# A SCHEME FOR ASSESSMENT OF THE NATURE CONSERVATION VALUE OF WETLANDS

**G. Winning**
Shortland Wetlands Centre
P.O. Box 130 WALLSEND 2307

## ABSTRACT

A scheme for the assessment of the relative nature conservation value of wetlands was developed for a study of the regional value of the wetlands of the Tomaree Peninsula at Port Stephens, NSW (Shortland Wetlands Centre 1988).

The scheme involves the use of a decison tree using special features, representativeness, alteration and vegetation/habitat as the main attributes, with the rating for vegetation/habitat being determined using a number of parameters. Separate vegetation/habitat rating processes were developed for estuarine and freshwater dunal wetlands, both of which occurred in the Tomaree Peninsula study area.

It is not intended that this assessment scheme be considered as definitive, but rather as an example developed for a specific purpose. It is presented here only to encourage continuing discussion on the subject.

An alternative approach to the assessment of the conservation priorities of wetlands is also briefly discussed.

## INTRODUCTION

A number of wetland assessment schemes have been developed in recent years, usually with the aim of assessing relative nature conservation value (recent examples in New South Wales include Pressey 1981, Gilligan 1984, Broadbent & Stewart 1986, Pressey 1987a, b). Each author of such a scheme has generally adopted a different approach to wetland value assessment, and there is no general agreement as to the best approach(es) (see Pressey 1985).

The selection of an assessment method and attributes which reflect conservation value depends to some extent on intuitive preferences, in addition to the aims of the study, types of wetlands and available resources.

The scheme presented here was developed to assess the relative nature conservation values of the wetlands of the Tomaree Peninsula, and was presented, along with the results of the assessment, in the study report (Shortland Wetlands Centre 1988). The methodology used in the scheme has been detailed here, along with some additional comments, to present it to a wider audience and to make it available for critical evaluation.

No attempt has been made to review previous assessment schemes, nor to compare them to the present scheme, although some discussion of the attributes selected by other schemes is provided in commenting on the choice of attributes for this scheme.

## ASSESSMENT UNITS

The conservation values of different types of wetlands were not considered to be directly comparable. A She-oak wetland, for example, would always rate lower for habitat diversity, based on variety of vegetation structure, than most freshwater dunal wetlands. Accordingly it was decided to rate wetlands within four basic types. The wetland types were defined largely on the basis of soil type, water salinity and vegetation. Data on soil types was obtained from surveys undertaken by the Soil Conservation Service of NSW for the Department of Environment & Planning (DEP 1982).

Estuarine Type - Wetland communities growing on estuarine sediments which are usually high in nutrients. As well as mangrove forests and saltmarshes, this type has been defined to include some small patches of *Casuarina* forest and fringing strips of *Melaleucas*. Seagrass communities were excluded from this study. The dominant water source for this type is saline tidal water, although fresh water from creeks etc. can also be an important influence.

Swamp-Oak Type - Communities dominated by *Casuarina glauca* and occurring on soils derived from estuarine sediments. Only one wetland dominated by this type was included in the study.

Paperbark Type - Freshwater communities occurring on alluvial sediments based on soils apparently comprising sandy podzols formed over estuarine sediments. These communities are often dominated by *Melaleuca quinquenervia*, commonly with wet heath species, *Blechnum indicum* and sedgeland dominated by *Gahnia clarkei* and *Restio tetraphyllus*.

Sedge Type - Freshwater communities occurring on alluvial sediments based on sandy podzols. This type is characterised by sedgelands dominated by species such as *Baumea teretifolia, Lepironia articulata* and *Restio pallens*. *Melaleuca quinquenervia* and other species of the Paperbark Type also occur, but usually at lower densities.

As a number of wetlands on the Tomaree Peninsula comprised more than one of these wetland types, it was necessary to divide such wetlands into two or more units for the purpose of assessment. Thus the methodology did not necessarily assess wetlands as discrete physiognomic units, but assessed units each of which comprised only one wetland type.

## ATTRIBUTES USED

There is no general agreement on the best attributes for assessing the conservation value of wetlands. In the past most authors of such assessments have adopted different approaches, although they have sometimes used similar attributes (see Pressey 1985, Broadbent & Stewart 1986 for summaries). Most of these schemes have attempted to assess conservation value by rating such attributes as species diversity, habitat diversity, habitat representativeness, interspersion of habitat types, and some rating of the surrounding habitat and/or land use. In practice, the selection of attributes will generally depend on the nature of the specific study.

Pressey (1985) placed wetland assessment attributes into two categories, those which reflect intrinsic biological or conservation value, and those which reflect conservation capability, although he acknowledged that some attributes, such as surrounding vegetation, reflect both intrinsic value and conservation capability.

The present scheme sought to assess the nature conservation value of the wetlands within the context of the Tomaree Peninsula and therefore for this study it was decided to use only attributes which reflected intrinsic value.

The scheme was designed to permit most of the actual assessment to be done directly from aerial photographs and maps. However, some fieldwork was necessary at each of the wetlands to compare aerial photograph patterns with actual communities, and to identify any rare or significant species. The attributes selected for this scheme were: (1) special features, (2) representativeness, (3) alteration and (4) vegetation/habitat which incorporated parameters which assessed both the wetland and surrounding habitat.

### Special Features

A special features attribute has been used by many authors (e.g. Pressey 1981 and Broadbent & Stewart 1986) to include unique features which might otherwise not be conserved. The special features used in this scheme were:

- used by large numbers of migratory waders (international and national significance);
- presence or likely presence of rare or significant animal species (as defined by Schedule 12 of National Parks and Wildlife Act 1974) (national or state significance);
- presence of rare or significant plant species (as defined by Leigh *et al.* 1981) (national or state significance);
- wetland surrounding, or filtering run-off flowing into, oyster nursery areas (national, state or regional significance); and
- presence of animal or plant species uncommon in area (Hunter/lower north coast) (regional significance).

### Representativeness

In any wetland evaluation, it is desirable to assess the degree to which each wetland represents a wetland community or type within a specified area. Such information is basic to ensuring adequate representation of all wetland types within a conservation program.

This study assessed the representativeness of each of the four broad wetland types (Estuarine, Swamp-oak, Paperbark and Sedge Types) on the Tomaree Peninsula with respect to each wetland. The use of wetland types in this study was based on the assumption that if wetland types are defined in such a way as to represent the full range of different environments in which wetlands occur within a study area, then the adequate representation in reserves of all wetland types should generally also result in adequate representation of all plant species and faunal habitats in the area, making further assessment of representativeness of plant communities and faunal habitats within types unnecessary.

Representativeness of a wetland of its type was measured as a simple percentage of the area of the wetland over the area of that wetland type within the Tomaree Peninsula.

### Alteration

The conservation value of a wetland can be reduced by human modification of the wetland such as drainage, clearing, filling, excessive nutrient or sediment input, etc. Evidence of such changes are exhibited by changes in the water regime and the vegetation of the wetland; for example, a drop or increase in water level can lead to a change in dominant vegetation; and excessive nutrient input will also often lead to a change in vegetation with an increase in the number of those plants prefering high nutrient conditions, especially weeds.

Pressey (1985) considered that modification or alteration of a wetland would be reflected in other attributes such as biological diversity, and therefore advised against using alteration as an attribute of biological value. However, the present study did not involve the same amount of detailed biological inventory work undertaken by Pressey (e.g. Pressey 1981), and therefore it was considered desirable to rate modification as a separate attribute. However, it was considered undesirable to subjectively rate different degrees of alteration, and instead it was decided to only assess whether or not a wetland was significantly modified.

This attribute was assessed subjectively for the Tomaree study, although it would be possible to increase objectivity by identifying criteria to define significant alteration (e.g. see Adam *et al.* 1985). Although a number of disturbances, especially drains, could be identified from aerial photographs, ground observations were required to determine the effectiveness of the drains in altering wetland hydrology.

### Vegetation/Habitat Rating

The intrinsic biological or conservation value of a wetland has been generally assessed in the past by including a range of attributes which reflect various vegetation and habitat characteristics. Because of the general dependence of faunal habitat on vegetation, they were treated by this scheme as one character. Several attributes were used which sought to assess vegetation/habitat value by rating each wetland for diversity of vegetation/habitat and for the habitat value of surrounding vegetation.

As it was considered that the vegetation/habitat values of the several different wetland types being examined in this study were not directly comparable, it was decided to develop two different, but parallel, schemes to determine vegetation/habitat ratings for estuarine type wetlands, and freshwater dunal wetlands (Paperbark and Sedge Types). A vegetation/habitat rating scheme was not developed for the only Swamp-oak wetland included in the study, as it received a high conservation value rating because it was the only wetland of the type, making further assessment unnecessary.

The attributes used were:

**Vegetation/Habitat Value - Freshwater Wetland Types**

Because of the variety of communities which occur in freshwater wetlands (even in a limited subset such as dunal wetlands) and the lack of knowledge of the value of each community type, it was considered appropriate to assess these wetlands in terms of the diversity of habitats which they provide rather than the value of the habitats.

Community Diversity (Number of communities within wetland)

This attribute rated the number of broad communities which occurred within the wetland. The communities were defined on the basis of broad structure and dominant floristics. The communitiy types identified for this study were:

open water
closed *Melaleuca* forest (sparse understorey)
*Melaleuca* forest (*Blechnum* understorey)
*Melaleuca* woodland (*Gahnia* / wet heath understorey)
*Melaleuca* woodland (sedge understorey)
sedgeland (e.g. *Lepironia, Restio pallens* )
*Gahnia* sedgeland / wet heath
wet heath / "dry" sedgeland
wet heath

Relative Extent of Communities (Standard deviation of % areas of each community)

Whilst there has been insufficient research to identify optimal spatial relationships of communities in wetlands (Pressey 1985), it is considered that a wetland with more evenly represented communities (e.g. 40%, 30% and 30%) can be regarded as having a greater diversity than one in which the spatial representation is less balanced (e.g. 80%, 15% and 5%). This attribute used standard deviation as a means of obtaining a single value to represent a series of values (one for each community), as standard deviation was found to be related to eveness such that a higher score was produced for wetlands in which the different communities are more or less evenly represented.

Wetland size.

Whilst there is some debate as to the usefulness of size as a measure of habitat value (see Pressey 1985, Broadbent & Stewart 1986) and it can be argued that many small wetlands may have a high conservation value despite their size, it is generally acknowledged that larger natural areas can support a greater diversity of species (Usher 1986), probably because, on average, habitat diversity increases with area (Simberloff 1986). (However, it should be noted that several small wetlands may have greater diversity than one large wetland with the same total area). Other advantages of large wetlands are summarised by Pressey (1985). Wetlands size was rated in this study primarily because of the general relationship between size and habitat diversity.

**Vegetation/Habitat Value - Estuarine Wetland Type**

It was considered inappropriate to assess estuarine wetlands with the same diversity attributes as used for the freshwater types because they do not exhibit the same community diversity; estuarine wetlands have only two broad community types, mangrove and saltmarsh (seagrass beds were not considered to be wetlands). The main habitat role of estuarine wetlands is as habitat for juvenile fish, prawns, crabs etc., as well as the animals which feed on them. The vegetation/habitat rating for estuarine wetlands seeks to reflect this role.

Proportion of Total Estuary (% area of mangrove/saltmarsh communities in wetland compared to total area of mangroves/saltmarsh in Port Stephens)

It is well recognised that estuarine communities in general, and mangrove communities in particular, play a significant role in the estuarine food chain (e.g. see Hutchings & Saenger 1987). Whilst it is not possible to absolutely assess the relative value of different wetlands with reference to this role without detailed studies, it is desirable to develop some indicative criterion to evaluate this feature.

This attribute sought to evaluate the relative estuarine habitat value of the wetland by comparing the area of mangrove and saltmarsh communities in the wetland to the total area of these communities in the Port Stephens estuary as mapped by West *et al.* (1985). The broader context of Port Stephens was considered necessary for this attribute because of the total estuary nature of fish and prawn nursery habitat. The rating for mangrove communities is weighted slightly higher than the rating for saltmarsh communities based on the assumption that the wetter estuarine communities (mangroves) have a higher habitat value than the drier communities (saltmarsh) (see Hutchings & Saenger 1987, West *et al.* 1985). In communities in which mangroves and saltmarsh occur together, the mixed community was classed as mangroves for the purposes of this attribute (after West *et al.* 1985).

Wetland size.

This attribute was included for the same reason it was included for the Freshwater Types.

**Surrounding Habitat**

The same set of attributes are used for all types of wetlands.

Surrounding Community Diversity (Sum of weighted proportions of communities occurring in 100 m zone around wetland)

Many animal species which use wetlands rely on surrounding drylands for supplementary habitat, and many upland species use wetlands (e.g. see Schitoskey & Linter 1978). Accordingly, this attribute sought to assess the diversity of habitat types surrounding the wetland. Previous assessment schemes have used a zone of or about 300 m (Pressey 1981, Gilligan 1984, Broadbent & Stewart 1986) to assess surrounding habitat, although all of these authors acknowledge the arbitrary nature of such a zone.

A smaller surrounding habitat zone of 100 m was used for this scheme because of the relative closesness of all of the wetlands to one another within the study area. The percentage area for each community was multiplied by a weighted factor which sought to place greater importance on more "natural" habitats. The total of these weighted factors is the "sum of the weighted proportions of communities". The factors used are listed in Table 1.

| Broad Community | Factor |
|---|---|
| More or less undisturbed natural communities (e.g. forest, heath, wetland,waterbodies) | 3 |
| Cleared or significantly disturbed areas generally used for agricultural purposes or, in the case of Tomaree, previously sand mined | 2 |
| Urban areas | 1 |

Table 1. Community types and weighting factors used to assess surrounding community diversity

Continuation of Wetland Habitat (% of wetland margin adjacent to other wetland unit)

This attribute rated the continuation of wetland habitat outside the boundaries of the wetland unit itself, and applied only to those physiognomic wetlands which were divided into one or more units for the purposes of assessment (see above). This attribute is complimentary to the previous attribute, and gives greater value to wetland over other natural communities as surrounding habitat. Thus if a wetland unit had a boundary along another wetland unit it scored higher than one that did not.

Proximity to Other Wetlands (% area of wetlands within 500 m zone around wetland)

There is some dispute as to the effect of isolation of natural areas on species diversity (e.g. see Margules *et al.* 1982). Whilst isolation is likely to have little effect on more mobile species such as birds, the movement of less mobile species, such as frogs, could be restricted. Proximity to other wetlands was rated for this reason.

Ideally, a measure of proximity should consider a wetland within the context of the spatial distribution (location, size, shape and intervening habitats) of all of the wetlands within the study area. However, this would require complex measurements and calculations which would imply a precision which is not justified in such a study.

Instead, the chosen measure sought to simply assess the amount of wetland habitat within an arbitrary zone around the wetland. A zone of 500 m was selected primarily because of the relative proximity of the wetlands on the Tomaree Peninsula. No attempt was made to differentiate between the different wetland types which, although justifiable, would unnecessarily complicate the picture.

## ASSESSMENT

The assessment process was undertaken with the aid of a decision tree and sought to derive a value for each wetland which is either high, moderate or low.

The decision tree (see Figure 1) places a hierarchy of importance on the selected attributes. Thus if a wetland had a special feature, it registered a high conservation value regardless of its representativeness, degree of alteration or vegetation/habitat rating. Similarly, if a wetland did not have a special feature but represented 50% or more of its wetland type within the study area, it received a high conservation value regardless of its degree of alteration or vegetation/habitat rating.

Wetlands which exhibited substantial alterations to water regime and/or vegetation as the result of drainage, clearing, filling, nutrient input etc. were rated as low conservation value unless they possessed a special feature or represented 50% or more of the wetland type in the study area. Wetlands which did not have a special feature, were not significantly altered and were not highly representative of their type were rated solely on their vegetation/habitat rating. Tables 2 and 3 set out the details of the vegetation/habitat rating determination process.

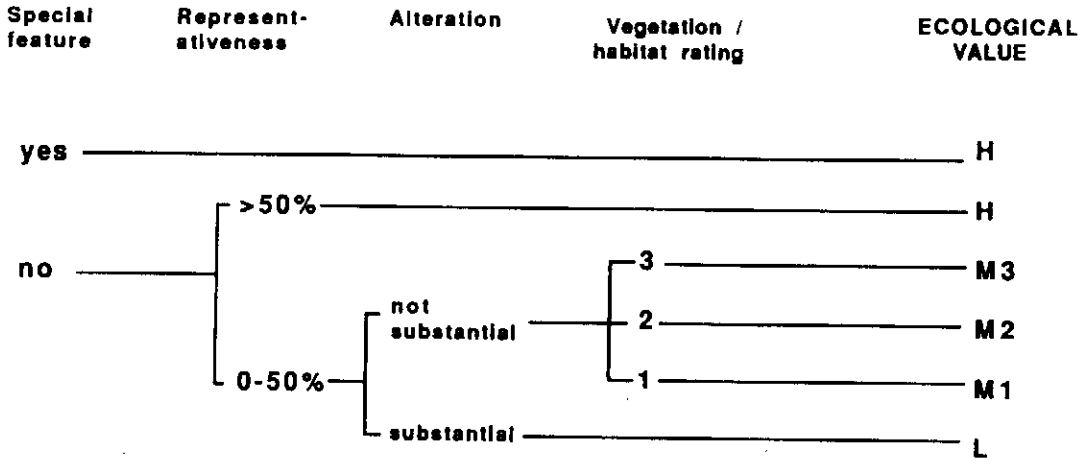


Figure 1. Decision tree for assessing the ecological value of wetlands

| Wetland Vegetation/Habitat Diversity | | | | | |
|---|---|---|---|---|---|
| Community Diversity | | Relative Extent of Communities | | Size of Wetland | |
| Number of communities within wetland. | Rating | Standard deviation of % areas of each communities | Rating | Size of wetland | Rating |
| ≥ 3 | 3 | < 10 | 3 | > 50 ha | 3 |
| 2 | 2 | 10-20 | 2 | 10 - 50 ha | 2 |
| 1 | 1 | > 20 | 1 | < 10 ha | 1 |

| Surrounding Habitat | | | | | |
|---|---|---|---|---|---|
| Surrounding Community Diversity | | Continuation of Wetland Habitat | | Proximity to Other Wetlands | |
| Sum of weighted proportions of communities occurring in 100 m zone around wetland* | Rating | % of wetland margin adjacent to other wetland unit | Rating | % area of wetlands within 500 m zone around wetland | Rating |
| 201 - 300 | 3 | > 50 | 3 | > 50 | 3 |
| 101 - 200 | 2 | 10 - 50 | 2 | 10 - 50 | 2 |
| 0 - 100 | 1 | < 10 | 1 | < 10 | 1 |

* See text for explanation.

| Overall Rating for Vegetation/Habitat | |
|---|---|
| Sum of individual ratings for vegetation/habitat diversity surrounding habitat and modification | Overall rating for vegetation/habitat |
| 17 - 21 | 3 |
| 12 - 16 | 2 |
| 7 - 11 | 1 |

Table 2. Determination of vegetation/habitat rating for Freshwater Wetland Types.

| Wetland Vegetation/Habitat Value | | | | | |
|---|---|---|---|---|---|
| Proportion of Total Estuary - Mangrove | | Proportion of Total Estuary - Saltmarsh | | Size of Wetland | |
| % area of wetland mangrove communities compared to total area of mangroves in Port Stephens | Rating | % area of wetland saltmarsh communities compared to total area of saltmarsh in Port Stephens | Rating | Size of wetland | Rating |
| > 10 | 3 | > 15 | 3 | > 50 ha | 3 |
| 1 - 10 | 2 | 5 - 15 | 2 | 10 - 50 ha | 2 |
| < 1 | 1 | < 5 | 1 | < 10 ha | 1 |

| Surrounding Habitat | | | | | |
|---|---|---|---|---|---|
| Surrounding Community Diversity | | Continuation of Wetland Habitat | | Proximity to Other Wetlands | |
| Sum of weighted proportions of communities occurring in 100 m zone around wetland * | Rating | % of wetland margin adjacent to other wetland unit | Rating | % area of wetlands within 500 m zone around wetland | Rating |
| 201 - 300 | 3 | > 50 | 3 | > 50 | 3 |
| 101 - 200 | 2 | 10 - 50 | 2 | 10 - 50 | 2 |
| 0 - 100 | 1 | < 10 | 1 | < 10 | 1 |

* See text for explanation.

| Overall Rating for Vegetation/Habitat | |
|---|---|
| Sum of individual ratings for vegetation/habitat diversity surrounding habitat and modification | Overall rating for vegetation / habitat |
| 17 - 21 | 3 |
| 12 - 16 | 2 |
| 7 - 11 | 1 |

Table 3. Determination of vegetation/habitat rating for Estuarine Wetland Type.

## DISCUSSION

Application of the scheme on Tomaree Peninsula resulted in 5 wetlands being ranked as high conservation value, 34 as moderate, and 1 as low. This result was largely due to the absence of rare species, and the relatively undisturbed nature of most of the wetlands, resulting in most of the wetlands being ranked as being of moderate conservation value. Further subdivision of the moderate wetlands produced similar results (6 of M1; 27 of M2; 1 of M3). These results are considered likely to be typical of any similar set of wetlands in a relatively undisturbed environment.

Subdivision of the moderate value wetlands based on vegetation and habitat characteristics, although justifiable for habitat evaluation, was probably a somewhat artificial means of determining relative values amongst these wetlands. Although there is a wealth of literature identifying relationships between various parameters and wildlife value (e.g. see Usher 1986), the variations in habitat diversity within a relatively small set of wetlands of similar types are unlikely to be significant enough to justify rating them. Also, the temporal variability of much wetland vegetation (and therefore habitat) makes it difficult to place a definitive habitat value on any one wetland.

It is now considered that all of the wetlands which fell into the moderate class should be considered to have similar nature conservation values, even though they can be rated differently using habitat evaluation techniques. This point suggests a wetland assessment scheme which seeks only to identify wetlands of high value and significantly modified wetlands, with all other wetlands being considered to be of similar (moderate) conservation value. Conservation and management priorities among the moderate value wetlands would then be determined on the basis of a range of extrinsic attributes reflecting manageability, education values, etc., such as land tenure, land use, proximity to schools, etc. Extrinsic attributes are preferred to intrinsic biological attributes at this level because the use of intrinsic attributes implies a distinction in conservation value which is considered to be artificial. This approach is portrayed diagrammatically in Figure 2.

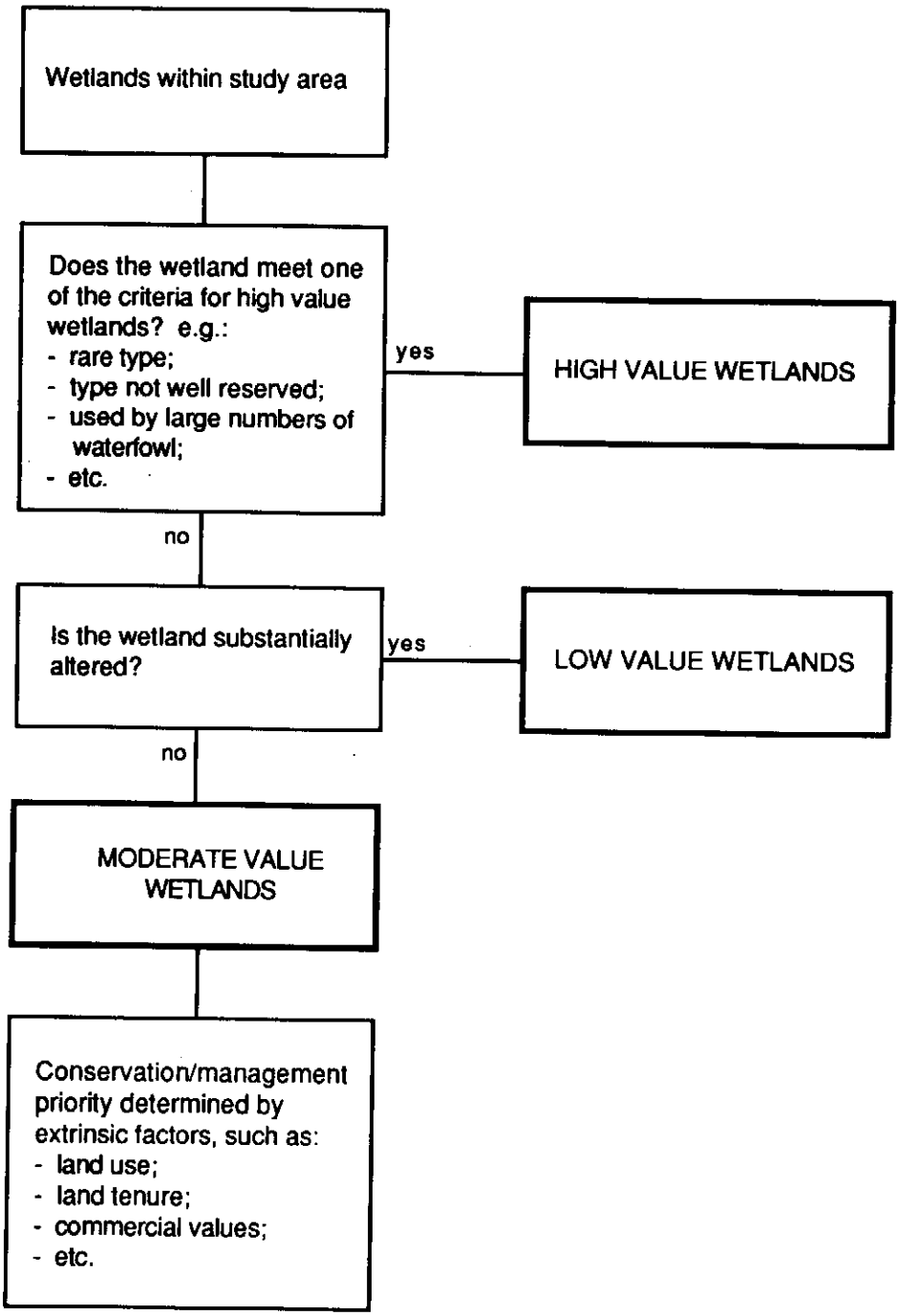


Figure 2. Assessment of conservation and management priorities of wetlands.

For such an approach to be effective, it is essential that the criteria used to select high value wetlands adequately cover biological conservation goals. Pressey (1985) detailed these goals as "preserving biological diversity, maintaining a complete range of existing natural environments, and protecting areas with a relatively high carrying capacity for fauna". The criteria used to select high value wetlands for the Tomaree study would be inadequate for larger studies (e.g. statewide), and it would be necessary to define a more extensive set of criteria such as those developed for the Victorian Wetland Conservation Program (Anon 1988).

Although this new suggested approach is based on experience in the application of wetland assessment schemes, it must be stressed that it is only hypothetical at this stage and needs to be tested.

**REFERENCES**

Adam, P., Urwin, N., Weiner, P. & Sim, I. (1985) *Coastal Wetlands of New South Wales - A Survey Prepared for the Coastal Council of New South Wales.* Department of Environment and Planning, Sydney.

Anon (1988) *Wetlands Conservation Program for Victoria.* Department of Conservation, Forests & Lands, Water Victoria, and Ministry for Planning & Environment.

Broadbent, J.A. & Stewart, R.S. (1986) *North Ocean Shores Regional Environmetal Study.* Prepared for Ocean Shores Development Corporation by Jackson, Teece, Chesterman and Willis Pty. Ltd.

Department of Environment & Planning (1982) *Hunter Region - Soil Types,* Map Sheets 25, 26, 30 & 31. DEP, Newcastle. Unpublished

Gilligan, B.J. (1984) A wetland habitat assessment scheme. *Wetlands (Aust.),* 4(2): 49-55.

Hutchings, P. & Saenger, P. (1987) *Ecology of Mangroves.* University of Queensland Press, St. Lucia.

Leigh, J., Briggs, J. & Hartley, W. (1981) *Rare or Threatened Australian Plants.* Australian National Parks and Wildlife Servce Special Publication 7, Canberra.

Margules, C., Higgs, A.J. & Rafe, R.W. (1982) Modern biogeographic theory: are there any lessons for nature reserve design. *Biological Conservation* 24: 115-128.

Pressey, R.L. (1981) *A Survey of the Wetlands of the Lower Hunter Floodplain, NSW.* National Parks & Wildlife Service, Sydney.

Pressey, R.L. (1985) Some problems with wetland evaluation. *Wetlands (Aust.)* 5(1): 42-51.

Pressey, R.L. (1987a) *A Survey of the Wetlands of the Lower Macleay Floodplain, NSW.* National Parks & Wildlife Service, Sydney.

Pressey, R.L. (1987b) *A Survey of the Wetlands of the Lower Clarence Floodplain, NSW.* National Parks & Wildlife Service, Sydney.

Shortland Wetlands Centre (1988) *Tomaree Peninsula Wetlands Study.* A report prepared for Port Stephens Shire Council. Unpublished.

Schitoskey, F. & Linter, R.L. (1978) Use of wetlands by upland wildlife. In Greeson, P.E., Clark, J.R. & Clark, J.E. (eds.) *Wetland Functions and Values: The State of Our Understanding.* American Research Assoc., Minneapolis.

Simberloff, D. (1986) Design of nature reserves. In Usher, M.B. (ed.) *Wildlife Conservation Evaluation.* Chapman and Hall, London.

Usher, M.B. (1986) Wildlife conservation evaluation: attributes, criteria and values. In Usher, M.B. (ed.) *Wildlife Conservation Evaluation.* Chapman and Hall, London.

West, R.J., Thorogood, C.A., Walford, T.R. & Williams, R.J. (1985) *An Estuarine Inventory of New South Wales.* Fisheries Bulletin 2. Department of Agriculture, Sydney.