



GOLDEN PASTURES

50 years of saltland agronomy in Western Australia

KEY PARTNERSHIPS & ACHIEVEMENTS

October 2004

Acknowledgements

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Photos were provided by SPA members and Agriculture Department archives

Footnote: In this limited document it is impossible to credit all those involved in the field of saltland agronomy over a 50 year time frame.

We hope to rectify omissions and provide more detail in a future publication, detailing the history of saltland agronomy.

– October 2004



CLIVE MALCOLM
saltland agronomy pioneer

Clive Malcolm is the first to admit that when he joined the Agriculture Department in the 1950's, he knew nothing about saltland.

But he took on the issue of saltland agronomy with passion and determination, making Western Australia a world leader in the field.

His primary research goal was to return salt affected land to production and his work across the state focused not only on the species mix, but establishment techniques and different grazing regimes and intensities.

He attributes the achievements in the field of saltland agronomy to

the combined efforts of farmers and researchers.

Throughout his career Clive has published more than 70 scientific papers and extension articles and in 1990 was awarded Greening Australia's Pioneer award.

Recognised internationally for his saltland research work, Clive has been awarded research fellowships to study in the UK and USA and consulted to the United Nations in Mexico and Tunisia as well as governments in Oman, Saudi Arabia and Iraq. ■



In Utah: Clive Malcolm collecting saltbush seeds in Utah, USA in 1967.



:: Early saltland research



Bevan Parker 1960: Bluebush with an understorey of grasses and burr medic on Bevan Parker's Jilakin Lake property.

Widespread concern about rising levels of salinity in the wheatbelt prompted a report on salinity by CSIRO researcher, Dr R Pennefather in 1950.

As a result, the Agriculture Department established the Soil Research and Survey Section in the Adelaide Terrace office, Perth three years later, with a focus on soil surveys, soil structure and salinity.

As a new recruit to the Agriculture Department in November 1954, Clive Malcolm joined Tom Smith and Trevor Stoneman in the newly formed section.

Two farmers, Jack Trott of Corrigin and Bevan 'Bluebush' Parker of Kulin, who were already making productive use of salt affected land in the 1950s, provided Clive with much early inspiration.

By 1954 Bevan had a well established system in place to graze extensive salt affected areas that had been colonised by bluebush.

The bluebush and an understorey of burr medic and grasses were supplemented with hay and stock had access to stubbles in adjacent paddocks.

Clive points out that internationally, work was underway to revegetate

rangelands but not salt-affected agricultural land.

"We were pioneers in the area of saltland agronomy and had to start all phases of the research from scratch," he says.

"The key was finding a cost effective means of treating broader areas."

"Bluebush withstood heavy grazing, but the saltbushes became degraded after heavy stripping," he says.

"The potential of bluebush was clearly evident and we collected seed from across the wheatbelt and turned our attention to factors affecting its establishment

"We were pioneers in the area of saltland agronomy and had to start all phases of the research from scratch."



from seed, such as storage needs and the use of mulch."

43 years on: The same area in 2003. The paddock to the left is still being cropped.

Clive was interested in the productive potential of saltbush and bluebush under different grazing intensities and began a five year experiment on Bevan's Jilakin Lake site in 1955 in which he stripped bluebush, silver saltbush and bladder saltbush.

He hand-stripped the plants to simulate light, moderate and heavy grazing by stock.



:: Establishment Techniques



Bluebush establishment: Jack Trott demonstrates how he got bluebush to establish by putting sticks on a branch of seeding bluebush.

Also in the 1950's Clive set up trials to gauge how a range of plants performed on Jack Trott's salt affected country at Corrigin.

"There was a focus on establishment and we mounded some of Jack's saltland to improve infiltration and flush the salt out," Clive explains.

Old man saltbush, bluebush, creeping salt bush, Wimmera ryegrass, fodder beet and barley were established on the site.

Clive says three principles became evident that still apply today:

- fence the site
- cultivate to create a niche for the

seed and improve infiltration

- sow appropriate species of plants

Over the next two decades, saltbush and bluebush seed dormancy, storage and germination remained an ongoing issue.

The work encompassed pre-seeding treatments including threshing, soaking and bract removal.

Bevan Parker found that if he ripped his bare saltland with a chisel plough in late summer, the seeds from nearby bluebushes established in the riplines and he ended up with rows of new plants.

He also observed that seeds caught in the remnants of hay that he fed to sheep on bare saltland resulted in established plants.

Jack Trott picked flowering bluebush branches, laid them on bare salt and held them down with a heavy stick.

This practice resulted in a host of seedlings.

Clive found that bluebush seeds lost viability unless they were kept with a drying agent and he recommended that farmers sow seeds in the season they were collected.

Later trials looked at various seed treatments for river saltbush seeds, such as washing and threshing the seed, as well as post planting treatments such as the use of vermiculite mulch and bitumen or black paint to raise the soil temperature.

Clive was awarded the Food and Agriculture Organisation's Andre Meyer Research Fellowship to conduct

research at the University of California, Riverside in 1966.

Following the research he travelled in USA, North Africa and the Middle East collecting seeds of salt tolerant forage species for testing in WA.

In 1971 Clive was invited to the International Shrub Symposium in Logan, Utah, USA.

This review led to the development of the niche seeding concept and eventually to the construction of the Mallen Niche Seeder. ■



He was asked to review the literature on establishment of shrubs on saline soil.

He identified many factors crucial for successful establishment and concluded that creation of a niche or special place for the seed and the use of spot placements of seed and mulch in the niche would give reliable establishment.

Latham seeding: An area direct seeded to saltbush by Kim Diamond near Latham.



Farmers and researchers working together: Clive Malcolm & Kim Diamond.

:: Species Mix

The saltland mix



Seed Placement: (foreground) Ashley Lewis and Clive Malcolm look over a newly sown site

Saltland revegetation contractor, Ashley Lewis sows an established mix of saltbush species – river, Old man, creeping and wavy leaf – as well as bluebush and Acacia saligna.

In recent years he has added two seed boxes to his niche seeder and broadcasts Evergreen's saltland mix (Rhodes grass, panic, tall wheat grass and puccinellia), tropical legumes – Aztec and Siratro and strawberry clover in the inter-row.

Grazing practices by farmers in the 1950's had demonstrated that bluebush could withstand heavy grazing.

Clive had collected seed and sowed a number of bluebush demonstration plots across the wheatbelt using a tyne seeder.

But the search continued for other appropriate salt tolerant plants.

Alf Humphries and David Wilcox from UWA had collected seed of rangeland plants from the pastoral regions in the 1950's.

This collection was handed over for testing at the Agriculture Department's South Perth nursery and according to Clive, river saltbush looked 'very impressive'.

River saltbush was included in tests throughout the wheatbelt in the 1970s and compared well with other species including those from the overseas collecting trip and exchanges with workers in other countries.

A special exploration trip was made to the pastoral region to find more varieties of river saltbush and test plots showed much variation in growth habit.

To ensure that the varieties were not lost, they were each planted in small plots on wheatbelt farms isolated from other river saltbush plants.

"The recommendation was to sow a mix of saltbush species and graze the saltbush in conjunction with understorey, hay or stubbles."

Most of these plots have survived after more than 25 years.

From a total collection of over a thousand lines of forage, the best introductions were quailbrush from California and wavy leaf saltbush from Argentina.

However they were no substitute for river saltbush which scored highly when it came to growth rates, plant

habit and recovery after grazing.

A six year grazing trial at Kondut in the early 1980's involving river saltbush, wavy leaf saltbush, marsh saltbush and bluebush confirmed the ability of river saltbush to sustain annual grazing in autumn and winter, with 94% of the river saltbush plants surviving over the six years.

Clive was called back from retirement in 1993 to assist Neil Davidson and Richard Galloway employed at the Agriculture Department under a Co-operative Research programme with Pakistan find the best female and male plants of river saltbush on a range of sites.

Plants grown from cuttings exhibited a six-fold difference in productivity.

"But productivity was not the only consideration," Clive explains.

"River saltbush often gave poor establishment from seed.

"We discovered that some lines of river saltbush produced many volunteer plants on harsh sites north of Bencubbin and east of Gutha.

"Seed from these plants gave better establishment in direct seeding experiments run by Helen Runciman."

This screening work culminated in the release of two promising selections of river saltbush *Rivermor* and *Meeberrie*.

By the early 1980's, Clive was able to make saltland agronomy recommendations based on his trial work and anecdotal evidence.

"The recommendation was to sow a mix of saltbush species and graze the saltbush in conjunction with understorey, hay or stubbles," Clive says.

"Bluebush tended to colonise areas once they were fenced.

"Grazing management also has some impact on the species mix on a site and where sites have not been grazed regularly,



Testing: Saltbushes under test at Collanilling.

samphire may invade the site."

Saltland agronomy trials were not restricted to saltbush and bluebush.

CSIRO had released puccinellia in the 1960's, a perennial grass introduced from Turkey.

At the same time, tall wheat grass was also under review but its release was held back because of its potential to act as a host for wheat rust. ■



:: Grazing Potential



Land Restoration:
Kim Diamond's Mallen niche seeder at work

The river saltbush plots provided an average of 1488 sheep grazing days per hectare per year over the six years.

Having lost 400ha on their Maya farm to salt between 1961 and 1964, Bill Diamond and his son, Kim wanted a broadacre solution that would return these areas to production, potentially providing valuable autumn feed.

Kim points out that the area lost to salt had been better country, the loss having a greater proportional impact on the overall farm gross margin.

Using an early version of the Mallen niche seeder, Kim sowed 100 acres in 1979 to river saltbush, wavy leaf saltbush and quailbrush.

Kim sowed the site on 2.5m x 1.5m spacings, resulting in a plant density of about 3000 saltbush plants per hectare.

Clive fenced two trial plots of 1ha on this Maya site and commenced a five year trial in 1980 with Eddie Pol from the Agriculture Department's Three Springs office.

The plots were each stocked with 15 sheep.

Early results demonstrated that during the autumn feed gap, sheep on the saltbush plot could be kept in forward store condition and save the cost of hand feeding.

A startling comparison was made between an area of saltland sown to saltbushes and a similar unsown area.

The saltbush gave 69 grazing days whereas the sheep had to be removed from the unsown saltland after four days.

The benefits of saltbush were clear.

Kim reckons he achieved 2-3 DSE/ha from the saltbush plot.

Clive's final results in 1983 verified the work from this trial.

The hogget wethers on the quailbrush and wavy saltbush were weighed weekly and gained weight up to day 35, before gradually losing weight.

The final body weights of sheep on the saltbush were higher than those on nearby stubble although some of the weight would have been due to body fluid increase.

Anecdotal evidence from Bill Diamond suggested that those wethers grazing the saltbush produced a cleaner wool sample and fibre strength was maintained.

A trial at Kondut in 1985 looked at the grazing of river, marsh and wavy saltbush as well as bluebush over a six year period.

Six sheep were put on each of the 16 plots

during autumn and sheep weights monitored.

The river saltbush plots provided an average of 1488 sheep grazing days per hectare per year over the six years.

For a long time Clive's research was limited.



He struggled to get the wool and meat sections of the Agriculture Department interested in research work that would verify the grazing value of saltland pastures.

Eventually the Great Southern Research Institute at Katanning looked into the effect of saltbush on grazing sheep.

Clive points out that the grey clay site was not ideal for saltbush.

In 1994, Agriculture researchers, Brian Warren and Tess Casson produced a report which concluded that saltbush was only good for maintaining animals.

Further still, it suggested animal weight gains were associated with the stock

Grower Interest: A saltland pastures field day at Latham in the 1980's.

increasing fluid levels to compensate for the salt-rich diet.

The rural press ran with the story, stating that it discredited much of the earlier saltland research work.

The research findings coincided with a wool stockpile of 10 or so years and low sheep prices.



:: Grazing Potential (cont'd)

The upshot of this work was that the Department of Agriculture went out of saltbush research altogether.

WA was a global reference point and a world leader in saltland research but this research work ground to a halt.

Clive points out that there was actually nothing wrong with the

Kim found he was able to extend the life of his stubbles and saltbush by allowing sheep access to both.

“Although difficult to quantify at a paddock-scale, we reckon we got 1.5 times the grazing value by offering this mixed diet of saltbush and stubble to our sheep,” he says.

– Kim Diamond at Maya, Michael Lloyd at Lake Grace and Peter and Tony York at Tammin – and for whom saltland grazing was an integral part of their farming system, who then became instrumental in demonstrating the potential of saltland pastures to the wider community.

“We got 1.5 times the grazing value by offering this mixed diet of saltbush and stubble to our sheep.”

The need for a farmer based lobby group became apparent and consequently the Saltland Pasture Association formed in 1997 with Michael Lloyd as Chairman and Clive as Vice Chairman.

The Productive Use and Rehabilitation of Saline Land (PURSL) conference in Albany in 1996 also played an instrumental role in getting saltland pastures back on the map. ■



Potential Realised: Sheep grazing established saltbush with hay stubble in Lake Grace.

Katanning research but the results needed to be considered in context.

“In the case of Kim Diamond at Maya, saltbush provided useful autumn grazing,” he says.

Peter and Tony York at Tammin allowed 2000 hoggets to graze a 24ha paddock of saltbush and bluebush in the autumn of 1985, the area providing 2510 sheep grazing days per hectare and the sheep maintaining condition.

Clive explains that it was farmers with substantial areas of salt

:: Are Saltland Pastures Sustainable?

Despite his official retirement from the Agriculture Department in 1991, Clive’s work is ongoing.

Just last month he completed a 1500km road trip through the wheatbelt looking at old saltland trial sites, the project funded by the Co-operative Research Centre for Plant-Based Management of Dryland Salinity.

Clive is checking up to 270 saltland sites across the state’s entire agricultural region, from Yuna in the north to Salmon Gums in the south east.

A crucial question he seeks to answer is whether saltland pastures are sustainable in the long term?

The message from Clive is a resounding ‘yes’ for about 76% of sites.

“Bluebush with an understory of burr medic still provides grazing on Bevan Parker’s Jilakin Lake property, 43 years on,” he says.

“Having looked at several sites over 20 to 40 years, I am convinced that long term sustainable saltland pastures are a reality’.

He has found some sites which have become more saline and waterlogged and believes that the soil and hydrology specialists should be trying to describe the key criteria that ensure or threaten sustainability.

Clive says there are sites at Belka Valley, Ejanding and Corrigin where the water table and salt levels have struck a balance and farmers regularly make use of grazing from the saltland at a time of year when they would otherwise have to hand feed to maintain the condition of those sheep.

But Clive stresses that the longevity of a saltland site is a function of the hydrology and on appropriate sites, saltland pastures can serve an important role in controlling on-site recharge. ■

“Bluebush with an understory of burr medic still provides grazing on Bevan Parker’s Jilakin Lake property, 43 years on.”



Land Brought to Life: (above) Early establishment on Charlie Stevensen’s Cranbrook property in the mid ‘80s. (below) The same site in 2002 supporting healthy grazing stock.





:: Future Directions

Trial plots to broadacre

The cost of seedling planting and the vast area of saltland pastures to be established convinced Clive that direct seeding was essential to reduce the cost of establishment.



Looking to the Future: Kim Diamond and Clive Malcolm with the twin row niche seeder.

Work in California showed that salt moved up a slope and germination was better part way down.

Clive worked with Richard Allen, a design student at the WA Institute of Technology to develop the Mallen niche seeder in the 1970's using a mouldboard plough with an extended share to create a slope.

This model was replaced with a machine using opposed discs to create a mound and a 'V' shaped press wheel to make a niche on the mound.

Because these sites were usually low in the landscape and prone to waterlogging, mounding was seen as fundamental to the seeding process and it allowed the salt to be leached out of the niche.

The machine deposited the seeds covered with mulch at intervals in the niche.

Chaff was used initially but introduced weed problems and vermiculite was found to be the best mulch.

Trials with river saltbush had shown improved germination rates where black bitumen was sprayed on the vermiculite, raising the soil temperature.

The Agriculture Department's machine had the facility to spray the deposits in one pass but for commercial development this was considered too complex and expensive.

Having heard Clive speak at a Gutha field day, Maya farmer Kim Diamond was keen to establish salt affected areas on his farm to saltbush using the niche seeder.

Kim Diamond wanted to build the machine and joined together with his father, Bill, Clive Malcolm and Richard Allen in 1983 to patent the niche principle, the original patent having lapsed.

Kim produced a modified version of the original machine, making it a twin row seeder.



Maya seeding: Kim Diamond using an early version of the Mallen seeder.

He took to the road contracting as a means of promoting the concept, working from the northern wheatbelt, south to the North Stirlings and traveling interstate to South Australia.

At one stage Kim had five machines on the road sowing saltbush on about 80 farms every year.

He may well be stating the obvious, but Clive points to the need to carry out a literature review before undertaking new projects.

In 1969 he reviewed the productive use of saline land and concluded that halophyte shrubs provided useful feed but needed to be diluted with low salt feed.

"Extensive research has already been carried out on saltland pastures over many decades," he says.

But he argues that some of the earlier research has been disregarded more recently.

"There is plenty of potential to solve problems with existing technology, be they projects associated with soil type, weed control or waterlogging," Clive says.

"We published journal articles stressing the need for hay supplements as well as good supplies of fresh water three decades ago.

"We need to commit ourselves to making saltland pastures more productive by getting the soil ripping, fertility and hydrology right and using the best varieties."



"There is a tendency to ignore the possibility of improving production from the species we are using on saline land."

Clive points out that farmers producing a wheat crop go to a lot of trouble to prepare the soil, put on the right fertiliser and use the best variety.

"We need to commit ourselves to making saltland pastures more productive by getting

Revegetated pastures: Sheep grazing direct-seeded saltbush pastures near the Stirlings.

the soil ripping, fertility and hydrology right and using the best varieties," he says.

"We will be amazed what we can achieve.

"And we don't yet know to what extent those sites that are predominantly samphire can be made more productive." ■



:: How Did Clive Malcolm Influence You?



Loading Up: Ashley has been contract seeding since 1988.

Ashley Lewis, Wickepin

Wickepin farmer and contractor Ashley Lewis attributes the early revegetation of saltland in his district to Clive Malcolm's extension work.

He says Clive's name was always associated with saltland pastures and his dedication and determination were unquestionable.

Ashley has been revegetating saltland for the past 20 years.

About 30% of his farm, 30 km east of Wickepin is affected by salt.

"The Wickepin LCDC bought a niche seeder 18 years ago and Clive came and spoke to us," he says.

"That motivated many people to revegetate salt affected areas around Wickepin at that time."

Ashley could see a gap in the market for a contractor and bought his own niche seeder in 1988.

Ashley was contracting up and down the state between June and October and treating on average 900ha per year.

Then in 1994 Brian Warren and Tess Casson's research data hit the media and his contracting work dropped off dramatically, to three or four jobs per year.

"Clive Malcolm had retired two years prior

and coincidentally we had had a wool stockpile for a decade and ewes were selling for \$2 or \$3," he says.

"It was an unfortunate chain of events, compounded by the fact that Clive, saltland's greatest advocate was no longer an Agriculture Department senior researcher.

"But behind the scenes he worked tirelessly to rebuild confidence in this area."

Ten years on, Ashley is now contract sowing saltland pastures on nearly 1000ha each season between Jerramungup and Wubin.

But he says the industry has not yet rebounded fully from the negative press of 1994 and believes at this stage we should have 10 contractors in the state seeding 1000ha per year.

"We reckon it costs about \$300/ha to fence, water and establish salt bush on a site but saltbush has shown its worth over the years and there is now a big case for saltland pastures," he says.

"The wool stockpile has gone, livestock are worth something and landowners have come to realize that revegetation works will be up to them as individuals."

In his time as a saltland pasture contractor, Ashley

has witnessed three predominant changes.

"The cost of knockdown herbicide has dropped dramatically and weed control is vastly improved and sites better prepared," he says.

"We have treated more sites higher in the landscape affected by perched water tables in the past three years, whereas in the past it was only valley floors.

"And we are starting to realize the potential of understorey species on saltland sites with grasses and legumes in the inter-row, with the addition of fertiliser and lime." ■

"The wool stockpile has gone, livestock are worth something and landowners have come to realize that revegetation works will be up to them as individuals."



:: How Did Clive Malcolm Influence You?



**Michael Lloyd,
Lake Grace**

Early Adopter: Michael Lloyd in saltbush on his Lake Grace property.

It was the late 1980's when Michael Lloyd's view of the salt affected country on his Lake Grace farm, Bundilla began to change.

Having attended a field day at Ashley Lewis' Wickepin property in 1989, Michael saw successful stands of saltbush and began to transform the 40% of Bundilla that was salt affected.

He sowed a 17ha area to quailbrush, wavy saltbush and river saltbush, with some Old man *De Kock* saltbush in 1989 and six months later had plants 1m high.

The following year Michael bought a niche seeder and sowed 100ha

and in subsequent years he sowed between 20ha and 60ha per annum.

Michael says the findings of Agriculture Department researchers Brian Warren and Tess Casson in 1994 marked a big turning point in the development of saltland agronomy.

"It was work that needed to be done but the comparison was made between pure stands of barley grass and pure stands of saltbush," he says.

"On the other hand there were plenty of farmers grazing saltbush – inspired by Clive Malcolm's work – who knew the system worked."

These research findings, compounded by a decade of low wool prices and the slump in sheep prices, bought the Agriculture Department's saltland agronomy research to a grinding halt.

"Clive Malcolm and I realized the need to set up a farmer-based group to lobby the agencies and the Saltland Pastures Association was formed in 1997," he says.

"It was relentless lobbying by SPA over an eight year period that kick started saltland agronomy research many years later.

"We eventually got agency and research staff from the four

southern states involved in a benchmarking study 'Animal Production from Saline Land'.

"The Co-operative Research Centre for Plant-Based Management of Dryland Salinity has since taken this work on board but I would like to see their work place a greater emphasis on discharge sites."

The wool industry picked up the funding baton three years ago when it indicated that saltland would feature in its Natural Resource Management Strategy and the launch of Sustainable Grazing on Saline Land (SGSL) followed in 2002.

"Saltland will be a valuable part of the farm, not white cancer."

SGSL is a subprogram of Land Water & Wool which is a joint initiative between AWI, Land & Water Australia, with support from MLA, CSIRO and the Department of Agriculture.

Michael believes that in 10 to 15 years time, a suite of salt tolerant perennials and legumes will be available which will allow valley floors to be transformed.

"Saltland will be a valuable part of the farm, not white cancer," he predicts. ■



:: How Did Clive Malcolm Influence You?



**Ian Walsh,
Cranbrook**

Farmer / Contractor:
Ian Walsh on his farm
in Cranbrook.

Ian and Joan Walsh's Cranbrook farm is 100km north of Albany and in a 450mm rainfall zone.

It is hardly considered saltbush country, but 40% of the farm is affected by salt or waterlogging.

Ian first sowed saltbush in 1986 after he read an article 'Making money from saltland', by Clive Malcolm.

The Agriculture Department had not previously sown saltbush this far south but agreed to establish a site in the area.

Nine species were selected for trial.

Seven other sites were sown by landholders in the North Stirlings, six of which were deemed to be successful.

From the outset Ian wanted to maximise stocking rates and have available a diversity of feed and opted to sow saltbush on his worst country and tall wheat grass on land that was marginally better.

Clover and ryegrass later began growing alongside the tall wheat grass.

By the mid 1990's he had developed a standard treatment for his saltland.

In spring he sowed the perennial grasses puccinellia, tall wheat grass and Rhodes grass

and then went over these grasses with the niche seeder, sowing river saltbush, Old man saltbush, wavy saltbush and Acacia saligna on 2m spacings with a 5m gap every six rows giving a plant density of 2000 saltbush plants per hectare.

Ian's saltland provides valuable autumn grazing and he views it as an asset.

He claims the autumn grazing provided by saltland pastures has allowed him to triple his sheep carrying capacity on salt effected land.

In 1994 when research results from the GSRI in Katanning suggested that saltbush was of

little grazing benefit, Ian openly disputed those claims.

"Experience had shown that we had been able to increase our stocking rates with saltland pastures and these research results probably caused more harm to the unconverted," he explains.

"I would argue that the saltland areas on my property have been transformed in terms of soil health and that is the point of the SGSL project on my farm, to verify that claim.

"The negative publicity surrounding the Warren and Casson research perhaps was a blessing in disguise and emphasised

"The negative publicity surrounding the Warren and Casson research perhaps was a blessing in disguise and emphasised the importance of good science."

the importance of good science."

Ian would like to see future saltland research work investigating the effect of potash and other fertiliser, soil microbial activity and biodiversity benefits. ■



:: Thank-you

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Saltland Pastures Association Inc.



