CLIMATE

# GUINEA PIGS IN A LABORATORY FOR CLIMATE CHANGE?

## Observing Our Own Responses

*Brian Sadler*

### Hindsight

Some 15 years ago the national Greenhouse 87 conference drew public attention to predictions of future rainfall decline in south-western Australia from global warming. These CSIRO scenarios, for a 20% rainfall decline by 2040, were surrounded by strong controversy. Discussion, as is still common now, was mostly in the realm of a hypothetical future.

In actuality, fifteen or more years before Greenhouse 87, in the late 60s to mid 70s, regional climate had suffered an abrupt rainfall decrease, in a real climatic shift which has persisted to this day. In 1987 however, that fact was not recognized even though the scale of decrease was similar to that which CSIRO projected in the Greenhouse 87 conference as a scenario for the year 2040.

In the mid 70s change, average winter rainfall decreased by 10% to 20% across the region of the wheatbelt, forests and coastal plain north to Jurien. The decrease came through less rain days, a later start to winter rains, less rain on extreme days and an absence of occasional "wet" winters typical of the past.

However, it not until the late 1990s, 20 or more years after the event, that climate science demonstrated a climate shift had occurred.

The abrupt rainfall decrease in the 70s has now been linked to global changes in atmospheric circulation which began at that time and which are similar to circulation changes projected for global warming. However, even now, research has not firmly determined the cause. Tentatively, it has been attributed to a mixture of multi-decadal variability and effects of human development, particularly to increase of Greenhouse gas emissions.

Behind this rainfall decrease another change was also occurring, in line with global and national trends. Surface temperatures rose progressively. Over the past 50 years this increase has been in the order of 0.5 ° C in the South West. The increase was more in winter than summer and more at night than day. Recent international reports have confirmed that the primary cause of this warming is accumulation of greenhouse gases in the atmosphere.

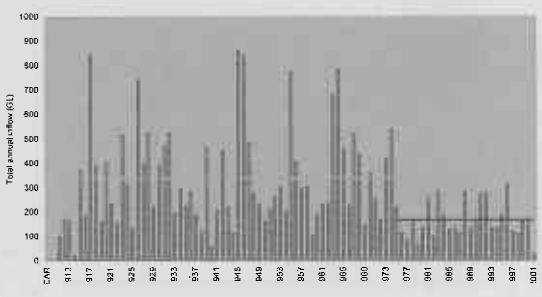
This history highlights the basic uncertainties of making decisions about climate change. It doesn't present with a clear "signature" and it's not easy to diagnose and separate from natural variability. Decisions on action are thus caught up with uncertainty about what exactly it is that we are trying to treat.

### How did we respond?

In the South West, water engineers were the first to act. The reasons were simple. The effects of the climate shift were greatly magnified in the resulting changes to river flows. Being only a small residual between rainfall and evaporation, river flows did not simply decrease proportionately but mean annual flows followed an abrupt and exaggerated decrease of some 50% after the mid 70s. Even this change was not immediately apparent at the time above the "noise" of natural variability.

It now appears that rainfall mechanisms at that time crossed some threshold in which occasional "wet" years virtually disappeared as a feature of regional climate variability. Because such years contributed strongly to storage replenishment the change has proved very serious for water supply management and has required hundreds of millions of dollars of extra investment. Such adjustments began in the late 80s but it was only in the late 90s that water engineers were confident that they were, in fact confronted with an abrupt and persistent climate shift.

Interestingly, farming fared very well under these changes. Wheat yields actually increased without any real recognition of climate change as an explicit management issue. Broad-acre agriculture had generally adopted minimum-till as best-practice. This measure, adaptable to later seeding, proved a well matched, if untailored, response to later onset of winter rains which accompanied the rain decrease. Also, although a serious concern to the water sector, the absence of "wet" winters was a favourable shift for many farms. In 2002 however, the winter season stepped comprehensively over the threshold of regional crop failure. Farming is now concerned that such thresholds might be crossed more commonly in the future under sustained trends of rainfall decline and warming.



Streamflows Perth Catchments 1911-2001

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Environmentally, the impacts to date are less clear. For the most part attention, over the last quarter century, focussed on hypothetical impacts of projected change and emissions control rather than on treating climate change adaptation as a current action issue. However, the sharp decline of river flows in the mid 70s suggests that moisture stress has been sustained at high levels for a quarter century in this region because of climate shifts. Coastal wetlands, for some time, have shown signs of increasing stress. For such wetlands, until recently, more attention was given to the impacts of water use and pine plantations than to climatic pressure which is the primary issue. Recent work has actively considered the possible impacts of rainfall decline and warming on the current state and sustainability of tuart and wandoo woodlands.

## National laboratory?

Consistently since '87, climate modelling has pointed to the South West as the Australian region most vulnerable to rainfall decrease.

The region, for whatever physical reason, has had a quarter century start down that path, which has impacted on our natural, economic, social and decision environments.

Whilst there is much hypothesising nationally and internationally about climate change impacts and responses, real experience is a scarce global commodity. Having sought such experience and found little, it has been argued that this region might be seen as a real-time national laboratory for study of climate change impacts and responses.

## A few observations

Climate change is a somewhat insidious process surrounded by uncertainties which are difficult for decision-making.

It is not easy to map the progress of change over the noise of natural variability. It took two decades for the region to confirm that the region had undergone a significant climate shift in the 70s and we are only able to make broad directional projections of future change.

Some changes may occur as relatively abrupt shifts rather than as steady trends.

Change impacts differently on various socio-economic sectors and there may be thresholds of change at which some specific impacts become critical.

Extreme years, such as 2002, which cross critical thresholds of drought and/or temperature will be expected to more frequently affect the natural regime in coming decades. Likewise, under declining rainfall, flood thresholds in some areas may be crossed less often with other implications for rivers and wetlands.

Until now, debate and decision-making about adaptation to climate change in Australia has been mostly hypothetical. In this region it is reality. Future debate and decision-making might benefit from closer study of particular aspects of actual climate impacts and responses in this region over the last quarter century.

## Decision support

The Indian Ocean Climate Initiative (IOCI) of the WA State Government is to continue with strategic investigation of climate variability and change over the next 5 years. The goal of the Initiative is to help reduce the uncertainties inherent in deciding management responses which address the impacts of change. The Department of Conservation and Land Management is a partner in IOCI.

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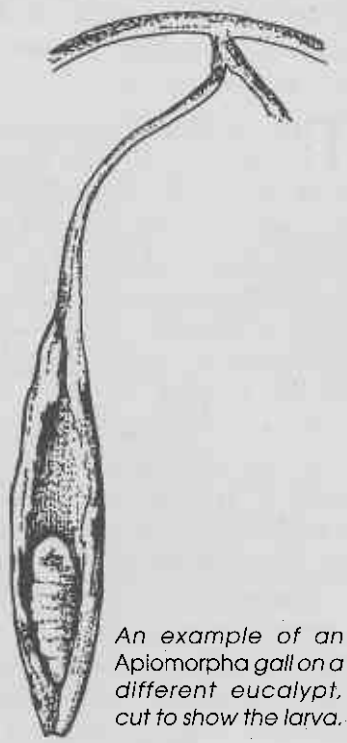
# BUSH DETECTIVE



*An example of an Apiomorpha gall on a different eucalypt, cut to show the larva.*

Ans

They are popularly known as Bloodwood Apples, and are a gall caused by infestation of the plant by an insect, in this case the bug *Apiomorpha* sp. It is a member of a group of insects called the gall-makers, in the Superfamily Coccoidea, related to scale insects and mealy bugs.

The female attaches itself to a host plant, and, by a process not fully understood, it's feeding activities stimulate the plant tissue to expand and cover the larva until it is completely enclosed. Often each species stimulates a different sort of gall, which is very distinctive in size and shape. This is a big drain on the plant's resources, and a heavy infestation can severely retard growth.

In *Apiomorpha* species, the large galls contain females, male galls are probably smaller and may be a different shape. Like many of our smaller organisms, the exact details of this one are not known.