

UPPER SNOWY LANDCARE NETWORK

SUMMIT ON LARGE SCALE TREE PLANTING ON THE SNOWY MONARO



**30 July 2019,
NPWS Conference Room,
JINDABYNE, NSW**

Hosted by USLN and NPWS

Coordinated by Lauren Van Dyke

Facilitated by Luke Pope

Report by David Woods

Traditional Owner Acknowledgement

USLN and summit participants would like to pay their respects to the Ngarigo-Monaro traditional owners both past and present, on whose land this summit was held.

PREAMBLE

On the 30 July 2019 the Upper Snowy Landcare Network (USLN) hosted a summit of industry participants involved in large scale tree planting across the Snowy Monaro. The summit was held at the NPWS building in Jindabyne and included presentations by people who had extensive experience in preparing sites, planting large numbers of trees and shrubs, and subsequently maintaining these rehabilitation areas. A common challenge for tree and shrub planting across the Snowy Monaro is extreme climate including frosts, extended drought periods, strong winds, short growing season and naturally poorer quality soils, exacerbated by various land-use practices over the past 150 years. Other challenges for successful plant survival include different pests with increasing pressure caused by deer.

In the past four years, along with partners including Greening Australia and a range of funders, suppliers, contractors and volunteers, USLN has installed 17 x 1 ha-sized biodiversity plots in response to the dramatic tree dieback on the Monaro in an area the size of the ACT. To alleviate the damage USLN have planted native trees and shrubs in densities of 1,000 stems per hectare, often in the most disturbed or highly degraded areas. USLN have funding to plant a further 11,000 trees and shrubs over the next three years. Greening Australia is augmenting this program with eight provenance trials to test the viability of out-of-area species and sub species of *Eucalyptus viminalis*.

SUMMIT OBJECTIVES

As agents of restoration and rehabilitation programs working in the Snowy Monaro region, people and organisations will have developed theories and methodologies on enhancing survival rates of native trees and shrubs. USLN would like to harvest this information for the benefit of its own work and that of the wider community. Consequently on-ground operators were invited to deliver a 15-minute presentation (10 minutes presenting and 5 minutes for questions) centred around the questions below. Following the presentations, a general discussion was held to discuss the methodologies, techniques and those aspects of restoration and rehabilitation that the presenters believed to be most paramount in dealing with the challenges experienced in the Snowy Monaro region.

To guide the presentations and summit, USLN gave the presenters several questions which gave context for their presentations. The following questions were tabled:

- What success rate do you realistically expect?
- What planting density do you use and why?
- What planting protection is most survival effective and cost effective?
- What species mix is most effective?
- What management measures are essential?
- What is an ideal site?
- How to deal with difficult sites?
- What compromises do you make?
- Mitigation measures against failure?
- Should we explore options for direct seeding, low-input, large-scale methods?

The summit was coordinated by Lauren Van Dyke (USLN Monaro Dieback Project Manager) and Pam O'Brien (NPWS Area Manager – Snowy River Area) hosted the forum in Jindabyne. Luke Pope (South East Local Land Services) facilitated proceedings on the day and David Woods (Environmental Contractor) scribed and prepared the Summit Report.

REPORT FORMAT

While most presenters used a Powerpoint presentation, the essence and emphasis of their presentation has been captured in the following report. The information that was delivered by each of the presenters has been summarised below and in the order of each presenter. In some instances, some of the information between presenters or comments from the summit participants may have been different or challenged. Nevertheless, the information has been captured in the first instance by each of the presenters to reflect their relevant experiences, unique challenges, and where provided, best and justified practice. The format of each presentation also differed, so there was no consistent parity as to how each of the questions posed by USLN was addressed (and no attempt was made by the scribe to align the responses of the presenters to the key questions posed by USLN in the report, but rather present what was delivered and emphasised on the day). Not all presenters systematically answered each of the questions.

However, following the presenters' information there is a summary of consensus (annotated where challenged) that emanated from the group discussions. It is here that many of the practices and guidance that USLN have sought from the summit will be found.

Although the report has been prepared to summarise the most important information, a good deal of information was provided in the Powerpoint presentations including photographs and occasionally diagrams. These presentations have not been appended to this report as the essence of the information has been captured. However, presenters kindly donated their presentations to USLN as additional reference and people may receive a copy by contacting USLN.



Liz McPhee (Rehabilitation Contractor)

Background - Liz has a broad history with plant propagation and rehabilitation including alpine areas in Victoria, NSW and ski resorts, as well as working at many sites throughout Kosciuszko National Park with time spent on rehabilitation of former Snowy Hydro sites.

- Planting trees and their survivorship is more than just about individual trees: it's about ecosystem restoration.
- Dieback of trees is one of the final symptoms of an ecosystem under pressure.
- Death of trees is death of an ecosystem.
- There's a resilience in ecosystems but once enough factors have been removed or changed then the ecosystem may cross a threshold and go into decline.

Therefore, there's a need to rebuild the functional ecology!

Issues that need to be addressed to restore *functional ecology*:

- Soil loss and compaction
- Lack of nutrition (NPK etc)
- Death or altered soil microbes (fungi, bacteria and invertebrates)
- Lack of microclimate (loss of strata in the ecosystem)
- Grazing pressure (hard hoofed animals, many more deer, rabbits and hares)
- Increasing incidence of drought (climate change)
- Hotter temperatures (climate change)
- Lack of provenance plant material (loss of biodiversity)
- Loss of buffering in the ecosystem because of the loss of biodiversity (no capacity to cope with stress)

Solutions to restore functional ecology in a rehabilitation or restoration program:

- 1 Do a soil test to assess what is missing regarding nutrition. Add compost and an organic fertiliser if required. Add as much carbon as you can.
- 2 Address compaction – auger plant holes or rip lines.
- 3 Use the colonizing species – especially the shrub layer – be biodiverse. Plant at 1 m spacing as this will add to evolutionary biology (the strongest will survive) and grow the wood thatch.
- 4 Use natural features such as rocks and mulch to create microniches.
- 5 Repair the land using patch dynamics.
- 6 Spray weeds prior to planting (with a non-residual herbicide) and mulch planted seedlings with an organic mulch.
- 7 Use fences or effective tree guards to control grazing. Exclusion areas where there is no grazing at all will directly contribute to repairing the soil and ecosystem.
- 8 Use well grown tubestock with enough carbohydrate in the stem and leaves to survive transplant shock. Use root trainer pots. Add mycorrhizae (local healthy soil) to the tubestock.
- 9 Harden tubestock to the conditions they will experience when planted. Reduce watering and expose to wind.
- 10 Plant in the early spring or mid to late autumn.
- 11 Water the tubestock in and only water again if no rain after planting.
- 12 Do the maintenance.

Liz placed much emphasis on post-planting maintenance and could account for many program failures by government and the private sector because of lack of maintenance, including at the planning and financing stages.

Points for Discussion that Liz itemised and went through in her Powerpoint slides. These are presented below. Extra comments and emphasis in italics.

- 1 Expect 90 to 100% survival if you address ALL the issues.
- 2 Plant at 1m spacing and drive evolutionary biology and replace the carbon as quickly as possible. Less maintenance and less weeds [*Liz noted that many planting programs have larger tree spacing. But smaller intense planting spaces is about ecological restoration and in the longer term will improve survivorship of plants at that particular site as there are ecological interactions being formed (e.g. natural mulch, soil moisture retention, protection from wind, fauna interactions etc that benefit individual plants as well as the new community). Allow the site to build and accumulate its own thatch*].
- 3 Once there are over 1500 plants, it is cheaper and better to fence a planting area. Tree guards have multiple negative issues [*Liz was not a supporter of tree guards and in particular mulch mats made from recycled fibre or paper – they restrict positive soil dynamics around the plants and in some cases redirect water away from the plant. Plastic/corflute guards also prevent the plants from adapting and strengthening to local conditions*].
- 4 Use a species mix that reinstates the upper, middle and lower strata. Use colonizing species. Plant a tree and shrub together.
- 5 The essential management issue is to address all issues to prevent the project from failing. [*Liz emphasised adaptive management but attention to maintenance. Also take a long-term view in building up the ecosystem and expanding upon the established patches*].
- 6 Any site is ideal as long as you address the issues. Some are easier, but all land can be repaired. [*Exclude cattle and livestock grazing as this compacts the soil*].
- 7 Difficult sites take more money and more time to be repaired but addressing the issues will make them easier.
- 8 If limited resources or time, compromise by using patch dynamics to rebuild ecosystems. Do a good job in a small area and build on that over time. Do not stretch resources over a big area and fail. [*Liz emphasised patch dynamics, particularly joining small islands to larger ones*].
- 9 Use ecological trends and functional changes to achieve land repair. Do not try and recreate a 'climax' ecosystem upfront. [*Take a long-term view and perhaps identify or work with target benchmarks backed by science. Successional planting where possible*].
- 10 Direct seeding is unpredictable and needs a lot of seed and microclimates to work. Frost heave is an issue to deal with. Use tubestock as there is a lot more control over outcomes.

Final comments by Liz included:

- *The increasing prevalence and impact of pest species that need to be reduced or excluded from the restoration sites.*
- *October/November and mid-March/mid-April is a good planting time for the Monaro.*
- *Plant two tube-stock in the one hole e.g. one eucalypt and one wattle*
- *Many sites can self-rehabilitate if grazing is reduced or excluded altogether.*

Dave Smith (Specialized Construction of Protected Environments)

Background – Dave has a broad history of rehabilitation and landscaping throughout south-east Australia and was for many years the landscaping business associate to Kangarutha Nursery near Tathra. Projects included Alpine Way slip site, rehabilitation of the Waste Point Tip and restoration of degraded areas in Namadgi N.P., Kosciuszko N.P., Bournda N.P. and South East Forests N.P.

Dave's presentation was succinct and addressed explicitly the questions posed by ULSN. He emphasised the following:

- A successful restoration and rehabilitation program needs a good budget and that budget needs to account for a post-planting maintenance program.
- SOIL MOISTURE is the most important site attribute that needs to be managed or addressed for successful large-scale tree planting!
- Dave's history for planting success is based on more than 90% for a 'good site' e.g. reasonable soil depth, good soil moisture retention etc.
- A heavily disturbed site with poor soil quality and a modicum of maintenance could expect about 33%. On some projects where a higher planting success rate was targeted and where the budget allowed, Dave created compost soil.
- Where it pertains to trees and shrubs, Dave works on a planting ratio of 300 – 400 stems per ha with particular focus of planting a lot of wattles with eucalypts as the preferred shrub associate. Numbers depend on budget, but where possible, try and include a mid-layer planting amongst the trees i.e. shrubs (at least wattles).
- Dave supports the planting protection but dislikes tree guards that are budget hungry and detrimental if not managed well – can inhibit tree/shrub growth and can become litter when deteriorate and blown from site.
- Dave supports fencing depending on size of patch and resources available, but fences are not impenetrable to deer and other fauna when not managed.
- Dave uses 'Sen-tree' browsing deterrent – a spray on egg-based adhesive that's embedded with carbide grit. Can last up to 3 months. His main use is against deer, occasionally macropods and other browsing herbivores. Sen-tree can be reapplied and is relatively cheap and quick to apply. You can spray several thousand tubestock in 15 minutes for about \$15. Dave sprays Sen-tree in the nursery not in the field. [Liz McPhee said that Sen-tree was not as effective against wallabies, with Dave suggesting that most browsing occurs within the first few weeks of planting].
- When plants get larger, Dave protects the trunk through the use of slotted Ag-pipe and declares this to be 100% effective against deer during the rutting season. Relatively cheap and reusable.
- Dave uses a mix of species and combines eucalypts with acacias because of their thatching qualities. And where possible, like Liz McPhee, Dave will place an acacia with a eucalypt in the same hole.
- Due to an increase of hotter and prolonged drier periods (climate change), Dave is starting to use, where possible based on project objectives, *Callitris* and hardy eucalypts.
- **QUALITY TUBE STOCK!**...Dave emphasised the need for good plants that are not root bound or 'lanky'.
- Keep stock out! Protocols and agreements need to be established with landholders to exclude stock from planting sites, particularly if fences are not used as an enclosure.
- Plant according to microsites – plant more in better soiled areas and avoid or plant less in thin skeletal soils.
- Dave avoids direct seeding – very little success.

Simon Oliver (on behalf of Jindabyne Landscaping)

Background - Jindabyne Landscaping has been operating since 1985 and has been engaged by USLN for the past five years. Jindabyne Landscaping have a broad history of planting contracts across the region with local council, NPWS, RMS, Snowy Hydro and private landholders.

Ideal Site - situated with full sun, rich organic soils with good balanced drainage, not too steep or too flat and with plentiful water supply and no grazing pests. Where this is not available, you need to provide and adapt.

Challenging sites can be found across the Monaro and Alpine Regions, but all challenging sites can be addressed:

- Mound planting has proved to be very successful.
- Rip-line planting should be backed up with use of a mechanical auger to prevent air pocket interface below ground.
- Spot planting in pre-augured holes can present root girdling or pot bound effects on plants if soil is tightly compacted.
- Rocky scree sites have been planted successfully with the use of soil compost and mulch.
- Consideration should be given to soil pH levels for these sites.

Plant Species Selection:

- Select native species that are endemic to the area
- Plant diversity should be balanced and match existing site species
- Hardiness and provenance of plant stock is key to survivability

Planting Density:

- Planting density should be determined by site to match the existing surrounding environment
- Planting should be balanced with a denser spacing and possibly thinned at a later stage

Planting Methods:

- Best Practice planting involves pre-soaking plant stock in fish emulsion or water before planting in ground
- The use of fertiliser tablets or slow release granule type fertilisers is beneficial
- Hydrated water crystals mixed through back fill soil provides essential moisture for new root growth
- Good back filling and light compaction minimises potential for air pockets to remain around the root ball
- Using wood chip mulch around plants has proved to be the best mulching practice
- Use of **Thatch** (remnant sticks branches and vegetation) and **Straw Mulch** for larger areas is a very effective method of soil stabilisation and weed suppression

Wood Mulch or Mulch Mats

- Using *Eucalyptus* or Arborist Mulch is superior to other mulch products
- Wood chip mulch aids in soil moisture retention
- Mulch provides nutrients through breakdown of organic matter
- Mulch suppresses weed growth
- Mulch insulates soil and roots in the colder months

Plant Protection

- What are we protecting new plants from? Identification of grazing pests is important for choosing the best protection
- Individual guards for small remote sites or high netting type perimeter fencing
- Cost and economies of scale must be evaluated when choosing the best plant protection
- Type of protection includes: Flute Guards, Plastic Sleeves, Wire Guards, Nylon Mesh Guards and high perimeter fencing
- Consideration of wind forces on plant guards is also important
- Plant guards should be recyclable. Our preference is the wire or nylon mesh guards
- Maintenance of tree guards must also be considered. Low maintenance guards should be used

Follow Up Maintenance

- Watering in plants is critical for survival
- Control of unwanted grazing by fauna (rabbits, kangaroos, wombats, deer etc)
- Weed control (herbicide spray or hand weeding)
- Replenishing mulch if possible is a huge advantage post planting
- Replacement planting maintains planting density and should be done ASAP

Survivability

- Typical survival averages we have experienced are around 75% (includes maintenance)
- Local climatic conditions contribute immensely to planting survival rates
- Drought, flood, frozen ground and fire all impact on plant survival rates

Nicki Taws (Greening Australia)

Background - Nicki Taws is Greening Australia's coordinator for south-eastern NSW and her work includes the Riverina, slopes, tablelands and south coast. Many of Greening Australia's projects occur across similar sites and challenging circumstances faced by USLN.

Revegetation – how?

Nicki identified three revegetation strategies: Natural regeneration, Tubestock Planting and Direct Seeding

Natural regeneration

- Cheap, but potentially slow
- Depends on seed, bare soil and moisture
- Remove grazing pressure (fence)
- Reduce competition (burn, slash, spray)
- Expose soil (scrape, cultivate, burn)
- Avoid directly under tree canopies
- Only viable where healthy adult trees present

Tubestock or Seeding?

- Site conditions (flat, steep, rocky)
- Site size
- Seed/plant availability
- Cost
- Labour availability

Site preparation

- Protect site from herbivores – fence from stock, control rabbits, goats and deer
- Reduce the competition – pasture and weed control
 - Start 6-12 months before
 - Undertake at least 2 weed control activities prior to revegetation program
 - Methods can include chemical, mechanical scalping, manual scalping and smothering/mulching
 - Can include a combination of control methods
- Prepare the soil (to relieve compaction, improve soil water and facilitate planting)
 - Ripping/hole digging by hand, excavator or auger when:
 - Soil is dry
 - Several months before planting
 - At least 40 cm but aim for 60 cm deep

Planting

- Plan and order in advance (Greening Australia generally grow own plants)
- Use provinces then different species
- Species to be climate-ready
- Plant deep in hole
- Firm down soil
- Water in well (but Greening Australia does not use water crystals)

Tree Guards

Greening Australia does use a range of tree guards and mulch mats that were questioned by other presenters. The use of guards depends upon the site and number of plants. But exclusion is paramount to protect from rabbits, hares, macropods, wombats, goats and deer.

Direct Seeding

- Mechanical efficient for larger sites but requires more seed and weed control essential.

- Rip-lines are often too deep for direct seeding as direct seeding is usually about 5 cm deep but seeding over the top of old rip-line sites can often double tree growth rates because the rip-line has aerated the soil, improved water infiltration and broken up soil compaction.
- By hand more labour intensive but targeted. Use where vehicle access is limited such as rocky sites, steeper slopes and wet sites.
- Weed control commences at least 6-12 months out including a spring herbicide effort to control C4 grasses and an autumn spraying effort (and possibly a third effort prior to seeding). Possible to use a shielded spray to avoid spraying any seedlings.

Timing

- Direct seeding – Spring – when there's maximum soil moisture and with good site preparations such as weeds
- Tubestock Planting – Autumn-Spring – inclusive of 6-12 months site preparation, plants ready and consider frost/snow

Density

- Woodland tree density 100-200 per ha=7-10m apart
- Shrubs 1 per tree = 400 stems/ha = 5m apart
- Shrubs 2 per tree = 625 stems/ha = 4m apart
- Shrubs 2 per tree = 1000/ha = 3m apart

Results

- Aim for 80% success with tubestock
- Site preparation is critical
- Follow up watering if required
- Some sites vary with the success of eucalypts or species of eucalypts, so adjust additional planting or future plantings based on experience in similar sites or locations.

Danny Mathews (NPWS)

Background - Danny is part of the NPWS Rehabilitation Team that has been rehabilitating former Snowy Hydro sites within Kosciuszko National Park. Although many of these sites are montane and sub-alpine physiographic zones, they include large-scale rehabilitation areas that have similar challenges to planting programs experienced across the more relevant tableland zones of the Monaro.

➤ Site Preparation – Danny placed much focus and effort toward ground and site preparation!

- Rip 6-12 months in advance and rip deep to break up soil compaction and allow increase soil moisture.
- A good budget has allowed the use of larger machines to break very compacted sites associated with quarries and soil dumps. Aim to rip with a blade-plough and aim for 60 cm deep, particularly on heavily compacted soils. But select the right machine for the site e.g. budget, compaction, access, transport.
- Control weeds.
- Preparation and provision of soil compost, often with hardwood sawdust. Some sites have required urea and dolomite on a ratio of 1 kg for every 1m³ of sawdust/compost base.
- Logs are good for establishing microclimates and improve tree growth rates (sites where logs couldn't be sourced and used didn't have as good success compared to where they were used).
- Caution on mulch source and contaminants. Scotch Broom has been introduced to some rehabilitation sites embedded in straw mulch.

➤ Plants

- Circumstances of many NPWS sites requires remote nurseries to be set up close to rehabilitation site(s).
- Such nurseries allow 'hardening' and 'acclimatisation', particularly if being used in higher elevations.
- If funds are short, reduce planting scale and create smaller but manageable patches and build up a good site ecosystem (and improve the long-term success).

➤ Pest exclusion

- Full animal fence protection is preferred over tree guards.
- Fencing materials can be cost effective over large areas and material used in subsequent sites (NPWS budgets for fencing in the planning stage).
- However, some sites or sections of planting may require tree guards where fencing has not been pursued but exclusion for a range of animals needs to be maintained including lyrebirds (an issue for forested or montane areas in KNP where lyrebirds have ripped out 2 year old eucalypts and rake hundreds of square metres of mulch).
- Tree guards consume more of the budget and require a higher degree of maintenance.
- When trees have reached a substantial growth height or form (about 10 years), fencing is or will be considered for removal.
- Good growth rates of plantings also help with subsequent weed suppression.

Sam Dryden (Creative Lines)

Background - Sam has experience with a range of ecosystems, particularly in the sub-tropics and on the south coast of NSW and is gaining experience and facing challenges with the planting environment across the Monaro. Sam espouses an ecological perspective for landscape restoration.

The Cause

- Pretext for any rehabilitation or revegetation program is to 'Reclaim Lost Ecology' by 'Farming Ecology' – a term used in Bruce Pascoe's "Dark Emu" in reference to indigenous land management
- Loss of ecology is a result of poor land management

The Solution

- This is achieved by:
 - planting thousands of trees
 - rejuvenating the soil ecology
 - reclaiming riparian zones (where relevant)

Planting Density

- Based on outcomes for different community types e.g. forest, woodland, grassland etc
- However, consider a successional structure for long term ecology planning
- Sam suggested possibly going denser than USLN's 1000 trees/shrubs per hectare (to build up the lost ecology)

Plant Protection

- A balance between survival effective and cost effective, with a clear objective of what the protection is for – different sites have different issues and challenges
- Consider:
 - Re-useable options
 - Tabbed core-flute
 - Black mesh guards – (Sam's preference with the option of using the rolls that can be cut to length)
 - Fencing (including exits to prevent fauna entrapment)
 - Post protection removal and maintenance of any tree guards

Species Mix

- Determined by landscape opportunities and challenges, so some thought and planning need to consider the context of the species and the influence the species will have upon current and future ecosystems. These include:
 - Catchments, water courses etc
 - Protected or exposed parts
 - Rocky outcrops
 - Sam support's Liz's approach to successional planting to build up the ecosystem and not focus on the end result by attempting to plant the 'apex' system and walk away e.g. trees.

Ideal Site

- Each site is unique and requires some study and planning, but consideration to include:
 - Vehicle access
 - Watering opportunity
 - Connectivity to another patch (link)
 - Bush regeneration potential

Difficult Sites

- Some sites may be best left to regenerate without plantings, but may still require some assistance or intervention (e.g. weed and pest management, exclusion from stock grazing etc)

Methodology

- Survival rate is affected by compromising any of the following elements:
 - Large hole
 - Compost
 - Mulch
 - Watering

Mitigation measures against failure

- Maintenance
 - A good growing season may require more effort toward weed management
 - A bad growing season may require greater effort toward water and fertilizer
- Use compost and mulch in the initial planting
 - Build and protect a healthy soil biology
 - Consider the degree and richness of creating humus and building up the mycorrhizal fungi associations. A richer healthier soil will be reflected in a much stronger and resilient revegetation program
 - May be worth exploring techniques for applying a mycorrhizal mix or inoculating tubestock with relevant mycorrhizae

Direct Seeding?

- This requires a large amount of initial disturbance, huge resource of seed, followed by perfect conditions to achieve good results

Success Rate

- Success rate is highly influenced by:
 - Invested time
 - Methodologies, and
 - Budget
- A measure of success, in its simplest form is obviously how many plants survive, but a broader philosophical measure of success is to find a balance between agriculture and the environment
- Measure of plant survival in a planting is the minimum cost per plant that can achieve the maximum plant survival rate – INVESTEMENT + METHODOLOGY
- Planning, planting and farming native ecology for all species of the food chain will ensure the success of native regeneration

Special Note: Sam supports the use of 'compost tea'

- *Sam has turned a 1000 litre water tank into a mobile aerating composter to take onto site and within 24 hours brew up an aerated compost tea with mycorrhiza. Mycorrhiza is collected from various plant nodules (select the species) and 800 litres of air per minute is pumped to oxygenate the brew. The challenge is balancing the number of bacteria and mycorrhiza fungi as the species will feed on different nutrients which can subsequently affect the benefits of the plantings. Oxygenation is important to reduce dark patches and an anaerobic biology.*

Matt Stone (Stone Bros. Contracting)

Background - Matt has a history of agriculture, pest management and forestry. He has participated in landscape restoration projects in Queensland, coastal NSW and now is experiencing greater challenges with planting amongst the harsh Monaro environment. Matt also has extensive experience in planting both native and exotic plantations.

According to Matt site preparation is 'everything'

- Site preparation is paramount to get soil moisture deep into the ground at least 6 months before planting
- Holes to be dug to at least 50 cm.
- Fence site immediately to prevent grazing and trampling and subsequently compaction, undoing the time, effort and cost of ripping.
- Source good plant stock and preferably plants that have been sourced locally, or at least hardened to the local conditions.
- Plants grow better on eastern side of hills, providing more protection from westerly winter winds
- Matt prefers to use 1.8 m high fences and 2 m high mesh fence material that provides a flange (fold) at the bottom. A small cost to go higher (deer) than normal stock fences, and flange lower to protect from rabbits, wallabies etc.
- Some modern pest mesh material can now use fewer running wires (when affixed correctly) that reduces the cost and effort to establish a fenced area.
- Fencing materials can then be used again after about 5 years of tree and shrub growth.
- Tree guards are fine for some circumstances. Matt has been using a modified guard netting that protects the trees but breaks down after about 2 years – the plants come with the guards attached (currently being trialled for both native plants and pine with the aim of reducing wallaby browsing). The product is like a stocking that rolls from the base and allows growth to pass through. These stocking-like guards are being affixed at the nursery (Monaro Trees).
- Matt has a dual philosophy toward farming and landcare objectives: trees for habitat and trees for sheep/cattle breaks.
- Matt uses slow release fertilizer tablets and is not concerned about tablet burning the roots of young plants. But must be positioned correctly in the hole just under the plant so that the nutrients are released to the soil below and subsequently made available to the roots. If positioned too deep or to the side, the nutrients may release beyond the plant's root access zone.
- Matt has observed a lot of failed regeneration sites due to land holders not upholding their obligation toward post-planting maintenance, particularly watering.
- Landholders not appreciating the requirements for successful tree and shrub regeneration, and not valuing the funding or ownership of management, particularly when it involves free or subsidized programs...finding the right landowners for cooperative programs is important and upholding agreed obligations, otherwise a waste of time and money.
- Matt mound-ploughs for planting blue gum plantations, it costs more, but better site preparation per plant. The mound still contains a well/furrow to retain surface water and provide a soft soil to plant within.
- Hydraulics behind dozer (D4 or D7) – down to 450 mm gathers deep nitrogen and brings these nutrients to the surface [Danny Mathews said that mound ploughing can increase soil erosion in poorer areas].

DISCUSSION

Following the eight presentations by the revegetation and regeneration peers, an open discussion was facilitated amongst all participants at the summit to address the following specific topics:

- Site preparation – weed control, ripping, etc.
- Planting methodologies – timing, species type, tubestock size, planting depth, tools, etc.
- Additives – fertilizer, pesticides, mulch, crystals, watering, etc.
- Post-planting care – watering, pest control, weed spraying, monitoring, etc.

Many of these topics were covered by each of the presenters, but the discussion allowed agreements and differences to be explored, including the circumstances and experiences as to why some techniques and products were chosen and others avoided.

Site Preparation

- More ripping for aeration and filtration and a consensus that this be done at least 6 months prior to planting.
- Weed control is paramount and timed before planting commences. Need to remove initial competition within the first six months of planting; for best results consider at least two spraying periods.
- USLN at most sites has been undertaking ripping well in advance of planting. However, timing of ripping is important – if it's too dry then clods may not break down – and further effort may be required to break up the soil around the plant-well at time of planting.
- [Dave Smith] rips a deep hole but also rips around the hole for better moisture infiltration and aeration.
- [Alison] broader definition of weed needs to be considered and not just declared noxious plants – particularly exotic grasses that may not be viewed as such by rural landholders. The impact of broader competition from a range of exotic species that compete with young plant stock.
- [James] Monaro is twice as hard to gain planting survival rates compared with the coast and coastal ranges due to the challenge of the soils, climate, but also the weeds (grasses) that compete more aggressively against plantings that take a longer time to establish and grow compared to other areas. So appropriate herbicide and site preparation is paramount.
- Fusilade and Simazine were used by many of the practitioners (at least by those who supported herbicide use).
- [Liz] who has a broad experience with natural environments suggests using Fusilade around native plants where grasses are the major weed target.
- [Phil] plants trees in African lovegrass as it provides an available mulch and it's a good example of using local resources.
- [Danny] quality versus quantity when it pertains to herbicide. The right herbicide for the circumstances of the site and at the prescribed application rates.
- [Luke] herbicide persistence can double its effect on mycorrhizae – so perhaps rest the site longer where possible between sprays. It takes mycorrhizae/rhizobia longer than plants to re-establish – this has implications for the timing and planting of legumes e.g. Acacia species.
- [Alison] every site is unique and may preclude some techniques over others, so adaptive preparation based on site attributes and not just budget.
- [Phil] whatever the site, budget limitations or preparation resources, as a minimum create a well around each plant to allow for natural drainage of any available moisture to be directed toward the plant. This was supported by others at the summit.

Planting Techniques

- [James] as part of planning and preparation, more time pre-planting needs to be considered for appreciating the site and which plants will be used and to what densities. Often not enough consideration is given to plant orders and planting according to micro-sites – part of the reason for plant failure.
- While several participants suggested to always plant plants deep, Matt and Liz said that that depends upon the species and the site – so there's no universal approach.
- There's a method of long-stem planting (The Long-Stem Planting Guide) <https://www.environment.nsw.gov.au/resources/grants/Longstemguide.pdf> suggesting leaving plants in tubes longer to attain a longer stem before planting deep [this contrasts with some of the

presentations that suggest not to allow plants to become root and pot bound. There were also some questions as to whether this had a broad application to drier environments and species with shallow rooting systems].

- Leon Miners didn't have success with long-stem planting with *E. viminalis* he used along riverbanks and creek lines.
- Nutrient tablets give some extra life to *E. viminalis* from succumbing to dieback, but expensive to keep up.
- Need to factor watering into cost of post-planting maintenance.
- [Lauren] for larger sites maintain vehicle width between rows to provide subsequent access.
- [Liz] - this may depend upon the planting and site objectives, particularly if close planting methods are used for a more concerted 'ecosystem' approach. So row spacing should be based on planting objectives. Don't discount using buckets of water for close plantings – although this has labour and time implications.
- Soak tubestock in Seasol prior to planting.
- [Liz] – plant alpine plants in autumn
 - Less windy
 - Better soil moisture
 - 6-8 weeks growth before winter
 - Then protected by snow (blanket) from the frigid and blasting winter weather
- Agricultural perspective
 - different fertilizer rates for different aspects
 - planting densities – not one-size fits all e.g. aspect, site, soil condition, species etc
- [Matt] – dealing with regeneration/revegetation collaborative programs with farmers – less is more! Smaller fenced planting areas that are easy to maintain are a better prospect than large extensive plantings that rely on landholder commitment to weed spray, water and keep stock out!!!

Timing

- [Harry] grant funding cycles sometimes dictate the timing of programs, particularly short-term grants of 1 year. This has implications for some of the sites and their success rates, including working in with the constraints of the landholder. Luke said that agencies are starting to recognise drought implications and becoming more flexible.
- Best timing surrounds best soil moisture and warmer soil temperatures when soil ecology is most active.
- However, contracts and grant pressures pertaining to expenditure and other project objectives often dictate timing.
- In general agronomy there's a prerequisite for 200 mm of moisture before planting [need to capture over what time frame the 200 mm of precipitation this refers to and to which crops].
- [Dave Smith] – Water plants in well at time of planting. If no rainfall is experienced in the preceding 2 – 3 weeks, water again. Thereafter every 2 months pending adequate natural rainfall events.
- [Dave Smith] – initial watering with 3 – 4 litres per plant for the size of his wells and allows the soil to settle and remove air pockets. Subsequent watering of 2 litres per plant.
- [Phil] – 10 litres per plant on initial watering, a further 10 litres in the subsequent 3 weeks, then PRAY because after that it becomes uneconomical!
- Some people are moving away from autumn planting and focusing on spring to avoid killer frosts and the drier winters (mostly a Monaro issue). [Liz still supports autumn planting in the alpine and subalpine areas as the soil is warmer, soil moisture is available to plants, and soil biota and nutrients more available].
- Main issues with spring planting and subsequent survival over summer is the extreme hot days and dry winds, which often occur when landholders and contractors are on holidays. If spring planting is the preferred time, then a watering contingency needs to be put in place to account for hot summers and periods of peoples' absence.
- As post watering is very important, some participants suggested planting less trees to help budget for post plant watering of planted stock.
- Agreement that watering should be costed and factored into all planting programs e.g. plant less trees to purchase watering set-ups.

Additives

- Sam Dryden – creates compost tea – brews nutrients and organisms to supplement planting and improve soil structure.
- Sam suggests 1 litre of liquid fertilizer additive per hole per plant hole.
- Lachlan – suggests compost tea is water and few extra nutrients and organisms – not a real dynamic change and no current science to support any huge gains for effort (more beneficial microbes in a handful of soil). [There was some discussion as to whether 'compost tea' did provide a greater soil biology by adding various microbes to the soil, or whether 'compost tea' was beneficial as a nutrient tonic].
- Liz – add some compost soil and additives to provide an initial transition support and longer-term support when saplings are most vulnerable.
- **Luke Pope – question – do people do pre-soil test to identify soil status?**
 - Mixed response – no scientific analysis *per se*, but often sample different areas of a site to identify soil moisture, depth and general texture.
- Cooma compost – a council initiative of blending cow manure from the nearby sale yards and waste from the sewerage plant...still a preliminary study.
- Lauren asked if people used Gibberellic Acid (plant hormone that facilitates growth).
- Liz suggested that there's at least 60 types of Gibberellic Acid.
- Luke Pope – Agriculture has been using Gibberellic Acid for several years, particularly for winter growth but only effective to assist nutrient uptake when the nutrients are present to be up-taken.
- [us of Gibberellic Acid not really supported by forum participants but acceptable as part of a trial]
- Liz suggested a 'mycorrhizal tablet' – worth a trial.
- Phil suggested this may be a questionable result.
- Participant support for soaking tubestock in Seasol or water-in with Seasol mix – to reduce transplant shock. But it's not a nutrient supplement.
- James Cook – Seasol provides a nutrient uptake balance.
- Compost allows colloidal retention of nutrients like Seasol.
- Alison Harmer asked if the use of green mulch or green woodchips is okay?
 - Green mulch/chips consume a large amount of carbon
 - Carbon increases phosphorus then slowly releases back to the soil, so it can be considered for use (notwithstanding other concerns such as introducing propagules/seeds etc).

PESTICIDES

- A planting monoculture could predispose sites to insect attack
- Generally, participants were not supportive of applying pesticides but could accept a 'one-off' use to keep trees alive during the early phase of planting but not continued use.
- If there's an insect issue creating detrimental impact, seek advice from the agricultural department.
- Let nature take its course – but build the resilience in the planting so that the plants can respond/regenerate to any impacts caused by insect attack - by good site preparation, watering and compost soil/nutrient applications (in essence, build up a good soil ecology).

POST PLANTING CARE

- Consider/plan/budget for supplement planting to account for any losses – one way to maintain 100% success.
- Water according to needs and seasonal events, but don't overwater!
- James Cook – don't let the thatch be too thick that prevents gas exchange and water filtration.
- Re-mulch if required to facilitate soil stability and soil moisture.
- Re-fertilizer when watering or use a slow-release tablet or 'dynamic lifter'.
- Liz suggested a tree tonic provides a surfactant and nutrient adder.
- Manage tree guards e.g. re-stake if loose, replace if torn or dysfunctional and collect as litter if blown from site.

- James Cook – get in early enough and maintain according to schedule – don't just appear to maintain but actually undertake requirements to attain maximum survival.
- No support for foliar sprays.
- When to de-guard?
- Phil uses the larger tree guards as most issues pertain to width and not height.
- Phil de-guards when the plant head exceeds the guard.
- Phil attempts to get three reuses of corflute guards and stakes.
- Plastic wire guards are more resilient and multiple reuses, as do metal wire guards when used in special circumstances.
- General support to negate the use (and cost) of corflute tree guards and consider fencing and netting.
- First and supported option – create a total pest exclusion with fencing, but if not economically viable, consider tree guards. If corflute, factor in frequent management and clean-up of broken guards and parts.
- General support for fencing of dieback areas to allow natural regeneration rather than active revegetation.
- Whatever the exclusion options (fencing or tree guards), consider the principle of reusing materials.

OTHER ISSUES

Luke asked, "who measures survival rates?"

- Most hands were raised. The premise tended to be twofold: to see if the methods and products were working at different sites, and the degree of success (and replacement of trees/shrubs if required) that was part of the contract.
- However, when Luke asked, "who measures survival rates accurately and routinely", very few practitioners raised their hands.

Lauren asked about using three-tine ripping but only planting within the middle row?

- Some respondents suggested that the adjacent lines may prevent water running into the main line.

Question pertaining to 'auger glazing' the sides of holes

- Generally not a problem although easily remedied by not making holes too narrow, but may depend upon the site conditions of the soil.
- Dave Smith uses a ripper at different angles that creates a wider hole but still retains a subsurface bowl for water retention [essentially Dave digs downs but rips out from the centre creating depth, loosens the soil, creates a bowl, but also drainage toward the centre of the hole].

Carbon sequestration by Raphael Wood

A brief presentation was given by Raphael Wood, Managing Director of Market Advisory Group (MAG), about the carbon market and participation in the Commonwealth Governments carbon and sequestration program. Details of the program can be found at MAG's website at <http://marketadvisory.com.au/>. Perhaps the take-home message from Raphael's presentation was that USLN and its partners and collaborators could participate in the program either as single sites or as a 'collective', which may help offset costs for site maintenance as well as provide funds for new revegetation sites. *USLN will explore what opportunities the carbon offset program may have for current and future tree planting programs.*

Round-up

To complete the summit, presenters and participants were given the chance to add one comment that they held as either the most important element in a successful revegetation program, emphasised as being very important or something not covered.

James – organisational management involving shared resources e.g. wire tree guards, mobile trailer, storage space, compost storage and manufacture etc. particularly amongst Council, NPWS and USLN.

Lachlan – planning – full thought out planning process that includes maintenance and the resources to undertake that maintenance.

Danny – reuse of materials through networking – similar to James' suggestion but also tip sites, industrial sites and farmland that have redundant materials that could be used for revegetation programs rather than burned, buried or discarded.

Dave Smith – at dieback sites, existing dead timber on the ground can be used to break the wind velocity and obstruct animals from walking over the top, giving an opportunity to plant within the fallen timber. Most farms have machinery with the capacity to move such large material around.

Nicki – consider direct seeding as a real option including hand seeding. No examples in the region but undertaking some direct seeding on the Monaro this spring within fenced pots.

Liz –

- maintenance should be 30% of the budget (and allocated before a project commences)
- monitoring – even if just observational
- build an information database about successful revegetation in the Snowy Mountains and Monaro region so that there's a go-to site for local landholders
- direct seeding – grow seed as a horticultural crop and tap into sewerage plants for accessible nutrients
- leave natural ecosystems alone (but fence to exclude grazing) and focus on disturbed areas

Sam – establish standards for nursery plant stock and purchase from accredited nurseries. *[Liz has prepared a 'standard' for alpine plant stock which could be used as a template for tableland plant stock].*

Leon – what aspects do you contribute towards revegetation programs and what is the farmer/landholder responsibility? How to increase their engagement and longer-term responsibility. If agencies do most of the work including post-planting maintenance, there's less ownership and less responsibility adopted by the landholder and subsequently less value of a rehabilitation program. This often leads to failure.

Luke – no reason some old programs can't be revisited and rebadged e.g. Trees on Farms.

Anita – property planning!... and there's information already available to landholders. There may be an opportunity to promote the principle and the available resources.

Kim – issues pertaining to ownership of programs and responsibility of individuals/landholders to contribute and maintain programs. Also, start small, manageable and realistic.

Phil – patch planting and control of pests including native grazers/browsers. Need to be more assertive to managing deer and macropods. Need to be more receptive to recreational shooters where cost and other resources are prohibitive (notwithstanding ethics, good protocols, trust etc).

Dave Woods –

- manageability of revegetation programs through clear objectives and responsibilities between USLN and landholder, including post planting maintenance.
- anticipate a dryer and hotter region by consider planting species at some sites that may be better suited e.g. *E. melliodora* and *E. bridgesiana* cf. *E. pauciflora* and *E. stellulata*.

- proactive media campaign to promote more good news stories and canvass more landholders to be involved.

Shane –

- what role USLN will have to get people more engaged in rehabilitation and planting programs
- fire management issues and implications when plantings mature and start to create greater amounts of ground fuel, but also future requirements and opportunity of fire as tool for seed germination including species that were present prior to planting
- integrate carbon sequestration into planting programs.

Lauren – more promotion and planting on low productivity landscapes including planting within African lovegrass. Opportunity to change large degraded areas. Perhaps an open day at Scottsdale Reserve for landholders to showcase what can be achieved.

Alison – commence planting for the future using dry species selection. Different areas will have different challenges including different objectives, but the consequences of climate change should be included in planning for a site.

Margaret – need to place a dollar value on carbon and biodiversity. Large-scale tree planting will only happen if the practice is incentivised by money, e.g. through the carbon and biodiversity offsets market.

Luke – preparation is essential. Need to identify the length of time for site preparation which is at least 2 years inclusive of weed spraying (annual grass weed control), resting the site from grazing (compaction) and ripping (soil aeration and water filtration). Subsequently no proposals with landholder to be accepted unless this preparation is identified and enacted.

Summary

- Presenters either explicitly stated or implied restoration ecology. Some were quite vocal as to the cause (poor land management) but supported ecological restoration and not just an accumulative planting of trees *per se*. While some may interpret this as the same thing with the same end result, taking on a focused and deliberate ecological restoration as the end result does culminate in adjustments to the techniques used throughout the tree planting program. It may change the planting schedule and site plan e.g. denser planting per unit of area and successional planting over time.
- Having a strong philosophical position created a more determined disposition to be clear about the need for building up the ecology (planning and commitment) as part of the objectives (if not the objective) for any revegetation program. Restoration and functional ecological approach will enrich the long-term survival of the site and build a greater resilience.
- In relation to site preparation there was a consensus for multi-treatments well in advance of the planting period. Choice of chemical treatments, not just appropriate herbicide, needs to consider timing and residual period. Digging or ripping well in advance of the planting periods may also allow greater moisture filtration and aeration, particularly on disturbed sites where there has been a history of soil compaction. There is a strong correlation between site preparation and successful site rehabilitation (e.g. plant stock survival).
- There was a mixed response to tree guards (particularly corflute guards) and mulch mats made from recycled material and cardboard (as per Liz's concerns). DW suggests that the corflute have worked in the first one or two years of tubestock to provide a microclimate, protect from wind and provide some pest protection. But then these guards should be removed and different plant protection considered. Those who supported guards tended to use the plastic open mesh type.

- There was a strong support for fencing as a means to exclude pests (and cattle). Materials can then be used at other rehabilitation project sites. In some projects the cost of fencing may be comparable to the costs of tree guards and stakes. In larger areas fencing is often a cheaper option than tree guards. Where possible large areas across the Monaro could self-rehabilitate if sheep and cattle grazing were excluded by simply fencing off target areas.
- Post-planting maintenance needs to be budgeted, committed to, and undertaken when required. The length of maintenance depends on site conditions (good quality site versus poorer ones) and seasons (e.g. drought). But at least 5 years including adaptive management to account for pests – particularly deer.
- Mulch and thatching – whether for plant specific sites or at a broader scale for ecosystem restoration, mulch and thatching were key themes. Initially apply mulch to protect soil and retain soil moisture, but a mulch that ‘breaths’ unlike the general criticism applied to material or cardboard-based mulch mats. Whether applied initially or as a result of accumulated leaf and twig fall from plantings, thatching also provides ground protection and facilitates a microecology that will help plants and their progeny survive. Steeper and less stable areas may need commercial products like jute-mesh.
- Watering varied amongst the presenters. No arguments about good watering when planting and a follow up watering within two weeks depending upon rainfall, but the longer-term commitment and frequency varied. Water crystals were acknowledged as beneficial but so was the added cost for their procurement. But worth a consideration as part of the budget and effort added to each plant hole, particularly if post-care maintenance (watering) was doubtful.
- Notwithstanding sites that have tight species objectives (e.g. conservation reserves), some presenters are now sourcing same species but from provinces where the species is more tolerant to drier conditions and poorer soils. Or where site endemism is not a prerequisite, to use more tolerant species identified in the region, particularly those better adapted to drier conditions e.g. replacing sites of *E. stellulata* and *E. pauciflora* with *E. bridgesiana* and *E. melliodora*. This may not be permissible in strict conservation reserves (e.g. national parks), and DW suggests that this may not be applicable to all sites as some sites may still be within the edaphic and climatic thresholds of plants that are challenged elsewhere across the Monaro.
- Consider replacement plants for those that have obviously died. This should be within a contingency budget and part of the monitoring and maintenance program. Having more plants growing at the same time will help the appearance of the site and build up the site’s ecology (compared to a more open site that only reflect those trees and shrubs that survived the initial planting).
- Direct seeding compared to the more widely used method of tubestock planting was not generally used or supported by presenters. However, Nicki Taws did support the method based on site conditions, seed supply and equipment, and advocated direct seeding pending the right site, preparation and maintenance.
- Although tabled by Liz McPhee, others supported the need for a tube-stock industry standard.

Summit Participants

Alison Harmer – NPWS Senior Field Supervisor (Snowy River Area)

Anita Brademann - Waterwatch

Danny Mathews – NPWS Senior Field Supervisor

David Smith – Specialized Construction of Protected Environments

David Woods – Environmental Consultant

Harry Bentley – USLN*

James Cook – Brighter Day Landscapes

Kim Burnett – Bush Heritage Australia (Scottsdale Reserve)

Lachlan Ingram – Senior Lecturer in Sustainable Grassland Management, University of Sydney and USLN

Lauren Van Dyke - USLN

Leon Miners – South East Local Land Services

Liz McPhee – Rehabilitation Contractor

Luke Pope – South East Local Land Service

Margaret Mackinnon - USLN

Mathew Stone – Stone Bros. Contracting

Nicki Taws – Greening Australia

Pam O'Brien – NPWS Area Manager (Snowy River Area)

Phil Palmer – Bush Heritage Australia

Raphael Wood - Managing Director of Market Advisory Group

Rhia Martin - USLN

Sam Dryden – Creative Lines

Shane Trengove - USLN

Simon Oliver – Jindabyne Landscaping

**USLN – Upper Snowy Landcare Network*