The Research Question ?

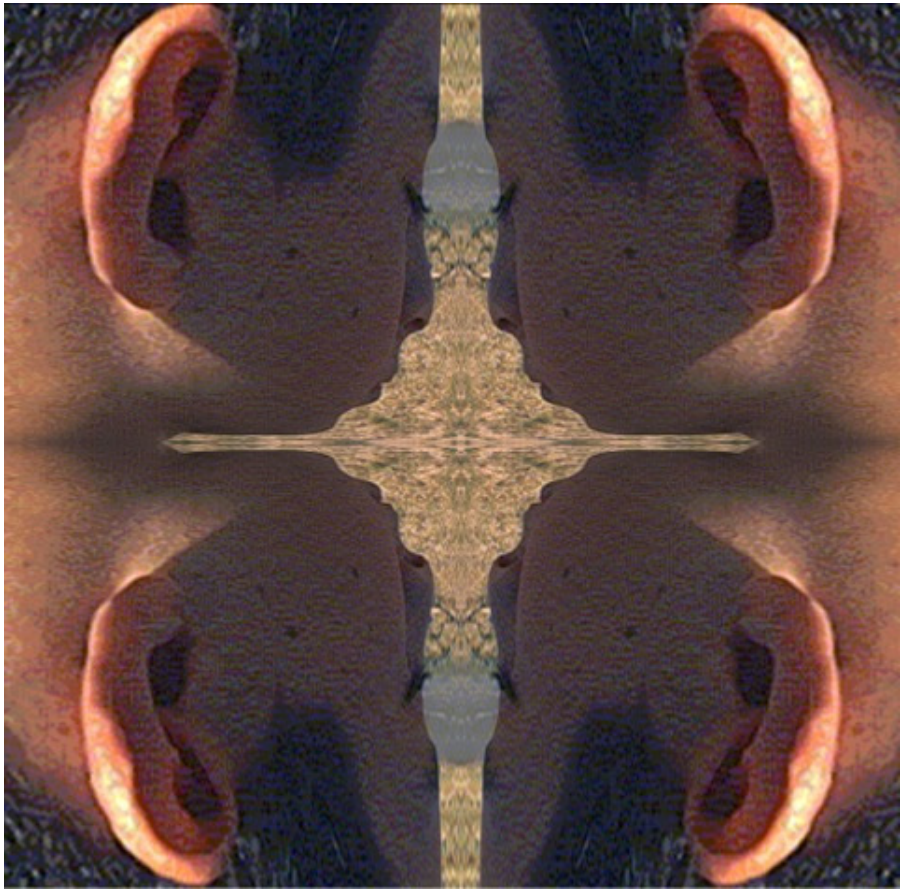
David Ward

School of Biological and Conservation Sciences

University of KwaZulu-Natal

Pietermaritzburg

What makes a paper interesting ?



Coming up with a research question isn't easy……

Different people have different opinions

Roy Turkington reviewed the opinions of 30 of the world's top plant ecologists of what they considered to be the top 5 papers in plant ecology:

- There was little agreement on the papers that these scientists found excellent

However, there were several key factors in common:

1. Question-driven research
2. Establishment of clear hypotheses
3. Sound experimental design
4. Appropriate statistical analysis
5. Clarity of writing

What sorts of research questions should we be asking?

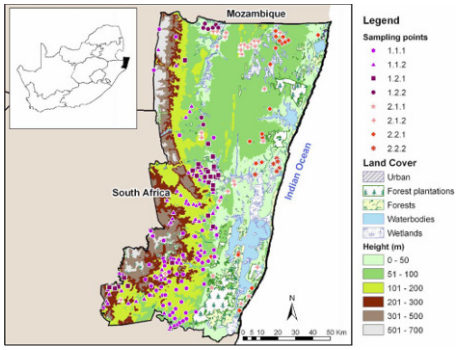
- A scientist may really need to know whether the values for a disk pasture meter are appropriate

- However, we need to ask whether this is an appropriate question for the journal we are submitting the data to.

We also need to ask whether this constitutes a primary research question …..

- Or is it a methodological issue that we need to determine for the sake of precision or accuracy, and then we can move on to more important questions……..

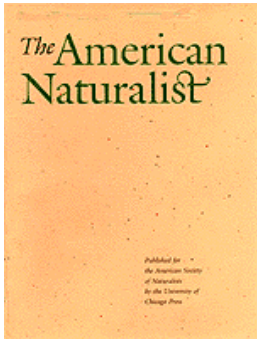
A similar problem may arise if we are trying to map all the vegetation types in a particular reserve



- Does anyone else need to know this information?

- Try to picture your audience.
- Is this useful information that someone can do something with, or is it merely a place to start out the research?

A useful place to start thinking about good science is to read as many articles as you can in “really good” journals



- I consider the following to be “really good” journals: Ecology, Oikos, Journal of Ecology, American Naturalist, Trends in Ecology & Evolution, Rangeland Ecology & Management
- These are all journals with a high “impact factor”
  - This means that many scientists cite their work
  - An example is Polis, G.A. & Strong, D.R. (1996) Food web complexity and community dynamics *Amer. Nat.* 147: 813-846. This paper has been cited 372 times and is the most cited paper in The American Naturalist.

Be careful – impact factors are not everything…..

- Fiona Godlee, editor of *BMJ* (formerly known as the *British Medical Journal*), agrees that editors take impact factors into account when deciding on manuscripts, whether they realize it or not.
  - "It would be hard to imagine that editors don't do that," she says. "That's part of the way that impact factors are subverting the scientific process."

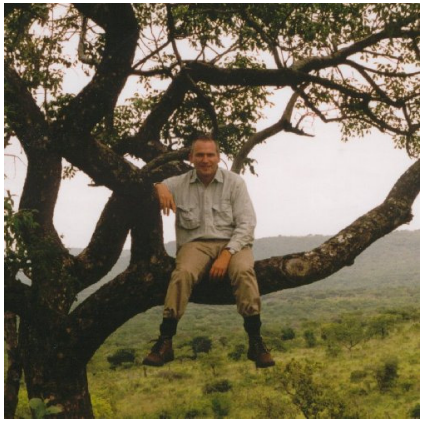
Usually a high impact factor is a sign of a good journal

- Impact factors are based on citation frequency
  - For example, African Journal of Ecology publishes some interesting articles but tends not to be cited very frequently.
- There are some journals that publish work that we might not consider as interesting (or *vice versa*) so we need to “not judge a book solely by its cover”
- Subscribe to the Table of Contents of many journals via your e-mail, which gives a good insight into the papers that might be interesting

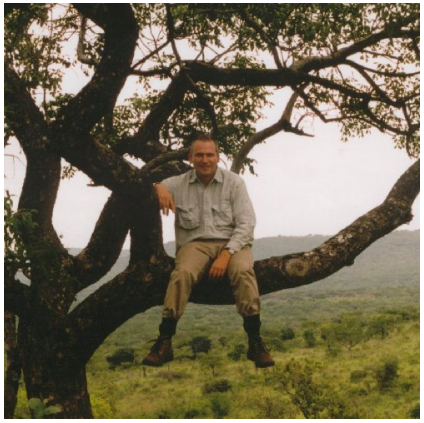
Be careful of journals such as Nature (impact factor = 32) and Science (impact factor = 31)

- These journals have very high impact factors but…..
- In our field, they usually publish only “sexy” stuff that is not very useful to the broader scientific public.

For example, Mark Ritchie and Han Olff published a paper in Nature (1999) called "Spatial scaling laws yield a synthetic theory of biodiversity. *Nature* 400: 557-560"



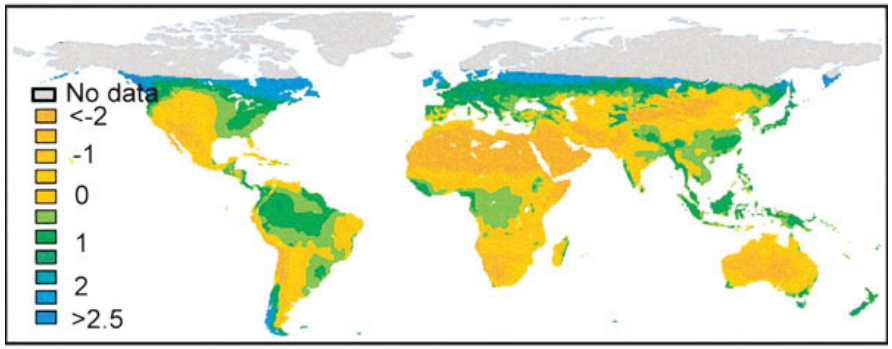
- They used spatial scaling laws to describe how species of different sizes find food in patches of varying size and resource concentration.
- This spatial packing rule yields a theory of species diversity that predicted relations between diversity and productivity more effectively than previous models.
- One would be forced to ask "Who would be able to use this information?"



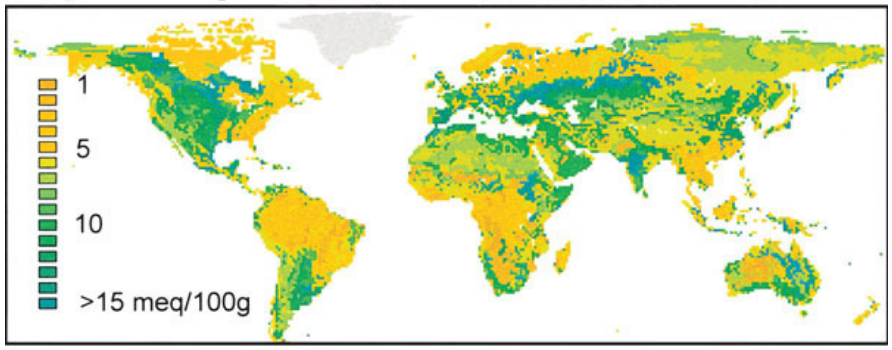
However, Han Olff, Mark Ritchie and Herbert Prins published another paper in Nature (2002) called "Global determinants of diversity in large herbivores. *Nature* 415: 901-904."

- They used soil fertility and rainfall data.
- These two parameters determine the quantity and quality of food.

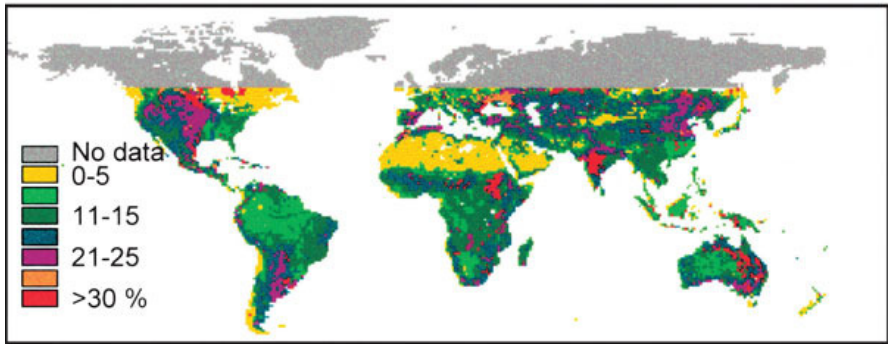
a Observed index for plant-available moisture
(log [rainfall/potential evapotranspiration])



b Observed index for plant-available nutrients
(total exchangeable bases)



c Predicted large herbivore biodiversity
(% of continental species pool)



They predicted where reserves should be placed

What’s the best way to start a study?

Having located your problem and satisfied yourself that it is important, you will have to convince your colleagues that you deserve support.

One way to accomplish this goal is:

1. A brief statement of what you propose, couched as a question or hypothesis.
2. State why it is important scientifically, not why it is important to you personally, and how it fits into the broader scheme of ideas in your field.
3. A literature review that substantiates (2).

Describe your problem as a series of sub-problems that can each be attacked in a series of small steps.

- Devise experiments, observations or analyses that will permit you to exclude alternatives at each stage.
- Line them up and start knocking them down.
- By transforming the big problem into a series of smaller ones:
  - you always know what to do next,
  - you lower the energy threshold to begin work,
  - you identify the part that will take the longest or cause the most problems,
  - and you have available a list of things to do when something doesn't work out.

Scientific questions can generally be divided into 2 groups based on their complexity

- "How" and "What" questions are usually simple
- "Why" questions are usually more complicated, and most of the debate in the literature deals with the appropriate null hypotheses for "Why" questions

A simple conceptual scheme

- "How" and "What" questions do not interest many people unless the answer is unexpected.
  - e.g. for centuries, nobody bothered to ask "How do baby crocodiles get from the egg buried in the nest to the safety of water?"
  - When Tony Pooley of the Natal Parks Board showed that the mother digs up the eggs, breaks open the eggshells, carries the babies in her mouth, and releases them into the water, everyone thought the question very interesting!

It is interesting and important to focus on the "Why" questions

- e.g., we have determined that there is a relationship between foraging activity and percentage cover of *Themeda triandra* in the diet.
- That was easy, but the process gets complicated if we ask "Why is there a relationship between foraging activity and percentage cover of *Themeda triandra* in the diet?"
- Is this because of high protein content, high digestibility, or simply because it is more common than alternative potential dietary items?

Science is shared knowledge

- Until the results are effectively communicated, in effect they do not exist.

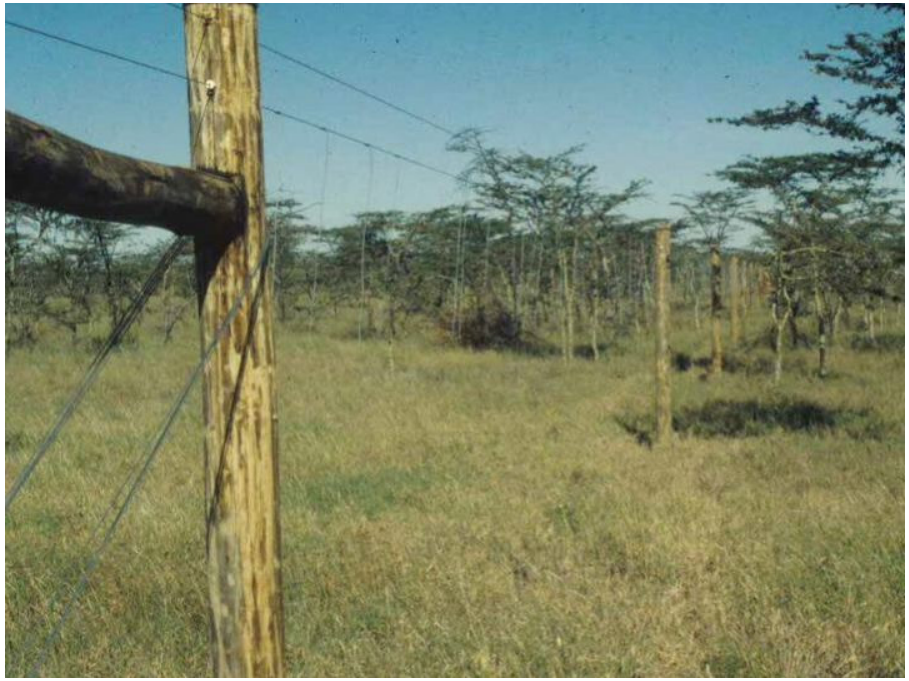
Always do an experiment rather than relying on complicated analyses to discuss an issue

- Clearly there are cases where something can't easily be understood by means of experiments

or

- The spatial or temporal scales are too small for an appropriate experiment

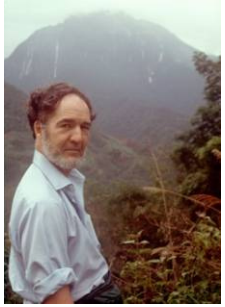
Sometimes it is possible to do very large experiments, e.g. the KLEE experiments in Kenya have 4 ha plots (16 of them), excluding cattle, or cattle and medium-sized game, etc.



One of the classic trade-offs in large experiments is replication

- Because such experiments are done on a large spatial scale, it may be logistically difficult to justify the extra expense of replication

- One study at Kluane in the Yukon examined the effects of predation in a single enclosure of 11 ha. Clearly, this lack of replication is a problem.
  - Try to replicate wherever possible



Comparisons of the strengths and weaknesses of experiments in ecology

- **Laboratory Experiment**: done in the laboratory
- **Field Experiment**: done in the field, usually small in scale due to expenses and logistics
- **Natural trajectory experiment**: comparisons done in the field of the same community before, during and after a witnessed perturbation by nature or humans, e.g. storm, volcano, introduction or extermination of a species, succession
- **Natural snapshot experiment**: comparisons of communities assumed to have reached a quasi-steady state with respect to a perturbing variable (e.g. reserves with and without predators)

Problems with natural experiments

- There are many things that co-vary with the hypothesis that you are interested in
- Are you really testing this or is it auto-correlated with something else?

Comparisons of the strengths and weaknesses of experiments in ecology

Axis	Lab expt.	Field expt.	Nat. trajectory expt.	Nat. snapshot expt.
1. Regulation of independent variables	**Highest**	Med/low	0	0
2. Site matching	**Highest**	Med	Med/Low	Lowest
3. Ability to follow trajectory	**Yes**	**Yes**	**Yes**	No
4. Maximum temporal scale	Lowest	Lowest	**Highest**	**Highest**
5. Maximum spatial scale	Lowest	Low	**Highest**	**Highest**
6. Scope (range of manipulations)	**Highest**	Med/Low	Med/High	**Highest**
7. Realism	0/Low	**High**	**Highest**	**Highest**
8. Generality	0	Low	**High**	**High**

Who should you collaborate with?

Decide *a priori* who you want to collaborate with

- My personal experience is that there is a non-linear relationship between the number of authors and the quality of the work done.
- It's good to collaborate but one must be sure that the collaborators are doing their jobs.
- If a person only provides technical support, the place for them is in the Acknowledgments and not co-authorship.

Sometimes people get difficult about this; rather accept their position as a co-author than fight about it.

Every dog has his day……

The road to the majors

- Work up to the major journals by publishing one or two short - but competent - papers in less well-recognized journals.

- You will quickly discover that no matter what the reputation of the journal, all editorial boards defend the quality of their product with jealous pride - and they should!

"Over-publishing" may be perceived by some as a problem (Ray Huey, Univ. Washington)

- Although "over-publishing" is a mistake, don't be embarassed by writing a few minor papers.
- We are often our own worst judges of what is truly significant
- One can always obscure truly trivial publications by changing your "List of Publications" to "Selected List of Publications" or "List of Publications since 200X"