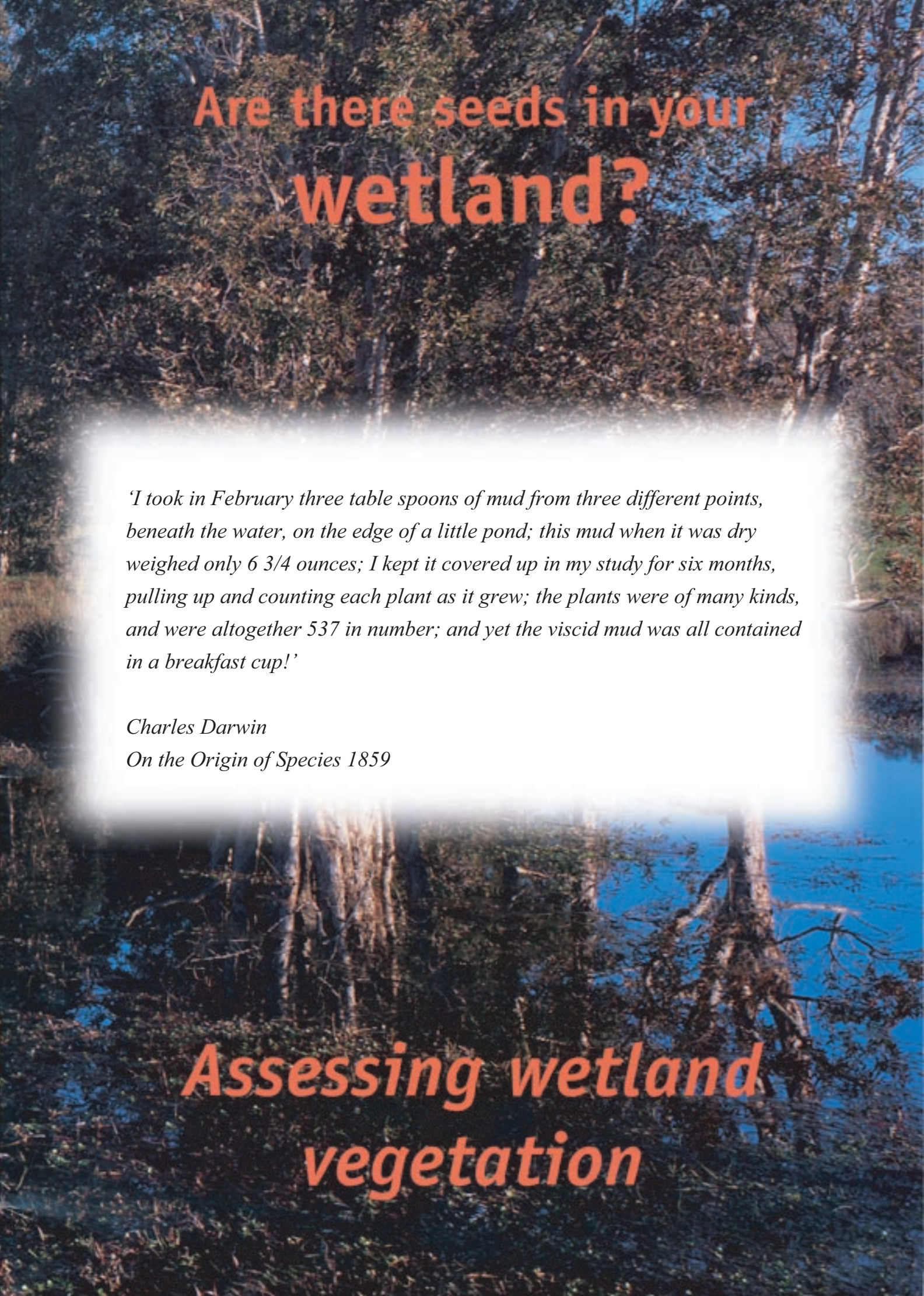

Are there seeds in your wetland?

'I took in February three table spoons of mud from three different points, beneath the water, on the edge of a little pond; this mud when it was dry weighed only 6 3/4 ounces; I kept it covered up in my study for six months, pulling up and counting each plant as it grew; the plants were of many kinds, and were altogether 537 in number; and yet the viscid mud was all contained in a breakfast cup!'

Charles Darwin
On the Origin of Species 1859

Assessing wetland vegetation

This hand book has been produced as part of the wetland research program of the Land and Water Resources Research and Development Corporation (LWRRDC), in association with the Department of Botany, University of New England.

The information contained in this publication has been published by LWRRDC to assist public knowledge and discussion and to help improve the sustainable management of land, water and vegetation. Where technical information has been prepared or contributed by authors external to the Corporation, readers should contact the author(s), and conduct their own enquiries before making use of that information.

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LWRRDC GPO Box 2182, Canberra ACT 2601, July 1997

ISBN 0 642 26692 1

Land & Water Resources Research & Development Corporation

UNE The University of NEW ENGLAND

Are there seeds in your wetland?

Assessing wetland vegetation

Contents

Why assess a wetland?

Wetlands typically contain shallow water, but they may not always be wet. They are areas that are wet for periods of time, so that the animals and plants which live in them are adapted to wet conditions for at Leastpart of their life cycle.

Wetlands are important for many reasons. They are the habitat for a diverse range of animals including water birds, frogs, invertebrates and fish species, as well as waterplants (eg. sedges and rushes) and trees such as the river red gum. Wetlands are the border between terrestrial and aquatic environments, and become strategic refuge areas in times of drought for many plants and animals. They are important breeding grounds and nursery areas for a large range of animals, and estuarine wetlands are linked to the productivity of fisheries.

Wetlands improve water quality downstream, because sediment can settle out in the slow flowing water They can also recycle nutrients, and artificial wetlands are being tested for their ability to perform this function for irrigation drainage water. They are also important in flood mitigation, and can be sites of groundwater recharge. They have important social and cultural functions, can be used for recreation and foreshore protection, and for grazing during droughts. Not the least of their value is their beauty.

In recent years the concept of ecologically sustainable development has focused attention on the health of wetlands. In the past, land management practices and changes to natural river flows have degraded many wetlands, affecting the natural vegetation.

However, now that the of value having wetland is more widely recognised, many people want to know more about their wetlands, and may consider the possibility of rehabilitation. Before any changes are made, it is important to assess the wetland vegetation.

Recent research at the University of New England, New South Wales, has focused on seed banks - the hidden treasure of wetlands, and they are an important part of any wetland assessment. Many healthy wetlands have wet and dry cycles, and although plants might not be obvious at all times, they can still be present as seeds in the mud and soil at the water's edge. Further research on how to make the best use of these seeds in the revegetation of wetland is proceeding.

A publication such as this is not able to give full details of waterplant identification, nor to describe healthy wetland vegetation in detail, because plants and conditions vary so much throughout Australia. A key is given to to identify waterplants by their growth form, a useful starting point for identification. Although some references are given, it is up to the investigator to seek expert guidance about local needs and conditions.

The techniques described in this booklet will help you understand more about the vegetation in your wetland, and how the seeds in the seed bank may germinate when conditions are right for them. The assessment described in this booklet can be the basis of future planning for revegetation projects.

The potential of an aquatic seed bank

People have been wondering about the potential of mud for a long time, as you can see from Darwin's observations.

Recent trials at the University of New England have shown that the muddy soil of wetlands may be a valuable source of seeds which can be germinated for the revegetation of wetlands.

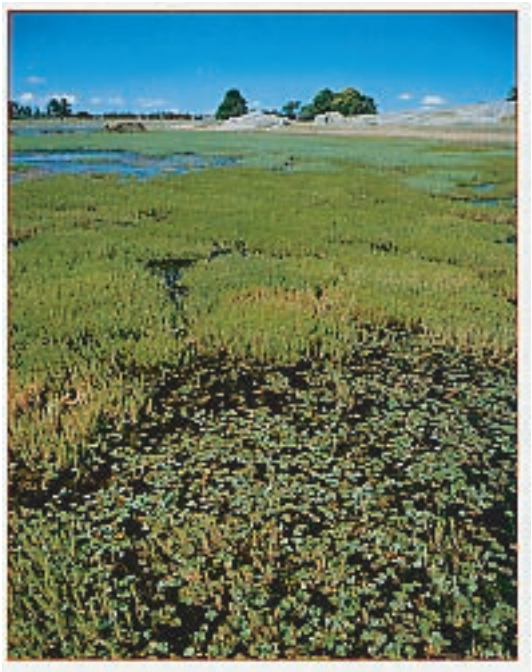
In Australian conditions droughts alternate with re-wetting, so mud may often be closer to dust. However, the ability of seeds to survive in either wet or dry sediments is crucial for the survival of aquatic species.

Entire Marshwort (Nymphoides geminata) and Water Milfoil (Myriophyllum variifolium) on the edge of Llangothlin Lagoon, near Guyra, NSW

In wetland mud you could find:

- The seeds of your own local species of wetland plants
- The seeds of plants which may have arrived during wet weather from other wetlands
- Unwanted weed seeds

This booklet will show you a way to germinate seeds from your wetland and how to decide whether the plants you germinate are useful to you or not. It will also outline a way of surveying your vegetation to find out what species arepresent, and in what density. The assessment section puts all this information together.



Natural wetland edge community, well-vegetated with Nardoo and Water Milfoil. Racecourse Lagoon, Uralla, NSW

Some important thoughts about germinating seeds from wetland mud:

First, the good news.....

The seeds in your wetland mud could provide an inexpensive source of plants for your revegetation project. The plants have been selected by Nature to be suitable for your particular environment. However, you may have to do some legwork to identify the wetland plants you germinate, since plant species vary so much throughout Australia.

. . . . Then the bad news

You may find that you have germinated lots of weeds as well as useful wetland plants. This may be likely especially if there is a local weed problem. It is still useful information to have about your wetland.

Also, ethical considerations . . . . . .

It is not good practice to remove seed bank material from other people's wetlands, or from natural wetlands without appropriate consultation, and permission should be obtained before any material is removed. You might damage another ecosystem, and end up with unsuitable plants for your site anyway. The purpose of embarking on a wetland assessment and germination project is to gain information about your wetland, not degrade other wetlands.

Assessing a wetland

By assessing your wetland you will be able to see whether there are useful native species present, and whether there are many weed seeds within the soil at the wetland edge. This information can be the basis for managing the wetland to keep it healthy.

Assessing a wetland involves several steps which are outlined in the box on the right.

Choosing your wetland site

Select part of a vegetated wetland, pond or river bank that you want to examine. You may choose a farm dam, the bottom of a paddock that floods in wet years, or a site on a creek or river. Your site need not be large or even natural. It could be either wet or dry at the time of your survey.

The survey

You can do a vegetation survey to measure the types and growth density of plants which are already growing in your selected site or sites. You can classify the plants by noting whether they grow on dry land, in mud at the water's edge, or actually in the water. If your wetland is dry at the time of your survey you may not have aquatic plants to survey. However, it is likely that aquatic plants will germinate when it floods.

To do a complete assessment of your wetland, all of the five steps (right) would be necessary. However, it would still be possible to gain useful information about aspects of your wetland by doing either the vegetation survey (1) or the seed germination exercise (2 & 3).

What's involved?

1. The vegetation survey – *finding out what is already there.*

Section One shows you how to survey the plants in a wetland site to find out what plants are already growing, and estimate how many of each group is present. Identification is initially by growth form.

2. Germinating the seeds – *finding out what plants are present as seeds in the wetland mud.*

Section Two outlines a way of collecting samples of wetland sediment and using it to germinate seeds.

3. Identifying the germinated seedlings.

Initially identification may be by growth form. Some useful sources of information on plant identification are listed on p. 16.

4. The results – *comparing the species in the seed bank with the vegetation already growing.*

This step involves drawing up a chart and putting in the results you have obtained from steps 1–3.

5. Making an assessment of the wetland site.

This will mean looking at your results and asking some questions to estimate the health of your site. Then you can make some decisions about its future.

1. The vegetation survey

Purpose: *To construct a profile of the wetland, with plant types plotted on it.*

Step 1. Select an area on your wetland which is well vegetated.

Step 2. Choose a point on the bank that is well above high water line and mark this as the start of your survey. *(The edge vegetation is very important for wetlands and this may be where you have your greatest number of species).*

Step 3. Use a tape measure or string and stake to run a line out towards the centre of your wetland. (See photo on next page).

Step 4. Starting above high water line, you can:
EITHER record each plant that touches the line and its depth above or below the water surface;
OR, if you prefer, use a quadrat (see box p. 7) and look at the plants enclosed in it. Record the number and type of plants in quadrats and record the depth of water.

Where plants are dense and it is difficult to assess numbers, you can still record the types accurately and then estimate the density of each type.

You will need:

• *Essential:* a metre rule; a tape measure; string and stakes; plastic bags for specimens; a notebook.

• *Optional* a garden rake; a 0.5m square quadrat (make this from wood or wire - see photo below). A mask and snorkel (yes, really!), a glass-bottomed bucket, and gumboots or waders would be useful for deep water work.

Equipment for a vegetation survey

Macquarie Marshes, near Quambone, NSW during a dry season.

Step 5. Record each plant by growth form (or name if you know it) using the growth form key in Figure 1 (p. 8).

Step 6. Collect plant specimens to press between sheets of newspaper later, if you wish to identify the plant species further. Approach people with local knowledge of plants in your region or use the references (see p. 16) to help identify plants.

Step 7. Continue to score as far as you can into the water. A garden rake and waders or a mask and snorkel may help in deeper areas.

Step 8. Repeat this procedure for as many places around the wetland as you wish.

Step 9. Identify plants as far as you wish - at least to growth form types but further to plant species if you wish.

Step 10. Using your distance and depth measurements draw a simple profile of your wetland and plot the species you have found on it. See Figure 2 (p.9) for an example of a wetland profile.

What is a quadrat, and how do you use it?

A quadrat is a simple square frame which will help you define a particular area. A useful size is to make the sides 0.5m in length, and then the square will enclose an area of 0.25 m^2. It can be made of wire, short lengths of conduit or any other similar material.

Use the quadrat by placing it on your line at set intervals, eg 1m or 5m. If the vegetation is dense, use the 5m distance. You can then survey the plants that are enclosed by the square (see photo, top right).

Sampling edge community species presence and abundance within the quadrat. Note the 30m tape laid out along the transect line.

Sampling in deeper water. Waders are useful here, as well as protection against the sun and insects.

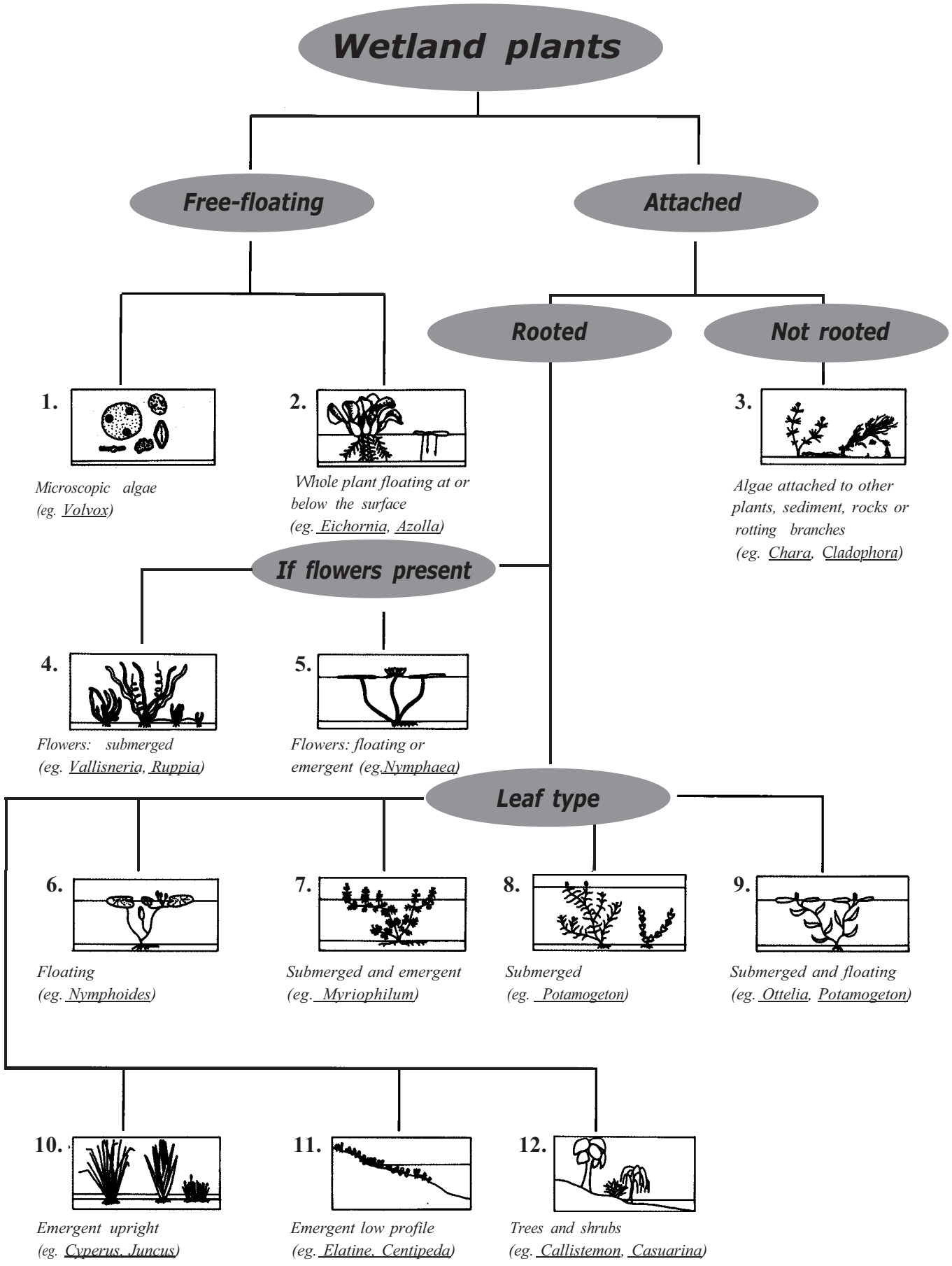


Figure 1. Growth forms of wetland plants

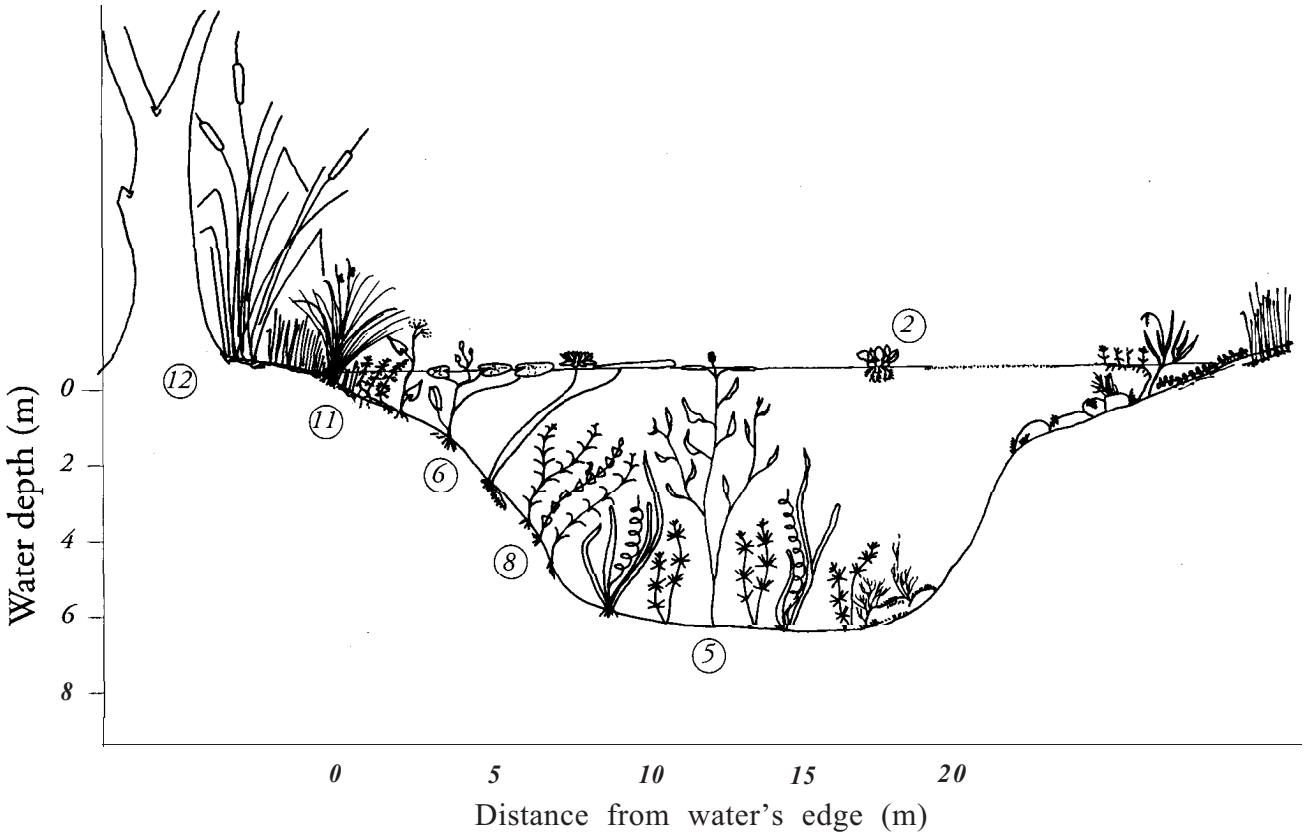


Figure 2. Wetland profile and plot of growth forms

2. Germinating the seeds

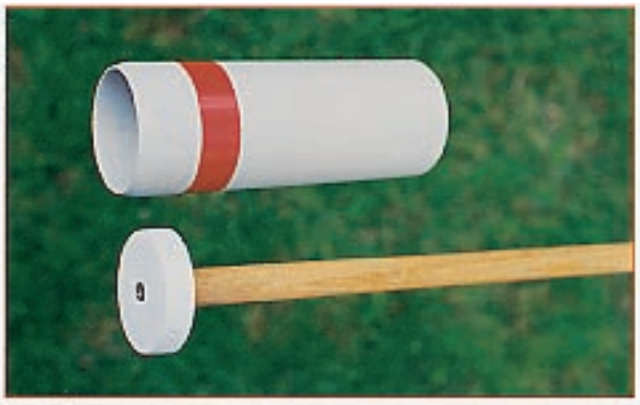
Purpose: *To collect wetland sediment and germinate the seeds lying within it.*

You will need:

- Your selected wetland, be it a creek site, the edge of a farm dam or part of a river bank.
- Some plastic containers that will hold at least 5cm of water (takeaway, margarine or icecream containers will do).
- A short (10–15 cm) length of PVC or metal pipe (about 5cm in diameter) for taking soil cores from wetland sites (similar method to using a cookie cutter, see photos right). One end of the pipe should be sharpened with a file. To get the soil core out easily, a simple 'extractor' can be made by screwing a jam jar lid to a piece of dowel.
- Tank or tap water
- A sunny spot that will not be disturbed by pets or children.

Taking a soil core with the corer.

Gently pushing the core out, using the extractor.



Detail of soil corer and extractor. The corer is marked with tape to indicate the depth of the core.

Soil cores, top side up, ready for drying.

What to do:

Step 1. Select soil from areas where the vegetation looks reasonably uniform along or near to the transect you surveyed. You might choose to collect some cores from near the water and some from below water, and to keep these cores separate.

Step 2. Collect a number of cores of soil (to a depth of about 2.5cm) from different places within the area chosen, using the PVC pipe (see pictures on p. 10). Collect five to eight cores for each container you wish to germinate. The more containers germinated from each area, the more reliable your results will be. But even one container will tell you something.

Step 3. If you wish, measure the diameter of your corer so that you can calculate the area sampled. In this way you can work out the number of germinating seeds per square metre (see Table 1 p. 12 for easy conversion figures).

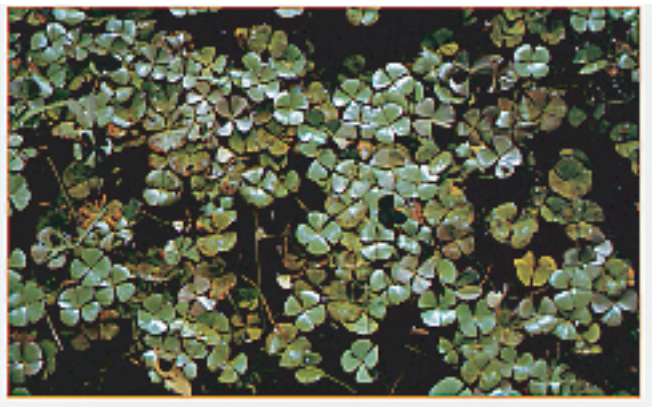
Step 4. Place the collected cores of soil into a tray the right way up (that is with the top surface facing upwards).

Step 5. Leave the samples to dry in the sun for 10 days before adding water. Place the trays in a sheltered place with plenty of light where they won't be disturbed or knocked over.

To germinate aquatic species, fill half the trays from each site with water. For the species which prefer dryer conditions, keep the rest of the trays damp as you would to germinate vegetable or flower seedlings.

The tray on the left contains air-dried soil cores. The centre and right trays have been re-wetted. Note the different water levels necessary for germinating both land and aquatic species.

The left-hand tray has been kept moist for 12 weeks to allow germination from the seed bank. 272 seedlings of 14 species were identified.



Floating Leaves of the water fern, Nardoo (Marsillea angustifolia). Racecourse Lagoon, Uralla, NSW

3. *Identifying the germinated seedlings*

Purpose: *To get some idea if the plants you have germinated are land plants, aquatic plants or weeds.*

Step 1. Record the number of individuals and number of species of plants germinating from the seed bank at set intervals of time (eg. the same day each week).

Step 2. You may find it difficult to identify the species of your seedlings at this stage. However, you will certainly be able to distinguish aquatic from land plants. And you will be surprised at how many you can match to the plants you have recorded in your vegetation survey. You might like to draw or photograph your seedlings at this stage as a record of what you they look like when small. Using pins with coloured heads to mark particular plants can help you follow individuals as they grow.

Weeds: If there is a weed problem in your area, you could collect some weed seeds and germinate them at the same time, to help you recognise the young weed plants.

Step 3. You might like to look at and draw the seeds as well. This could be useful in getting to know your wetland better. Remember, this exercise is all about getting to know YOUR wetland and ITS potential for revegetation.

Step 4. Draw up a table with the number of seedling types you have found, the number of each type and the names or identifications of plant type you have given the seedlings. See Figure 3 (p. 13) for an example.

Seedlings marked with coloured pins to follow their individual progress as they grow.

How many seedlings per square metre?

You need to know the area of the corer, the number of cores per container, and the number of germinating plants per container.

To find the area of the corer:
For a rectangular corer, multiply length by width; for a circular corer, measure the radius (r) (half the diameter) and multiply πr^2 (π is 3.14).

Example:
A 5cm diameter (2.5cm radius) jar; 8 cores per container; average number of seeds germinating per container = 64
Area of corer = 3.14x 2.5x 2.5= 19.6 sq cm
Total soil area = 19.6 x 8 = 157 sq cm
So 64 seeds germinated from 157 sq cm of soil.
A sq metre is 10,000sq cm, so the number of seeds per sq metre =10,000/157x64=4,076

ie. The wetland has the potential to produce at least 4,076 plants per sq metre

Table 1. *Calculating germinated plants per square metre.*

Wetland 1

Plant type	Container number					
	1	2	3	4	5	6
Leaves low profile (11)	1	–	2	–	–	–
Unknown A	2	1	–	4	1	–
Unknown B (9)	10	5	6	2	8	5
Reed A (10?)	6	4	3	15	3	1
Weedy species A	4	50	6	12	3	1
Weedy species B	7	12	30	17	6	9
Grass A	4	5	3	6	7	2
Grass B	213	1	3	4	1	5
Ribbonweed?	2	2	1	2	1	3
Duckweed	1	–	1	1	–	–
Feathery submerged (8)	3	21	7	11	2	13
Water lily? (6)	4	11	7	2	3	9

Figure 3. Example of results from the germination trial

4. Comparing the results

Purpose: *To compare information from the survey and the germination trial to assess the wetland.*

You can use the information from your survey and germination trials to match the plant types present as seeds in the mud with those already growing in the wetland. You can use the following questions to organise your results.

Putting it all together .....

1. How many types of plants were growing in your wetland?

2. How many plant types germinated from the sediment samples?

3. How many plant types occurred in both the vegetation and the seed bank?

4. How many plant types occurred germinating from the mud, but were not found actually growing in the wetland?

5. How many plant types were found growing in the wetland but did not appear to germinate from the mud? (Remember that there could still be dormant seeds in the sediment).

6. How many types of plants do you think are submerged aquatic plants? Which types are dominant? You could use Figure 1 to help answer this question.

7. How many types of plants do you think are emergent aquatic plants? Which ones are dominant?

8. How many types of plants do you think are floating aquatic plants? Which types are dominant?

9. How many types of plants do you think are amphibious plants that grow at the water's edge? Which types are dominant?

10. Did you identify any undesirable species which you would not want to encourage?

11. Did you identify any species or combinations of species that you would like to encourage?

5. Assessing the wetland site

After completing the steps of this assessment, you will now know a lot about what is in your wetland and what is in the seed bank.

What next?

You can use this information to imagine what sort of vegetation you would have in your wetland if it fully rehabilitated, and plants of suitable species for your area were growing in the right proportion to each other. You could get some expert advice to see what is possible andpractical.

Within certain limits, you may be able to manipulate your wetland to encourage some species or to discourage others. We are at present continuing research on how best to do this, but examples of the kind of manipulation that may be useful can include:

• Lowering or raising water levels to encourage or discourage particular species. You may know some local examples of this.

• A small amount of mud containing a desirable seed bank may be used to help establish vegetation in a nearby wetland which has become degraded. We recommend the tablespoon or teacup as a suitable sized unit for such transfers. Just as Darwin wrote, 537 seedlings germinated from only three tablespoons of sediment.

Please remember that robbing one wetland of part of its potential in order to regenerate another degraded wetland is a risky environmental practice. Obtain professional advice before transferring any seed bank material.

Wetland plant community dominated by Potamogeton trincarinatus and Paspalum distichum, Racecourse Lagoon, Uralla, NSW

Wetland plant species provide habitat for all kinds of wild life. This photo shows an adult dragonfly emerging from the nymph *stage. Llangothlin Lagoon, near Guyra, NSW*

References

Many references may be available by ordering through your local library. Also, your local Landcare or Rivercare group, or Greening Australia may be able to help you.

You may have to use your ingenuity to obtain help in identification, seeking out local experts, Departments of Agriculture, or CSIRO.

Texts

The first text contains general information about wetland plants. The others will be more useful in assisting you to identify your plants.

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   e.g. Harden, G. (editor). (1990, 1991, 1992, 1993). *Flora of New South Wales: Vol 1–4.* New South Wales University Press.