Strategy for the Management of Rice Grass (*Spartina anglica*) in Tasmania, Australia

Before

Trent Water (Bridport) 1997

After

Trent Water (Bridport) 2002

October 2002
(Second Edition)

Natural Heritage Trust
Helping Communities Helping Australia
A Commonwealth Government Initiative

Tasmania
DEPARTMENT *of*
PRIMARY INDUSTRIES,
WATER *and* ENVIRONMENT

Notice to Reader

This is the second edition of the Strategy for the Management of Rice Grass (*Spartina anglica*) in Tasmania, Australia. Paul Hedge compiled the original strategy under the guidance of the Rice Grass Advisory Group (RGAG). The Strategy has been revised to incorporate advances and developments in rice grass management in Tasmania, particularly with respect to the dramatic reduction of numerous infestations and new information on control techniques and their implementation. The revised document also provides more information on the challenges associated with eradication of rice grass infestations.

This is a dynamic document, which will continue to change as the nature of the problems associated with rice grass changes.

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NOTE OF CAUTION

Rice grass inhabits a potentially dangerous habitat. Soft sediments may make some regions very difficult places to work, and once stuck, it can be very difficult to get out. For guidance in planning field trips or advice please contact the Rice Grass Management Officer at the Department of Primary Industries, Water and Environment.

FOREWORD

Tasmania's estuaries are a valuable resource with immense ecological, community and economic value. The spread of rice grass emerged as a serious problem in the degradation of Tasmania's estuaries in the late 1980s and early 1990's. Although introduced earlier this century for its potential benefits to coastal engineering, rice grass was quickly recognised as a weed with the potential to displace native vegetation such as seagrass and saltmarsh species. The rapid spread and vigorous growth of rice grass transforms mud and sandflats to dense broad meadows of vegetation excluding many species of fish and altering the habitats of birds and other wildlife. By altering the tidal flows of estuaries, impacts can also be felt by marine farms, whose ventures rely upon the delivery of nutrients to their aquaculture leases and stock (particularly shellfish). In 1995 a conference on *Spartina* control was held in Victoria. The major outcome of this conference was the need to control and where possible eradicate rice grass from Australia's waterways.

In recognition of the growing problem of rice grass to Tasmania's estuaries and waterways, the Rice Grass Advisory Group (RGAG) was established in 1996 to address its management. RGAG membership has changed with the passing of time and much appreciation goes to former members. Current membership of RGAG includes:

Marine and Coastal Community Network - Christian Bell, • Fisheries Action Program – Avril Brown, • CSIRO Centre for Research on Introduced Marine Pests – Nic Bax, • University of Tasmania Centre for Environmental Studies - Lorne Kriwoken, University of Tasmania Centre for Geography and Marine Environmental Science - Joanna Ellison• Local Government Association – Catherine Nicholson, • Department of Primary Industries, Water and Environment (DPIWE) – Gwen Fenton, Scott Parkinson and David Eldridge (Marine Resources), Christian Goninon (Land Management Branch), Tim Rudman (Nature Conservation Branch), Chris Rees (Coastal and Marine Program), Alasdair Wells (Policy Analysis), Paul Hedge.

as well as my own involvement as a representative of industry.

The RGAG received funding from Coastcare Australia and Fishcare Australia in 1996 to put together the first edition of this document, the cornerstone to gaining funds for rice grass management in Tasmania. Securing funding for the program proved to be a challenging task. The Honourable Wilson Tuckey (Federal Minister for Fisheries), the Honourable Robert Hill (Federal Minister for Environment and Heritage), the Honourable John Anderson (Deputy Prime Minister) and the Honourable David Llewellyn (Environment Minister, Tasmania) provided critical support for a statewide rice grass management program in Tasmania. In 1998 the DPIWE received a substantial funding package through the Natural Heritage Trust Fisheries Action Program initiative for a three-year period. The funding package included substantial commitment and support from the state government, industry and community.

DPIWE developed a dynamic and integrated Rice Grass Management Program in cooperation with all spheres of government, industry and the community. Three successive control seasons have demonstrated unprecedented results in controlling and containing rice grass. The high level of cohesion and commitment of all stakeholders involved in this project has been instrumental to project success. In recognition of the outstanding achievements of the program and its contribution to the restoration of Tasmania's natural waterways, the project was awarded the prestigious Australian Water Association, Tasmanian Water Environment Merit Award 2000/2001. The project has also been recognised by the internationally scientific community as world's best practises in the treatment of rice grass. Finally, I have recently been advised that the Natural Heritage Trust Fisheries Action Program is to provide more funds to resource the Rice Grass Management Program for an additional year extending the current phase of the program to late 2003.

Colin Dyke

CHAIR (RICE GRASS ADVISORY GROUP)

3/10/2002

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Executive Summary

Rice grass is a Northern Hemisphere intertidal saltmarsh plant that was deliberately introduced to Tasmania between the 1930s and the 1970s. It has become established in seven regions of the State's coastal zone. In 1997, rice grass occupied 590 hectares of the State's intertidal zone, believed to be a very small percentage of its potential habitat. Its biology is typical of an invasive species. Its dense growth habit and rhizome/root network act as a trap for sediments and debris altering the natural rate, magnitude and location of sediment deposition and erosion. These processes elevate shorelines and river banks to create terraces and marsh islands by promoting deposition and accretion which may have considerable impacts on the hydrodynamics and ecology of estuaries, aquaculture, wild fisheries, tourism and recreation.

There is particular concern about the impact of rice grass on the biodiversity and integrity of native saltmarsh and seagrass communities, migratory birds and other nearshore marine fauna, such as estuarine invertebrates and fish. Several Ramsar listed wetlands (wetlands of international importance particularly with respect to migratory birds) are also threatened by the continued spread of rice grass including Moulting Lagoon, Great Oyster Bay and Pitt Water.

There is concern that changes to hydrodynamics and estuarine nutrient cycling caused by rice grass threatens the sustainability and expansion of Tasmania's aquaculture industry, particularly with respect to the intertidal leases (e.g., Little Swanport estuary, the Rubicon estuary and the Smithton region). The weed also threatens to destroy the habitats of juvenile fish and other marine species and therefore may seriously impact on adult fish populations that form valuable commercial and recreational fisheries, as well as the ecologically important non-commercial species.

Tourism and recreation have also been impacted by the spread of rice grass. For example, in the River Tamar, well-established infestations inhibit public access to the shoreline, many private boat ramps and jetties have been rendered non-functional and several once popular sandy beaches have been transformed to muddy rice grass meadows. Thus, rice grass has reduced the utility value and aesthetic appeal of the River Tamar shoreline and has effectively reduced its attractiveness to residents and tourists.

Rice grass management is a very challenging task fraught with legal, institutional, economic and practical difficulties. The Rice Grass Advisory Group (RGAG) was formed in 1995 to provide advice and direction on rice grass management in Tasmania. The RGAG received funding from Coastcare and Fishcare Australia to research the ecology, impact and control of rice grass and to develop the management strategy.

The Strategy identifies community consultation, environmental monitoring, research and independent peer review as being fundamental to rice grass management. Environmentally responsible, safe, practicable and cost-effective control techniques are outlined. Area-based management objectives are recommended for each infested region. Government, industry and community are all responsible for rice grass management in Tasmania. Commitment from regional industry and community groups is particularly important in areas targeted for eradication.

The DPIWE received a comprehensive funding package from the Natural Heritage Trust Fisheries Action Program in 1998 to implement the management strategy in accordance with its vision, objectives and tasks. A mobile and specialised team currently leads rice grass management in Tasmania. Three successive control seasons have demonstrated unprecedented results in controlling and containing rice grass infestations. In recognition of the success of the program and its contribution to the restoration of Tasmania's natural waterways, the project was awarded the prestigious Australian Water Association, Tasmanian Water Environment Merit Award 2000/2001. The award is a reflection of the considerable commitment, cohesion and vision shared by all stakeholders.

Vision

To reduce the area of infestation of the introduced weed, rice grass, thereby eliminating and mitigating its negative impacts on the coastal zone of Tasmania.

Objectives

The strategy has four major objectives:

1. To integrate the management of rice grass by promoting the sharing of responsibilities between the different spheres of government, the community and industry.
2. To identify options and preferred means for controlling and eradicating rice grass in an environmentally responsible, safe, practicable and cost effective manner.
3. To monitor the extent of rice grass infestations.
4. To update and disseminate information on rice grass in Tasmania and raise public awareness.

Tasks

The Rice Grass Advisory Group (RGAG) has identified nine tasks to achieve the strategy objectives:

1. Consolidate the role of the RGAG as the central integrating and advisory body for managing rice grass in Tasmania.
2. Co-ordinate a Statewide management plan for rice grass. Co-ordination will be facilitated by government agencies, industry representatives and community groups.
3. Evaluate all available techniques for controlling rice grass with the view to adopting an integrated weed management program.
4. Develop and implement training programs for people working on the management of rice grass, preparing them for the difficulty, hostility and sensitivity of the estuarine intertidal zone.
5. Standardise mapping techniques and terminology for monitoring and recording the extent of rice grass infestations.
6. Establish an ongoing monitoring program to determine the effectiveness of the management plan.
7. Encourage and support the continuation of regional initiatives to control rice grass infestations.
8. Establish a communication network, including all major stakeholders, primarily for the purpose of disseminating updated and relevant information.
9. Raise the profile of rice grass as an aquatic weed through media and general environmental education by highlighting its negative impact on estuarine ecosystems, aquaculture and fisheries industries and social amenity.

1. Background

Spartina anglica, commonly referred to as rice grass, is a vigorous saltmarsh grass typically inhabiting the upper intertidal zone of temperate estuaries. A remarkable ability to spread rapidly, accrete sediments and mitigate coastal erosion are the main reasons for its widespread introduction to many temperate coastal zones around the world (Boston, 1981). Rice grass was introduced to many sites in Tasmania from the late 1920s onward, (Boston, 1981, see Figure 1). Between 1970 and the late 1990s rice grass spread rapidly establishing mature infestations in seven coastal regions of Tasmania (see Figure 2). Australia's two largest infestations occur in the River Tamar (415 ha) and the Rubicon estuary (135 ha), Tasmania.

Although the introduction of rice grass has improved navigability in the River Tamar (Pringle, 1993; Wells, 1995), it is considered a pest species that threatens the ecological integrity of estuarine wetlands of international importance in Tasmania (Doody, 1990; Wells, 1995). Rice grass, particularly in the River Tamar, has reduced the amenity value of coastal reserves and boat ramps (Pringle, 1993). Furthermore, the economic sustainability and growth of Tasmania's intertidal aquaculture industry may be threatened by the spread of rice grass. Spreading infestations can substantially reduce the total area available for intertidal aquaculture and dramatically alter the hydrology of estuaries, affecting the volume of water and delivery of nutrients to aquaculture leases. The spread of this exotic plant also poses an ecological and economic threat to Victoria (Williamson, 1995) and in many other countries (Shaw and Gosling, 1995; Doody, 1990).

Growing concern about the ecological threat of rice grass in the late 1980s and early 1990s, received significant attention in 1995 at the Australasian Conference on *Spartina* control held in Yarram, Victoria. There was strong support for the control and eradication of rice grass, in an attempt to stop its rapid spread and mitigate its negative ecological impacts (Bridgewater, 1995). In 1996 the RGAG received funding from Coastcare Australia to put together a management strategy outlining the requirements for a statewide rice grass management plan. Following the release of the strategy in 1997 the RGAG pursued funding opportunities. In 1998, the Natural Heritage Trust Fisheries Action Program provided a substantial funding package to the Department of Primary Industries, Water and Environment to implement the management strategy. The funding package included significant in-kind support and commitment from the State government, industry and the community.

In cooperation with government agencies, industry and community, DPIWE developed a dynamic and integrated Rice Grass Management Program. The vision, objectives and tasks of the management strategy provided clear directions for the developing program. A management steering group was also established to oversee project implementation. Community consultation, environmental monitoring, research and independent peer review were fundamental to the development of the management program.

Three successive control seasons in Bridport, Little Swanport estuary and five seasons in St Helens and the River Derwent have demonstrated unprecedented results in controlling and containing rice grass, reducing infestations by up to 99%. In other areas, such as Smithton and the Rubicon, the area of infestation has been strategically reduced to mitigate impacts of infestations and promote and protect environmental values.

The high level of cohesion and commitment of all stakeholders involved in this project has been instrumental to project success. In recognition of the success of the program and its contribution to the restoration of Tasmania’s natural waterways, the project was awarded the prestigious Australian Water Association, Tasmanian Water Environment Merit Award 2000/2001. The award is a reflection of the considerable effort, cooperation and vision shared by all involved stakeholders.

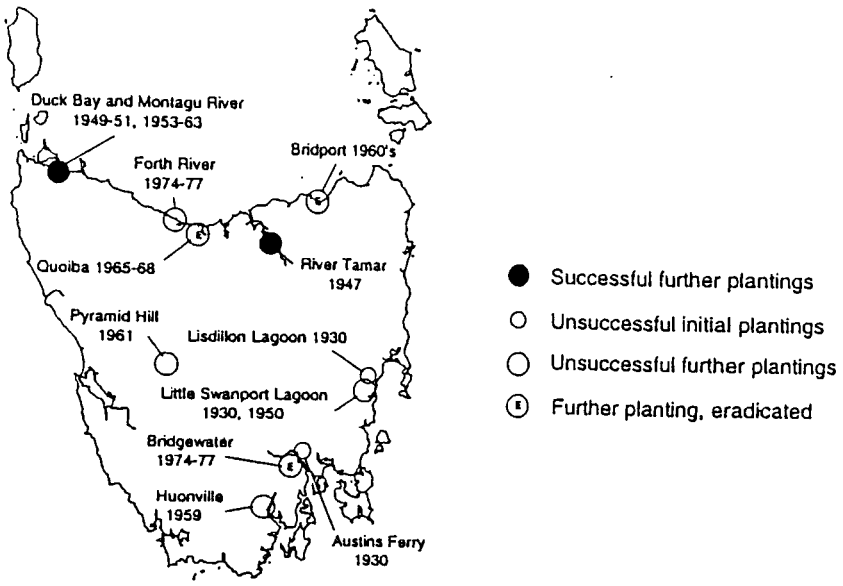

Figure 1. Rice grass introduction sites in Tasmania (modified from Boston, 1981).

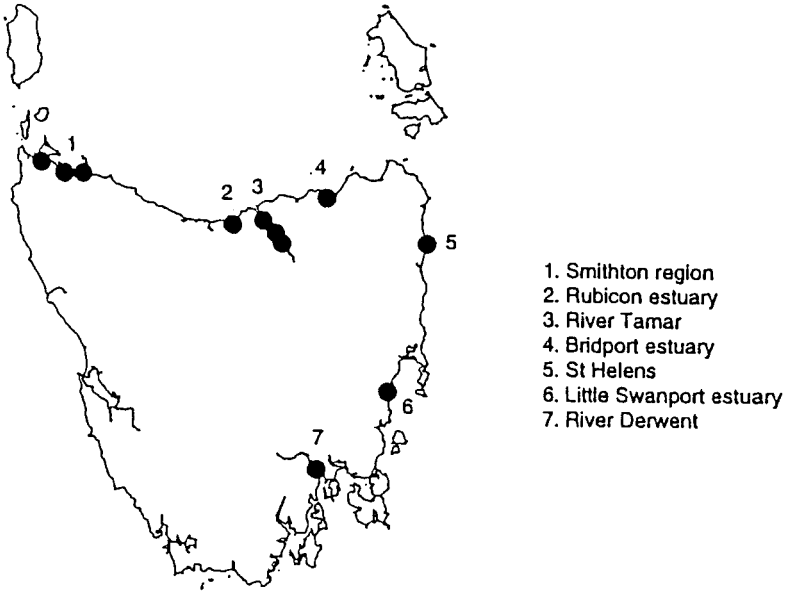

Figure 2. Generalised distribution of rice grass infestations in Tasmania.

2. Management

2.1 Managing Rice Grass

During the past 20 years, rice grass infestations in Tasmania have been subject to a variety of control and eradication measures. Attempts to control rice grass commonly encountered a variety of problems because:

- Rice grass inhabits a zone of overlapping management between government departments; thus, responsibility for control is not clearly defined;
- Access to infestations from land can be difficult and time consuming, especially when needing to cross private land;
- Many infestations can only be accessed at low tide, particularly in the north of the State where tidal amplitude may be up to 3 metres;
- The substrate which rice grass inhabits is commonly very soft and does not easily support the weight of humans or machines, thus speed and mobility is commonly reduced;
- Estuaries are regularly exposed to strong coastal winds that create difficult working conditions, and
- Human activity in and around infestations can fragment rhizomes and aid seed dispersal of rice grass, leading to its further spread.

2.2 Evaluation of control techniques

The identification of a suitable and effective control techniques is an essential task in the development of a successful pest management program. DPIWE invested considerable resources to research and evaluate potential rice grass control techniques, including extensive collaboration with interstate and overseas experts. Only those techniques that were identified as environmentally responsible, safe, practicable and cost-effective are suitable for treatment of rice grass infestations in Tasmania. There are two control techniques currently used to reduce and contain rice grass infestations in Tasmania, physical removal and the use of Fusilade® (a post-emergent, grass selective herbicide). The following paragraphs describe and discuss the effectiveness and limitations of physical removal and the use of Fusilade® to control rice grass in Tasmania. Ineffective techniques together with developing techniques are also discussed.

2.2.1 Current techniques

Physical Removal

Efforts to pull and dig rice grass plants have occurred on a number of occasions at different sites. These efforts have clearly demonstrated that pulling and digging rice grass is a very labour intensive process. However, it can be a useful technique when removing single plants or very small tussocks, provided all plant material is disposed of correctly (i.e., plant material bagged and sent to land fill or burnt) (Pringle, 1993; J. Butler, pers. com.). Control experiments conducted by the Rubicon Coast and Landcare Group Inc. indicate that once clones exceed approximately 15-cm diameter, it is highly unlikely that physical removal will include all rhizomes (G. Stokes, pers. com.). Removing all roots and rhizomes can be difficult, especially for those people with minimal experience or training.

Mechanical excavation using heavy earth moving machinery has also been investigated. Although not suited to most areas, excavation may be an alternative control technique in areas where suitable access permits. However, this technique is destructive and may pose problems with liberation of sediments and rhizome/root material and also causes damage to non-target vegetation and fauna.

Note that digging/excavation in coastal areas can be classed as 'works'. As rice grass is usually found on Crown land, a planning permit from the Council may be required. Any management works on Crown Land requires approval from DPIWE. It is therefore necessary to seek advice from your local Council and the Crown Lands Service Branch of the DPIWE before proceeding with any such works.

Herbicides

The most cost-effective and efficient technique for eradicating and controlling medium to large-scale rice grass infestations in Australia is chemical weed management. DPIWE have invested considerable resources into identifying an environmentally responsible, safe and cost-effective herbicide to treat rice grass in Tasmania.

Fusilade® (active constituent: 212 g/L fluazifop-P present as butyl ester (FPB)) has been identified as the only suitable herbicide to control rice grass in Tasmania for the following reasons.

- Efficacy (kill rate) can be as high as 99%, with a mean efficacy of 95%.
- Fusilade® is a highly selective post-emergence grass killer that does not affect native salt marsh vegetation or seagrass.
- FPB is reported to rapidly degrade in moist soils with a half-life of less than one week. The major degradation product is the acid form of FPB, which has a half-life of 3 weeks (Humburg and Colby, 1989);
- Ongoing environmental monitoring of FPB degradation in water and sediments in Tasmania confirms rapid degradation of FPB in estuarine environments. Detailed field studies have demonstrated that FPB degrades below detectable limits within 1-3 days of the spray event in water and below the detectable limit in Pacific oysters, *Crassostrea gigas*, within one day.
- Toxicity trials examining the affect of Fusilade® on near-shore marine fauna (fish and invertebrates) in Victoria indicate that mortality rates are very low (Palmer *et al.*, 1995).
- Detailed studies examining the impacts of Fusilade® on a range of intertidal invertebrate communities in Tasmania demonstrate that there are no significant or detectable changes in diversity or abundance of communities following small, medium and large scale spray events (Hedge 1997; Davies, 2001).
- Toxicity trials on Pacific oysters indicate that Fusilade® does not affect survival, mortality or growth rates of juveniles or adults, and that the active ingredient FPB, does not bio-accumulate in oyster tissue and is rapidly depurated (Hedge *et al*., 2000).

Fusilade® is typically mixed with an adjuvant (BS1000) to enhance performance and is generally applied with the aid of a low-pressure sprayer fitted with a hand-held boom. In Tasmania, the recommended formula for the control of rice grass is Fusilade® mixed with water at 1:100 (Fusilade®:water), with 0.2% v/v of BS1000 and the addition of spray marker dye (red or blue). The mixture is applied at the rate of 1000 litres per hectare, i.e., 10 litres of Fusilade® per hectare (Palmer *et al.*, 1995). See Appendix A for a complete list of recommendations for controlling rice grass with Fusilade® in Tasmania.

Please note that the use of Fusilade® for the control of rice grass requires a Permit, issued by the National Registration Authority. At present, DPIWE are the sole permit holders for the use of Fusilade® in Tasmania to control rice grass. It is an offence to apply Fusilade® to rice grass without a Permit.

2.2.2 Developing techniques

Biological control

Biological control or 'biocontrol' is described as the control of a pest species through the use or introduction of its natural predators or parasites. Research in California, USA, has identified a range of potentially suitable organisms for the control of *Spartina alterniflora* (smooth cordgrass) and *S. anglica*. The most promising of these organisms is the planthopper *Prokelisia marginata* (a small aphid-like insect). Greenhouse trials have shown the planthopper has significantly reduced the above ground biomass of *S. alterniflora* and *S. anglica*, with some plants suffering total mortality (Daelher and Strong 1997; Wu *et al*. 1999). Trials conducted in the USA on plants grown from seed collected from Tasmania, Victoria, UK and the USA show *S. anglica* to be highly vulnerable to the affects of the planthopper *P. marginata*.

Biocontrol may provide a new option in controlling rice grass. However, prior to any organism being released in Australia, a comprehensive risk-assessment would need to be conducted to examine all

potential positive and negative impacts. Of specific concern is the effect that the loss of rice grass will have on sediment re-distribution, particularly in the Tamar and Rubicon estuaries. Rice grass is estimated to harbour between 200,000 and 500,000 tonnes of sediment in the Tamar estuary. The effect that the release of these sediments will have on the ecology, hydrology, amenity and industry (shipping, aquaculture, fishing and tourism) in the Tamar estuary is currently unknown. The University of Tasmania and DPIWE have received funding from the Australian Research Council to investigate the consequences of large-scale rice grass removal in the Tamar estuary. The study began in mid 2002 (see River Tamar Section 2.5.3).

Biocontrol is a developing and unproven method for the control of rice grass, and as such advances in the development of this technique overseas will be monitored.

2.2.3 Other techniques

Smothering

A variety of materials, such as black plastic and weed matting, have been used to smother small rice grass infestations. Smothering is believed to kill rice grass by inhibiting photosynthesis and increasing temperatures beneath the plastic above the tolerance limits of the plant. Field experiments in the Rubicon estuary and Little Swanport estuary show that smothering is an effective way of controlling rice grass (Bishop, 1995). Although a proven control technique, smothering does have inherent problems:

- Smothering is a labour intensive technique, especially when treating large areas.
- Treatment must remain in place for extended periods (up to 6 months).
- It kills all plants within treated areas, including native saltmarsh and seagrass plants (i.e., it is non-selective).
- In exposed sites, covers may be damaged or released by wind and waves. Covers may also be subject to vandalism. Covers that are vandalised or released by storm conditions may cause problems elsewhere (e.g., health of marine animals, shoreline litter or navigation problems).

Heat treatment

Heat treatment includes a variety of techniques including steam, infrared and burning. Each of these treatments acts in a similar way using heat to destroy plant cells, causing massive tissue damage to aerial parts of the plant. An advantage of this approach to weed control is the absence of treatment residues commonly associated with chemical control.

The major disadvantage of these techniques is that treatment is very slow and the heavy equipment makes manoeuvrability in the working environment difficult and inefficient. These techniques are also non-selective with considerable environmental damage caused to non-target vegetation as well as resident fauna.

Tasmanian trials conducted on the suitability of burning have proved inefficient and ineffective, both at Little Swanport (D. Steane, pers. com.; C. Dyke, pers. com.) and at Port Sorell.

While these techniques have been used with some degree of success on terrestrial weeds, both in Australia and overseas, the working environment associated with rice grass infestations has proved the limiting factor in its application to rice grass management. It is also likely that techniques involving heat treatment are not well suited to application in estuarine environments due to the thermal buffering affects of water.

Grazing

Selected areas of the River Tamar infestation (e.g., in Spring Bay and Redwood Bay) have historically been grazed by sheep and cattle. Although relatively effective at stunting growth, only a small proportion of the total infestation area is being controlled and not all sites are suitable grazing areas. More importantly, grazing sheep and cattle in wetlands causes serious environmental degradation (Section 3.3.2).

2.2.4 Conclusion on Control Techniques

All available control techniques have inherent advantages and disadvantages, however it is evident that application of the herbicide Fusilade® is currently the only cost-effective technique for controlling and

eradicating rice grass infestations at all scales. Fusilade® is currently the primary control method adopted by the Rice Grass Management Team in Tasmania and is used in conjunction with physical removal of small tussocks and seedlings. Biocontrol is a new and developing technique; advances in its development overseas will continue to be monitored.

2.3 Management Responsibility for Rice Grass

Government agencies, industry and the community play important roles in Tasmania's Resource Management and Planning System. A critical component to the success of the management program has been the successful integration of all these sectors to gain a representative view on relevant issues and how these will affect the proposed actions and desired outcomes of rice grass management.

2.3.1 Government

Rice grass has not been listed as a Weed of National Significance nor as an introduced marine pest. Rice grass lives in a habitat that is neither truly marine or terrestrial. The somewhat artificial nature of areas of government responsibility, with land and marine resource managers, has resulted in rice grass "falling between the cracks." The Rice Grass Advisory Group (RGAG) was set up in response to the difficult issue of management of an intertidal weed.

DPIWE Marine Resources have taken the lead management role in implementing the Rice Grass Strategy with significant funding from the Natural Heritage Trust. While the RGAG provides advice and direction for the long term management of rice grass, the Rice Grass Management Steering Group (RGMSG) established in 1998, oversees the running of the rice grass program. The RGMSG is composed of the Manager of the Marine Environment Section DPIWE, a representative of the aquaculture industry, the Principal Weeds Management Officer DPIWE and the Rice Grass Program Leader. It is the role of the RGMSG to provide guidance and support in the implementation of the strategy and to report back to the RGAG.

2.3.2 Industry

Rice grass is recognised as a threat to the aquaculture industry, particularly the expansion and sustainability of the State's pacific oyster industry (Section 3.2.3). The rice grass management program has been well received among the State's oyster growers who are immediately threatened by rice grass invasion. These growers have not only given their support for the management program, but have also contributed both time and resources to assist in rice grass control and research. Consultation and communication between oyster growers and the DPIWE is essential to ensure timing of control programs in the proximity of oyster leases has minimal impact upon production. Where appropriate and possible, control efforts are timed to co-incide with the spawning cycles of stock to ensure the withholding period placed on farms within treated areas does not coincide with market sales. Such management arrangements will not always be possible, and some interruption of production may be expected.

The Tasmanian Fishing Industry Council also recognises its role in the management of rice grass and assisted the RGAG obtaining funds to investigate the control and impact of rice grass in the preliminary stages of the management program.

2.3.3 Community

Community involvement has been an integral component of the success achieved by the rice grass management program. Community education and awareness programs (presentations, workshops, displays, brochures, newsletters and a website) have all been well received and continue to raise the profile of the problems associated with rice grass. Community forums have been held and will continue to be held in affected regions to discuss management options and to develop and review Area-Based Management Plans. Regional contacts are used to facilitate project implementation and provide an interface between the management team and regional communities. Communities also play an important role in the monitoring of infestations and the reporting and removal of new infestations.

The role of communities becomes increasingly important when infestations are reduced to very low densities. Active participation by local community groups has and will continue to be a critical component of rice grass management. Local residents are highly likely to spend more time and be considerably more familiar with their local foreshores that others. For this reason, they are more likely to find remnant tussocks and seedlings – a particularly important task when targeting eradication (see Section 2.6.2).

2.4 Setting Management Objectives

There are three main options to be considered when setting management objectives for rice grass in Tasmania:

- Contain; use of control techniques to stop the spread of rice grass with the primary objective of restricting spread to clearly identified boundaries (i.e., within an estuary or keeping designated areas free from rice grass such as recreation and wildlife reserves).
- Reduce; use of available control techniques to reduce the total area of infestations.
- Eradicate; complete and permanent removal of rice grass from a defined area with little or no risk of reinvasion (see Section 2.6.2).

Monitoring is an essential element in a weed management program. To effectively quantify the performance of weed management programs, monitoring must be conducted regardless of the selected management objective (see Section 2.6.3).

The selected management objective within an estuary or catchment should reflect:

- Size and magnitude of infestation.
- Land use, ecosystem importance and anthropogenic activity in areas adjacent to infestations.
- Attitude of all stakeholders.
- Resources available to conduct a control program.

Thus, management options should be area-based, i.e., one area may have a different management objective to another area.

2.5 Recommended Area-Based Management Objectives for Tasmania

Rice grass infestations inhabit seven distinct coastal areas in Tasmania (see Appendix B). The following regional outlines identify each area recommending an appropriate management objective. Recommended area-based management objectives are summarised in Table 1 and complete Area-Based Management Plans are contained in Appendix C.

Table 1: Recommended Area-Based Management Objectives for Tasmania's rice grass infestations.

Area*	**Short Term** (up to 3 years)	**Medium Term** (3 - 10 years)	**Long Term** (> 10 years)
Smithton/Stanley	contain/reduce	eradicate/monitor	monitor
Rubicon estuary	contain/reduce	contain/reduce	contain/reduce
River Tamar	contain/monitor	contain/monitor	contain/monitor
Bridport	eradicate/monitor	eradicate/monitor	monitor
St Helens	eradicate/monitor	eradicate/monitor	monitor
Little Swanport	eradicate/monitor	eradicate/monitor	monitor
River Derwent	eradicate/monitor	eradicate/monitor	monitor

*Refer to maps in Appendix B.

2.5.1 Smithton/Stanley

In 1997, a survey of the Smithton region reported approximately 52 ha of rice grass. In 2001 the infestation was estimated to have spread at a rate of 7.5% per year to approximately 68 hectares.

In 2000 DPIWE, in cooperation with local industry and community, developed an Area-Based Management Plan for the Smithton region (see Appendix C). The objective of the plan was to **contain** the area of rice grass infestation to Duck Bay in the Smithton /Stanley region.

In 2001 & 2002 all known infestations in Black River, East Inlet, West Inlet, Big Bay, Acton Bay, Robbins Passage, Montagu River and Harcus River were treated by DPIWE. Consequently, the vast majority of the infestation at present is contained in Duck Bay. Stakeholders met in late 2001 to discuss the area based management plan. The outcomes of this were; (a). 2002 to extend the rice grass free zone to include Kemps Bay and Perkins Island thus confining rice grass to Duck River and Deep Creek Bay; (b). 2003 treat infestation in Deep Creek Bay and Duck River.

Given the nature and diversity of threats caused by rice grass encroachment, the size of the infestation, and the demonstrated enthusiasm and commitment of local community and industry groups, it is recommended that **eradication** be the ultimate area-based management objective for Smithton/Stanley.

2.5.2 Rubicon Estuary

In 1997, the Rubicon/Port Sorell rice grass infestation was estimated at 109 hectares. By late 2000 rice grass was estimated to have invaded 135 hectares of intertidal habitat, Australia's second largest infestation.

In 1999 DPIWE, in cooperation with local industry and community, developed an Area-Based Management Plan for the Rubicon/Port Sorell region (see Appendix C). The objective of the plan was to **contain** the area of rice grass infestation south of Eagle Point on the eastern side and Squeaking Point on the western side of the estuary to create a *rice grass free zone* (see map in Appendix B).

In 2000 and 2001, DPIWE, local community and industry groups combined resources to implement the management plan. Community and industry groups focused on monitoring and removal of seedlings and small tussocks while the DPIWE treated larger infestations in the 2001 and 2002 field season.

Stakeholders met in late 2001 to review the Rubicon/Port Sorell Area-Based Management Plan to consider the resources and commitment required to marginally increase the size of the *rice grass free zone* (Eagle Point on the eastern shore and to Spaldings Lane on the western shore). All members supported the extension to the *rice grass free zone* and the DPIWE committed the resources required for this extension. This extension and survey of the expanded *rice grass free zone* was completed in March 2002 with a total of 1.5 ha treated.

Considering the severe impacts of rice grass in the region, eradication would be the preferred management objective for the Rubicon/Port Sorell estuary. However, there are three reasons for not opting for eradication at this time.

- The ecological impacts associated with prolonged and regular use of herbicides in estuaries has not been investigated on such a large scale.
- The effect of large-scale rice grass eradication on sediment dynamics within estuaries is poorly understood. It is estimated that rice grass infestations in the Rubicon estuary stabilise thousands of tonnes of sediment. Rapid release of large quantities of sediment could have detrimental effects on the resident oyster industry, navigation channels and the utility of some coastal and recreational reserves.
- Due to the immense size of the infestation at Rubicon/Port Sorell and the limitations of current control techniques, eradication would require long term (decades) funding commitment.

The recommendation for this area is **contain** and slowly reduce the infestation.

2.5.3 River Tamar

The River Tamar infestation is Australia's largest infestation, estimated in 1997 to cover 415 hectares over a 50-kilometre section of the river. Recent reports indicate that rice grass continues to spread downstream in the River Tamar. Dieback (Section 3.1), invasion and climatic extremes in the River Tamar are likely to produce ongoing spatial and temporal variation in the area that rice grass occupies. The absence of infestations in adjacent coastal areas (particularly the down wind eastern shorelines) indicate that natural processes (winds, tides and a lack of nearby suitable habitat) contain the infestation within the River Tamar.

Stakeholders in the estuary include aquaculture and fisheries, and users adjacent to the estuary include agriculture, other land-based industry, and residential and commercial activities. Furthermore, there are numerous recreational and coastal reserves including the River Tamar Wildlife Sanctuary. The spread of rice grass in the River Tamar has had a profound effect on the physiography of the estuary. It has also reduced the attractiveness and amenity of the coastal reserves (e.g., Gravelly Beach) and is thought to be responsible for decreases in visitor numbers at some reserves.

Containment and monitoring, rather than eradication, is the recommended area-based management objective in the short to medium term for the following reasons.

- Due to the immense size of the infestation in the River Tamar and the limitations of current control techniques, eradication would require long term (decades) funding commitment.
- The affects of large-scale rice grass eradication on sediment dynamics within estuaries is poorly understood. Furthermore, the ecological impacts associated with prolonged and regular use of herbicides in estuaries has not been investigated.
- The argument to eradicate rice grass from the River Tamar is not clear cut. Rice grass improves navigability, provides some stock fodder and is claimed by some to improve foreshore aesthetics.

A critical factor when considering rice grass control in the River Tamar is the affect of control efforts on sediment dynamics within the estuary. In recognition of this, the University of Tasmania and DPIWE developed a research project to investigate the consequences of large-scale rice grass removal in the Tamar estuary. The study has recently received funding from the Australian Research Council and begun in 2002. The results of this study will be paramount in the future consideration of rice grass management in the Tamar River.

2.5.4 Bridport

In 1997 a mapping survey reported that rice grass invaded approximately 3 hectares of intertidal habitat in the Trent Water of the Bridport estuary. A more recent survey in 1999 found new infestations in the

upper wetland regions of Trent Water, Lades Beach and Little Forester River. Collectively, rice grass infestations in the Briport region were estimated to be approximately 5 ha.

In 1999 the DPIWE, in cooperation with local industry and community, developed an Area-Based Management Plan for the Bridport region (see Appendix C). The objective of the plan was to **eradicate** all rice grass infestations in the Bridport region. Between 1999 and 2002 DPIWE and local community groups combined resources to implement the management plan. By 2002 rice grass infestation in the Bridport region had been reduced to less than 10 m^2 (0.2% of original infestation).

Effective implementation of the Area-Based Management Plan and cooperation between stakeholders has demonstrated that **eradication** of rice grass is a realistic management objective for the Bridport region. Stakeholders met in late 2001 to review the Bridport Area-Based Management Plan and the community unanimously voted to implement a community–based approach to achieving eradication of rice grass from the Bridport area. The community, with help from the DPIWE, will review this new management plan late 2003.

2.5.5 St Helens

In the early to mid 1990s the Parks and Wildlife Service removed small rice grass infestations from Medeas Cove and Georges Bay at St Helens. In 1997 a survey indicated that a single clump of rice grass remained (less than 1 m^2). Monitoring surveys in 1999, 2000, and monitoring and treatment in 2001 and 2002 have found only 6 small plants remain which have all been treated. **Eradication** is a realistic management objective for the St Helens region. With continued monitoring and treatment, the eradication of rice grass is achievable in the near future in this area.

2.5.6 Little Swanport Estuary

In 1997 a mapping survey reported that rice grass invaded approximately 10 hectares of intertidal habitat in the Little Swanport estuary. A more recent survey in 2000 revealed that the infestation had spread to 13 ha.

In 1999 the DPIWE, in cooperation with local industry and community, developed an Area-Based Management Plan for the Little Swanport estuary (see Appendix C). The objective of the plan was to **eradicate** all rice grass infestations in the Little Swanport estuary. Between 2000 and 2002 DPIWE and local community groups combined resources to implement the management plan. By 2002 rice grass infestations in the Little Swanport estuary had been reduced to 30 m^2 (0.2% of original infestation).

Effective implementation of the Area-Based Management Plan and cooperation between stakeholders has demonstrated that **eradication** of rice grass is a realistic management objective for the Little Swanport region. Stakeholders met in late 2001 to review the Little Swanport Area-Based Management Plan and the community unanimously voted to implement a community–based approach to achieve eradication of rice grass from the Little Swanport region. The community, with help from the DPIWE, will review this new management plan late 2003.

2.5.7 River Derwent

In the mid 1990s the Parks and Wildlife Service mapped and treated rice grass infestations in the Derwent River (Megalos 1997). In 1997 a mapping survey indicated that rice grass occupied approximately 0.8 hectares of intertidal habitat between Lindisfarne Bay in the lower reaches and Bridgewater Bridge in the upper reaches of the River Derwent.

Between 1998 and 2001, DPIWE conducted annual treatment and monitoring. In 2001 the total area of the infestation in the River Derwent was estimated to be 40 m^2. All known infestations were treated in 2001 and 2002 with less than 1 square meter currently in the river (2.5% of original infestation). **Eradication** is a realistic management objective for the River Derwent infestation.

2.6 State Strategy to Achieve Area-Based Management Objectives

In order to achieve Area-Based Management Objectives and achieve effective rice grass management within Tasmania, an integrated and cooperative approach is required (Wells, 1995). In the initial stages of the project, the DPIWE pointed out the need to move from a sectoral approach led by *ad hoc* decision making, to a statewide-integrated approach to rice grass control in Tasmania.

In 1998 DPIWE received funds to implement the strategy. DPIWE, industry and community groups have dealt with many challenges during the implementation phase. What has become evident is that successful implementation relies on a systematic and focussed approach which maximises stakeholder cooperation and resource efficiency and incorporates environmental monitoring and peer review.

2.6.1 A Dynamic Team to Lead Rice Grass Management in Tasmania

The Natural Heritage Trust funding package has been used to assemble a multi-disciplinary team to lead rice grass management in Tasmania. The team's primary responsibility is to achieve the objectives of the strategy. The team has been carefully selected to provide a specific range of skills, including:

- project management
- introduced marine pest management
- application of herbicide in the marine environment;
- weed mapping (geographical information systems);
- environmental monitoring and research;
- ecological processes, and an understanding of complex estuarine environments; and
- Communication and problem solving skills, particularly when in consultation with members from industry and the general public.

The management team consists of three people, (one management officer and two technical officers). The team employ new and innovative ways to increase efficiency when conducting control work. For example the team contracts the services of a hovercraft and operator as well as the use of an all terrain vehicle (ATV) in order access difficult areas. The hovercraft is particularly useful in soft sediments and where road access to the coastline is restricted. Application of the herbicide is through the use of hand-held sprayers, pressurised either manually or through the aid of pumps. In 2001 contract sprayers were hired to assist in the Smithton area utilising high-pressure spray equipment.

The team has the responsibility to ensure that implementation includes a high level of community and industry involvement, particularly with regard to development of area-based management plans and monitoring of infestations.

A key component of the success of the team is to manage staff changes. Given the rigours of the work a high turnover of staff in the program has occurred. This level of turnover would be expected in similar projects and needs to be factored in to the planning of such a project.

2.6.2 Considering Strategies for Eradication

Eradication can be described as the complete and permanent removal of rice grass from a defined area with little or no risk of reinvasion. There are two distinct phases in the eradication process; the eradication of rice grass (complete removal where no rice grass can be found after conducting a thorough survey), and eradication monitoring (ongoing monitoring to ensure that rice grass is permanently removed). In both cases, strong community involvement is the vital ingredient to a successful eradication program.

Successful eradication relies heavily on regular systematic monitoring surveys. The effectiveness of monitoring surveys is maximised by:

- appropriate planning and leadership for surveys and eradication monitoring;
- maximising the number of survey and eradication monitoring participants;
- maximising local knowledge and familiarity of shorelines in survey and eradication monitoring groups;
- appropriate training for survey and eradication monitoring participants; and

- appropriate timing and resourcing of survey and eradication monitoring.

If eradication is declared, it effectively states that the problem has disappeared. The usual response is that efforts to deal with the problem are dismantled or discontinue. It is therefore vitally important that eradication is confidently declared.

A prescribed and logical method is required to confidently calculate the period of time required for eradication monitoring (before eradication can be declared). The two major variables influencing the length of the eradication monitoring period are life span of seed and propagules and precision of monitoring surveys. Information on life span of seed and propagules and precision of community-based monitoring surveys is needed to determine the appropriate eradication-monitoring period required before declaring eradication. DPIWE will also work closely with community groups to ensure that participants involved in surveys and eradication monitoring are sufficiently trained and prepared.

2.6.3 Environmental Monitoring, Research and Independent Peer Review

Environmental monitoring and research has proved to be a particularly important component of rice grass management. Monitoring programs have targeted the impacts of rice grass and the impact of control techniques on water quality, sediments, invertebrate communities and aquaculture. Monitoring the impact of control techniques has provided vital information to DPIWE, industry and community aiding in the decision-making processes of rice grass management.

Environmental monitoring and research will continue to play an important role in the implementation of the strategy. The University of Tasmania and DPIWE developed a research project to investigate the consequences of large-scale rice grass removal in the Tamar estuary. The study has recently received funding from the Australian Research Council and began in mid 2002. The results of this study will be paramount in future considerations of rice grass management in the River Tamar. Ongoing environmental monitoring of water quality, sediments and invertebrates will continue.

Independent peer review is a valuable process for assessing project development and progress. Implementation of the strategy has been subject to peer review from independent experts (Dr Peter Davies) and established peer groups (Natural Heritage Trust, Australian Water Association and Rice Grass Advisory Group). Periodic independent peer review processes will continue to be used throughout the process of strategy implementation.

2.6.4 Duration of Management Program

It was estimated that 5 years would be sufficient to fulfil the short term to medium term objectives of the management program (although larger infestations targeted for eradication, such as Smithton and Little Swanport, may not be eradicated during this period). After 3 years of on-ground control, it’s clear that this initial estimation is accurate and realistic.

m evolves and new technologies and information become available, there may be a need to review the strategy. It is proposed that this second edition of the strategy be reviewed in late 2003, particularly to accommodate advances in knowledge on the requirements of eradication.

3 Characteristics of Rice Grass

3.1 Biology and Ecology

Rice grass is an erect rhizomatous perennial grass, up to 130 cm high, inhabiting the intertidal zone of temperate estuaries (Curtis and Morris, 1994). This pioneer species forms a dense, above-ground biomass of culms that is typically half the biomass of the underground roots and rhizomes (Jackson *et al.*, 1986). Its ability to produce an abundance of fertile seed, extensive rhizomal networks and prolific clonal growth has allowed it to spread rapidly throughout Tasmania (Gray *et al.*, 1990; Marks and Mullins, 1990; Thompson, 1991). Apart from humans, wind and tide generated currents appear to be the only vectors of rice grass propagules. Rice grass has a physiology typical of C_4 photosynthesis (Thompson, 1991). Many C_4 grasses are vigorous and productive in warm regions but not in temperate regions. Rice grass is unusual among C_4 grasses because it is able to maintain competitive growth rates at low temperatures (Thompson, 1991).

The ecology of rice grass in Australia is poorly understood. In Tasmania, rice grass typically colonises the vacant angiosperm niche between high and low tide. However, field observations show that it may also invade the lower salt marsh community, directly competing with and excluding native herbs, such as *Salicornia quinqueflora*. Overseas research and local field observations show that rice grass is a hardy grass capable of tolerating.

- Temperatures as low as 5^{o}C during the growth season (Thompson, 1991).
- Tidal inundation for up to 23 hours (Pringle, 1993).
- Exposure to strong and persistent winds (e.g., Duck Bay and Smithton).
- A range of salinities between the extremes of fresh water and marine water (Long *et al*, 1990; Thompson, 1991).

Some rice grass populations are reported to undergo dieback (i.e. reduced vigour or death of large areas of mature rice grass populations due to a soft rotting of the rhizomes). Although not fully understood, dieback is thought to be caused by prolonged waterlogging (Gray *et al.*, 1990; Thompson, 1991).

3.2 Negative Impacts Associated with Rice Grass in Tasmania

Rice grass, if allowed to spread, has the potential to dramatically alter the ecology, geomorphology, hydrology and integrity of Tasmania's estuaries, lagoons and inlets.

3.2.1 Geomorphology and Hydrology

Its dense growth habit and rhizome/root network act as a trap for sediments altering the natural rate, magnitude and location of sediment deposition and erosion. These processes elevate shorelines and river banks to create terraces and marsh islands by promoting deposition and accretion. Overseas studies show that annual rates of sediment accretion within rice grass meadows vary from 3 mm to 19 cm (Lee and Partridge, 1983; Chung, 1990). Sediment accretion rates are highly variable and are dependent on several variables: geology and land use in catchments, sediment characteristics and compaction (Lee and Partridge, 1983). The spread of rice grass in the Rubicon estuary has considerably elevated the height of shorelines and channel banks while narrowing and deepening adjacent water channels. In the shallows of the Little Swanport estuary, sediment accretion on isolated clumps and swards is leading to the formation of marsh islands. Altering sediment dynamics and geomorphology also modifies the hydrology of estuaries, lagoons and inlets (Gray *et al.*, 1990).

3.2.2 Ecology

The impact of rice grass on the ecology of Tasmania's estuaries, lagoons and inlets is based on field observations and anecdotal evidence. Field observations reveal that rice grass competes with and excludes seagrass such as *Zostera* spp., and lower salt marsh plants, such as *Salicornia quinqueflora* (Hedge & Kriwoken, 2000). There is also concern that rice grass will rapidly colonise the habitat (mudflats) of resident and migratory wader birds leaving few habitat refugia in infested estuaries (Gibbs and Phillips, 1995; Simpson, 1995). There is mounting international concern for the decline of migratory

wader birds including some of the species that visit Tasmania (Ramsar Convention Bureau, 1994). In Tasmania, several Ramsar wetlands (wetlands of international importance) are threatened by the spread of rice grass including: Moulting Lagoon located near Little Swanport estuary in Great Oyster Bay and Pitt Water adjacent to the Derwent River. The proposed Ramsar wetland at Robbins Passage is immediately threatened by the spread of rice grass from Montagu River and Duck Bay infestations. Two international agreements oblige Australia to protect migratory bird species and their habitat:

- JAMBA (Japan - Australia Migratory Bird Agreement); and
- CAMBA (China - Australia Migratory Bird Agreement).

Studies in Victoria (Simpson, 1995) and overseas (Evans, 1986; Jackson, 1985; Goss-Custard and Moser, 1990) confirm that wader birds avoid rice grass infested areas. There is also concern from conservation agencies about the impact to fish and invertebrate communities. Results from two Tasmanian studies indicate that both macroinvertebrates (Hedge and Kriwoken, 2000) and fish communities (Sullivan, 2001) are altered by the introduction and presence of rice grass. Overseas studies also confirm that rice grass does alter the community structure of macroinvertebrate infauna (Jackson, 1985, Evans, 1986).

3.2.3 Aquaculture and Wild Fisheries

Rice grass has been recognised as a serious threat to the sustainability of Tasmania's aquaculture industry, particularly the production of Pacific oysters (Kriwoken and Hedge, 2000). A Statewide survey confirmed that rice grass and oyster leases co-exist at four regions in Tasmania: Little Swanport estuary, Georges Bay, Rubicon estuary and the Smithton region (see Appendix B). To compete on the international market, lease holders require optimal conditions to promote oyster growth and a clean water supply. Hydrological modifications to estuaries, bays and inlets caused by the expansion of rice grass infestations may redirect or reduce the flow of water reaching oyster leases. A reduction in the volume of water passing through oyster leases would be accompanied by a decrease in the supply of nutrients to oysters. A reduction in the growth rate of oysters is the likely outcome. Redirecting the flow of water would have similar consequences and in the long term, some leases may need to be relocated. Furthermore, expanding infestations can substantially reduce the total area available for intertidal oyster farming. In Washington State, USA, rice grass has invaded 1200 to 2000 hectares of oyster ground in Willapa Bay. The government has responded by approving its eradication using a range of management techniques, including the use of the herbicide Rodeo (Nosho, 1996) (Not register for use in Tasmania).

Commercial and recreational wild fisheries may be detrimentally affected by the spread of rice grass. Some fish species use estuaries as nursery grounds, others use estuaries as foraging grounds (Hodgkin, 1994). Intertidal seagrass beds, which can be displaced by rice grass, are recognised as providing important habitat for juvenile fish. Whilst some species may adapt to areas infested with rice grass, particularly small mobile species, other species due to their shape and feeding habits cannot. Important commercial species such as flounder and flathead are excluded from rice grass areas due to their size and shape and the barrier that rice grass poses for ‘flat’ fish (Sullivan, 2001). As a result, rice grass may detrimentally affect wild fisheries by altering recruitment or growth rates of ecologically, recreationally and commercially important species. Further studies are currently being conducted to assess fish use of rice grass infested areas of the River Tamar, with particular emphasis on commercially important species.

3.2.4 Tourism and Recreation

The shoreline of estuaries, bays and inlets provides valuable social amenity and cultural heritage to Tasmania's residents and visiting tourists. Rice grass infestations threaten the cultural landscape heritage, inhibit public access to the coast, and in the River Tamar have rendered many private boat ramps and jetties non-functional (Pringle, 1993). Furthermore, the transformation of sand beaches to muddy rice grass meadows, such as Gravelly Beach in the River Tamar, has effectively reduced the attractiveness of the Tamar shores to residents and tourists. Tourism accounted for about 6.9% of Gross State Product in 1992 and employed (directly and indirectly) about 9.1% of the State's workforce (State of the Environment Unit, 1996). Threats to the continued growth of tourism in Tasmania, such as rice grass, should be minimised and controlled.

3.3 Positive Impacts Associated with Rice Grass in Tasmania

Although rice grass may be perceived as a nuisance plant, it does provide some benefits.

3.3.1 Coastal Engineering

The benefits of rice grass as an agent for coastal engineering were recognised early this century (Boston, 1981). In the River Tamar, rice grass currently mitigates erosion, stabilises mudflats and reclaims intertidal land (Pringle, 1993; Wells, 1995). The dense growth habit of rice grass promotes sediment accretion, building up and broadening the shoreline, while narrowing and deepening channels. In the River Tamar, these utilities combine to significantly improve the navigability of shipping channels and reduce the erosion of channel banks.

3.3.2 Agriculture

In China, the feed value of rice grass for stock compares favourably with straw from corn, rice and soybean and rice bran (Chung, 1990). Pringle (1993) indicates that rice grass is grazed by sheep and cattle at Spring Bay and Redwood Bay in the Tamar valley. While farmers and graziers may receive some benefit from grazing stock on rice grass, the community incurs a cost. Cattle and sheep grazing in wetlands cause environmental degradation: damage to native saltmarsh vegetation through trampling, soil erosion and compaction from hooves, and eutrophication from urine and faeces (Shaw and Gosling, 1995).

3.3.3 Aesthetics

Extensive mudflats originally flanked the channels of the River Tamar. Rice grass has colonised many of the mudflats transforming them to green meadows. Some residents of the Tamar valley are reported to prefer the view over ‘green meadows’ than one encompassing ‘brown mudflats’. Rice grass meadows are also reported to ameliorate odours expelled from anaerobic sediments in the River Tamar.

3. Rice Grass in Tasmania

4.1 The Introduction of Rice Grass to Tasmania

Between 1927 and 1952, numerous consignments of rice grass seed, seedlings and cuttings were imported into Australia (Boston, 1981). Although the vast majority of early attempts to propagate rice grass were unsuccessful, persistence and determination eventually lead to success in some of Australia's temperate estuaries. The few successful and established rice grass introductions provided the source for numerous subsequent intra-state and inter-state transplants.

The decision to introduce rice grass to Tasmania was generated by a decade of overseas success with the plant. London newspaper and magazine articles effectively marketed rice grass as a particularly useful plant for land reclamation, coastal engineering and stock fodder. There was, however, no single reason for introducing rice grass to Tasmania (Boston, 1981). In some areas, such as the Little Swanport estuary and the River Derwent, the decision by the Department of Agriculture to introduce rice grass is unclear but was probably to reclaim land or to provide fodder. In contrast, the introduction of rice grass to the River Tamar was hoped to stabilise mudflats, reclaim land and improve the navigability of the shipping channels (Boston, 1981; Pringle, 1993).

Import and consignment records indicate that from 1930 to 1977, rice grass was planted at 11 locations within Tasmania (Figure 1). A State survey, conducted for the Rice Grass Advisory Group in 1996/97, confirmed that rice grass currently inhabits seven distinct regions in Tasmania: four on the north coast, two on the east coast and one in the south east (Figure 2 and Appendix B). The survey also revealed that some rice grass infestations were considerably larger than previously reported, particularly in the Duck Bay, Montagu River and Bridport areas.

4.2 The Potential Extent and Spread of Rice Grass in Tasmania

To fully appreciate the threat of rice grass to Tasmania, its potential extent should be identified. The ecology of rice grass in Australia has received little attention and is thus poorly understood. Research by

Pringle (1975; 1988; 1993) provides valuable information on the colonisation, distribution and physical effects of rice grass in Tasmania, particularly the River Tamar infestations. She stated that in the River Tamar it was unlikely that rice grass would spread downstream of East Arm. However, surveys by students from the University of Tasmania in 1995 and rangers from the Parks and Wildlife Service in 1995, confirmed that rice grass has colonised a number of sites downstream of East Arm including: Bell Bay, West Arm and Middle Arm (L. Kriwoken, pers. com.). Without ecological information specific to Australia, it is difficult to estimate the potential extent of rice grass and the rate at which it spreads.

The current distribution of rice grass in Tasmania suggests that, generally, it does not spread from infested estuaries to nearby uninfested estuaries. However, monitoring of uninfested areas has been limited. Geomorphology of coastal regions and local climate variation is likely to play an important role in the dispersal of seed and propagules from infested to uninfested regions. In the Smithton region, hydrological links between bays, passages and inlets has allowed wind and tide driven currents to effectively disperse rice grass propagules from original introduction sites to many other sites including: Robbins Passage, Deep Creek Bay, West Inlet, East Inlet, Black River and many smaller bays. In other areas, such as Little Swanport, the River Tamar and the Rubicon estuary, semi-landlocked estuaries and narrow estuarine mouths impede the spread of propagules from infested estuaries.

Many infestations exhibit sudden and rapid expansion after an initial colonising phase marked by slow but progressive growth (Gray *et al.,* 1990; Pringle, 1993). The Rubicon estuary and the River Tamar infestations have both exhibited the explosive growth stage. The cause of explosive growth is not known but is thought to be related to climatic and/or genetic factors that lead to a good year in seedling establishment (Gray *et al.*, 1990; Pringle, 1993). Studies in New Zealand found that the boundary of rice grass infestations can spread outward at the rate of 5.3 m/annum but is highly variable and dependent on suitable habitat (Lee and Partridge, 1983). Anecdotal evidence suggests that eutrophication (nutrient enriched waters) was the catalyst for the explosive expansion in the Rubicon estuary (Lane 1995; Wells, 1995).

Given that established infestations in Tasmania continue to expand and assuming that the majority of Tasmania's estuaries provide suitable rice grass habitat (Section 3.1), it can be concluded that rice grass is a threat to other uninfested regions, such as Moulting Lagoon and Pitt Water, and currently inhabits a very small percentage of its potential extent. Furthermore, relatively small infestations, such as those in the Bridport estuary, Little Swanport estuary and the Smithton region, may undergo explosive growth spurts if infestations are not controlled threatening areas of ecological and economic importance.

Glossary of Terms

biomass	The total quantity of matter in an organism or group or organisms, usually expressed in terms of weight per unit area.
C_4 plant	C_4 photosynthesis is a unique adaptation for plants adapted to high temperatures or arid regions.
contain	To stop the spread of rice grass with the primary objective of restricting spread to clearly identified boundaries (ie., to within an estuary or to keep designated areas free from rice grass, such as recreation and wildlife reserves).
die-back	Reduced vigour and death of large areas of mature rice grass populations due to a soft rotting of the rhizomes.
eradicate	Complete and permanent removal of rice grass from a defined area with little or no risk of reinvasion.
geomorphology	The study of the shape and dynamics of the earth's surface.
hydrology	The study of the distribution and movement of water.
integrated weed control	Using a range of techniques to control weeds.
photosynthesis	The conversion of water and carbon dioxide into carbohydrate (sugar) by plants in the presence of light and green chlorophyll.
propagules	A plant structure used to disperse, such as a seed or rhizome fragment.
reduce	To reduce the total area of rice grass infestations.
rhizome	Horizontal underground stem of plants, serves to vegetatively spread plant.
social amenity	The qualities and usefulness of the environment including aesthetic, recreational and environmental amenity.
satellite infestation	A small rice grass infestation located a large distance from any other infestation.
vector	A carrier or transporter of propagules.

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Appendix A: Recommendations for the use of Fusilade®

Fusilade® is not licensed for use in the coastal environment. The DPIWE have obtained an exclusive permit for the minor off-label use of a registered product through the National Registration Authority for Agricultural and Veterinary Chemicals (**Permit number PER5096**). This document details the Persons, Products, Directions for use and the State in which the permit has been obtained. More detailed Operational Conditions are found in the Environmental Protection Notice (**Notice Number 398/5**) issued under the Environmental Management and Pollution Control Act 1994. These conditions include specific instructions regarding the application of Fusilade®, such as.

- All application of Fusilade® shall be conducted using low and high-pressure sprayers fitted with a handheld boom and the application shall be to plant foliage when plants are fully exposed during low tide.

- The application rate of Fusilade® shall not exceed 1000 litres/hectare of a 1% Fusilade® solution mixed with fresh water. The surfactant BS1000 shall be mixed at 0.2% v/v to maximise efficiency.

- The person(s) responsible for the activity must have access to a copy of an emergency procedure guides or similar document pertaining to the chemical Fusilade® which details actions to be taken in the event of a spill or accident, including emergency contact numbers of relevant agencies.

- The application of Fusilade® must not occur on days when the prevailing wind speed and direction is likely to create off-site spray drift impacts.

- The application of Fusilade® should occur to allow the maximum period of time following spray application before reimmersion. Spraying should therefore occur between approximately least 3 hours before dead low tide and 2 hours after dead low tide.

Furthermore the DPIWE require that all persons operating under these permits and guidelines, be trained and experienced in the handling and application of herbicides to ensure minimum effective quantities are used and personal safety is maximised.

Appendix B: Distribution of Rice Grass in Tasmania

Notes on Mapping and the Collection of Data

Rice Grass distribution data used to construct the following maps have been gathered from a variety of sources. The majority of infestation data has been collected during control efforts in each region. In these regions, information has come from members of the community and industry, as well as the Rice Grass Management team during surveys and control efforts.

In areas where little or no control efforts have been conducted, data collected in previous surveys has been used in conjunction with information provided by local residents as well as existing knowledge of infestations in that region.

Data in each region were collected and recorded onto 1:25000 Tasmaps and then transferred into the geographical information system (GIS) computer program MapInfo *Professional*, to produce the final maps.

In order to show adequate detail of infestations; the Smithton/Stanley and Tamar River regions have been divided up into smaller work areas, loss of information during this process has been kept to a minimum. On each map, there are details on the size of the infestation, as well as the area treated in the 2002-control season.

To view infestation map data see separate pdfs for each year:

Derwent	1997	2002
Little Swanport	1997	2002
St. Helens	1997	2002
Bridport	1997	2002
Tamar (Lower)	1997	2002
Tamar (Upper)	1997	2002
Port Sorell	1997	2002
Circular Head (Stanley)	1997	2002
Circular Head (Duck Bay)	1997	2002
Circular Head (Big Bay)	1997	2002
Circular Head (Montagu)	1997	2002

Appendix C: Area-Based Management Plans

The following Area-Based Management Plans for rice grass management in Tasmania were originally developed in 1998. They have since been reviewed in to keep in line with Plan Objectives, Management Action, areas of infestation. These plans are the result of a community consultation process whereby community and industry members were invited to comment on the proposed changes at public meetings. For infestation maps see Appendix B.

Rice Grass Area-Based Management Plan

Circular Head Region (2002-2003)

Location and Objectives of Plan

Location: Circular Head Region

Objectives:
To *contain* the area of rice grass infestation to Duck Bay and *reduce* infestations within Duck Bay in the Smithton/Stanley region.

- Year 2002: Treat remnant infestations and regrowth at Black River, East Inlet, West Inlet, Big Bay, Acton Bay, Robins Passage and Montagu River.
- Year 2002: Extend area declared as *rice grass free zone* to include areas west of and including Kemps Bay, and Perkins Island, thus confining rice grass to Duck River and Deep Creek Bay
- Year 2003: Treat remnant and regrowth infestations in all previously treated areas and extend *rice grass free zone* to include Deep Creek Bay.

Duration of Plan: 2002 to 2003

Nature of Infestation

Size of current infestation: 65 ha. (visual estimates during 2001 field season).
Size of pre-treated infestation: 68.5
Rate of spread: Approximately 8% spread/year in untreated areas.
Potential extent: Rice grass has the potential to invade more than 450 ha. of intertidal habitat in the Smithton/Stanley region. Rice grass currently inhabits less than 10 % of its potential range in the region.

Impacts to Region

Ecology: Infestations dramatically alter the ecological and natural heritage of estuaries and waterways. Invasion alters the distribution and habits of a range of resident flora and fauna, including shore birds, fish, invertebrates, seagrasses and saltmarsh.
Industry: Infestations progressively invade the immediate and surrounding area of intertidal aquaculture zones (e.g. Pacific oysters) altering estuarine sediment dynamics, flow rates and patterns and geomorphology.
Recreation: Rice grass may inhibit coastal access and use, and detrimentally effect recreational fishing and boating.

Regional Planning Considerations

Existing Plans and Strategies: This management plan is designed to compliment existing regional plans and strategies that affect the estuary. The following regional plans and strategies have been identified as having working associations with this plan:

- Strategy for the Management of Rice Grass (*Spartina anglica*) in Tasmania, Australia (1998);
- Weedplan (Tasmanian Weed Management Strategy 1996);
- Marine Farming Development Plan: Far North West (May 1999);
- West North West Tasmania Coastal Management Project:- Draft Circular Head Coastal Management Plan (February 1999);
- Partnership Agreement, Government of Tasmania and the Circular Head Council (June 1999).

Industry Considerations

Industry:
The Rice Grass Management Steering Group has conducted extensive consultation with the Circular Head Shellfish Growers and the Tasmanian Shellfish Quality Assurance Program. The timing of the use of approved herbicides to control rice grass will be determined in conjunction with oyster growers and DPIWE to ensure minimum impact on oyster production and market sales.

Management Action

Control Techniques:

- Only the approved herbicide (Fusilade®) and physical removal techniques to be used during growing period to treat outlying and satellite infestations (Black River, East Inlet, West Inlet, Big Bay, Acton Bay, Robins Passage and Montagu River) in the region. Fusilade® will also be used to treat the outer areas of the Duck Bay region (Boulduans Bay and Perkins Island). Fusilade® will be applied by approved and accredited operators at a rate of 10L/ha by hand held hydraulic sprayers.
- Approved herbicide and physical removal techniques to be used to treat regrowth during following years.

Timing of Control:

- Control efforts will occur in accordance with agreements with industry and community and are as follows:

  February: Duck Day
  March: Big Bay, Montagu, Robbins Passage
  April: Any untreated areas (outside areas affecting marine farms)

- Chemical control methods will cease to allow a minimum of 3 hours drying time before tidal submersion or when average wind speed exceeds safe operating conditions.

Management Responsibility: The DPIWE will be responsible for planning and implementing all efforts using chemical control methods. Responsibility for planning and implementing non-chemical control efforts, monitoring and mapping will be shared by DPIWE, industry and the community. Declaration of *rice grass free zones* and the organisation of cooperative work efforts between the DPIWE, industry and/or the community will be coordinated by the Rice Grass Management Officer.

Expected Outcomes:

- Year 2002.
  - → Maintain areas declared as *rice grass free zones* containing rice grass infestations within Duck Bay in accordance with this plan.
  - → Reduce the area of infestation in the Duck Bay region including; Boulduans Bay, Kemps Bay and Perkins Island.
- Year 2003.
  - → Maintain areas declared as *rice grass free zones*. Treat areas within Deep Creek Bay.

Review of Plan

This Area-Based Management Plan will be reviewed by identified stakeholders and DPIWE during the winter of 2003 or as required. A report of the review will be made available and mailed to all persons who attended the Circular Head Rice Grass Management Meeting in December 2001.

Rice Grass Area-Based Management Plan

Rubicon/Port Sorell Region (2002-2003)

Location and Objectives of Plan

Location: Rubicon and Port Sorell

Objectives:
To *reduce* and *contain* the area of rice grass infestation in the Rubicon and Port Sorell region and to create a *rice grass free zone*.

- Year 2002: Increase the area within the *rice grass free zone*. Thus containing the rice grass infestation south of Spalding's Lane on the western shore, and Eagle Point on the eastern shore of the estuary.
- Year 2003: Maintain the *rice grass free zone*.

Duration of Plan 2002 to 2003.

Nature of Infestation

Size of infestation: 120 ha.
Rate of spread: Unknown at this point.
Potential extent: Rice Grass has the potential to invade up to 650 ha. of intertidal habitat in the Rubicon estuary. Rice Grass currently inhabits approximately 20% of its potential range in the Port Sorell region.

Impacts to Region

Ecology: Infestations dramatically alter the ecological and natural heritage of the estuary. Invasion alters the distribution and habits of a range of resident flora and fauna, including shore birds, fish, invertebrates, seagrasses and saltmarsh.
Industry: Infestations progressively invade the immediate and surrounding area of intertidal aquaculture zones (e.g. Pacific oysters) altering estuarine sediment dynamics, flow rates and patterns and geomorphology.
Recreation: Rice grass may inhibit coastal access and use, and detrimentally effect recreational fishing and boating.

Regional Planning Considerations

Existing Plans and Strategies: This management plan is designed to complement existing regional plans and strategies that affect the estuary. The following regional plans and strategies have been identified as having working associations with this area-based management plan:

- Strategy for the Management of Rice Grass (*Spartina anglica*) in Tasmania (1998);
- The State of the Natural Resources and Management of the Greater Rubicon Catchment. Status report. (May 2001)
- Marine Farming Development Plan (Draft): Port Sorell Estuary (May 2001).
- Weedplan (Tasmanian Weed Management Strategy) (1996).

Industry Considerations

Industry:
The Rice Grass Management Steering Group has conducted extensive consultation with the marine farming industry and the Tasmanian Shellfish Quality Assurance Program. Industry has advised that the use of approved herbicides to control rice grass be timed so that impacts to production and market sales are minimised.

Management Action

Control Techniques:

- Only the approved herbicide (Fusilade®) to be used in 2001/2002 growing period to treat infestations north of the *rice grass free zone*. Fusilade® will be applied by approved and accredited operators at a rate of 10L/ha by hand held hydraulic sprayers.
- Where possible, non-chemical control methods will be used to maintain the *rice grass free zone* from the 2001/2002 control period and thereafter.

Timing of Control:

- Control efforts need to occur during the growth phase of the plant between November to June. All control efforts will occur on the falling tide when rice grass infestations are fully emerged.

- Chemical control methods will cease to allow a minimum of 3 hours drying time before tidal submersion or when average wind speed exceeds safe operating conditions.

Management Responsibility: Responsibility for planning and implementing control efforts, monitoring and mapping will be shared by DPIWE, industry and the community. Declaration of *rice grass free zones* and the organisation of cooperative work efforts between the DPIWE, industry and/or the community will be co-ordinated by the Rice Grass Management Officer. Control efforts in 2001/02-2003 control periods will be shared between DPIWE, community and industry.

Expected Outcomes:

- Year 2002: *Contain* areas of rice grass infestation south of Eagle Point and Spalding's Lane.
- Years 2001-2002: Maintain areas declared as *rice grass free zones* north of *rice grass free zone* boundary in accordance with this plan.

Review of Plan

This Area-Based Management Plan will be reviewed by identified stakeholders and DPIWE during winter of 2003 or as required. A report of the review will be made available and mailed to all persons attending the Rubicon Rice Grass Management Meeting.

Rice Grass Area-Based Management Plan

Bridport Region (2002-2003)

Location and Objectives of Plan

Location: Bridport, Little Forester River and Lades Beach

Objectives:

- To *eradicate* the area of rice grass infestation in the Bridport region to create a *rice grass free zone* in the following manner:
  - Years 2001-2003: Treat areas where regrowth occurs (see map).

- To plan for and implement a community/industry developed management plan with the aim of achieving eradication

Duration of Plan: 2001 to 2003

Funding: Funding is provided by the Natural Heritage Trust and is committed until September of 2003.

Nature of Infestation

Size of current infestation: 100 m^2 (2001 data)
Size of pre-treated infestation: 4 ha
Rate of spread: Effective treatment has suppressed spread.
Potential extent: Rice grass has the potential to invade 80 ha. of intertidal habitat in the Bridport region. Rice grass currently inhabits <1% of its potential range in the Bridport region.

Impacts to Region

Ecology: Infestations dramatically alter the ecological and natural heritage of the estuary. Invasion alters the distribution and habits of a range of resident flora and fauna, including shore birds, fish, invertebrates, seagrasses and saltmarsh.
Industry: Infestations progressively invade the immediate and surrounding area of intertidal zones altering estuarine sediment dynamics, effecting shipping, tourism and potential marine farming.
Recreation: Rice grass may inhibit coastal access and use, and detrimentally effect recreational fishing and boating.

Regional Planning Considerations

Existing Plans and Strategies: This management plan is designed to compliment existing regional plans and strategies that affect the estuary. The following regional plans and strategies have been identified as having working associations with this plan:

- Strategy for the Management of Rice Grass (*Spartina anglica*) in Tasmania 1998.
- Dorset Council: Bridport Foreshore Strategic Framework (1996); and
- Weedplan (Tasmanian Weed Management Strategy) (1996).

Management Action

Control Techniques:

- Physical removal, Fusilade® and smothering may all be used to maintain the Bridport region as a *rice grass free zone* during the 2002 growing period and thereafter.

Timing of Control:

- Control efforts need to occur during the growth phase of the plant between November to June. All control efforts will occur on the falling tide when rice grass infestations are fully emerged.

- Chemical control methods will cease to allow a minimum of 3 hours drying time before tidal submersion or when average wind speed exceeds safe operating conditions

Management Responsibility:
DPIWE, industry and the community in accordance with this management plan will share responsibility for planning and implementing control efforts, monitoring and mapping. Organisation of cooperative work efforts between the DPIWE, industry and/or the community is to be coordinated by the Rice Grass Management Officer. Given funding arrangements, it is essential that continued monitoring and control of rice grass is conducted in a coordinated and thorough manner in order to achieve eradication.

Facilitating community and industry involvement:
Facilitating the transfer of management responsibility and ongoing control and monitoring efforts will require a number of key objectives to be met from now until the conclusion of this program. Community and industry in consultation with the Rice Grass Management Team will determine these objectives. Peter Edson of the 'Bridport 2000 Plus' community group has agreed to act in the position of Coordinator for the Bridport region.

Expected Outcomes:
- Years 2002-2003: Maintain the estuary as a *rice grass free zone*. Follow up treatment for regrowth to be managed and monitored in agreement with this plan.
- Development of a community and industry based management plan for 2004 and onwards.

Review of Plan
This Area-Based Management Plan will be reviewed by identified stakeholders and DPIWE during the winter of 2003 or as required. A report of the review will be made available and mailed to all persons attending the Bridport Region Rice Grass Management Meeting.

Rice Grass Area-Based Management Plan

Little Swanport Estuary (2002-2003)

Location and Objectives of Plan

Location: Little Swanport estuary

Objectives:

- To *eradicate* the area of rice grass infestation in Little Swanport estuary creating a *rice grass free zone* in the following manner:
  - Years 2002-2003: Treat all areas where regrowth occurs.
  - 2003 onwards: Monitor infested areas.

Duration of Plan: 2002 to 2003.

Funding: Funding is provided by the Natural Heritage Trust and is committed until September of 2003.

Nature of Infestation

Size of current infestation: 250 m^2 (2001 data)
Size of pre-treated infestation: 13 ha
Rate of spread: Effective treatment has contained spread.
Potential extent: Rice grass has the potential to invade 50 ha of intertidal habitat in Little Swanport estuary. Rice grass currently inhabits <1% of its potential range in the estuary.

Impacts to Region

Ecology: Infestations dramatically alter the ecological and natural heritage of the estuary. Invasion alters the distribution and habits of a range of resident flora and fauna, including shore birds, fish, invertebrates, seagrasses and saltmarsh.
Industry: Infestations progressively invade the immediate and surrounding area of intertidal aquaculture lease zones (e.g. Pacific oysters) altering estuarine sediment dynamics, flow rates and patterns and geomorphology.
Recreation: Rice grass may inhibit coastal access and use, and detrimentally effect recreational fishing and boating.

Regional Planning Considerations

Existing Plans and Strategies:
This management plan is designed to compliment existing policies, plans and strategies that affect the estuary. The following policies, plans and strategies have been identified as having working associations with this area-based management plan:

- Strategy for the Management of Rice Grass (*Spartina anglica*) in Tasmania, Australia 1998.
- Little Swanport Catchment Management Plan (2001)
- Weedplan (Tasmanian Weed Management Strategy 1996);
- Spring Bay Landcare Strategic Plan (1995);
- Marine Farming Development Plan: Great Oyster Bay and Mercury Passage (October 1998);
- Glamorgan Spring Bay Coastal and Marine Management Strategy (1995); and
- Glamorgan-Spring Bay Planning Scheme (1994).

Industry: The Rice Grass Management Steering Group has conducted extensive consultation with marine farmers in the region and the Tasmanian Shellfish Quality Assurance Program. Industry and TSQAP have indicated control efforts using the approved herbicide (Fusilade®) can take place without the closure of oyster farms, provided a daily limit of 7 litres (mixed herbicide) is not exceeded within the estuary.

Management Action

Control Techniques:

- Physical removal, Fusilade® and smothering may all be used to maintain Little Swanport as a *rice grass free zone* during the 2002 growing period and thereafter.

Timing of Control:

- Control efforts need to occur during the growth phase of the plant between November to June. All control efforts will occur on the falling tide when rice grass infestations are fully emerged.

- Chemical control methods will cease to allow a minimum of 3 hours drying time before tidal submersion or when average wind speeds exceeds safe operating conditions

Management Responsibility: Responsibility for planning and implementing control efforts, monitoring and mapping will be shared by DPIWE, industry and the community in accordance with this management plan. Organisation of cooperative work efforts between the DPIWE, industry and/or the community is to be coordinated by the Rice Grass Management Officer. Given funding arrangements, it is expected that the Rice Grass Management Team will not be operative in its current format after the completion of the 2003 control season. Therefore there is a need for management responsibility to shift from the DPIWE to industry and community over the coming years.

Facilitating community and industry involvement:

Facilitating the transfer of management responsibility and ongoing control and monitoring efforts will require a number of key objectives to be met from now until the conclusion of this program. Community and industry in consultation with the Rice Grass Management Team will determine these objectives Tom Tenniswood has agreed to act in the position of Coorodinator for the Little Swanport region.

Expected Outcomes:

- Years 2002-2003: Maintain the estuary as a *rice grass free zone*. Follow up treatment for regrowth to be managed and monitored in agreement with this plan.
- Development of a community and industry based management plan for 2004 and onwards.

Review of Plan

This Area-Based Management Plan will be reviewed by identified stakeholders and DPIWE during winter of 2003 or as required. A report of the review will be made available and mailed to all persons attending the Little Swanport Estuary Rice Grass Management Meeting.