecting. Data management and analysis remain in their infancy, and virtually no standardised technique exists to enable data sharing.

This issue is now being dealt with by several groups. The Australian Acoustic Tagging and Monitoring system (AATAMS) has been set up under the umbrella of the federal governments Integrated Marine Observing System (IMOS). This group presently holds a pool of underwater receivers for communal use, but only a very rudimentary database management system exists to enable data sharing.

The V-track software addresses this issue by storing the vast data sets generated by underwater listening arrays in an efficient and easily accessible manner. It can be used to locate user defined behavioural events within the data, and view the movements of multiple animals in satellite imagery. Movements can be viewed on their own or run alongside a background of environmental information such as sunrise, sunset, moon phase, tidal cycle, and ocean currents; enabling rapid assessment of the ecological criteria underpinning an animal's behavioural decisions.

The Eco-lab and Australia Zoo worked together to tag a 4 m estuarine crocodile on the Steve Irwin wildlife Reserve in August 2009. The crocodile was named Aristotle and you can view his movements and current location through www.uq.edu.au/eco-lab/track-crocs.

On a V-track to success
(continued from page 8)

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The flexible nature of V-track means that new features of analysis can be easily added as steps within the program, depending on the study animal and the ecological question. For example, we recently added a feature to assess circadian dive behaviour in freshwater snakes, and another to determine when freshwater turtles were leaving the river to sun-bask and nest.

As digital technology improves, the gadgets that we use to track animals will continue to get smaller and the data sets larger. There is a communication gap between those out in the field tagging the animals with those best suited to manage, analyse and model spatially complex datasets. Bridging this gap will be vital to ensure the integrity and accessibility of wildlife telemetry data, and V-track is a big step in the right direction.

For further information or to obtain the V-track software, contact Hamish Campbell from the ECO-lab hamish.campbell@uq.edu.au or Matt Watts from AEDA m.watts@uq.edu.au. Details of all our tracking can be found at www.uq.edu.au/eco-lab.


This project is funded with an ARC-Linkage grant awarded to Professor Craig Franklin with Australia Zoo as industry partners.

V-track was originally developed to manage data collected from tagged estuarine crocodiles, but is now tracking the movements of a whole range of animals.
When is science valid?

Back to basics on what we do

In science, the test of any idea is not so much whether it is 'correct', but more so whether it is useful. For scientists, an idea is useful if it helps us make good sense of the world around us. However, if evidence contradicts an idea, or other ideas emerge that make better sense of the world, then science - ever pragmatic - will adopt the more useful idea.

Of course, initially an idea may only be accepted by a small part of the scientific community – who might be regarded as the vanguard of a new wave of thinking. But unless the majority of scientists in the field eventually take on the idea, then it will wither and may eventually die.

On the other hand, if the idea becomes accepted by the majority of scientists in the field because it usefully describes the world we live in, then it becomes mainstream. The idea is then ready to be challenged by the next wave of evidence-based ideas.

To take a current example, let’s consider the concept of human-induced climate change. This idea is now mainstream and accepted by the vast majority of the world’s scientists. It has passed the test of expert examination, and the international deliberations of thousands of scientists support that view.

Of course there are some scientists who do not support the view of the mainstream majority on human-induced climate change, but they are in a tiny minority. Until that minority publishes their ideas - thereby confronting the mainstream view in the scientific literature so that the alternative views can be rigorously tested against the evidence - then the community will continue to adopt the concept of human-induced climate change.

Key points

• Science works by systematically testing ideas against the evidence.
• Evidence-based ideas are examined by peer review and published for further scrutiny in the scientific literature so that additional tests can be applied.
• Scientific ideas are adopted when they usefully describe the world.
• When scientific ideas are widely accepted they become mainstream, and are applied until replaced by the widespread adoption of an alternative idea that makes better sense of the evidence.
• A scientific idea is validated when it is published in the peer-reviewed literature in the field, has stood up to further tests, and has been positively cited.

“T

the test of any idea is not so much whether it is ‘correct’, but more so whether it is useful.”

Species aren’t equal!

Species aren’t created equal in the eyes of conservation scientists, or so the numbers suggest according to a new study in Conservation Biology. The research looked at the frequency of scientific studies among 1909 at-risk mammals, birds, amphibians, and reptiles across southern Africa (between the years 1994 and 2008). Large mammals and reptiles were much more commonly investigated than small mammals, birds and amphibians. And certain species received a disproportionately large amount of attention while other species were not studied at all. For example, among threatened reptiles 98% of the scientific efforts focused on just 22% of the species. As in the world of conservation action, particularly ‘charismatic’ species did the best. Most studied species included chimpanzees, elephants, gorillas, and loggerhead turtles - well-known poster species of conservation campaigns. The authors contend: “With limited capacity and the likelihood that some species are over-studied and others are understudied, it is time for a proper evaluation of scientific investments.”