Community and agencies working together – Strategies for aquatic weed management

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Abstract. The complexities of managing noxious aquatic weeds present difficulties for NSW Department of Primary Industries, local control authorities, landholders and communities. However, for two noxious aquatic weeds, the recent introduction of biological control agents, as part of an integrated management strategy, has rebuilt enthusiasm and encouraged cooperation between community and agencies. These are salvinia, S*alvinia molesta*, in the Wollombi Brook of the Hunter Valley of NSW; and water hyacinth, *Eichhornia crassipes,* on the Gingham Watercourse in the Moree district. This paper outlines the latest chapter in two separate case studies with long histories of intractable aquatic weed problems. It traces the challenges associated with bringing diverse groups together in one forum, in which the landholder obligation is for public benefit and produces little private benefit to the individuals.

Keywords: salvinia, water hyacinth, biological control, aquatic weed management, strategy, integrated.

Introduction

The development of a coordinated extension approach is needed to bring community and agencies together in a working relationship in industry, regional, State and Australia-wide delivery systems. Extension is primarily about building capacity for change in individuals, communities and agencies involved in the primary industry sector and with natural resource management (SELN 2006). From the following case studies, it is possible to form an understanding of the social issues confronting communities and how this in turn affects adoption of new ideas and technologies. The process of change is needed for extension to be effective in addressing natural resource management (NRM) issues today (Vanclay 2004).

The 1980s and 1990s saw extension theory and practice using a selection of participatory methodologies (Cornwell et al*.* 1993, Pretty & Chambers 1993). However, as Vanclay and Lawrence (1995) point out, reliance on landholders' local knowledge to solve problems that are new to their experience, such as many environmental problems, are unlikely to be successful. The insidious nature of such problems often means that landholders do not recognise problems until it is too late and extensive damage or impact has occurred. In relation to the case studies in question, it was not until aquatic weeds had invaded areas and were causing major threats to communities and the environment that the issues were addressed.

It is evident from this paper that extension methods have progressed when we reflect back to the early 1980s through to the 1990s and look at how communities then managed noxious aquatic weeds. During the 80s, extension was in transition and systems thinking was primarily concerned with landholder needs and solutions (Cornwell et al*.* 1993, Pretty & Chambers 1993). This was followed by the extension period of the 90s which was supported by social learning processes and participatory methodologies as a means to enable practice change.

From 2000 onwards, the notion of solving complex aquatic weed problems has required the use of participatory processes involving community and agency stakeholders. This extension paradigm now encompasses capacity building and community engagement. The shift has moved from State agencies being the primary provider of services, to encouraging public and private partnerships to produce both public and private benefit with regional NRM groups being the major stakeholders (SELN 2006).

Background

Salvinia molesta

Salvinia molesta is a free floating, sterile aquatic fern that was first recorded in Australia during 1952 (Forno 1987). Parsons & Cuthbertson (1992) report that it was presumably introduced to Australia as an aquarium plant in the post WWII period and has since become a serious aquatic weed in many coastal and inland water bodies of eastern Australia. Salvinia reproduces by vegetative means and spreads within an aquatic system through movement of plants by wind and water currents, or by animals after drinking infested water. Salvinia is spread to new areas principally by people moving plants, intentionally as ornamentals, or unintentionally on boats, vehicles and machinery.

Salvinia in its native range is found in a mixed community of floating and emergent plants and is kept under control through a balance between the plant and its natural enemies (Forno & Bourne 1988). However, away from its native environment, salvinia forms dense monocultures and kills submerged plants by preventing light from entering the water resulting in anaerobic conditions and reduced biodiversity (Parsons and Cuthbertson 1992).

Under the New South Wales (NSW) Noxious Weeds Act 1993, Weed Control Order No. 19, salvinia is listed in the Hunter Region Councils of Cessnock, Maitland, Newcastle and Port Stephens as a weed control Class 3. Control measures for salvinia are defined as follows: 'The plant must be fully and continually suppressed and destroyed and the plant may not be sold, propagated or knowingly distributed'.

Eichhornia crassipes - Water hyacinth

Water hyacinth is widely recognised as the world's worst aquatic weed. A native of Amazonia, it was originally exported because of its attractive flowers. The species rapidly spread throughout tropical, subtropical and warm temperate regions of the world. Water hyacinth forms dense impenetrable mats across water surfaces, limiting access by humans, machinery, animals and birds (Julien et al. 1999). As an invader of aquatic communities, it eliminates other plant species (Wright and Purcell 1995).

Julien et al. (1999) state that chemical and mechanical control measures have been used since the early 1900s, but they are expensive and ineffective on all but small infestations. Eradication of the weed is rare because of its rapid growth rate and its ability to reinfest from long life seeds. Germination to seed set can be less than two months and seeds can remain viable in the soil for up to 30 years (R. Browne pers. comm.). However, since the 1960s, there has been growing interest in the use of host-specific biological control agents.

The most significant infestation in Australia is on 10,000 ha of the Gingham Watercourse near Moree in New South Wales. These waterways are part of the headwaters of the Darling River system and pose a threat to much of the inland waters including the lower parts of the Murray River (Parsons & Cuthbertson 1992).

Under the NSW Noxious Weeds Act 1993, Weed Control Order No. 19, water hyacinth is listed as a weed in the control Class 2 in Moree Plains Shire Council. Control measures for water hyacinth are defined as follows: 'The plant must be eradicated from the land and the land must be kept free from the plant'.

Case study 1

Salvinia molesta - Wollombi Brook Hunter Valley 1988

Cessnock City Council regarded *Salvinia molesta* as having a long problematic history since the noxious aquatic weed discovery in the Hunter Valley in the early 1980s. A small piece of salvinia weed from an aquarium was placed into a creek near Cessnock. Five years later the consequences for the Hunter River, according to experts, were *potentially horrific!* (Newcastle Herald 1988).

Salvinia molesta - Wollombi Brook Hunter Valley 2005

Salvinia had been a problem in the Wollombi Brook for nearly 20 years. Around 100 kilometres of the 150-kilometre long Brook were infested by 2005. Local landholder and agency opinion was that if the Wollombi salvinia was not controlled, it could move downstream and infest the Hunter River. Past attempts to control the infestation had been hindered by ownership responsibilities of the issue as well as legislative constraints. Nevertheless, it was believed that the extensive infestation could only be controlled through a coordinated combined effort involving the relevant government agencies and local landholders.

In early 2005, Cessnock City Council (CCC), community groups and all other concerned stakeholders met with NSW State Ministers to discuss the issue of salvinia in the Wollombi Brook. Following the meeting, a ministerial decision was made that the Hunter–Central Rivers Catchment Management Authority (CMA) would initially co-ordinate a response to the problem.

In June 2005, Hunter–Central Rivers CMA chaired a meeting with major stakeholders, including the Department of Primary Industries (DPI) and the Department of Environment and Conservation (DEC), that confirmed a partnership between the CMA, Cessnock City Council (CCC) and Hunter Councils (HCCREMS) for the management of salvinia in the Wollombi Brook. The outcome of the meet was to pave the way for the development and implementation for the Regional Management Strategy for *Salvinia molesta* in the Wollombi Brook. In the future, HCCREMS would be best placed to coordinate and implement the strategy as they would host the Regional NRM Weeds Coordinator to work with the Wollombi Community, the CMA and CCC. Additionally, the CCC, CMA and DPI representatives began planning other control options as prioritised at the June 2005 meeting which

included: to retain representatives from the June meeting as a steering committee, and to have NSW DPI representatives make recommendations from the Hawkesbury/Nepean Salvinia Strategy.

At this stage, as part of the DPI's commitment to the Regional Management Strategy, the NSW State Aquatic Weeds Coordinator brought in the Weed Biological Control Coordinator to meet with key representatives from the CCC. The meeting was called to make recommendations for the installation of booms at strategic locations along the Brook and to use an integrated approach based on biological control.

Regional Management Strategy - Salvinia molesta in the Wollombi Brook

A media release was issued promoting the boom installation as the first step in the control of salvinia along the Wollombi Brook. It also highlighted this first step of the combined community effort by a headline: 'Fighting the war against the noxious weed salvinia has begun with the Hunter-Central Rivers CMA, Cessnock City Council, Hunter Councils and private landholders joining forces to install a series of booms' (Hunter-Central Rivers CMA 2005). After years of mismanagement, the community had expressed an urgent need to solve the salvinia problem. Leeuwis (2004) explains that for people to invest in learning they must have some confidence that they can solve the problem and they must trust their own capacities or be supported effectively by others in finding and implementing solutions.

A range of actions had been carried out as a lead up to the implementation of the management strategy. Firstly, a trial release of the biological control agent, the Salvinia weevil, *Cyrtobagous salviniae*, was made at two sites on the Brook and one off-stream site (Agriculture Today 2005). The DPI breeding program for the Salvinia weevil increased its capacity and was able to provide large numbers of the weevils as required. The trial releases were monitored with the help of community groups and if successful, further large numbers of weevils would be released at the start of the new season. It was highlighted that the weevils may take some time to reach sufficient numbers to have an impact on the salvinia in the Brook and would only represent part of the overall solution.

In addition, the CMA commenced a containment program which aimed at limiting the spread and movement of salvinia along the waterway. This included the installation of booms across sections of the Brook and plans for more installations as required. Control of the salvinia around the booms was carried out by the CCC, and landholders were not liable for the cost of control at these sites. CCC also targeted *hotspots* in areas where it was important to limit the accumulation of salvinia in terms of the containment strategy.

Community consultation

A mail-out was sent to all landholders along the Wollombi Brook providing an update on the strategy which identified the issues of continuing salvinia infestations on the Wollombi Brook. Various options for control were outlined including the long-term management of this aquatic weed. However, the specific details varied from section to section based on a range of factors including accessibility, resources, landholder concerns and ecological issues.

The next step in the process was to engage the community in effective consultation to identify the specific mix of control methods and resources required for each section of the Brook, starting from the top of the catchment. Once sections were identified, the landholders from each section were invited to attend in situ meetings to discuss their options, responsibilities and concerns regarding the salvinia infestations and to develop a management plan for their respective section. Although legal responsibility for the control of salvinia lies with the landholder, the task was beyond the scope of most individual landholders. However, landholders were required to make some contribution towards control on the Brook adjacent to their land. Landholders were also encouraged to adopt a stretch of the Brook where they would monitor the condition of the salvinia, the presence of the bio-control agent and water quality. Training was then conducted by NSW DPI on biological control monitoring with landcare and community groups at the Brook. The Landcare groups reported: 'the Salvinia weevils were doing well as large areas had browned off and the booms were also working well in holding back the salvinia'. Community people who took part in the training assisted in the monitoring of the weevils at the release sites over the following months to assess how they would cope with the cold winters.

The project coordinator and local landholders also identified sections of the Brook suitable for hand removal by volunteer teams. Additionally, incentives were available from the CMA through the in situ planning workshops for landholders to manage salvinia in line with the strategy. Again, there was general agreement on the need for the coordination of efforts from the top of the catchment down to the containment of each section.

Case study 2

Background

Water hyacinth was accidentally introduced into the Gingham Watercourse from the Gwydir River during the 1950s and by the 1970s an estimated 7,000 hectares of wetlands had been infested. Since then, numerous attempts have been made to control the hyacinth using measures which included herbicides, draining of infested areas, hand picking, and the construction of a hyacinth fence a decade ago to prevent its spread westward.

During the 2005/06 summer, the issue was brought to the attention of the Minister for Primary Industries by community representatives. The Gingham Watercourse, a significant natural feature of the Gwydir Wetlands, became completely covered by hyacinth. These wetlands are one of the most extensive and significant, semi-permanent, terminal wetlands in north-western NSW (Keyte 1994). The Gwydir Wetlands were the first wetlands in Australia to have private land listed under the Ramsar convention (Mawhinnery 2002).

Wildfowl and other wetland fauna had been prevented, by the hyacinth, from accessing the area and downstream environmental flows had had been restricted. An even greater concern was that a big flood would create a massive dispersion of the weed, with a significant risk of the weed spreading to and establishing in the Murray-Darling catchment. This would have major environmental implications.

Unfortunately, water hyacinth seeds can survive for up to 30 years and its control requires a regular long-term program. Therefore, a collaborative approach was required to reduce and stabilise the current population of water hyacinth to prevent it reinfesting further downstream.

A new strategy for water hyacinth in Gwydir Wetlands

NSW DPI, in conjunction with key community groups and agency stakeholders, were to play a key role in the coordination of the project. The first step in the process was to undertake an aerial survey together with on-ground monitoring to assess the impact of the hyacinth on the Gywdir Wetlands. Julien (pers. Com.) was of the opinion that the use of biological control, as part of an integrated strategy, could be considered as an option for the Gwydir Wetland.

During early April 2006, an initial on site meeting with key stakeholders was coordinated by DPI to identify the issues relating to containing and reducing the hyacinth infestation. A subsequent meeting was then held with a larger stakeholder group including representatives from DPI, Moree Plains Shire Council (MPSC), Department of Natural Resources (DNR), Border Rivers-Gwydir Catchment Management Authority, and landholders representing the Gingham Watercourse Association. Action plans were developed, with short term objectives to be undertaken before June 2006 and medium-term objectives to be undertaken within 12 months depending on the level of funding support

Short-term Action Plan The first action utilised the small window of opportunity to aerial spray the main channel by May, before the first frost and after the district's cotton defoliation (chemicals registered for use on water hyacinth cannot be applied during the cotton growing season). Due to the limited time-frame, Moree Plains Shire funded the project while awaiting agency funding approvals.

Medium-term Action Plan Following the aerial spraying, the DPI installed booms for the weevil nursery sites. MPSC control sprayed water hyacinth at each end of the waterhole and repaired the amphibious vehicle used for control spraying, harvesting and monitoring of the waterhole.

The project was initially funded by the Border Rivers-Gwydir Catchment Management Authority, and involved local landholders from the Gingham Landcare Group working alongside NSW DPI, DNR, Department of Environment and Climate Change (DECC) and MPSC. Additional funding options were sought and later accessed from the Australian Government Envirofund and the Wetland Recovery Program.

As part of a long-term strategy to control the world's worst aquatic weed in the wetlands, the Gingham Watercourse would become a nursery for over 3,000 hyacinth weevils introduced by DPI.

With the first stage underway, the reconstruction of the hyacinth fences for better containment was undertaken. This was coupled with control and monitoring to manage hyacinth within the wetlands and included biological control, strategic and timelier herbicide use, and the mechanical removal of the weed.

Discussion

Initially at the start of the Wollombi Brook project, the use of biological control as an option had been considered as unsuitable by CCC, given the local climatic conditions. Temperatures in the

Wollombi during winter were thought to be too low to sustain biological control agents over the winter period. However, NSW DPI and Hawkesbury River County Council (HRCC) had been producing encouraging results from their research using biological control to manage salvinia outbreaks in the Hawkesbury-Nepean River where winter temperatures are similar to those experienced in the Wollombi Brook. The Salvinia weevil, *Cyrobagous salviniae*, has been released at regular intervals since August 2004, and was now controlling large stretches of the river. Recent research had shown that the weevils could survive very well in the Sydney climate over a number of years with colder than normal winters. They were also able to lay eggs at lower temperatures than previously reported (Hennecke & Postle 2006).

Given the encouraging results from the Hawkesbury region, the introduction of the Salvinia weevil into the Brook was to be included as part of the strategy and would be coordinated by the NSW DPI Coordinator Weed Biological Control. Cessnock CC reported that insufficient numbers of bio-control agents had been released in the past. Releases were not made at the optimum time, i.e. early spring, and sites were allowed less than one year to be controlled biologically before they were sprayed. This coupled with the lack of monitoring or community involvement and the continued use of pesticides is likely to be the reason why the agents had not established rather than being due to the harsh winters. Additionally, this was the first time that a large quantity of weevils have been released in the region to help control salvinia. Ongoing community involvement was another contributing factor, and as the president of a local landcare group reported: 'It was positive to have ongoing landholder stewardship for the condition and health of their section of the Brook together with the benefits of reporting changes as they occurred'.

Alternatively, there has been a history of failed attempts to control Water Hyacinth in the Gingham, due mostly to a lack of ongoing funding combined with the lack of momentum and coordination by a specialist lead agency. DECC (2006) had identified that any substantial increase in water hyacinth would severely degrade the wetlands and be a threat to the ecological character and effective management of the Gwydir Wetlands. Therefore, biological control could offer sustainable, environmentally-friendly, long-term control. This is the only method to provide a level of control for infestations which cover huge areas or are difficult to access (Julien et al. *1999)*.

The biological control agents are an important aspect of the overall strategy. The two biological control agents released into the Gwydir Wetlands - *Neochetina eichhorniae* and *N. bruchi* are both ecologically and economically sound in that they will attack only water hyacinth. However, it may take up to six years for the weevil populations to increase to a level where they will have a significant impact on the infestation.

Conclusions

The first press release highlighted that the infestation at Wollombi Brook was extensive and could only be controlled through a combined effort involving the relevant government agencies and local landholders. This would be the first step in controlling salvinia in the Wollombi Brook. By November 2006, with the weather warming up, it was apparent that the area known as Paynes Crossing had been decimated by weevil activity. The weevils had over-wintered in high populations to control the salvinia outbreak at Paynes Crossing on the Wollombi Brook. They could now be used with confidence on other sections of the Brook. Landholders, landcare groups and Australian Conservation Volunteer Teams are now continuing to play their roles in the strategy in consultation with the stakeholder agencies.

Furthermore, the Gingham Water Hyacinth Control Program offers the best possible outcome for success in controlling water hyacinth in the Gingham Wetlands. The program incorporates herbicide application from air and ground, combined with mechanical removal, and releases and monitoring of the South American weevil bio-agent.

The partnership of agencies and community working together on the program has ensured ongoing involvement of each party and optimum control activities within the project. By the autumn of 2008, the open areas of the Gingham Waterhole are free from water hyacinth, the weevil populations in nursery sites are active and are impacting on the hyacinth, and water birds have returned to the site.

In terms of natural resource management, Australia is asking its landholders to make a significant personal investment for what is largely a public benefit. Because of the notion of stewardship and the concept of good natural resource management, most landholders are prepared to make this contribution. However, they need to know that their contribution is appreciated and valued by the broader community (Vanclay 2004).

Take home message

The development of a coordinated extension approach has shifted from its original rural development mandate to include natural resource issues that include complex noxious and environmental aquatic weed problems. Rural extension now needs to be an effective policy instrument that can be used by extension practitioners to provide the necessary capacities for achieving institutional and policy developments as well as on-ground change for landholders.

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