



Productive management of saline soil

Andrew Southwell

"Glenflesk", Rye Park NSW 2586

Abstract. We run two properties in the Rye Park area, where there are problems with salinity, caused by naturally occurring salt in the rocks and rising water tables. Up to 20% of our land has visible or potential damage from salinity. Rather than be depressed by the problem, we have taken a positive attitude, learnt what we can and applied it. By a combination of subdivision, sowing the correct species, adequate fertiliser, improved grazing management and managing water flow we have lifted the productivity of our saline areas to be some of the best performing areas on our property. We believe that the correct mental attitude and persistence can allow landholders to live with the problem of salinity.

It is a privilege and honour to be able to speak to you today. I certainly am no expert on the topic that has been asked of me, and the time allocated is inadequate to give the topic of productive management of saline soils full justice. I will do my best to share some of the experiences and knowledge we have gained as we have attempted to manage the property we own.

I have spent all my life in the Rye Park area, except for 2 years at Orange Agricultural College doing an Associate Diploma in Farm Management in the early 1980's. I operate a family partnership with my wife and my parents, who are in the process of trying to retire.

The Property

The land we have the privilege and responsibility of owning and managing is near Rye Park, approximately 40 km north of Yass and 30 km east of Boorowa. The property is in two parts. "Eden Brae" covers an area of 789 hectares, the original part of which was purchased in 1950, and we have added adjoining blocks as they have come on the market. "Glenflesk", which has an area of 400 ha, was purchased in 1980 and is 10 km north of "Eden Brae".

The land includes fertile creek flats, waterlogged flat areas, undulating pasture areas and reasonably steep hills. Elevation ranges from 545 to 710 metres, and average rainfall is 740 mm. Soils range from granite based sandy loams over clay subsoils to light shaley sandstone soils. The area was covered in trees at the start of the century, mostly stringybark (*Eucalyptus macrorhyncha*), brittlejack (*E. mannifera*), Blakeley's red gum (*E. blakelyi*), yellow box (*E. melliodora*) and some ironbarks and wattles. Most of these trees were cleared by 1950.

We have a self-replacing merino flock, shearing 7000 to 7500 sheep each year. Our aim each year is to produce at least 30,000 kg clean, 20 micron, best-topmakers' wool, around 95 mm long and 40 Nkt in strength, with less than 1% vm in the fleece and around 2.5% vm in the skirtings.

The salinity problem

We have a salinity problem due to a combination of factors, including the topography, a rising water table, salt naturally occurring in the parent rock, and poor management decisions from time to time. At present 10%, or 120 hectares, of the land has been visibly affected by salinity, with 25 hectares of this area affected to a moderate to severe level. I would consider another 10% of our land has a high risk of developing salinity problems (Table 1).

You may ask, what is it we have done on our land that gives me a right to stand up here and talk to you today? How is it that for the 5 years from 1994 to 1998, our saline paddocks have carried 11.8 dse/ha with some paddocks carrying over 20 dse/ha, while our property average is 9.3 dse/ha (Table 2; Figure 1)? What have we done to get our saline areas producing. Before I tell you what we have done, I need to explain our attitude? You see, I could tell you what we have done in our particular situation, you could go home and do the same thing, and I would guess that for many of you, it wouldn't work. In fact, it could make things worse. I believe salinity occurs in different ways and the topography,

Table 1. Extent of the salinity problem on "Eden Brae" and "Glenflesk".

Total property area	1189 ha
Visibly affected by salinity	120 ha (10%)
At risk of developing salinity	120 ha (10%)

Table 2. Productivity of saline paddocks compared to all paddocks on the property.

	Saline paddocks		Whole property	
	Average	Range	Average	Range
Total paddocks	20		78	
Average paddock size	8 ha		15.2 ha	
Productivity(dse/ha)				
1994	9.6	4.3-20.4	7.9	3.1-20.4
1998	11.7	1.7-29.4	9.8	1.7-43.1
1994-98	11.8	3.6-21.9	9.3	3.2-21.9

subsoil, rainfall and stocking rate all influence how you manage it. The key to managing saline soils, in my opinion, is a mental attitude.

Never think you have all the answers

You need to always be ready to learn. Read what you can, go to field days and seminars. As well as learning, give things a go, ask questions, join a landcare group, be a pain to your local agronomist by nagging him or her for information all the time. I am blessed with parents who love to learn, and they have passed that on to me. My father will go to field days and seminars and then come home and see how he can give what he has learnt a go. My mother loves to read and so I have done the same.

This is our attitude in regard to salinity. We have learnt a lot through various channels. Some information we have used and felt it didn't apply or work. Some information we have learnt and used and found it worked, and that is what I will share in a moment. Other areas we are still investigating for ourselves, and we are yet to come to an opinion on their worth.

But don't ever believe that you have all the answers. One of the reasons for this is that those of us that manage an area of land have one of the most difficult jobs on earth. We are in reality trying to manage a very complex biological system with millions of combinations and outcomes. We have a wide range of species - insects, bacteria, fungi, plants (grass or legume, annual or perennial, weed or wanted), animals (sheep, cattle, kangaroos, rabbits, hares, foxes), birds, worms, lizards and snakes. There are also a wide range of other variables - rainfall, temperature, sunshine, wind, aspect, topography, soil types, fertiliser and commodity prices. On top of that, throw in the most complex system of all. We are trying to manage humans - ourselves, our family, the bank manager, the government, etc. No wonder there are no hard and fast answers that work in every situation.

Making saline areas productive

What practical things have we done to either keep, or get our saline areas productive?

Reduce paddock sizes

I mention this one first, not because it is most

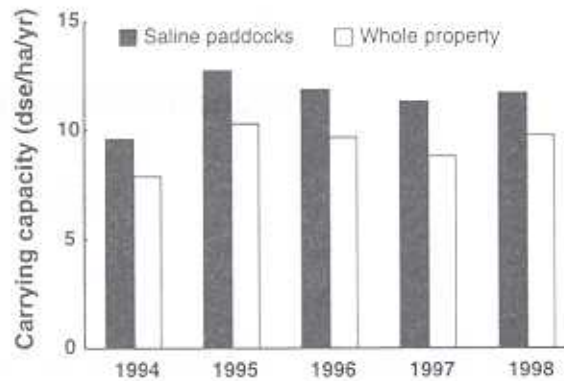


Figure 1. Productivity of saline paddocks compared to the average for the whole property, 1994-1998.

important, but because it is a visible thing when you walk onto our property, and because it is one link in a system that I hope will become clear in a moment.

We manage and own 1189 hectares. That land is divided into 78 paddocks plus a number of small holding paddocks, and we want to make even more paddocks. Our average paddock size across the property is 15 hectares, with our 20 saline paddocks averaging 8 hectares (Table 2). There are a number of reasons for keeping paddocks small, and I believe it can be an advantage even if salinity is not a problem. It improves the evenness of grazing of a flock of sheep and makes management easier in knowing when to put livestock in and out of a paddock. The factors that limit the number of paddocks we have are the cost of fencing and the cost and ability to provide watering points. Electric fencing and temporary fences have helped with fencing costs and we need to do more work on providing watering points at an effective price.

We try to fence so that we are creating paddocks of similar soil types and topography. Unfortunately, salinity does not develop in nice rectangular shaped areas, so in reality it is impossible to do this accurately. However, as best we can, we try not to have too much variation. Sheep are very selective in their grazing habits. If you have a paddock with high dry areas together with saline areas, then in winter they will graze the high areas and leave the saline areas, and do the opposite in summer. This results in areas being overgrazed and/or under-grazed, which damages the pasture and reduces the production performance of stock.

Identify saline areas

The earlier a developing saline area can be identified and then managed, the more hope and potential there is to get that area to remain productive. Once you know how, it is relatively easy to see a patch of ground that salinity is affecting. If you don't know how at the moment, go and see a Landcare Co-ordinator or Landcare Group and they will help you.

It is vital in our area, where the topsoil is so thin

and fragile and the sub-soil is so poor and hard to manage, to keep the topsoil on the saline site. If there is grass on the site, even if it is only sea barley grass and couch, then try to keep it there. It will slow down erosion caused by the wind and water. Fence the area off if the stock are beginning to camp on it, as they often will, especially in a large paddock. Keep an eye on the site and start thinking about how you are going to manage it

The importance of retaining topsoil on saline areas is shown by the two soil tests in Table 3. Many of you would not want to have either soil on your place but, if you had to make a choice, I think most people would prefer the soil in Test 1. This is the topsoil on one of our saline paddocks, a paddock that over the past 5 years has run 14.7 dse/ha. Test 2 is the subsoil of the same paddock. This has highlighted to me again why it is so important to keep the topsoil on the saline area. It is much easier to get a pasture to produce on the topsoil that is there than the subsoil underneath.

Rotationally graze

We don't have any fixed grazing system. There are no particular plans that we go by, and each year is different depending on the seasonal conditions at the time. But, as a general rule, we don't set stock a paddock for an extended period of time. On average in 1998, each paddock was grazed for 112 days, with the saline paddocks being grazed for 107 days and rested for 257 days or more than two-thirds of the time. Our most productive saline paddock last year carried 29.4 dse/ha and was grazed for only 36 days during the year.

Rotational grazing does a number of things. It gives a more even graze on the pasture across the whole paddock, it allows more rest for the pasture to then recover its root reserves before the next graze, it causes some soil disturbance by the sheep's hooves due to the larger flock sizes that occur with rotational grazing, and it reduces the amount of camping and salt/soil licking that the sheep do.

If a bare saline area is fenced off from stock, then the salts cause a crust on top of the soil, because the water-table is at or above the surface, and evaporation removes the water, leaving the salts behind. This crust prevents rainfall penetrating, is a poor micro-climate for pasture seedlings and is harsh on growing plants. Sheep in a set-stocked situation either just walk along tracks in and out of the saline area, or they camp on the area, lick and scratch the salt, and eat the salt and the top-soil, removing it and exposing the sub-soil.

For some reason, salt is to sheep like ice-cream is to children - they love to eat it. Rotational grazing means that the sheep are busy getting their share of the grass so they don't spend as much time licking the salt, and they walk across a greater percentage of the crusted area. The action of the hooves disturbs the bare scalded areas enough to enable some

Table 3. Soil test results from a saline paddock.

	Test 1	Test 2
Colour	Greyish Brown	Pale Brown
Texture	Very fine sandy loam	Light clay
Depth	0-10 cm	10-60 cm
pH (CaCl ₂)	5.6	5.0
Nitrate (mg/kg)	2	2
Sulphate sulphur (mg/kg)	94	427
Phosphorus (mg/kg)	22	5
Cations (meq/100 g)		
Potassium	0.26	0.24
Calcium	3.8	5.0
Magnesium	5.7	8.9
Sodium	2.4	5.0
Total cations	12.2	19.3
Sodium as % of total cations	19.6	25.8
Chloride (mg/kg)	369	867
Electrical Conductivity (dS/m)	3.5	7.0

of the grass seed that is usually nearby to find a spot to establish in. The trick is to get enough soil disturbance without getting too much to cause erosion in heavy rainfall. This is where the relationship between paddock size, mob size, grazing pressure and time of grazing comes into play. It is a science with no definite formula as far as I can determine.

Sow salt-tolerant pastures

To create a productive grazing system on a saline area, there is a need for the right pasture species to be present. We haven't found that 1 or 2 species work in all areas. Our philosophy at present when it comes to sowing pastures in a saline area (or for that matter any area) is to use a shotgun approach. We sow as many different types of pasture seed as we can. We believe that there is so much variation of situations within a few metres, let alone across a paddock, that there is no way that we will know what will grow best on any given spot. So we leave that part to Nature and provide as much choice as we can.

Having said that, we find the following pasture species usually perform best on saline areas:

- Tall wheat grass (*Thinopyrum elongatum* -formerly *Agropyron*)
- Puccinellia (*Puccinellia ciliata*)
- Tall fescue (*Festuca arundinacea*), particularly cv. Triumph
- Strawberry clover (*Trifolium fragiferum*)
- Balansa clover (*Trifolium balansae*)
- Subterranean clover (*Trifolium subterraneum*), particularly cvs. Trikkala and Gosse

However, even in saline areas, we will plant the following as well because they will grow in places on saline country:

- Phalaris (*Phalaris aquatica*) cv. Australian

- White clover (*Trifolium repens*) cvs. Haifa and Tahora
- Perennial ryegrass (*Lolium perenne*)
- Subterranean clover cvs. Goulburn and Leura

We are trialing Puna chicory and Maku lotus. They should be okay, but to date our results have been poor. We have found that in a couple of places kikuyu and paspalum have moved in and are performing well. I think we need to look at them more closely than we have been. Yorkshire fog is considered a weed by most of us, but grows in saline areas and stock do well on it if it is kept short and green.

Even if all you have at present is sea barley grass, couch grass and a bit of Yorkshire fog, then they are better than nothing. Don't look at barley grass and couch as a curse until you have the ability to replace them with something better. The only grass that uses moisture out of the soil is green grass, whatever it might be. The only way to remove soil moisture before it gets to the soil surface and leaves its salt behind as a crust is by a bore and pumping the water out, by planting and growing trees or by having green growing grass. All three have their place, and we are using trees around saline areas, but the most efficient way on saline areas is with grass. It is preferable for this grass to be perennial, as it stays green and growing for a longer time each year and it is deeper rooted than most annuals. For example, we find in our situation that in most years, the phalaris does not go completely dormant over summer, but continues to grow if moisture is available in the soil.

We sow pasture by spraying in the spring with Roundup®, grazing pretty hard over the summer, spraying again in the autumn with Roundup®, and then sowing with a direct drill soon after.

Keep fertiliser on the paddock

Before you plant your new pasture on a saline area, and after you have planted it, you need to put fertiliser on. Really, it is no different to any other pasture - if you want it to grow, you need to feed it. Like everything else in primary production, you need to do your budgets before you start, when you finish and before you do it next time. If putting fertiliser on prevents a piece of \$1200/ha land turning into a patch of bare ground worth very little, or turns pasture that runs 5 dse/ha into land that runs 10 dse/ha, then that needs to be considered. To be honest, with present wool prices and land prices, it is not worth fertilising most saline areas. However, being the eternal optimist that I mostly am, I believe things will get better, at least enough to make it worthwhile.

We try to put 125 kg/ha of single superphosphate on all our country every year. However, in the last few years, we have only fertilised two-thirds each year. At the time of sowing pasture, we fertilise

with 125 kg/ha of Starter 15. It is important for the seedling to get a quick start, so it can get its roots down and develop sufficient leaf area. The nitrogen helps the plant to establish.

I find budgeting the most inexact science of them all, so you must do budgets on your own place under your conditions. To give an indication of costs, my budgeting tells me it costs around \$175/ha to sow a perennial pasture on a non-saline area. In our system, the only extras for saline areas are generally to add tall wheat grass and *Puccinellia* to the seed mix, costing about \$23/ha extra. So, in round figures, it costs \$200/ha to sow a pasture on a saline site. The gross margin in our business for 1997/98 was \$6.70 per dse, so if this new pasture increases the carrying capacity from 5 to 10 dse/ha, then the gross margin per hectare rises by \$33.50 giving a return on outlay of 17%.

There are many other factors that need to be taken into account as well. If earthworks are needed then that can increase the cost per hectare very rapidly. Also, the cost of fencing needs to be included, as well as the risk of failure of the new pasture. On the other hand, the increase in the capital value of land with a pasture on it compared to bare eroded soil needs to be included.

Try to get water off the area

Wetlands are an important part of the ecological balance. I am not talking about draining them, but on our property many of the saline areas are places where water either is running across them during much of the winter, or they are small depressions where water lies during winter and then dries up quickly in spring. For some reason, these areas often turn saline. It could be due to the water-logging, reduced nitrogen, poor pasture production, or salts from other areas accumulating there as the water evaporates. Whatever the reason, we have found that by reducing the amount of water on these areas, we have helped heal up saline areas, in some cases quite markedly.

This may be done by changing a drainage line so water flows into the creek at another location and doesn't flow across the saline area, or by providing a drainage line through the area so the water does not spread out but stays in a narrow area and is removed more quickly. The cost needs to be evaluated, but often with a couple of contour banks or a tractor and mouldboard plough a lot can be achieved, in some places quite cheaply.

Never give up trying

I started out by saying that it is vital to have an attitude of being willing to learn, and I thank you for listening today and showing that attitude. I want to end up by saying that there is one other attitude we all need to have when handling saline areas on our farms. We need to never give up trying.

I run the risk of sounding like we have all the answers to getting our saline areas producing on our farm. Maybe you have areas that are more saline than ours. I haven't given details on the level of the water-table under these areas, the salinity of that watertable or the actual salinity of the soil. Whether mine is worse than yours is not the issue. The issue is how to get ours and yours as productive as possible.

Remember, we have had plenty of failures too. We still have saline areas that are unproductive, are bare and an eyesore, and we haven't really worked on yet. We still have a saline paddock that we have spent a lot of money on that runs only 3.7 dse/ha. If your place is like that, then never give up - this is a new science for us all. Look at those salty areas as a challenge and an opportunity, not as a burden on

your back.

There has been a tendency in the Landcare movement to place guilt upon any landowner who has a saline area on his or her place. Don't feel guilty - guilt never achieves anything. Rather, use that saline paddock as an opportunity to learn, to grow and to become a better person. Most of all though, don't give up. That achieves nothing.

Acknowledgments

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