3. Ecological Character Analysis: Baseline and Monitoring Information

3.1 Introduction

The requirement of Article 3.2 of the Ramsar text, basically requests Contracting Parties to inform the Convention if the ecological character of a wetland on the List has changed, is changing, or is likely to change as a result of human interference. The second analysis described here explores the adequacy of the old RIS guidelines in displaying, and determining changes in ecological character. As no formal definition for ecological character and change in ecological character were provided in the original RIS guidelines, this analysis will utilize the definition presented in the Annex to Resolution C.6.1 of the Brisbane, Australia Conference in 1996.

3.2 Methods

3.2.1 Site selection

As described in section 2.2.1.

3.2.2 Matrices

The analysis was achieved through the use of a series of two dimensional matrices, which identify the values, threats, monitoring and baseline data available in each of the twenty nine RIS's.

This analysis consisted of two stages, utilizing four, two dimensional matrices. The first stage comprised two matrices, the first identifying the values and the second identifying the threats for each of the twenty nine RIS. This gives a basic understanding of the ecological character of the wetlands and of factors which might affect them. The second stage also comprised two matrices and explores whether baseline information or details of monitoring are provided for each of the threats and values listed in the first two matrices. This provides information on the ability of the RIS's to provide information from which change in ecological character can be determined. A more detailed account of each matrix is provided as follows:

Values matrix

A two dimensional matrix analysis was undertaken for each RIS to determine the values present at each of the wetlands. The left hand side of the matrix details the possible values that may be present at the wetland under the following four broad categories: water regime, exploitation and production, natural heritage, and cultural heritage. The reference number and abbreviated name of the individual wetlands are provided at the top of each column (Appendix 4).

The term 'values' in this analysis is used for convenience and encompasses all the key components of ecological character including: processes; functions; values; products; and attributes as described in Table 1.

The entire RIS document for each wetland was examined to ascertain which values applied to each wetland. Particular attention was paid to the categories which directly dealt with wetland values including: hydrological and biophysical values; social and cultural value; noteworthy fauna and flora; and reasons for inclusion. Identifying the values for each RIS provides important information on the ecological character of the individual wetland, which may need to be further examined further to ascertain whether a change in ecological character is being experienced.

The next step in the analysis determined if any monitoring or baseline information was available for each of the values listed, so as to form a basis from which a change in ecological character could be assessed.

Threats matrix

A two dimensional matrix analysis was undertaken for each RIS to determine the threats present at each of the wetlands. The left hand side of the matrix details the possible threats that may be present at the wetland under the following five broad categories: water regime, water pollution, physical modifications, exploitation and production, and cultural heritage. The reference number and abbreviated name of the individual wetlands are provided at the top of each column (Appendix 5).

The term 'threat' in this analysis is used for convenience and also encompasses issues for each of the wetlands. The definition of 'threats' and 'issues' utilized for this analysis is taken from Ntiamoa-Baidu et al (1997, p16) where:

> "A wetland **issue** is an underlying socio-economic and/or political factor (e.g. agricultural expansion, urbanization, population pressure, sectoral structures) that could lead to adverse change in the ecological character of a wetland."
>
> " A **threat** to a wetland is a human-included factor (e.g. water pollution, siltation, over-exploitation) that could change adversely the ecological character of the wetland."

The entire RIS document for each of the wetlands was examined to ascertain which threats applied to each wetland. Particular attention was paid to the categories, which directly dealt with wetland threats including: disturbances and threats, and current land use.

Identifying the threats and issues for each RIS provides an indication of the particular aspects of each individual wetland that may be experiencing a change in ecological character. The next step to the analysis determined if any monitoring or baseline information was available for each of the threats to form a basis from which a change in ecological character could be assessed.

Baseline and monitoring matrices

A two dimensional matrix analysis was undertaken for each RIS to determine whether baseline information or monitoring could be ascertained from information provided within the RIS. The two matrices in this analysis closely resemble those of the first stage with one providing baseline information and monitoring for the values matrix, and the other providing the same information for the threats matrix. The left hand side of each matrix provides details on the possible values or threats which may be present at the wetland. The reference number and abbreviated name of the individual wetlands provided at the top of each column. (Appendix 6 & Appendix 7). The following symbols were utilized as follows:

- ● Baseline information provided;
- □ Monitoring information provided; and
- * Value or threat is present at this wetland but no baseline or monitoring information is supplied.

A baseline is a collection of data which can be used as an information base or starting point for future analysis (Tomas Vive, 1996). All sections of each RIS were examined for data that could be considered appropriate as baseline information for the individual values and threats listed. The desired information included, qualitative and quantitative parameters, measurements over time, and natural and seasonal variation.

Monitoring involved statements within the document that regular monitoring of parameters was being conducted, which related directly to the values and threats listed. In addition, (with the exception of problems/issues which are covered under the studies definition of threat), evidence of the components for the 'framework for designing a wetland monitoring program' were required to indicate the presence of a monitoring program. The framework embodies the following components: objective, hypothesis, method and variables, feasibility/cost, pilot study, sampling, analyses and reporting (Ramsar Convention Bureau, 1996c). The references mentioned in the bibliography were not considered to be evidence of monitoring in this study. However, all other sections within the RIS for each of the wetlands was examined to determine if monitoring information was present for each of the values and threats to assist in determining if changes in ecological character are taking place.

Identifying and analysing information on baseline data and monitoring provides a more critical analysis of whether the information obtained in the RIS for describing changes in ecological character is adequate or merely superficial.

3.2.3 Manipulation of data

Values and threats matrices

The occurrence of values and threats was tallied to produce a total for each RIS as shown in Table 5. The total number of values was then added and divided by twenty nine, being the number of RIS's in this study, to produce an average number of values. Similarly, the total number of threats was added and divided by twenty nine to produce an average number of threats for the RIS examined.

Baseline and monitoring matrices

The number of values or threats to have the symbol indicating the presence of baseline information were tallied. This figure was then recorded against the total number of occurrences for a particular threat or value displayed in Figures 4 to 14.

3.3 Results

3.3.1 Values and threats

The two dimensional matrices on threats and values given in Table 5 indicate that on average there are twice as many values at the selected wetlands compared with threats. The majority of the values for each of the RIS's in this study fall into the category of natural heritage followed by exploitation and production, and water regime. The majority of the threats for each of the RIS in this study fall into the category of physical modification, followed by exploitation and production, water pollution and lastly water regime.

Table 5 indicates the RIS with the highest number of values was Champagne scoring eighteen, followed by Whangamarino with fifteen and Okavango, Kolkheti, and Kopuatai which all scored a total of fourteen values. The lowest number of recorded values was at Hula, Hortobagy (3HU008b), Hortobagy (3HU008d1), Hortobagy (3HU008d3) which all received a score of seven.

The RIS with the highest number of threats was Titicaca scoring a total of twelve, followed by Hula and Manchon which both received a score of ten. The RIS to score the lowest number of threats include Hortobagy (3HU008a), Hortobagy (3HU008d2), and Hortobagy (3HU008d3) each scoring one threat (Table 5).

The analysis also revealed that Titicaca and Cicovske were the only two RIS's to have equal numbers of threats and values being twelve and eight respectively. Also, Hula and Manchon were the only two RIS's to score more threats than values. The RIS for Saloum indicates six threats were recorded with the majority being in the category of exploitation and production (Table 5).

Table 5 The number of threats and values recorded at each wetland and the category to which the majority of these belong.

(The number of values for each RIS is ranked in descending order with the ranking for threats shown in the brackets ().)

WETLAND	NUMBER OF VALUES	DOMINANT CATEGORY OF VALUES	NUMBER OF THREATS	DOMINANT CATEGORY OF THREATS
Champagne	18	Exploitation & production, Natural heritage	4 ($^{14}/_{29}$)	Physical modifications
Whangamarino	15	Natural heritage	6 ($^{6}/_{29}$)	Physical modifications
Okavango	14	Natural heritage	1 ($^{20}/_{29}$)	Water regime
Kolkheti	14	Natural heritage	5 ($^{10}/_{29}$)	Physical modifications, Exploitation & production
Kopuatai	14	Natural heritage	5 ($^{10}/_{29}$)	Physical modifications
Example	13	Natural heritage	3 ($^{18}/_{29}$)	Physical modification
Lagartos	13	Natural heritage	4 ($^{14}/_{29}$)	Physical modifications
Titicaca	12	Exploitation & production Natural heritage	12 ($^{1}/_{29}$)	Water pollution
Azagny	11	Natural heritage	4 ($^{14}/_{29}$)	Physical modification
Natal	11	Natural heritage	5 ($^{10}/_{29}$)	Physical modification
Xianghai	11	Natural heritage	3 ($^{18}/_{29}$)	Exploitation & production
Kushiro	11	Natural heritage	5 ($^{10}/_{29}$)	Physical modification
Hortobagy 3HU008c	10	Natural heritage	2 ($^{19}/_{29}$)	Water pollution
Morton	10	Natural heritage	7 ($^{5}/_{29}$)	Water pollution
Biguglia	10	Natural heritage	6 ($^{6}/_{29}$)	Water pollution
Carlos	10	Natural heritage	5 ($^{10}/_{29}$)	Physical modifications
Engure	10	Natural heritage	6 ($^{6}/_{29}$)	Physical modifications
Hortobagy 3HU008d2	9	Natural heritage	1 ($^{20}/_{29}$)	Water regime
Manchon	9	Natural heritage	10 ($^{2}/_{29}$)	Exploitation & production
Salouni	8	Exploitation & production Natural heritage	6 ($^{6}/_{29}$)	Exploitation & production
Hortobagy 3HU008a	8	Natural heritage	1 ($^{20}/_{29}$)	Exploitation & production
Cicovske	8	Natural heritage	8 ($^{4}/_{29}$)	Water pollution
Minesing	8	Natural heritage	6 ($^{6}/_{29}$)	Physical modifications
Fuschertal	8	Natural heritage	4 ($^{14}/_{29}$)	Water pollution
Hula	7	Water regime, Natural heritage	10 ($^{2}/_{29}$)	Physical modification
Hortobagy 3HU008b	7	Natural heritage	2 ($^{19}/_{29}$)	Water pollution
Hortobagy 3HU008d1	7	Natural heritage	2 ($^{19}/_{29}$)	Water regime, Exploitation & production
Hortobagy 3HU008d3	7	Natural heritage	1 ($^{20}/_{29}$)	Water regime
Matchedash	7	Natural heritage	4 ($^{14}/_{29}$)	Physical modifications, Exploitation & production
Average number of values/wetland	10	**Average number of threats/wetland**	5	

To assess whether any correlation existed between the number of values and the number of threats present at each wetland, the details outlined in Table 5 were plotted.

As shown in Figure 3 this revealed that there was no obvious correlation between the number of threats and values recorded for each of the RIS in this study.

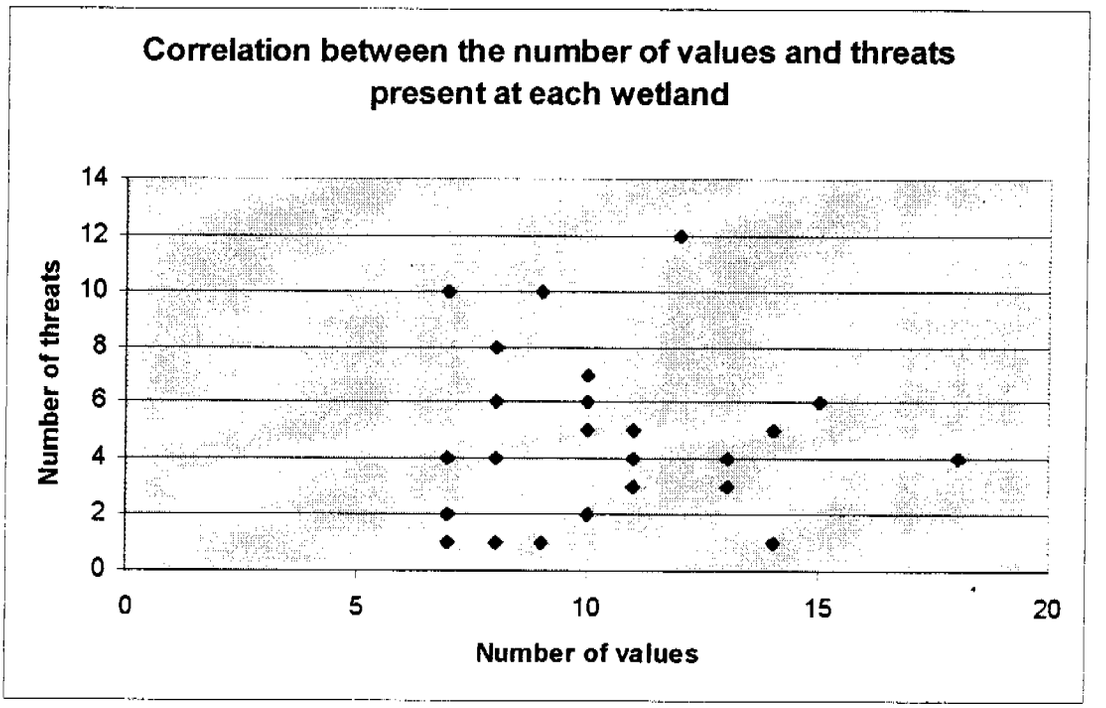

Figure 3 The correlation between the number of values and threats observed for each of the twenty nine RIS.

3.3.2 Baseline information – summary of categories for values & threats

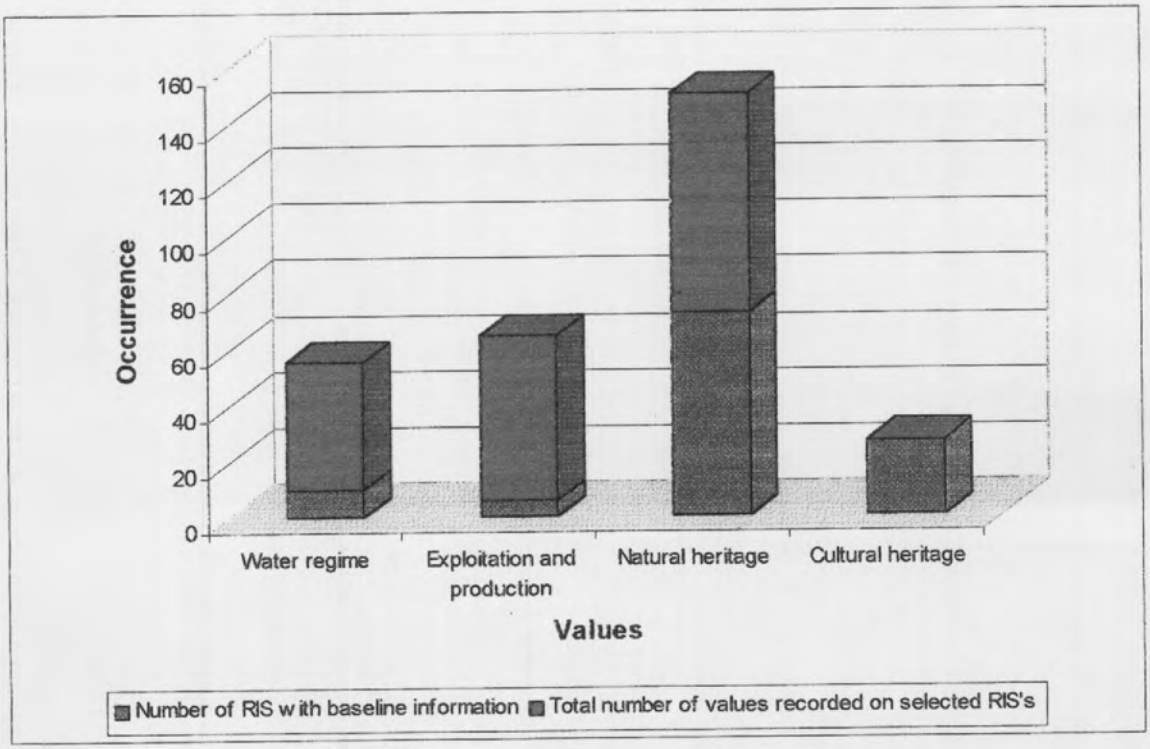

Figure 4 Summary of values within each category scored from selected RIS's .

The results in Figure 4 show that cultural heritage is the only category where all values recorded are also provided with baseline information. This was followed by the category of natural heritage, which scored one hundred and fifty one occurrences of which seventy three provided baseline information.

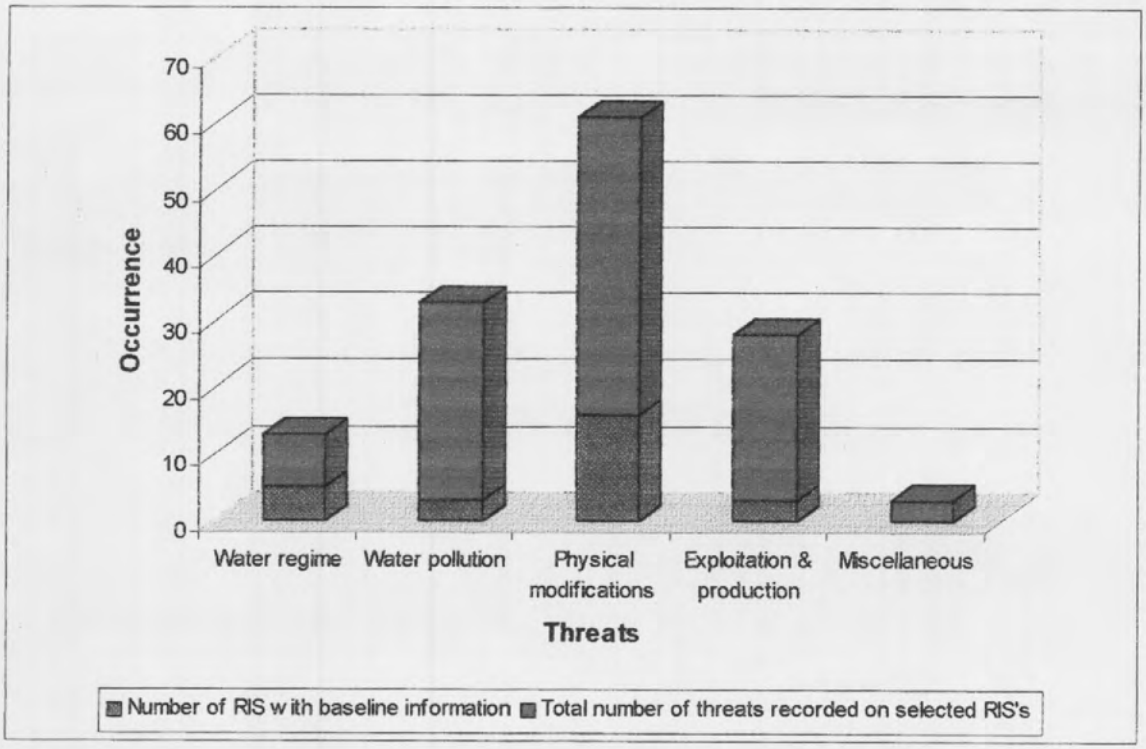

Figure 5 Summary of threats within each category scored from selected RIS's.

The results in Figure 5 show that in general all categories record a low occurrence of baseline information. Almost half of the occurrences of threats in the category of water regime are provided with baseline data. This includes a score of thirteen occurrences with five supplying baseline information. This was followed by the category of physical modifications, which scored sixty one occurrences of which sixteen provided baseline information.

3.3.3 Baseline information – values

It was sometimes necessary in the following presentation of results to shorten or abbreviate the names of the values and threats presented in Appendices six and seven. This ensures they are all represented in the figures below.

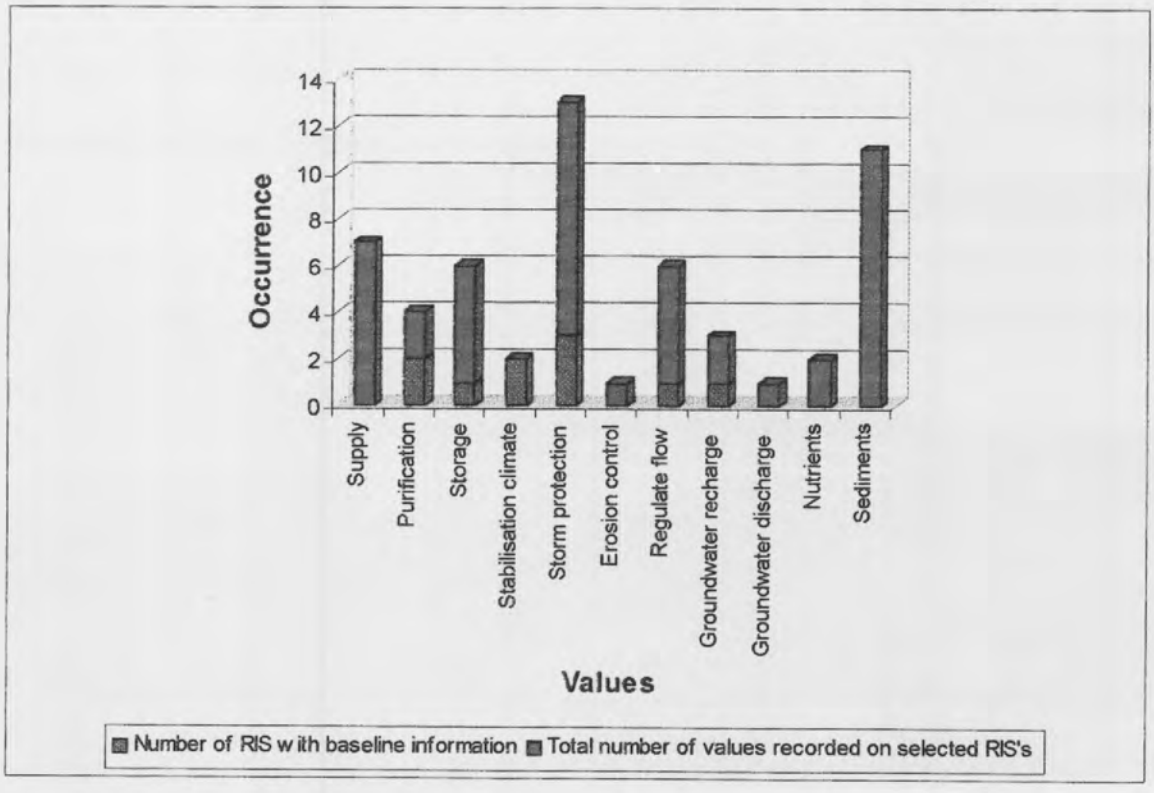

Figure 6 The number of values in the category of water regime recorded on selected RIS's.

As shown in Figure 6 the values in this category that scored for baseline information are water purification, storage, stabilization of local climatic conditions, storm water protection, regulation of flow, and groundwater recharge. Additionally, the value of storm protection recorded the highest number of occurrences totaling thirteen of which three provided baseline information. The analysis also revealed that sediment retention scored the second highest number of occurrences but did not score baseline information.

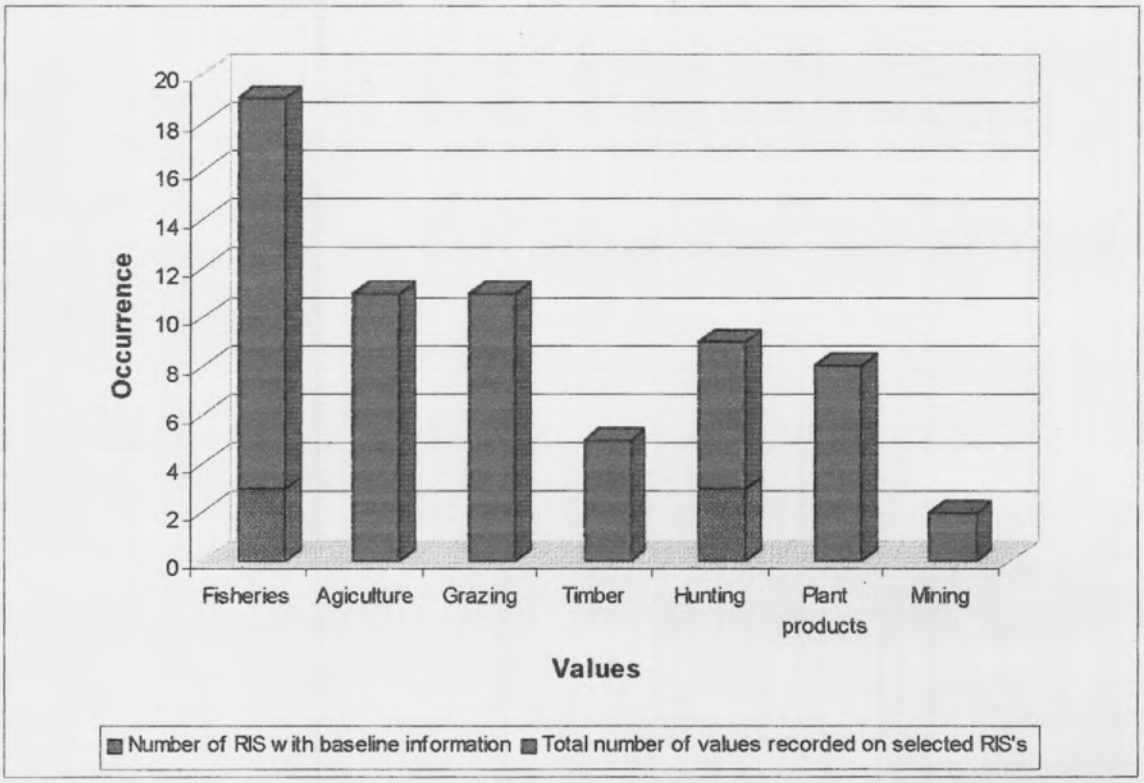

Figure 7 The number of values in the category of exploitation and production recorded on selected RIS's.

As shown in Figure 7, two out of the seven values that of fisheries and hunting in the category of exploitation and production recorded baseline information. The values of agriculture and grazing scored the second highest occurrence in this category with a score of eleven.

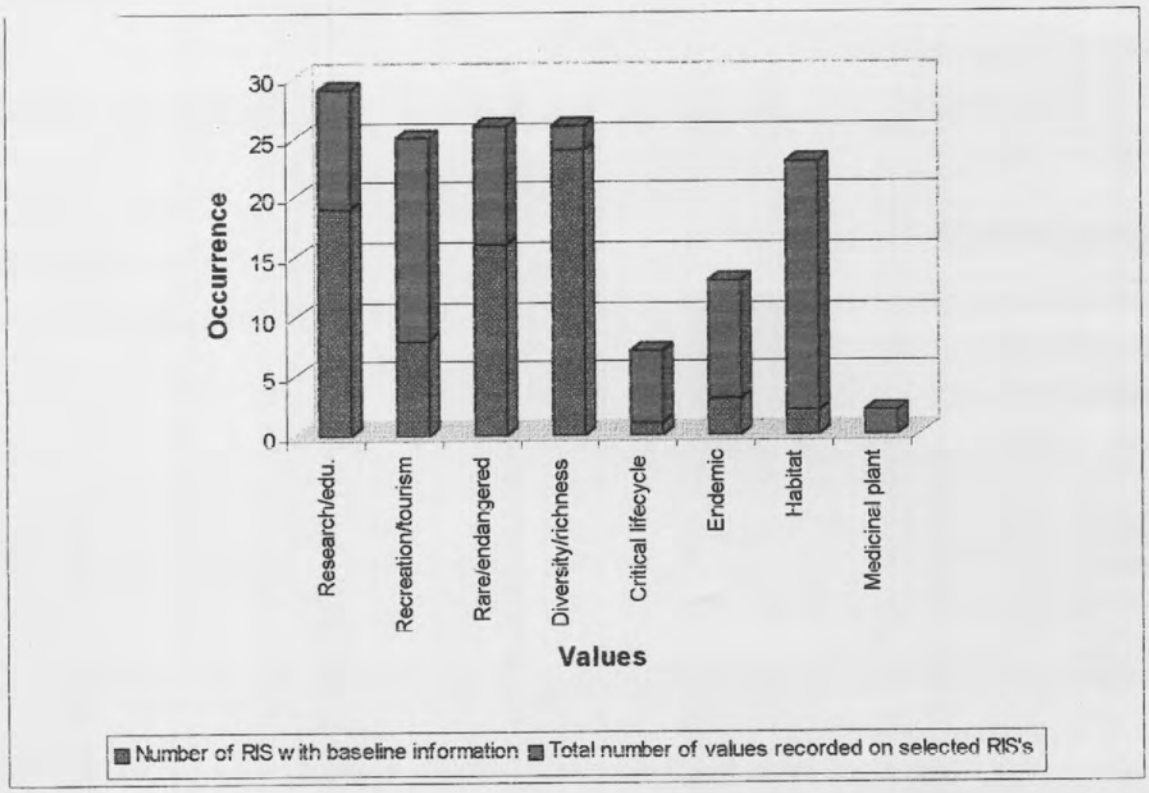

Figure 8 The number of values in the category of natural heritage recorded on selected RIS's.

The results in Figure 8 indicate that seven out of the eight values in this category record baseline information. The value of biological diversity and richness scored the highest number for baseline data being twenty four out of twenty six occurrences. The value of rare and endangered species also scored twenty six occurrences but only sixteen provided baseline information. The highest number of occurrences was for the value of scientific research and education with a score of twenty nine. Nineteen of these provided baseline information.

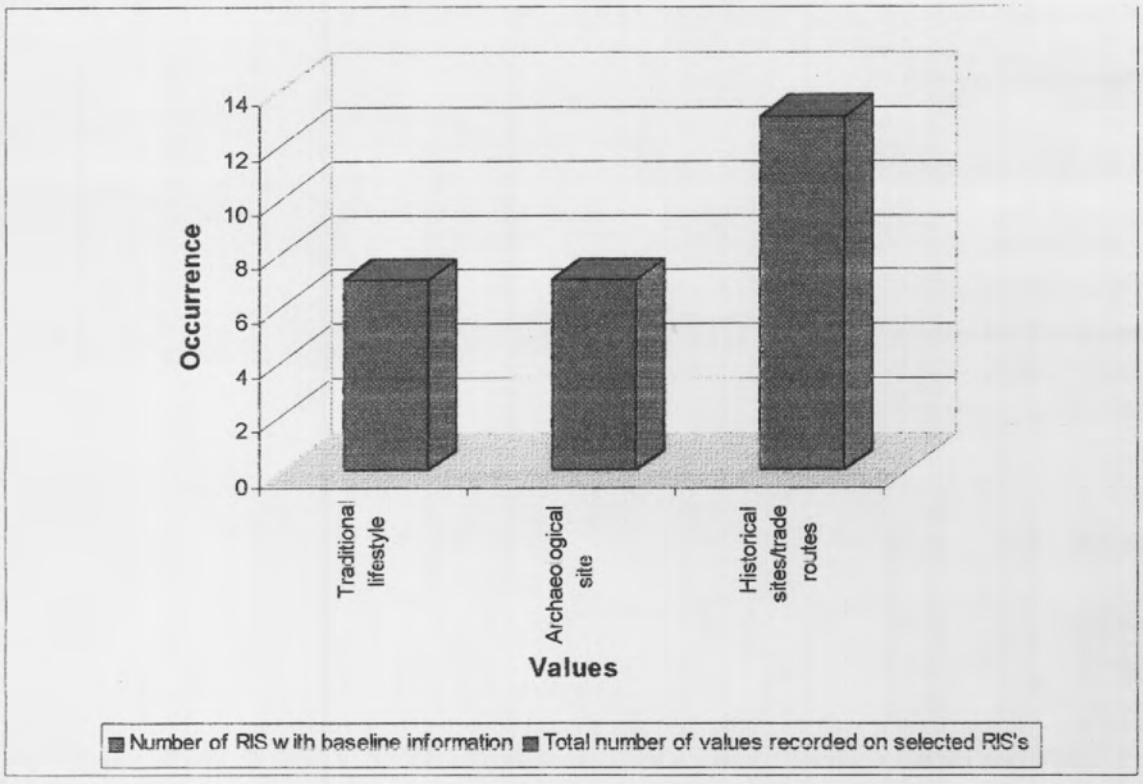

Figure 9 The number of values in the category of cultural heritage recorded on selected RIS's.

As shown in Figure 9 all of the values including traditional lifestyle, archacological sites, and historical sites/trade routes in the category of cultural heritage scored baseline information.

3.3.4 Baseline information - threats

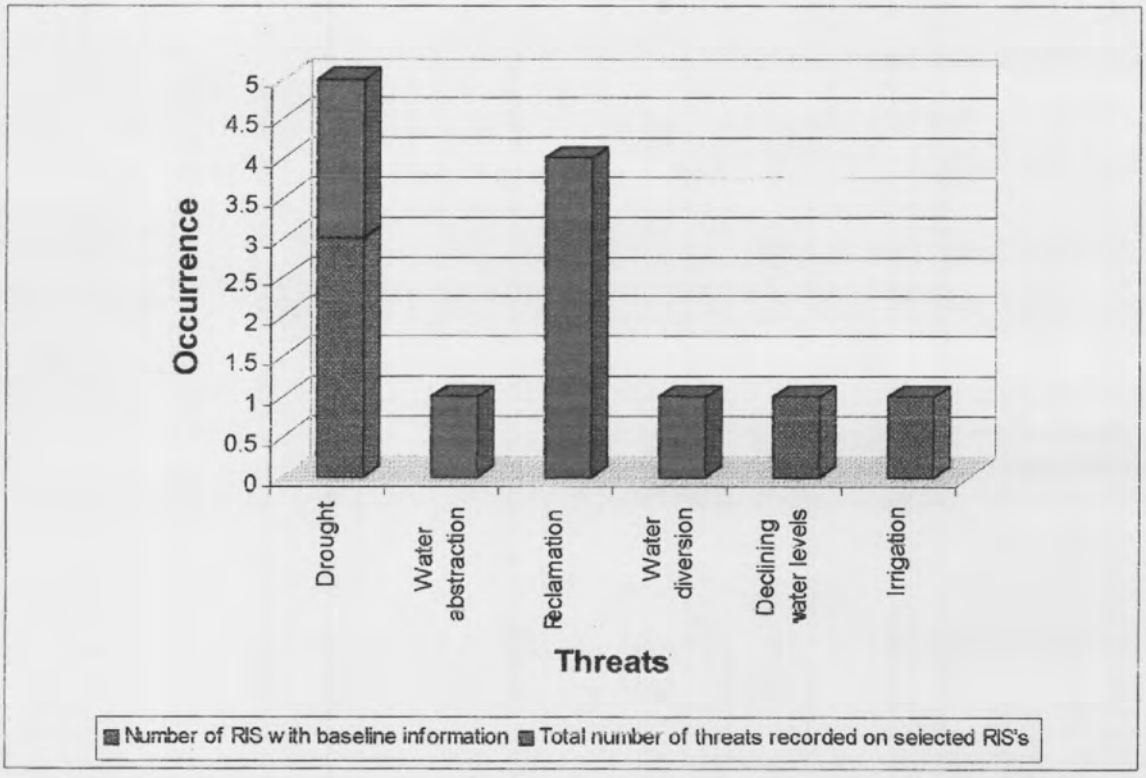

Figure 10 The number of threats in the category of water regime recorded on selected RIS's.

The results in Figure 10 indicate the three threats to score baseline information. The highest number of occurrence was that of drought with a score of five for which three were supplied with baseline data. The two other threats scoring baseline information were declining water levels, and irrigation both recording one occurrence. The threat of reclamation scored the second highest number of occurrences without recording any baseline information.

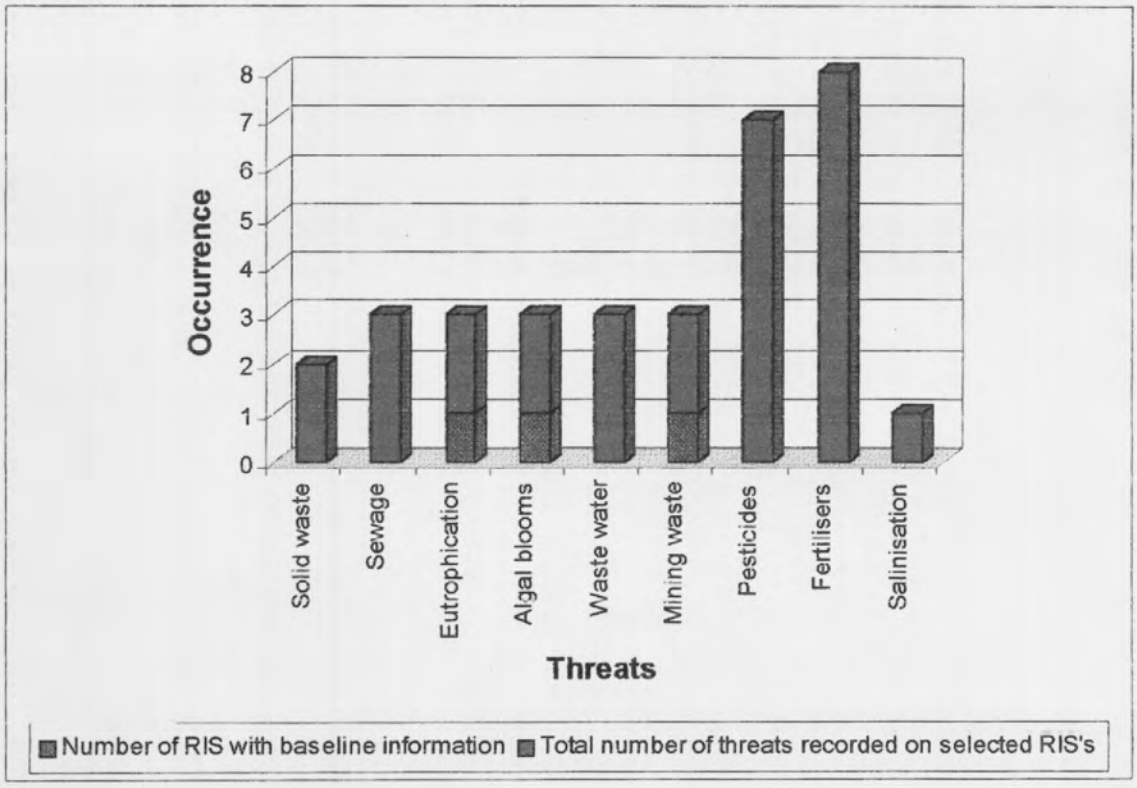

Figure 11 The number of threats in the category of water pollution recorded on selected RIS's.

As shown in Figure 11, six out of the nine threats in the category of water pollution did not score baseline information. The threats of eutrophication, algal blooms, and mining waste each scored an occurrence of three with a score of one for baseline information. The threats of pesticides and fertilizers recorded the highest number of occurrences with a score of seven and eight respectively.

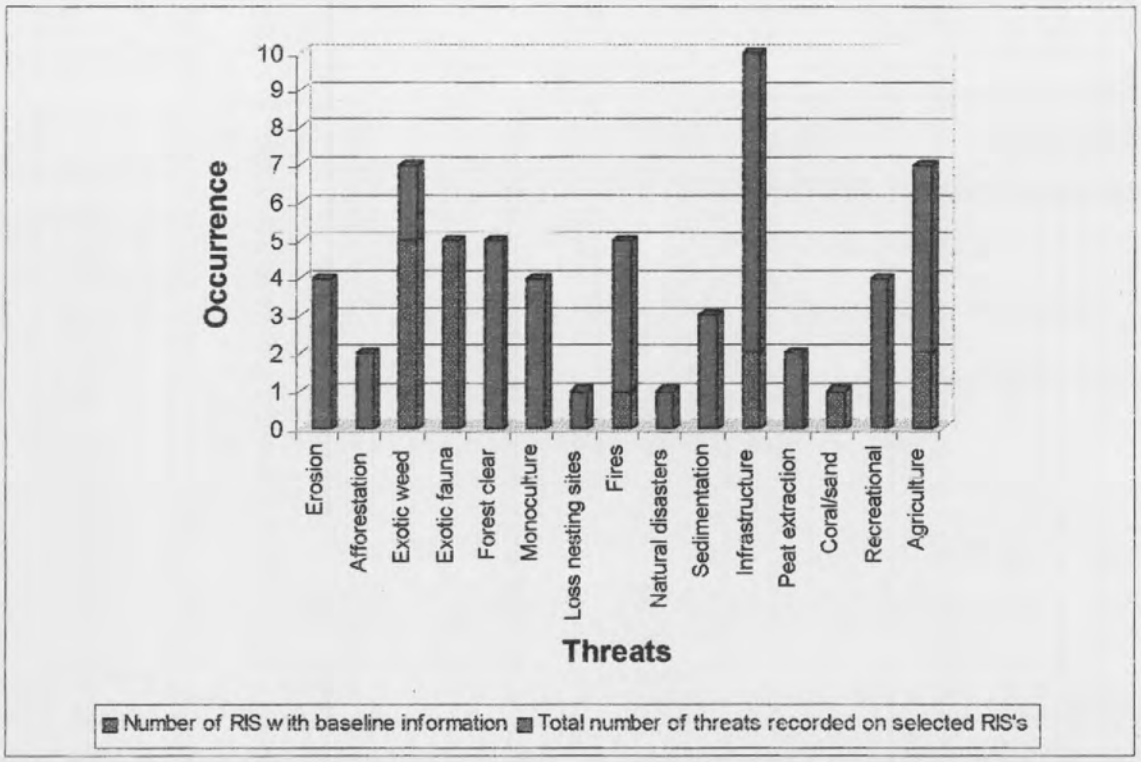

Figure 12 The number of threats in the category of physical modifications recorded on selected RIS's.

The results in Figure 12 show that six out of the fifteen threats in the category of physical modifications recorded baseline information. The threat of infrastructure scored the highest number of occurrences scoring ten of which two recorded baseline data. This was followed by agriculture and exotic weed intrusion with a score of seven and recording a score of two and five respectively for baseline information. Furthermore, the only two categories to score equal numbers for baseline information and the number of threats was exotic fauna with a score of five and coral/sand abstraction with a score of one.

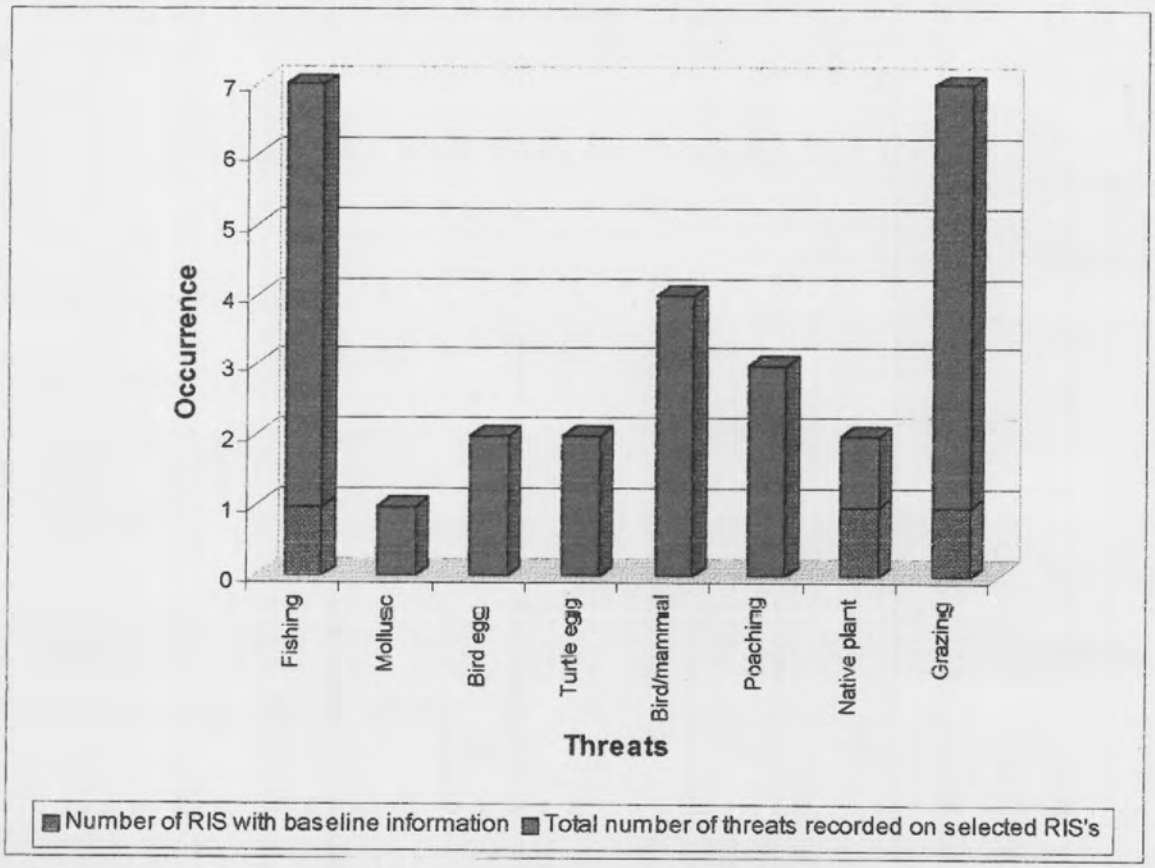

Figure 13 The number of threats in the category of exploitation and production recorded on selected RIS's.

The results in Figure 13 show only three out of the eight threats for this category recorded baseline information. The highest numbers of occurrences were recorded for fishing and grazing with a score of seven both of which scored one for baseline information. The threat of native plant extraction scored two occurrences with one providing baseline information. Poaching and bird/mammal hunting received scores of three and four respectively.

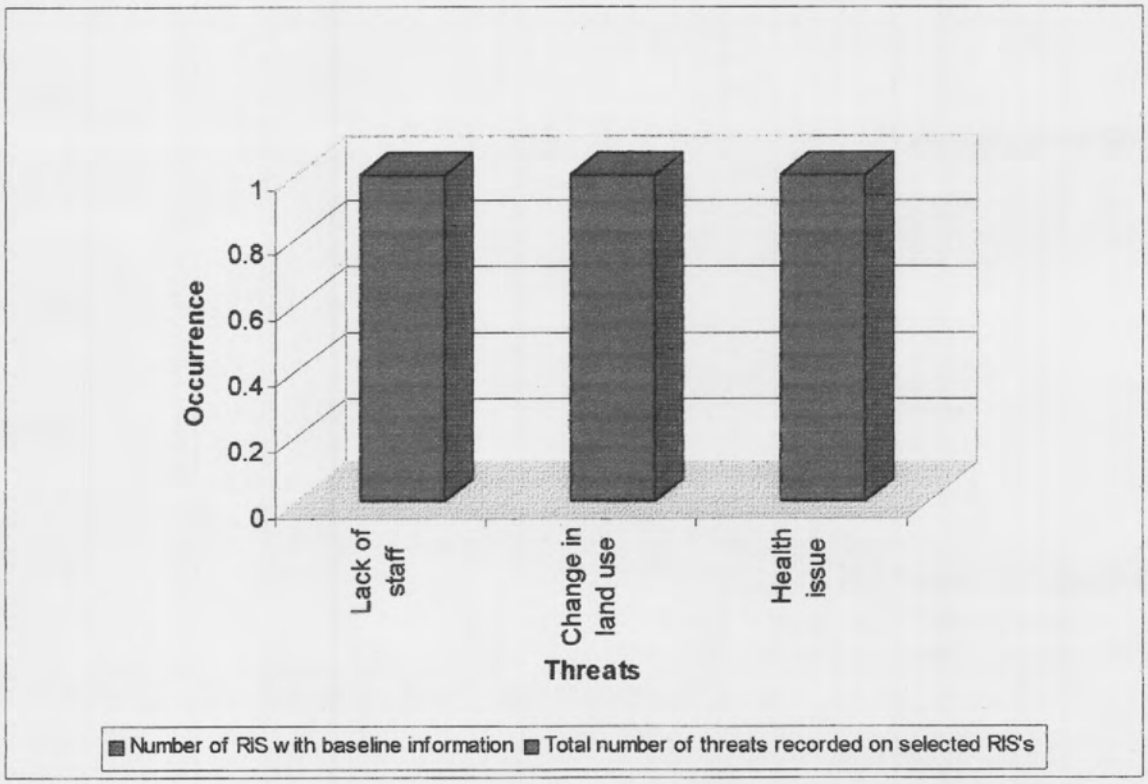

Figure 14 The number of threats in the category of miscellaneous recorded on selected RIS's.

As shown in Figure 14 all the threats for the category of 'miscellaneous' scored an occurrence of one without recording any information on baseline data.

3.3.5 *Monitoring information – values and threats*

Table 6 Details of monitoring being conducted at selected wetlands for values and threats.

NAME OF WETLAND	VALUE (V) OR THREAT (T)	MONITORING PROGRAM
Natal	Biodiversity & richness (V)	Abundance of large herbivores in Giant's Castle; Population sizes of large herbivores in Highmoor; Population sizes of large herbivores in Royal Natal; *Protea nubigena* monitoring at Royal Natal; Population and distribution of eland in the southern Drakensberg.
Hula	Recreation & tourism (V)	Daily and monthly visitor numbers.
	Biodiversity & richness (V)	Waterfowl transects (4 trials bi-weekly); Vegetation transects (4 trial twice a year).
	Pesticides (T)	Water quality at eight selected sites (bi-monthly).
	Fertilisers (T)	Water quality at eight selected sites (bi-monthly).
	Sewage (T)	Water quality at eight selected sites (bi-monthly).
	Drought (T)	Water levels (weekly).
Kushiro	Biodiversity & richness (V)	Change of mire vegetation (5 yearly).
Engure	Biodiversity & richness (V)	Waterbird populations.
Manchon	Biodiversity & richness (V)	Phenology of different plant associations.
	Pesticides (T)	Chemical analysis of water samples.
	Fertilisers (T)	Chemical analysis of water samples.
Biguglia	Biodiversity & richness (V)	Avifauna monitoring since 1985.

As shown in Table 6 only five of the twenty nine RIS's examined provided information on monitoring for the values and threats listed. The highest number of occurrences was for biodiversity and richness having been recorded on six occasions. This was followed by pesticides and fertilisers which both occurred twice.

3.4 Interpretation of Results

3.4.1 Values and threats

The reason for wetlands being protected through conventions such as Ramsar is primarily to conserve the values placed on them by society. That is providing benefits to the people who live in or adjacent to them, rather than directly concerning ecological processes. Wetlands have been described as one of the most productive environments in the word providing a large range of benefits to the plants, animals and people inhabiting them. The conservation of this ecotype is important if the ecological functions, values and attributes are to be maintained for future generations (Mitsch & Gosselink, 1986; Matthews, 1993; Davis, 1994).

Analysis indicated that on average twice as many values as threats were recorded on RIS's. This may be attributed to the RIS document being prepared to show the international importance of the selected wetland, with the majority of the categories being created to display the wetland's values and ecological character. Other reasons for values scoring highly include: the fact that they are seen as being a positive aspect of the wetland and are therefore easy to promote; information on threats may be more difficult to obtain especially with regard to indirect long term effects; and the compiler of the RIS may not have interpreted or listed all the relevant information.

The dominant category for values is that of natural heritage, which may be attributed to the initial purpose of the RIS that includes criteria by which a wetland is considered internationally important. The criteria broadly cover four main areas as follows:

1. Criteria for representative or unique wetlands;
2. General criteria based on plants or animals;
3. Specific criteria based on waterfowl; and
4. Specific criteria based on fish (Ramsar Convention Bureau, 1996a).

Six out of the eight values including biological diversity & richness, endemic species, and habitat for wildlife (especially waterfowl) in the category of natural heritage, fall into points two and three above. Therefore, this category scored highly as the RIS was initially designed to take these values into consideration. In addition,

this category provides information on 'values', and 'attributes' described in Table 1, which are considered to be important components in defining ecological character.

The second most dominant category was that of exploitation and production. The values for this category are extremely important to many societies as a source of food, shelter, income, and often also in maintaining their traditional lifestyle. An example of this is Titicaca, which lists six out of the seven values for this category. The RIS for this wetland indicates that the birds and fish of the lake are an important food supply for rural communities practicing indigenous fishing techniques and subsistence hunting, with some birds and fish also being sold at the local markets. In addition, totora plant is used for construction of houses, feed for livestock, substrate for plantations and in some cases the rhizomes of the totora are consumed as a food source. Furthermore, this category provides information on 'products' described in Table 1, which is considered to be an important component in defining ecological character.

The value and importance of a wetlands water regime have been well documented but often not fully understood and may account for this category's low dominance score. In general, this study found that the values that are not adequately addressed in Table 1 of the RIS document are those concerning 'processes' and 'functions'. The processes and functions of a wetland provide values such as flood control, storm protection, water purification, groundwater recharge/discharge, and retention of nutrients and sediments which are important in describing ecological character. Identifying and understanding these processes often requires more sophisticated equipment and trained personnel than values which come under the categories of natural heritage and exploitation and production.

Information on values such as rare and endangered species, endemic species, fishing, and plant products in the latter categories can often be determined through monitoring techniques that require simple observation, or flora and fauna surveys that do not necessarily require expensive equipment or technical expertise. The values in the water regime which include water purification, retention of nutrients/sediments and water supply may require monitoring of parameters such as pH, salinity, conductivity or ionic concentrations, and nitrogen and phosphorus concentrations to identify and better understand processes and functions taking place. The RIS for Manchon has indicated that there are no values in the category of water regime for this wetland. The document goes on to state however, that at present, the

hydrological value of the wetland has not been evaluated. Although, the RIS's for Engure and Koputai scored values for water regime, both acknowledge the hydrology of their wetland is poorly understood and insufficiently studied. In addition, complicated models are often utilized to give an understanding of the process and functioning of groundwater recharge and discharge, and the stabilization of local climatic conditions. These parameters or models often require specialized equipment and expertise that is not available or affordable to many countries, and thus may have contributed to the low score of values in this category.

The category for cultural heritage was the least dominant in the study, however, many of the RIS's including Moreton, Whangamarino, Champagne and the example, considered all the values in this category to be important. These RIS's mentioned traditional lifestyles, archaeological sites, historical buildings/sites and trading routes as important to the societies living in the area surrounding the wetland. These values are considered to be 'attributes' in Table 1 and are therefore, an important component in describing the ecological character of a wetland.

The difference in the number and type of values at each wetland may also be due to the amount of information that is currently available. The RIS's to score the greatest number of values includes Champagne, Whangamarino, Okavango, Kolkheti, and Kopuatai. These RIS's are generally well compiled with categories within the RIS following the requirements of the guidelines provided. It is also evident through information provided under 'current scientific research and facilities' and 'bibliography' that these wetlands have been subject to a number of studies relating to a wide variety of subjects including population ecology, the effects of fires, and surveys on rare and endangered species. In addition, they supply information on why each of the selected criteria applies to their particular wetland.

The RIS's to score the least number of values are Hula, Hortobagy (3HU008b), Hortobagy (3HU008d1), Hortobagy (3HU008d3). With the exception of Hula these RIS generally provide only the minimum amount of information required by the guidelines with very little information provided on 'current scientific research and facilities' with only one study mentioned for each RIS. In the 'bibliography' the reader is refered to the HNP directorate although a number of bibliographies appeared difficult to access. Furthermore, these RIS indicate further studies are required in the area of hydrology.

In order to manage wetlands to conserve the values placed on them by society, it is necessary to identify any threats or issues that are currently, or have the potential to, adversely affect the wetlands ecological character. The Ramsar Convention states that a change in ecological character at a wetland occurs when there is an, "impairment or imbalance in any of those processes and functions which maintain the wetland and its products, attributes and values " (Ramsar Convention Bureau 1996c, p2).

The number of threats in the analysis is on average only half of that compared with values. This may be attributed to the purpose of the RIS being to indicate why a wetland should be considered internationally important, rather than, displaying the adverse affects to the wetlands ecological character. A threat to a wetland can often be seen negatively, and may imply poor management of that resource, and therefore, could possibly be understated or not recorded. The RIS for the example in the Ramsar manual declares that there are, 'no perceived threats' to the wetland but then goes on to describe the invasive exotic weed Purple Loosestrife (*Lythrum salicaria*) and residential developments as having some impact on the resource values. The RIS for Whangamarino indicates that hunting waterfowl is a value not a threat. However, the RIS goes on to indicate the Brown Teal (*Anas aucklandica chlorotis*) has been recorded at the wetland and that it is one of New Zealand's rarest ducks and considered one of the five rarest ducks in the world. Although hunting permits are issued, unless the hunter is well trained at distinguishing different waterfowl species, this activity has the potential to impact directly on this rare species by shooting them and indirectly by disturbing nesting sites. Furthermore, information on threats may be more difficult to obtain especially if they are indirect and long term. Finally, the compiler of the RIS may not have interpreted or listed all the relevant information.

This analysis has shown that all the selected RIS's in this study record at least one or more threats to their wetlands. Although the number of threats recorded was on average less than that compared with values, each individual threat has the potential to adversely affect a number of wetland values. It is evident, with the exception of Hortobagy (3HU008a), that the RIS recording the lowest number of threats being Hortobagy (3HU008d2) and Hortobagy (3HU008d3) have the potential to effect more than one of their values. The only threat mentioned in the RIS's for these wetlands is that of drought, which has the potential to affect grazing, rare and

endangered species, biological richness and diversity, and habitat for wildlife, being values common to both wetlands.

The analysis also shows no correlation between the number of threats and values present in each RIS. However, if the ecology of the wetland is taken into consideration, there can often be direct and indirect correlations between values and threats, although this is rarely expressed explicitly within the RIS's analysed. The RIS for Titicaca establishes a direct negative link between the threat of drought leading to the exposure of the totora plant *(Scirpus californicus spp. tatora)*, one of the wetland values, which is subsequently burnt by farmers wanting to reclaim land for agriculture. This also serves to exacerbate the threat of bird hunting and indirectly effects many of the values at the wetland including grazing, agriculture, and biodiversity. Furthermore, water pollution at Titicaca is threatened by sewage, eutrophication, algal blooms, and industrial waste, which the RIS indicates will have a negative affect on the hydrobiological resources of the wetland including its fisheries. In general the 'processes' and 'functions' components utilized to describe ecological character in Table 1, are insufficiently addressed in all the RIS's selected for this analysis, however, previous literature indicates that links can be drawn from examining certain threats and values listed for each wetland. The RIS for Cicovske does not explicitly provide information on the processes occurring within this wetland. Nevertheless, it can be assumed that the threat of fertilizers has led to the threat of eutrophication which has in turn caused the threat of algal blooms resulting in a negative effect on the fisheries, being one of the values of this wetland.

The threats to each wetland will be different due to the variability of the socio-political processes and actions occurring around or within them. However, when grouping the different threats into categories, that of physical modification was shown to be dominant. This category has the potential to impair or destroy the 'values' and 'attributes' of a wetland, which are described in Table 1 and are important components of the ecological character. This may result from the effects of the threats in this category being easy to identify without the need for specialised equipment or trained staff. The RIS for Hula shows exotic weed and fauna intrusion, sedimentation, infrastructure, and recreational activities as being threats affecting this wetland all of which can be recognized by visual observations.

The next most important categories were that of exploitation and production, and water pollution. The category of exploitation and production provides

information on 'products' described in Table 1, which is considered to be an important component in defining ecological character. This category could be particularly threatening to the societies who utilize the wetland as sources of food, shelter, income, and also in maintaining their traditional lifestyle. For example, the RIS for Saloum has nearly all its threats in this category, which include mollusc, bird and marine turtle egg harvesting, fishing and grazing. It further states that these diverse activities on which the population depends for its survival may threaten the ecological equilibrium of the region.

The category of water pollution has the potential to impair the 'processes' and 'functions' found in Table 1 which are important in describing a wetlands ecological character. The process that appears to be occurring at Titicaca is that the sewage and industrial wastewater is leading to the eutrophication of the water supply and causing algal blooms. The effect of the algal blooms would be to reduce the light penetrating through the water resulting in a loss of primary production from aquatic plants. The algal bloom would also reduce the dissolved oxygen present in the water leading to changes in trophic levels. This would occur through the death of species unable to tolerate the reduced oxygen levels and an increase in other species, which have a high tolerance to low dissolved oxygen levels. The RIS for Manchon shows pesticides as a threat. These chemicals have the ability to disrupt food chains by killing or adversely affecting organisms such as macroinvertebrates, which are a food source for fish, the fish are then a food source for birds. In addition, these chemicals can produce long term indirect adverse effects from bioaccumulation and biomagnification time (Chambers & Davis (eds), 1995; Goldsmith (ed.), 1995; Spellerberg, 1994; Mitsch & Gosselink, 1986).

The next dominant category is water regime which once again has the potential to adversely affect the 'processes' and 'functions' found in Table 1 that help describe a wetlands ecological character. The processes and functions of a wetland provide it with many values such as storm protection, water purification, and groundwater recharge/discharged and are important in describing ecological character. Identifying and understanding these threats and how they affect the water regime often require sophisticated equipment and trained personnel. The threats in the water regime include drought, water abstraction, water diversion, declining water levels and irrigation. They may require regular monitoring of parameters which include: groundwater levels which require bores to be sunk; instillation of flow

meters; land surveys; and the monitoring of climatic conditions, this will assist in identifying and better understand processed and functions taking place. The RIS for Hula shows drought as a threat, it would be necessary to monitor information such as water level for both open and groundwater and record precipitation for a number of years in order to determine the extent of the drought. In addition, it would be beneficial to develop models which could indicate the likely affect drought or other threats will have on the wetland values under future hypothetical parameters. The equipment, technical expertise and financial support may not always be available to carry out this type of monitoring. Additionally, the RIS for Engure and Koputai both acknowledge the hydrology of their wetland is poorly understood and insufficiently studied.

To determine whether the ecological character at a wetland is changing it is necessary to establish baseline information, which can be utilized as a starting point for future analysis, and show that monitoring is taking place to determine change over time. The next analysis determines whether baseline information and monitoring is available within each RIS for the threats and values listed at individual wetlands.

3.4.2 Baseline information

This analysis investigated the availability of baseline information in selected RIS for each of the values and threats related to ecological character (as described in Table 1). The collection of baseline data for these values and threats is necessary to establish a reference base or starting point from which a change in ecological character can be assessed. As this study has already indicated, individual wetlands have different and specific values and threats that will require the collection of differing types of baseline information for change to be determined (Tomas Vives (ed), 1996; Finlayson, 1996a).

In general, insufficient baseline data has been recorded for both values and threats. Threats however, appear to have even less baseline information than values. This may result from the initial purpose of the RIS being to record information by which wetlands are considered internationally important, with the majority of the sections in the RIS providing information on values. Also, threats are perceived as negative, which may lead to baseline information being omitted or understated in

some way. Furthermore, the RIS were not initially designed to record baseline information for the assessment of ecological change.

The one category that contained baseline information for all its values was that of cultural heritage. This information is often an integral part of a community's identity, which either currently, or at one time influenced their way of life. The RIS for Whangamarino indicates that the wetland was important to early Maori inhabitants and used extensively by them as a source of food, plant materials and for transport. It provides information on the location of nine 'pa' (Maori fortress) sites around the wetland. The information recorded in this category may be part of an area's history. The Carlos RIS states that the San Luis de Alba, a small Hispanic fortress constructed during the Conquest has been restored. Furthermore, there is a section in the RIS titled 'social and cultural values' which specifically records information for values in this category. Therefore, it may be that the requirement for recording baseline information in this category is simply indicating the occurrence or absence of some aspect of cultural heritage for a particular wetland.

The categories with the most baseline information were that of natural heritage for values, and that of physical modifications for threats. This may be because the baseline information recorded for these categories utilizes unsophisticated technology that can be applied with relative ease. However, a closer examination of the baseline data provided in the selected RIS's indicates it is too superficial to produce useful information from which a change in ecological character can be determined.

This study found that the majority of the baseline information supplied in the selected RIS's was qualitative. The values and threats for which the most baseline information was available included: rare and endangered species, biological diversity and richness, and exotic weed and fauna intrusion, the majority of which were recorded as scientific species names that are easily acquired through simple observations. Additionally, the information supplied for the values of scientific research and education, and recreation/tourism involved simply listing the past and present research, and the different types of recreational activities currently conducted at the wetland.

In cases such as that at Whangamarino, where quantitative information is also supplied, it covers only a few selected species and even then the information has a degree of uncertainty to it. For example, the RIS speculates that there may be up to

two hundred and fifty Australasian Bittern (*Botaurus poiciloptilus*) inhabiting the wetland. This information has been derived from a census of the entire country. In other cases where quantitative data is supplied the information is unclear and often ambiguous. The RIS for Carlos provides a percentage breakdown of the different vegetation types which 'provides habitat for wildlife, especially waterfowl'. However, it does not indicate whether this information is related to the area covered or the number of species present. A map showing population densities and structures for the different vegetation types may provide more useful and appropriate information.

Analysis revealed that not enough parameters were utilized to provide baseline data for individual values and threats. The RIS for Titicaca indicates that nearly all the threats including sewage, eutrophication, algal blooms, industrial wastewater, and salinisation are problematic at this wetland. However, the only threats for which baseline information was given were that of eutrophication (covering an area of sixteen square kilometres), algal blooms (being up to three centimetres thick in places), and a salinity level of less than 1000mg/litre. Minimal information is provided and does not indicate the cumulative effects of a number of threats nor addresses the real issue of water quality. More detailed baseline information for the category of water pollution would incorporate measurement for a series of parameters to cover most aspects of the wetland's water quality. This may include recording standardised information for pH, conductivity, total dissolved solids, concentrations of nitrogen and phosphorus and chlorophyll *a*, turbidity and dissolved oxygen levels. Changes in ecological character can be more readily detected where standardised data has been collected over a specific period of time (Goldsmith (ed.), 1995; Spellerberg, 1994; Mitsch & Gosselink, 1986).

Another problem with information supplied in the RIS is that it often does not provide details on when the information was recorded (i.e. date, time, season), the location of the recorded information, what equipment was used, who recorded the information and for what purpose? If this information is not supplied it is difficult to determine the type and magnitude of the changes in ecological character that may be occurring. A well designed monitoring program would include an objective, a description of the methodology, and identification of variables needed to assess a change in ecological character (Ramsar Convention Bureau, 1996b & c; Finlayson, 1996a & b). The RIS for Titicaca shows that baseline data was recorded for the

threat of salinity. A salinity value of less than 1000 mg/l was considered to represent baseline level. Information on when and where the information was recorded, what equipment was utilized and the methodology are not given. It would therefore, be difficult to accurately replicate this information to assess what effect the parameter of salinity plays in, for example, a change in trophic levels within the water column over time.

The category of water regime provides information on the 'processes' and 'functions', which are integral components of all wetlands. The information supplied on the threats and values in these categories is often superficial and does not correlate information between the different categories, which is essential in describing the importance of energy flows or nutrient cycling within wetlands. The RIS for Xianghai supplies information on annual average temperature, precipitation, evaporation and frost-free days, which can be utilized as baseline data for the value of 'stabilization of local climate conditions'. There is however, no information relating directly to the process taking place at the wetland, which resulted in this value. This makes it difficult to know if other important parameters need to be recorded to accurately assess a change in ecological character. The process encompassing the stabilization of the local climate may involve the evaporation of water from the wetland surface. However, the percentage cover of different vegetation types may be important in the formation of clouds, which is also related to local climatic conditions. Therefore, baseline information for vegetation may also need to be recorded to provide accurate baseline information for assessing changes in ecological character at this wetland. In addition, the RIS for Hula indicates fertilizers and sewage as threats, which will have a direct effect on the wetlands ability to retain nutrients. It can also be assumed that if these threats are not controlled algal blooms will occur which will alter the trophic structure or cause food chains at the wetland to collapse. If the 'processes' and 'functions' at wetlands are not explicitly recorded in the RIS, parameters unique to a particular wetland and important in describing changes in ecological character, may not be recorded. Furthermore, the RIS's for both Engure and Kopuatai explicitly state that information on hydrology is poorly understood and insufficiently studied yet both have scored values in the category of water regime (Ramsar Convention Bureau, 1996b & c; Finlayson, 1996a).

Seasonal variation in values and threats was poorly addressed with little information provided on any RIS. The RIS that did mention seasonal variation often

provided inconsequential information, such as that recorded for Fuschertal on seasonal plant growth as being: winter – hibernation; spring – vegetation grows and blossoms; summer – vegetation blossoms and bears fruit; and autumn – fruits ripen. Another area important in the determination of change in ecological character is that of natural variation. The RIS did not supply any baseline information relating to natural variation for the threats and values listed. Both seasonal and natural variations are important to distinguish between changes to the wetlands ecological character which fall within its normal range and those incipient changes, which have the potential to cause damage if not rectified (Goldsmith (ed.), 1995; Spellerberg, 1994; Mitsch & Gosselink, 1986).

The occurrence of baseline information for values and threats in the category of exploitation and production is insufficient to adequately determine a change in ecological character. This may be related to many communities regarding the values and threats in this category as part of their traditional lifestyle from which they derive food, shelter, and incomes. It is therefore, important to record baseline information on them so that the values can be maintained for future generations. Difficulties arise when communities do not recognize the long term benefits of conservation over the short term increase in economic gain. Obtaining baseline information for this category is especially difficult if the threats involve illegal activities such as poaching or there are no legal controls such as hunting permits or bag limits from which baseline information can be recorded.

When assessing whether the RIS's are adequate for detecting changes in ecological character it is also important to bear in mind that they were not initially designed for this purpose. This has led to difficulties in finding information in the first place, as the entire document must be searched to ensure all relevant information on values and threats is recorded. In addition, the values and threats are not directly correlated to show that values are in danger of being impaired or altered by specific threats. Furthermore, the RIS guidelines do not request parameters with the values and threats in mind, which has resulted in only superficial information being recorded as baseline data. The RIS's are best suited to provide a general overview of the description of a particular wetland site.

3.4.3 Monitoring information

Determination of a 'change in ecological character' requires that data is collected over time, this can be accomplished through the use of a monitoring program. The Ramsar Convention has formulated a "framework for the design of a monitoring program" to assist Contracting Parties with this task. The framework sets out important components of a monitoring program which include an objective, a description of the methodology, and identification of the variables needed to assess a change in ecological character. The components are then followed by a brief description detailing the basic requirements for each (Ramsar Convention Bureau, 1996b & c; Finlayson, 1996a & b).

In general the analysis found that information on monitoring in the selected RIS's was poorly addressed. A small number of the RIS's recorded that monitoring programs were being conducted, however, many of these did not correspond to the values and threats listed at the wetland. Those monitoring programs that were mentioned did not provide any details on the specific components that encompass a framework for a monitoring design. It was therefore, difficult to associate monitoring programs mentioned in the RIS's with the values and threats listed. This is especially pertinent when the 'objective' is missing which ascertains the basis for the collection of the data (Ramsar Convention Bureau, 1996b & c; Finlayson, 1996a & b).

The most common value associated with a monitoring program was that of 'biological diversity and richness'. The main type of monitoring being conducted for this value involved population studies of fauna at Engure, Natal and Biguglia wetlands, and vegetation monitoring at Manchon and Kushiro wetlands. The RIS's for Hula and Manchon recorded monitoring programs for the most common threats which included 'pesticides', 'fertilizers' and 'sewage'. These threats received a score for monitoring if an analysis of water quality was mentioned. There is however, no mention of the type of variables being monitored or what values were recorded for them. The RIS was not initially designed to provide detailed information on monitoring programs and as the analysis indicates this type of information, if present, has only been superficially addressed.

3.5 Conclusions

The analysis of threats and values indicates that not all the components of ecological character have been addressed adequately in the RIS's examined. The 'values', 'products' and 'attributes' in Table 1 have usually been mentioned somewhere in the RIS for each wetland. The 'processes' and 'functions', however, are rarely explicitly expressed. Even when a process appears to be taking place by the type of threats that are occurring at a wetland the connections between them are not described. Therefore, it would be difficult to determine a change in a wetlands ecological character if all the components of its definition have not been fully addressed.

The analysis of baseline and monitoring information indicates that the RIS's are not adequate for detecting changes in ecological character. In general, information on baselines and monitoring for the values and threats were poorly addressed in the RIS's examined. The information provided was found to be superficial and best suited to providing a general site description.

The collection of baseline information is important in establishing a reference base or starting point from which a change in ecological character can be assessed. Analysis revealed that the majority of baseline information provided in the selected RIS's was qualitative. This included extensive lists of scientific species names relating to the category of 'natural heritage'. In some cases the RIS's also provided limited quantitative data on a few selected species. Issues important to adequately establish a meaningful baseline were either poorly addressed or not considered. These included:

- providing a sufficient number of parameters to describe baselines for individual values and threats;
- supplying important details on parameters including: when the information was recorded (i.e. date, time, season); the location of the recorded information; the equipment utilized; who recorded the information; and for what purpose;
- seasonal and natural variations, important in distinguishing between changes which fall within a wetlands normal ecological range and incipient changes which have the potential to cause negative impacts to the wetlands ecological character;
- providing information on 'processes' and 'functions', which are integral components of all wetlands; and

- correlating parameters for baseline information with the values and threats to ensure relevant information is recorded.

The collection of data over time, through the use of a monitoring program, is essential in the determination of 'change' in a wetlands ecological character. The analysis indicates that the small amount of monitoring information supplied in the RIS's examined, merely involved mentioning that a monitoring program was being conducted. The specific components that encompass the "framework for designing a wetland monitoring program" which include an objective, a description of the methodology, and identification of the variables, have not been recorded. This made it difficult to ascertain the basis for conducting the monitoring programs resulting in further difficulties in correlating them to the values and threats listed (Ramsar Convention Bureau, 1996b & c; Finlayson, 1996b).

In addition, the RIS was not initially designed to detect changes in ecological character, which has led to difficulties in finding the information. The entire document must be searched to ensure all relevant information is recorded. This is time consuming and does not readily or concisely show correlations between information necessary to determine changes in the ecological character of a wetland.

It may be unreasonable to shift the emphasis of the original purpose for the RIS to incorporate the complex issue of 'change in ecological character' by making limited modifications to the RIS guidelines as outlined in point 2.9.1 of Resolution C.6.1 (described in section 1.5). The additions to the existing guidelines will add to the already substantial amount of information required by some components of the RIS guidelines. The first analysis in section two has indicated that too many requirements in a particular component of the RIS leads to confusion on the type of information that is actually required. This resulted in a lower compliance to the requested information in the guidelines for particular components (Ramsar Convention Bureau, 1996b & c; Finlayson, 1996a).

The improvements to the guidelines also state that baselines can be established by describing the functions, products and attributes of a site that give it benefits and values of importance. Firstly, the analysis of values and threats in section three of this document has indicated that the 'process' and 'functions' components of ecological character (Table 1) were not sufficiently described. Secondly, the analysis on baseline and monitoring information indicates that simply

describing the components of ecological character and providing basic information on them does not necessarily establish baseline data or provide information on monitoring from which change can be assessed (Ramsar Convention Bureau, 1996b & c; Finlayson, 1996a).

The conclusion drawn from this analysis is that the RIS's provide superficial information which is best suited to providing a general description of the wetland site but is not adequate for detecting changes in ecological character.