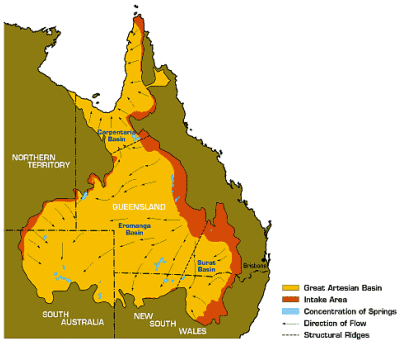
TOPIC NOTES FOR BIOL3701: CONSERVATION BIOLOGY AND RESTORATION ECOLOGY

Completed in 2017 with HD

Contents

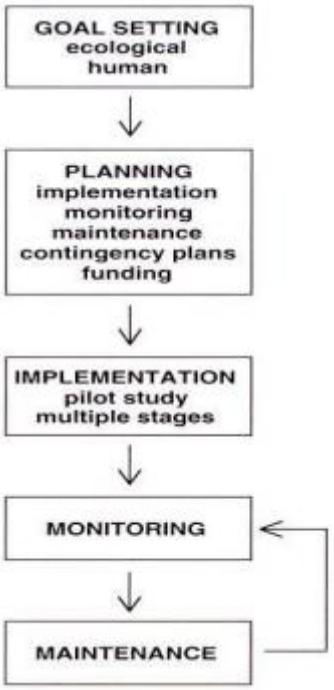
WK1: Conservation biology of plants of the artisan springs of the great artisan basin - (Associate Professor Duncan Mackay)



The Great Artesian Basin stores approximately 65 billion mega litres and occupies a 5th of the Australian landmass. The water originates from rainfall that lands across the Great Dividing Range before moving underground. Some the water becomes exposed to the surface via naturally formed springs. Due to the isolation of the artesian springs, plants and animals that occur around them may be isolated by hundreds of kilometres from the next population, or may be completely endemic and found nowhere else.

The drilling of bores since the nineteenth century for pastoral industry has resulted in the creation of thousands of free-flowing artesian bores throughout the Great Artesian Basin. Subsequently, the pressure head has declined by 5-15 metres resulting in a reduction of spring discharge of more than 40%.

WK1: EIA Monitoring Protocols – (Professor Peter Fairweather)



Monitoring is integral to assess impacts or recovery for species, communities or entire ecosystems. Studies of harmful effects on the environment has occurred since at least the 18th century. However, a concern to routinely assess impacts of development before they occur is much more recent, therefore enabling for the prediction of environmental impacts.

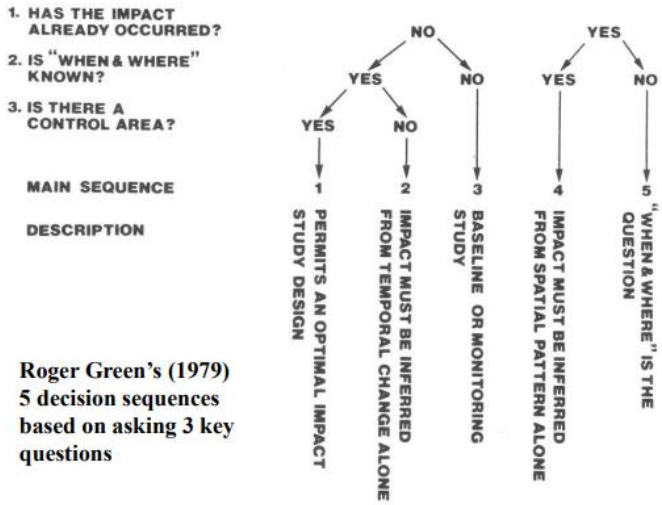
However, sampling for large amounts of data is not informative if the data isn't understood or is collected without meaning. Subsequently, there is a need to interpret and assess the data to extract conclusions.

The aim of environmental protocols is to detect an environmental impact. This is challenged by natural variably which occurs in time and space and causes the environment to change. This creates difficulty in identifying what impacts are caused by human activity which are further imposed on top of the natural patterns of change.

Impact: any effect, usually detrimental, that is the result of a stress or disturbance due to a development or ongoing human activity.

Control: any area or situation that lacks the human stress or disturbance that a punitive impact area suffers, preferably very similar in all other characteristics but it does not need to be identical, just comparable.

To assess for impacts, data collected from after the putative impact could be compared to data collected prior. If there is a difference in the data, then an impact may have occurred. Nevertheless, this could be influenced by natural changes in the environment such as seasonal variation. Alternatively, the impact site(s) can be compared with control site(s) that lack the human factor. This can however result in any changes between the spaces being interpreted as an impact.



Roger Green's (1979) 5 decision sequences based on asking 3 key questions

Both methods can be combined to form the BACI method, which compares impact sites to control sites both before and after a development. This process is further benefitted by multiple control sites as an average of the extracted data will minimise the impact of variation (reflecting the 'normal' conditions).

WK2: Protocols for Monitoring Restoration – (Professor Peter Fairweather)

The typical content that is included in an Environmental Impact Assessment (EIA):

- Statement of existing environment (inventory of the biota) - description
- Analysis of likely environmental interactions – description
- Analysis of likely environmental impacts and consequences – prediction
- Consideration of protective or mitigative measures (if necessary), plus alternative or no development – control

Questions	Design aspects
Does an impact exist?	Compare control versus impact sites; type of impact? On which variables? Any indirect effects?
Its magnitude?	Desired effect size to be detected
Its spatial extent?	Gradient analysis
Any trends over time?	Frequency and duration of sampling
Is recovery possible?	Defining time course of sampling; deciding on acceptability of whatever biota returns

The statistical outcome of EIA in relation to detecting environmental impacts is reliant upon hypothesis testing which could be subject to Type I & II errors. A type I error (α) occurs when it is predicted that there is an impact but there is actually none, having no actual consequence to nature. A type II error (β) occurs when it is predicted that there shall be no impact but an impact does occur, this however is associated with substantial consequence e.g. habitat destruction or species decline.

The probability of making each type of error is given in parentheses

		Prediction or conclusion of study: IMPACT	Prediction or conclusion of study: NONE
Real state of nature	IMPACT	Correct	Type II error (β)
	NONE	Type I error (α)	Correct

EIA require that the existence and severity of impacts are determined prior to it actually occurring. In order to make predictions, information is extracted from previous knowledge. This can include data regarding biota at the potential impact site as well as the results of previous impacts at alternative sites and the effect of restoration efforts. Should an impact occur then it is paramount that that it should be reversed. To do this, the site must be monitored to assess the successfulness of any restoration efforts. This however requires a pre-defined endpoint or target that marks whether restoration has worked and reached a satisfactory point.

In order to approach the 'endpoint', there is a requirement to compare the impacted site to a reference or target to allow for the detection of change. This can be done by comparing to controls which will also highlight new differences.

- Controls – unrestored sites, that can be used to determine whether a change has occurred (positive or negative) and demonstrates whether restoration is having an effect
- References – are targets that restoration efforts aim to meet, and are used to demonstrate how successful it has been.
    - Ideally, reference and control sites are setup prior to a development occurring and are sampled over time, assessing any demographic changes (recruitment, growth, reproduction) and check for time lags in the indirect effects.

From a statistical standpoint, utilising 2 simultaneous comparisons from multiple sites allows for the assessment of the effectiveness and the efficacy of restoration efforts, assuming:

C = Control – degraded area with no restoration E = experimentals – degraded areas being restored

R = references – pristine areas as targets

- E vs C = normal statistical test such as T-test or ANOVA
- E vs R = bioequivalence because null hypothesis = a difference. Bioequivalence testing uses a ratio of restored to reference (E/R) which approaches 1 as recovery occurs.