THE HYDROLOGICAL SOCIETY OF S.A. INC.

c/o Water Resources Branch
Box 1751, Adelaide, S.A. 5001

NEWSLETTER NO. 70

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What price the hairy nosed catfish?

John Rolls

Ecopolitics Conferences bring together all those interested in politics and the environment, from academics and activists to politicians and professionals.

One paper from the most recent of the series, Ecopolitics V, drew sharp attention to the essential dilemma facing modern industrial society.

We have no efficient, timely and socially acceptable method of answering questions like, "Do we want product X so badly that we are prepared to condemn yet another species to extinction?"

In water management, establishment of beneficial uses for receiving waters is, in some quarters, seen as a sensible way of setting environmental performance standards. Yet this is not a trivial, or indeed a straight- forward, exercise.

For example, it may be decided that for a particular river the hairy nosed catfish population must be protected.

Who should be involved in establishing this objective?

What water flow and quality characteristics are needed to achieve that objective?

What changes would be required in the catchment in terms of land use and management, and the treatment of wastes, in order for the stream to be able to meet those characteristics?

What would be the social, economic and environmental costs and benefits of achieving the objective?

A major difficulty arises from the assumption that because of an ecosystem's need to cope with natural variability, eg in climate, it has an ability to cope with various assaults, including pollutants, without being damaged.

We need to ask, "How much of each of a range of pollutants can the river system assimilate without compromising the objective?"

This involves knowing the tolerance of any selected species to each of the constituents of a waste.

Commonly, because we simply do not have adequate local data to make reliable assessments, we adopt an answer based on US research of dubious applicability.

These are complex scientific, technical, economic and social questions and represent a hugely complicated and costly process of social decison making.

All too often we abandon a cautious approach in favour of progress seemingly because of our society's ideological belief that all productivity is good.

We do not address the question, "Do we need product X anyway?, nor the question, "Do we value the production of X more than the loss of species Y?"

We make the pretence that the market system, with all its crudities and unfulfilled assumptions, can make social decisions of exquisite complexity.

If we continue to allow our environment to be despoiled in the name of progress, we may yet be judged by our descendents as having been regressive rather than progressive.

GROUNDWATER IN THE SOUTH EAST

Feature articles from the Centre For Groundwater Studies

Groundwater Flow Systems; Past and Present: Gambier Embayment, Otway Basin, South-East Australia

[Reporter : Andrew Love]

Potable groundwater occurs within Cainozoic aquifers of the Gambier Embayment of the Otway Basin, South-East Australia.

The two major groundwater systems are: -

- a multilithological limestone, marl and dolomite sequence (the Gambier unconfined aquifer), and
- a sand, gravel and clay sequence (the Dilwyn confined aquifer).

Declining potentiometric water levels in the high quality confined system is of concern for the long term sustainablity of the resource and also as a potential back-up for the unconfined system.

There is a potential for recharge to occur to the confined aquifer in the eastern portion of the basin where there is a head difference in favour of downward leakage. This head difference decreases towards the middle of the basin where the hydraulic heads in both aquifers are the same. Westward of this, the head in the confined aquifer becomes higher indicating a potential for upward leakage.

Environmental isotopes have been used in conjunction with hydrochemical and hydrogeological data to evaluate recharge, water movement and palaeohydrology of the two major groundwaters systems. Hydraulic head data provides information on the present day groundwater flow system while environmental isotopes and chemistry reflect different time scales and are a window into past hydraulic and climatic conditions in the basin.

Groundwater samples were collected and analysed for major ions, stable isotopes and radiocardbon along two transects for the northern and southern sections of the basin. The transects follow the inferred direction of groundwater flow as determined from the phreatic and confined potentiometric surfaces.

Three different scales of groundwater flow and storage are recognised.

Local flow systems occur within the upper sequence of the unconfined aquifer and are controlled by the configuration of the water table elevation. Recharge areas correspond to dune highs while discharge is focused towards the lower lying interdunal regions.

Superimposed upon these local systems is an intermediate flow system controlled in part by the topography and geology.

A regional flow regime occurs within the Dilwyn confined aquifer system. Recharge to the confined system has been identified to occur in two regions: -

(1) to the west of the Kanawinka Fault (between Naracoorte and Lucindale) in the northern portion of the basin, and

(2) overlying the Gambier axis in the south of the basin in the Nangwarry region.

The deuterium and oxygen-18 composition of groundwaters display a wide range (Fig 1).

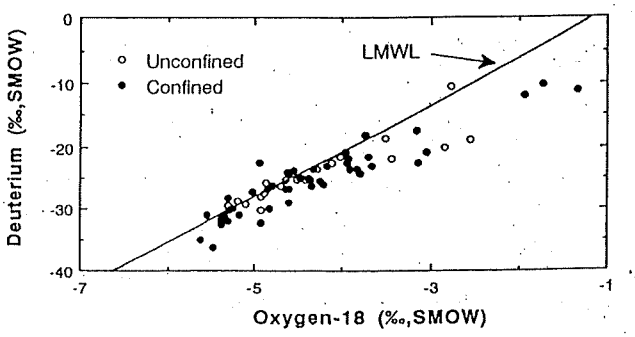

Fig 1 δ^2H vs $\delta^{18}O$ for Otway Basin groundwaters. LMWL=Local Meteoric Water Line.

Most water plots on or near to the local meteoric water line (LMWL). A group of groundwaters for both aquifers plot to the right of the LMWL.

An hypothesis to explain the data is that recharge takes place via two mechanisms:

- directly via rapid infiltration without isotopic fractionation
- water delayed and subjected to evaporation in the unsaturated zone or swamps that are scattered throughout the region.

Stable isotope ratios for deuterium and oxygen-18 for the confined aquifer show a clear trend of depletion either along the transect or with reference to Percent Modern Carbon (Fig 2).

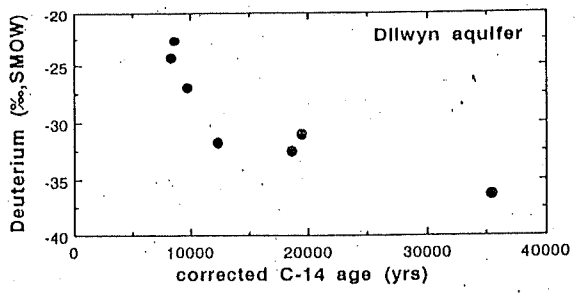

Fig 2 The relationship between δ^2H and ^{14}C groundwater "age". Modern groundwater input for δ^2H ranges from -24 ‰ to -28 ‰.

Confined groundwaters with a ^{14}C "age" > 10^4 years are isotopically lighter (up to 8 per mille) with respect to younger groundwaters suggesting that these groundwaters were recharged either under a colder climate or a different atmospheric circulation pattern than today. Recharge, at least since the Holocene, appears to have occurred via the two mechanisms previously described.

However, recharge prior to that may have undergone less evaporation during the recharge process.

The corrected ^{14}C "velocity" from the zero head difference location to the sea along the transects is higher than the hydraulic velocity calculated from Darcy's Law (by a factor of 4 in the northern section and a factor of 2 in the southern section of the Basin).

An hypothesis to explain this discrepancy is that water levels were lower in the past as they responded to eustatic sea level lowering during the last glacial period (sea level was 120-150 metres lower than present at 18 kyr BP).

An analytical hydraulic model was developed that predicts the change in water level response to an instantaneous change in sea level at the downstream boundary of the system throughout the last 27 kyr BP. The model predicts that a lower sea level stand would result in partial dewatering of the unconfined aquifer and lowering of the confined potentiometric surface. This would result in increased gradients and drainage and as a consequence higher velocities than those calculated from the present day head distribution. The ^{14}C "velocity" is considered to integrate the hydraulic heads of the system during lower sea level in the past.

Each aquifer responds at a different rate to an instantaneous change in the downstream boundary condition (sea level). The unconfined aquifer with a low hydraulic diffusivity responds slowly while the confined aquifer with a high hydraulic diffusivity responds rapidly. As a result of this the zero head difference position migrates with time.

This has resulted in a change in both the location and magnitude of recharge and discharge zones to the Dilwyn confined aquifer throughout the last 27 kyr BP.

Estimation of recharge and evaluation of recharge mechanisms for the Naracoorte Ranges

[Reporter : Fred Leaney]

The increased use of groundwater from the unconfined limestone aquifers of the Naracoorte Ranges region led the South Australian government to proclaim the groundwater resources in 1986.

While the resource was at that time not displaying the normal signs of stress (declining heads or increased salinities) experience suggested that these effects may not be far away.

The criteria used to determine allocation is that use should not exceed recharge minus natural discharge.

Two studies involving CSIRO and DME staff were undertaken to provide a better estimate of recharge for the area.

Recharge is one of the most difficult parameters to estimate, even under the best of conditions. The diverse nature of the soil and aquifer material in the South East makes the potential mutiple recharge mechanisms in the area even more difficult to study.

The initial study, completed in 1980, aimed at providing an estimate of diffuse recharge. Results indicate that, for three sites, recharge rates are low (less than 10mm/yr). These low values are attributed to the high amount of storage in the top few metres of soil and to the poor drainage of the soil.

The present study seeks to determine the importance of several sites to the regional water balance. Poocher Swamp, Attadale and Pretty Gully runaway holes, North Pearson Swamp and a drainage bore were targetted and instrumented with nests of bore and water level recorders. Water samples were taken at least every two months and analysed for stable isotopes, chlorine-36 and radon in addition to conventional ion chemistry.

The results to date show clear differences in hydrological and hydrochemical response to rainfall. Water within the vicinity of these features displays different chemical and isotopic signature to the regional groundwater.

This suggests that recharge from these features is not a dominant part of the regional recharge process. It is now planned to place limitations on the range of relative contributions from point source and diffuse source recharge compared with that of lateral flow for the area.

Nitrate in groundwater under pastures in the lower South East

[Reporter : Naser Pakrou]

South Australia, with 12·5% land area of Australia, benefits from only 2% of its water resources. 38% of this comes from groundwater.

Non point source contamination of groundwater by nitrate is a significant problem in the lower South East. This may limit the use of this large resource. Current pollution is amongst the severest in the settled parts of Australia and the source of nitrate is largely grazed leguminous pastures.

A study which looks at key processes in the nitrogen cycle in the pasture- soil-plant system has been undertaken in an intensively grazed dairy farm near Mt Gambier.

Borehole sampling under this farm indicated the potential pollution of groundwater.

In total 26 lysimeters have been installed to estimate the amount and concentration of nitrate leached from the soil profile during winter. The lysimeters also refine previous estimates of recharge and evapo - transpiration adjacent to irrigated and non irrigated paddocks.

Most of the leached nitrate originates from mineralisation of soil organic matter, and nitrogen fixed by leguminous pasture crops.

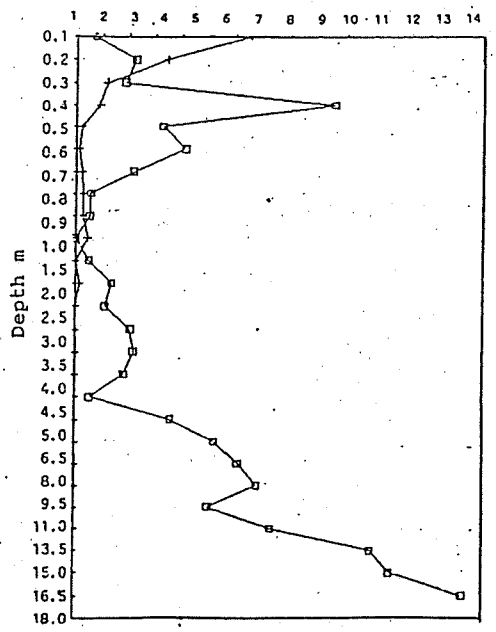

Fig. 1
Nitrate and Ammonium Distribution
Deep Bore under Pasture

□ Nitrate mg/l +Ammonium mg/kg

Animal wastes are expected to play a significant role in cycling of nitrogen in the pasture system. This project will focus on the effect of animal wastes on the quality of water recharge beneath pastures.

THE GAMMON RANGES PROJECT

[Reporter : Chris Wright]

The Scientific Expedition Group's Gammon Ranges Project arose out of curiosity - how did the Gammon Plateau support such a dense growth of vegetation in a low rainfall area. This was heightened by an experience in which extremely heavy rain in the ranges was observed to be confined almost entirely to the ranges.

The project started in September 1988. The project consists of four principle monitoring activities :

- rainfall at 3 sites
- vegetation at 6 sites
- stream biology and chemistry at 2 sites
- human impact at 3 sites.

The Hydrological Society has supported the project with funds to assist the rainfall monitoring component.

A report on the first three years rainfall data has been prepared. Whilst this is an inadequate record from which to draw conclusions, particularly in such a variable rainfall regime, we have been able to record some big events. Their true place in the frequency distribution will become clearer as more data is collected.

Three pluviometers have been established in the ranges. The first of these is at an elevation of about 930 metres, making it the highest in the Flinders Ranges. All three sites are within the Areona Creek catchment and it is hoped to install a stream gauging station to allow comparisons of rainfall and runoff to be made.

It is also intended to use these data to compare rainfall in the ranges with that in the surrounding area. Little is known about the variability of rainfall with height in this semi-arid climate, but orographic effects can cause an increase in rainfall at favourable locations. It is suspected that there will be considerably more rainfall and more intense storms in the ranges.

RIVER MURRAY HYDRAULIC MODEL

[Reporter : Andrew Jessup]

A River Murray Hydraulic Model (RMHM) has been developed to provide accurate estimates of daily discharge and water level along the 817 km length of the River Murray between Wentworth and the mouth, near Goolwa.

This 'real time' computer based model will be used for ; -

- flood warning
- predicting trigger flows for evaporation basin releases to the river
- advising flows and levels to shack owners, houseboat users and others
- scheduling maintenance at locks
- anticipating navigational problems associated with low flows
- planning barrage operations to assist Lake Albert level fluctuations and mouth scouring.

Its development was recommended after a review of numerical modelling needs for management of the river in South Australia, undertaken for the EWS Department by Water Studies Pty Ltd.

Development of a complementary salinity model was also recommended and this is currently proceeding.

The RHMH incorporates hydraulic effects of storage routing, river locks and barrages. It also incorporates lateral discharges to and from off stream storages, both regulated and unregulated, as well as diversions and losses due to evaporation.

A backwater model is used to provide accurate numerical estimates of storage-discharge relationships. Over 100 detailed cross sections of the river channel and its floodplain are used.

The model is operated as a menu driven system designed to be used on desk top PCs. It is quick to run, taking only minutes to simulate a month's daily data. A feature of the model is the suite of input files which allow easy updating of information.

FINGERPRINTING WATER

The CSIRO and the WA Health Department have combined their energies to analyse the quality of bottled water, with some very interesting results. Apparently all water has a characteristic signature, in the form of stable isotopes, which mark its origin on the globe - both altitude and latitude.

STRATEGIES ADDRESSING WETLAND DEGRADATION ALONG THE RIVER MURRAY IN SOUTH AUSTRALIA

[Reporter : Elizabeth Young]

The Natural Resources Management Strategy (NRMS), an initiative of the Murray Darling Basin Ministerial Council, is currently funding a number of community and government projects aimed at enhancing important but degraded wetlands along the River Murray in South Australia.

The government projects are part of the SA River Murray Wetlands Program. This program commenced in 1989-90 and is being coordinated by an inter- departmental committee with input from a non-government consultative panel. The program is currently focussed on 4-8 priority wetlands. However with continued funding it is hoped that the program will be expanded to other significant wetlands as well.

The program consists of three major components : -

- hydrological management
- monitoring
- riparian vegetation rehabilitation.

The hydrological management component has involved increasing the frequency of flooding of four wetlands which have been severely affected by river regulation and the disposal of irrigation drainage waters; Ramco Lagoon, Bulyong Island EB, Disher Ck EB and Berri EB. The inlet and outlet structures connecting the wetlands to the river have been lowered to allow flooding to occur about once every two years compared with the present situation of about once every four to seven years.

A further part of the hydrological management component is the installation of additional culverts in flood plain causeways which restrict flows through wetlands. The feasibility of manipulating water levels in the river to enhance wetland flooding has also been investigated.

During 1991-92 a hydrological management plan for another important wetland system, the Pike Mundic Creeks, will be developed.

The second and third components of the program complement this work.

The second component is monitoring. Its main objective is to assess the effects of the more regular flushing flows by monitoring a number of variables including water quality, aquatic vegetation and wetland fauna.

Further objectives are : -

- to establish comprehensive baseline and comparative data on priority wetlands
- to determine a set of parameters which can be used to establish the ecological status of wetlands and assess the impact of management changes.

The third component involves rehabilitating wetland vegetation by tree planting, direct seeding and by controlling weeds and rabbits.

Management plans for each wetland site are being prepared. The project has benefitted from considerable involvement of local community groups and it is hoped that some of these groups will continue their involvement by managing the wetlands in the long term.

In addition to these government projects a number of wetland enhancement projects are being undertaken by several enthusiastic community groups. These projects range from tree planting and pest control to fish management and water level manipulation.

In addition to the considerable resources contributed by these groups, the projects are assisted by funds provided under the Communities Of Common Concern program which is a part of the NRMS.

JUST FOR INTEREST :

Wyong Shire (NSW) is to spend $10 million on a program to rehabilitate Tuggerah Lakes, which have eutrophication problems. Piece by piece the lakes will be dammed, the water will be pumped out, machines will be sent in to cut out and remove sludge, the dams will be removed and the water allowed to flow back in.

WATER WATER EVERYWHERE, BUT NOT A DROP TO DRINK

[Reporter : Claus Schonfeldt]

Water is indeed a strange substance. It is the most abundant liquid in the world. In fact it is the only inorganic liquid that occurs naturally anywhere on Earth.

It is a scientific freak, having the rare and distinct property of being denser as a liquid than as a solid, and it is the only chemical compound that can be found naturally in solid, liquid and gaseous states. It is a powerful reagant, capable of dissolving any other substance on the planet. Nothing is safe from it, and yet it is colourless, odourless and tasteless. It irrigates all of Earth, forming 15% of even 'dry' dust and covers 71% of the globe.

In Australia, even though we have relatively little water when compared with other continents, we enjoy a good quality of life because of it. We do have adequate supplies of safe and good quality water delivered directly into our homes. Our water resources are not yet heavily polluted.

But this isn't so everywhere.

In the November 1990 issue of TIME Magazine the cover story, **The Last Precious Drops** painted a different picture.

In some parts of Madras, India for example residents do not have water on tap in their households. They must get water from a public tap. The water at the tap only flows between 4 and 6 am. Residents cue from 3.30 am to fill 5 buckets of water for the day's supply.

Compared with many in India this is a luxury.

Thousands of villages have no water supply at all. And this is not uncommon throughout the world.

Even in high rainfall areas supplies are often tight and quality is deteriorating. 60% of the world's population must get by on only 50 litres of water per day. In some cities even dirty water is in short supply.

The illusion that engineering could produce water where and when it was needed led to egregious waste; monsoon crops being grown in desert regions and grounds being lushly watered in desert housing developments.

Whatever the consequences for people there is even greater effect on other living things. Fish, birds and countless other creatures are crowded out, marooned or poisoned as industry and agriculture re-route rivers, dry up wetlands, dump waste and otherwise disrupt ecosystems.

There are limits to our ability to move water from one place to another without seriously disrupting the natural balance.

Humanity has long deluded itself into thinking that water shortages merely reflect temporary problems of distribution. Now we are beginning to realise that water is a finite and vulnerable resource, a commodity that must be respected and preserved.

Ignorance by early settlers and developers can be forgiven. Now that we better understand the intricate interdependence between our actions and our environment we must ensure that sins of ommission do not become sins of commission.

MARA WINS IAN LAING PRIZE FOR 1991

Each year the Society offers a cash prize to students whose interests and coursework involves some study of hydrological, aquatic or related sciences or water resources management. This prize was initiated by Ian Laing when he was Chairman of the Society. Sadly Ian died several years ago and the prize is now named in his memory.

The purpose of the prize is to promote an interest in and to encourage students to study and later work in a water related field.

This year's winner is Mara Hood, a final year civil engineering student at Adelaide University.

As with past winners Mara's academic record is outstanding. Mara also has a keen interest in water resources management and a particular interest in design hydrology.

During her work experience she researched design parameters for urban runoff modelling, an interest which she is pursuing in her final year project.

Congratulations Mara.

CONFERENCE ON DAMS

18 - 21 November

The Australian National Committee On Large Dams (ANCOLD) will hold its annual conference in SA at Wirrina Cove Resort.

One of ANCOLD's aims is to adopt a more multi-disciplinary approach in its evaluation of the environmental and social impact of dam projects. Consequently the conference technical sessions have been split into two themes - 'Flood preparedness' and 'Dams and the environment'.

The conference has been structured to allow part time attendance for members of particular interest groups, such as the Hydrological Society.

Six papers are to be presented on each theme, with David Ingle Smith (Centre for Resource and Environmental Studies - ANU) to be lead speaker for the 'Flood preparedness' session and Dr Bryan Jenkins (Director for Environmental Economics and Planning - Kinhill Engineers) to be lead speaker for the 'Dams and the environment' session.

Hydrological considerations form a large and important part of planning for any new dam project as well as assessment of the spillway adequacy of existing dams and emergency planning for flooding downstream of dams. These topics will be discussed in the technical sessions and anybody interested in these areas will benefit from attending.

Costs for attendance at both sessions is $35 plus $15 for lunch if required.

For further information contact Lawrie Schmitt (226 2278).

DID YOU KNOW

Waterlink, April - July 1991 issue, reported that a newly developed 'synthetic' compound can help to detect potential algal blooms before the bloom is visible.

1992 HYDSOC COMMITTEE

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The Committee welcomes suggestions for initiatives which the Society might undertake and in particular topics for general meetings.

NEWSLETTER CONTRIBUTIONS

The Newsletter editor is Claus Schonfeldt and he also welcomes any contributions. Claus can be contacted on 226 2499 and articles can be sent to facsimilie 226 2161 or to him at the EWS Department. GPO Box 1751, ADELAIDE.

THE POLITICS OF WATER

Middle East peace talks may yet become frustrated by dispute over water supplies.

Israel will want assurances on access to water resources and is unlikely to relinquish land to the Arabs which contain Israel's key fresh water sources. Many of these are in the occupied territories.

Israel and Jordan are both using resources 15% faster than they are being replenished. 20% of Israel's wells are no longer used because they have become contaminated through over pumping. The Sea of Galilee is at its lowest level ever.

And Turkey, which controls the headwaters of both the Tigris and Euphrates, is emerging as the water 'superpower' in the region.

FROM LAST ISSUE

The answer to the teaser in the last newsletter is

30

Well done, Chris Burton, for being the first correct entry. You win a free copy of the next Newsletter.