Introduction to field workshops on management planning

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The afternoon's workshops on management planning are outlined. This involves putting in context as well as logistical information. The background material draws on the Ramsar Convention's new guidelines on management planning, as well as other sources.

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Workshop objectives

The objectives of the Conference's Management Planning Workshop were as follows:

1. To update Conference participant's management planning skills through a practical exercise.

2. To assist in developing thinking about management needs of the species at the sites visited. Participants may have faced similar management issues in other territories and information exchange may bring useful insights into practical conservation problems in Bermuda.

3. The UK has to update Information Sheets on all its Ramsar sheets in the course of the next year for submission to the ninth Conference of Parties to the Convention in 2005. The workshop provides a useful opportunity to collect descriptive information on those areas to be visited which are designated Ramsar sites.

4. To allow conference participants to experience some of Bermuda's important natural habitats and understand the range of local conservation issues and management problems.

Management planning

Management planning is an essential activity to ensure that the management of sites, whether for nature conservation or other heritage values, is undertaken within a logical and coherent framework. This is essential to ensure consistency of approach between individual managers and across years, and so ensure that management is directed to greatest effect.

In recent years there has been considerable development of the format of site management plans. One widely accepted format is that adopted by the Ramsar Convention. This closely links to formats derived independently in France and the UK in the 1980s (*e.g.* Nature Conservancy Council 1987).

The Ramsar Convention initially adopted management planning guidance in 1993 (following an international workshop in North Wales in 1992). In the light of international experience with its application, this guidance has been recently revised and updated. It was adopted by Ramsar's eighth Conference of the Parties in November 2002. The *New Guidelines for management planning for Ramsar sites and other wetlands* can be found on the Ramsar web-site at: www.Ramsar.org/key_res_viii_14_e.pdf.

Despite its title, the Ramsar guidance is also applicable to non-wetland sites.

Much of the following outline is based on this guidance, and considerable further detail and background is given in the Ramsar guidance.

Five Essential Steps

Any Management Plan has five essential steps:

a) Preamble/policy (Why are we doing this?)
b) Description (What do we know?)
c) Evaluation (Why is the site important?)
d) Objectives (What do we want to do?)
e) Action Plan (How are we going to do it?)

Preamble and policy statement
The preamble is a concise policy statement that should reflect, in broad terms, the policies and/or practices of those organisation(s) concerned with the production and implementation of the management plan. It should emphasise how this might effect the implementation of the plan.

For example, the scope and nature of a management plan produced by a governmental body, with statutory or regulatory powers, will be different in nature and scope to a plan produced by a non-governmental organisation with different obligations and powers.

Description
The Description provides the essential background information about a site and its features of importance. This data and information are used to drive the rest of the site management planning process. It provides a collation and synthesis of all the relevant existing data and information for the site, and in terms of management it should provide a 'one-stop shop' for management-related information.

This part of a Management Plan should be regularly reviewed and updated, so as to incorporate new sources of data and information, including updates from monitoring activities. This feedback is essential, since aspects of the site's ecology will change in response to management. This information needs to be captured so as to be able to assess and review the efficacy of management.

Evaluation
The Evaluation process identifies or confirms the important features or foci for management planning. It addresses the question as to why the site is important and exactly for what (in terms of species or habitats) are we seeking to plan. Clarity of approach at this stage is essential.

Evaluation of important features is undertaken separately for different interests, including:

- ecological character features
- socio-economic features
- cultural features
- and any other important features identified

A range of familiar criteria are used to help evaluate ecological character features. These include:

- Size
- Biological diversity
- Naturalness
- Rarity
- Fragility
- Typicalness
- Potential for improvement and/or restoration

Other criteria may be used to evaluate other features of importance on a site (such as aspects of cultural importance).

An outline from Ramsar's guidance (top of next page) illustrates the separate evaluation of different types of feature on a site and how these logically link to objective setting.

Objective setting
Through undertaking the Evaluation, a list of the important site features will have been identified. The next step is to prepare management objectives for each of these features.

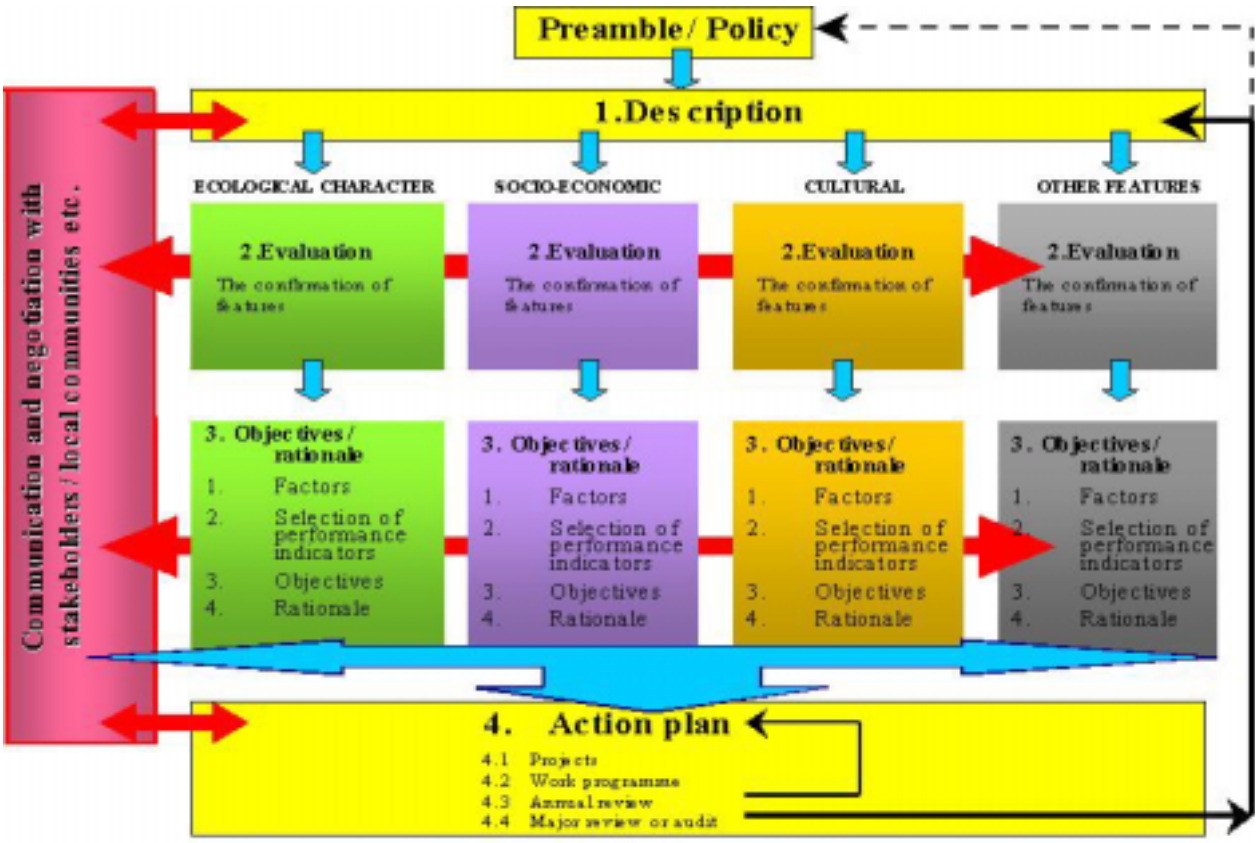
An Objective is an expression of something that should be achieved through management of the site. Objectives should have the following characteristics:

1. ***Objectives must be quantified and measurable:***
   - this is because if they are not measurable, it is impossible to assess through monitoring whether they are actually being achieved.

2. ***Objectives should be achievable, at least in the long term:***
   - because there is little purpose in pursuing objectives that are inherently unattainable!

3. ***Objectives must not be prescriptive: they define the condition required of a feature and not the actions or processes necessary to obtain or maintain that condition:***
   - because Objectives are an expression of purpose;
   - and there is a need to differentiate between the purpose of management and the management process itself. Thus, for example, in restoring a site with damaged ecology, a range of quite different actions may be necessary progressively at different stages of the restoration process.

There are three key stages in the process of preparing measurable objectives for a site:



i) Describe the *condition* (*i.e.* the end-point) that is required for a feature.

ii) Identify the f*actors* that influence the feature, and consider how the feature may change as a consequence.

iii) Identify and quantify a number of *performance indicators* for monitoring progress in achieving the objectives for that feature.

Projects

The objectives of a Management Plan will be delivered through a number of projects. Each of these should specify the following:

When:	when will work be carried out and for how long?
Where:	where will activities take place on the site?
Who:	who will do the work and how much time will be required?
Priority:	what priority is given to the project?
Expenditure:	how much the work will cost?

Management planning on Bermuda

Most of the six sites visited during the workshops are small. Thus there is a particular need to consider the importance of external influences on ecological processes within these protected areas. The following issues are particularly important:

- to what extent are the sites influenced by off-site factors?
- what are these?
- and how might these be controlled?

The essential point is that to adequately conserve most protected areas, management planning should not stop at the site boundary. Usually much larger frames of reference will be needed, including catchment management planning or (in mainland contexts) river-basin planning.

The participants on the workshops were asked to consider a range of factors that were probably affecting the sites to be visited, and a number of questions were posed:

1. ***The impact of non-native or invasive species on the features of importance (species and habitats)***

   - *e.g.* feral cats and their impacts on nesting bird populations
   - Non-native plants
   - What are the impacts of these non-natives on features of importance?
   - How might these impacts be controlled?

(Even if it is not feasible to eliminate impacts, is it possible/desirable to reduce impacts?)

2. ***What is the role of local communities in management of sites?***

   There is a very high population density in Bermuda, and most protected areas are small. Thus what is the role of surrounding local communities and how does that create either problems or opportunities? In particular, what are the opportunities and needs for education and public awareness at each of the sites.

Guidance to leaders and rapporteurs

The following notes (also including the Workshop Objectives noted above) were supplied to the leaders and rapporteurs for each group, and these were supplemented by briefings.

The following sites will be visited, with a note on habitats and conservation issues:
Hungry Bay (Ramsar site, Nature Reserve): Bermuda's largest mangrove swamp threatened by erosion consequent on human impacts and rising sea-levels

Pembroke Marsh East (Ramsar site, Nature Reserve): Freshwater *Typha* marsh. Pollution from adjacent garbage dump and urban development

Devonshire Marshes (not designated): Peat swamp basin. Integration of management with surrounding areas

Spittal Pond (Ramsar site, Nature Reserve)

Cooper's Island (Partly Nature Reserve): Relatively unmodified coastal habitats: potential to significantly expand reserve and create major ecotourism attraction. People management issues.

Coney Island (National Park): Marine pond with mangroves; rocky shoreline dominated by native plants; seagrass beds. Degraded coastal hillsides with dense stands of *Casuarina.* Need to relocate the scrambling track; restore water exchange; eliminate invasive plants.

Leaders
Leaders will play an important role in facilitating the exploration and discussion of the issues concerned. It is suggested that initially leaders identify expertise within the group. There is no fixed format for field activities. One option may be to work as a single group, alternatively there may be value in splitting into two or more separate groups to consider different issues - especially if there are people with complimentary skills in the group.

Given the reliance on local helpers to provide information on the sites and issues, there may be merit at least at first, in working in a single group until participants are broadly familiar with the site and conservation/land management issues to be addressed.

We can expect local helpers to give participants a briefing on issues at each site, although it may be helpful to make contact with 'your' local helper in advance of the field trip for a personal update on the relevant issues.

A minimum desired product from each group will be:

- A list of the features of conservation importance at each site; and
- Measurable conservation or other management objectives for each of these features (note these objectives should not necessarily be related exclusively to nature conservation, if there are heritage or other cultural values present).

At least some management recommendations at each site would be desirable.

Rapporteurs
The role of the rapporteurs will be to assist Leaders to capture the conclusions of the group in a fairly systematic manner (you will have forms for completion in the field which will assist in this).

These forms will be compiled to produce a number of outputs from the workshop including feedback to the Conference.

Please return forms to David Stroud at the conclusion of the field trips.

Local experts
The role of the local experts will be to brief the field groups on the main features of importance at each of the sites, the background to past conservation action there, and current issues.

It would be useful to provide information to the group not only about conservation actions that have been successful, but also those that have been less so. This might provide valuable areas for discussion and consideration (learning from past mistakes).

Notes for participants

Conference participants were supplied with a set of outlines on the six sites edited from the Background site descriptions reproduced in the following site sections. This was preceded by the following introductory note:

"On Tuesday afternoon, the conference will divide into small, manageable groups, each to visit one of Bermuda's interesting sites to make a structured effort at developing a plan for aspects of management. This further develops an initiative which proved very popular at the Gibraltar meeting. Lists will be placed on the Reception desk so that participants can indicate a preference as to which field workshop they would prefer. Please note that, whilst the organizers will do their best to accommodate these preferences, this will not be possible if too many sign up for any. You are advised to indicate your choice early to give the best chance of its being met.

"This document summarizes the six options to help you indicate a preference. Participants in each workshop will receive some fuller notes for 'their' site."

Once the groups were created, each participant received the full background site description and aerial photograph for 'their' site.

Field workshop reports

In the following pages, a report is given on each site visited. At the start of each report are the notes provided to the participants , including the aerial photograph (the latter are Copyright of Bermuda Government Ministry of Works and Engineering). Following this, is the report from the field workshop. Where possible, the text is illustrated with photographs supplied by members of the workshop team or others.

Acknowledgements

There was considerable positive feedback from participants following the field workshops. Thanks to all for their many and varied inputs which helped make it such a collectively successful exercise.

Particular thanks go to Annie Glasspool, Andrew Dobson, Jack Ward, Joseph Furbert and David Wingate for the provision of initial background material, to Mike Pienkowski for suggestions and help, and especially to all the leaders, rapporteurs and local experts for their crucial role in synthesising conclusions, summarising these over-night and presenting them to the following morning's session): Michael Brooke, Liz Charter, Colin Clubbe, Andrew Dobson, Alison Duncan, Vin Fleming, Joseph Furbert, Annie Glasspool, Brendan Godley, Madeleine Groves, Julie Marshall, Drew Pettit, Peter Ryan, Sarah Sanders, Joseph Smith-Abbot, Andrew Syvret, Jack Ward and David Wingate.

David Stroud and Mike Pienkowski are particularly grateful to Judie Clee for logistic support to the organisers, and guiding us in style around several of the sites.

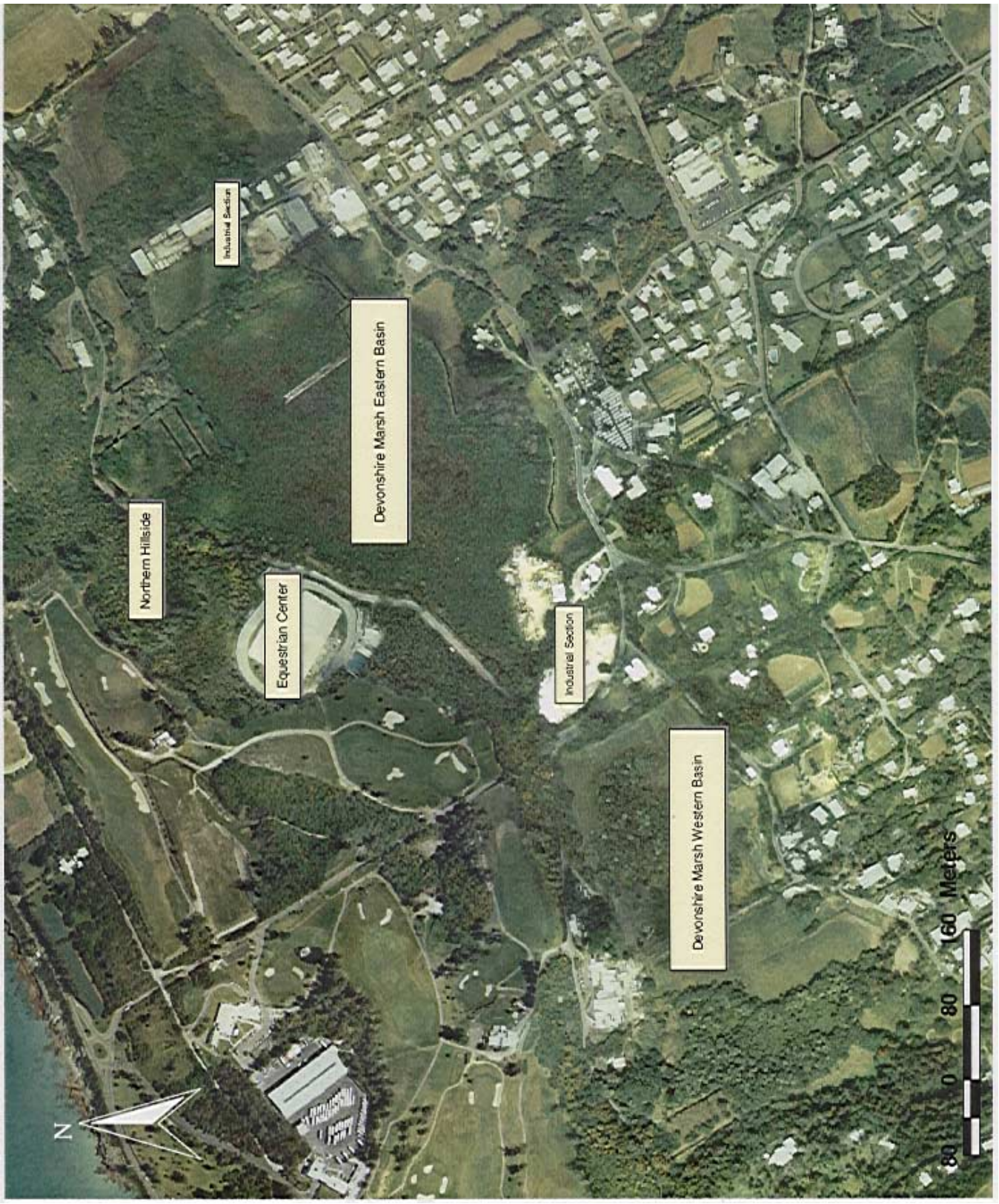
Reference

Nature Conservancy Council 1987. *Site management plans for nature conservation: a working guide*. NCC, Peterborough. 40 pp.

Devonshire Marshes

Leader: Liz Charter; rapporteur: Vin Fleming; local expert: David Wingate

Charter, E., Fleming, V., Wingate, D. & Stroud, D. 2003. Devonshire Marshes. pp 200-211 in *A Sense of Direction: a conference on conservation in UK Overseas Territories and other small island communities* (ed. M. Pienkowski). UK Overseas Territories Conservation Forum, www.ukotcf.org



Background site description

Status - Possible Ramsar site

Ramsar criteria - not yet analysed

Size - 30.14 ha (eastern section 19.6 ha, western section 10.54 ha)

Principle biotopes
Two large peat marsh basins consisting mainly of sawgrass swamp, bracken savannah, wet pasture and a section of swamp forest.

Description and ecological features
(Information from UKDT Ramsar review information sheet 1992, & David Wingate)
Two large peat marsh basins consisting mainly of extensive sawgrass swamp, fire-climax bracken savanna, wet pasture and, in the western section, swamp forest. Peat depth reaches 12 m. The two basins are separated by a narrow strip of dry ground with a highway, and lack open water except in mosquito control ditches. The marshes are periodically flooded by heavy rains and the water is almost fresh (4 ppt salinity).

Devonshire Marsh vegetetation (EC)

The site is the largest peat marsh basin in Bermuda (and largest tract of open land left in the islands) and one that has never been used for the dumping of rubbish. Freshwater is extracted from filtration galleries around the marsh edge for domestic use.

The western basin has the only continuing wet pasturing on Bermuda, whilst the eastern basin is primarily used for fodder cutting.

Noteworthy flora
Extensive stands of sawgrass *Cladium jamaicensis*, bracken fern *Pteridium caudatum* and *Osmunda* ferns with scattered *Myrica cerifera*. *Ilex vomitoria* and small paches of endemic Bermuda cedar *Juniperus bermudiana* and the rare endemic Bermuda palmetto *Sabal bemudana* swamp forest including the naturalised palm *Phoenix reclinata*. Marsh edge pastures are dominated by *Paspalum urvillei* and *Panicum purparescens*.

West Marsh pasture (BP)

East Marsh (BP)

Noteworthy fauna
An important area for some passage and wintering waterbirds, notably American Bittern *Botaurus lentiginosus*, Cattle Egret *Bubulcus ibis*, Green Heron *Butorides virescens*, Little Blue Heron *Egretta caerulea*, Glossy Ibis *Plegadis falcinellus*, Sora Rail *Porzana carolina* and Common Snipe *Gallinago gallinago*.

Several introduced species occur in the marsh including the Orange-cheeked Waxbill *Estrilda melpoda*, the toad *Bufo marinus* and the frogs *Eleutherodactylus johnstonei* and *E. gossei*.

Social and cultural values
Aesthetic

Site vulnerability and management statement
Fires. The site was originally cedar dominated but these were destroyed in the great fire of 1914. Use of the marsh for grazing and celery cultivation during the early part of the twentieth century

Devonshire Marsh ferns (EC)

initiated habitat changes that have made the site progressively more vulnerable to fires. The marsh has now changed to an open savannah habitat dominated by fire-climax species such as sawgrass and bracken fern, which not only survive fires but produce much litter. Subsequent fires in the 1940s, 1950s, 1970s, and in 1996 have prevented the marsh from becoming reforested.

A suggested option might be to create water barriers which would serve as fire breaks, thereby reducing management needed. This could increase habitat diversity (a desirable objective?) and produce soil and peat for sale.

There is conflicting use of land with an industrial site in the middle of the site.

"One of the overall visions for this area is to integrate the northern hillside into the existing nature reserve by closing the access road, grassing it in and making it a walking trail. By taking out the road and joining the two parks, the largest contiguous open area in Bermuda would be created, which would be adjacent to a large golf course. This area is very importance aesthetically and ecologically."

Team discuss the road (EC)

Current scientific research/survey/monitoring and facilities
Not known

Current conservation education
Not known

Current recreation and tourism
Not known

Possible management issues to explore on site:

What off-site factors influence the management of the site? How might these be addressed? How to integrate the management of the site with that of the surrounding area?

How to reduce and manage fire risk? Creation of fire breaks? Issues?

Illegal dumping at Devonshire Marsh (EC)

Industrial encroachment and proposed expansion of equestrian centre (but development is, to an extent, constrained by lack of solid foundations requiring deep piling)

Disturbance?

Overgrazing

Any invasive species issues and their management?

Monitoring needs?

Cat feeding station (BP)

Some of the Field Workshop team plan their work (BP)

Report of Field Workshop

Group members:
Liz Charter (leader)
Iain Orr
Bruce Potter
David Wingate (local expert)
Steve Conway (local expert)
Jim Sinclair and colleague (local experts)
Vin Fleming (rapporteur).

Summary

The group were impressed with the quality of this site which consists of two peatland basins (bisected by a road and current industrial uses) and adjoining areas of (non-native) woodland. Together with an adjacent golf course, they form the largest area of open ground remaining on the islands. The wetlands consist of predominantly native vegetation, support some rare and scarce plants and are important for passage and wintering birds. The group felt that the site met criterion 1 of the Ramsar Convention, namely that it contains *a representative and rare example of a natural or near-natural wetland type found within the appropriate biogeographic region*. It should thus be considered as a candidate wetland of international importance.

From, a quick evaluation of features, it was clear that the site scored very highly for features such as size, naturalness, biological diversity, rarity (of habitat), typicalness and potential for education, public awareness and research, especially in light of its central location and ready access.

Nevertheless, there are a number of problems that affect the site including those of alien species, industrial encroachment, fly-tipping and changes to hydrology related, amongst others things, to sea level rise. Although one of the largest open-spaces remaining on Bermuda, it is currently little used or valued by most Bermudians. Most importantly, there is considerable potential for the site to become a greater resource for the enjoyment, education and understanding of the natural heritage of Bermuda by residents and visitors alike. When combined with habitat restoration and other enhancement opportunities, this site has potential to be much more valuable to both wildlife and the community. The group hopes that this potential will be realised and acted upon by the appropriate authorities and NGOs in Bermuda and will also be properly acknowledged by designation as a Ramsar site. Some actions, such as preventing further industrial and unauthorised encroachment into the site, require urgent attention.

The features of interest of the site and the management issues are summarised in Annex 1 whilst a rudimentary management plan for the site is provided in Annex 2.

Our visit to the site, and our discussion and conclusions, were immeasurably enhanced by the local guides (listed above) to whom we extend our grateful appreciation.

Industrial area on East Marsh

Annex 1 – Evaluation of features and issues of importance

Feature of importance/issue	Approach to solving problems	Measurable conservation objective
Features of interest		**Ideal (long term) objectives**
Largest peat marsh / basin mire (consisting of two peat basins) on the island (likewise freshwater lens), comprising predominantly native vegetation and containing rare / scarce species. Peat has a depth of up to 12m.	Wetland is of considerable importance in a Bermudian context. Peatlands are a wetland-type which are under-represented in the Ramsar series (as are wet grasslands). Issues of changes in hydrology, industrial encroachment and alien species. Site contains a fossil archive of changes in Bermuda's vegetation over the Holocene.	To maintain / restore an intact, functional peatland system comprised of native vegetation
Woodland on northern hillside – predominantly non-native – separated from basin mire by minor road	Valuable area of woodland (for birds, landscape etc) even though dominated by non-native vegetation.	To restore to native vegetation a large block of native woodland and to restore its ecological continuity with adjoining wetlands.
Largest open space on island – provides a feeling of wildness – especially when combined with surrounding land-uses (*e.g.* golf course)	Although large open space, most of the land is not readily accessible to the public and the space is under-valued and under-used. Significant potential for education and enjoyment which is not currently realised.	To enhance the educational, recreational and research value of the site within a coherent identity
Issues		**Operational objectives**
Alien species	1. The eastern basin does not have a significant problem of invasive plant species and those present could be eradicated. 2. The same is not true of the western basin where, for example, *Phoenix* palms have invaded hammock vegetation and little control work has been undertaken so far. 3. Much of the northern hillside is composed of non-native trees and shrubs but is valuable for birds etc regardless. The woodland could be progressively restored whilst retaining the value and visual continuity of the woodland cover. 4. There is a feral cat feeding station within the woodland, which increases predation pressure on nearby breeding birds and there are red-eared terrapins *Trachemys scripta elegans* in the marsh. The former at least should be re-sited elsewhere or the cats controlled.	Eradicate alien plants from eastern basin by xxxx. Initiate measures to control further spread of alien plants in west basin (ongoing). Maintain current extent of open wet grassland (through traditional land management of grazing and fodder cutting). Restore woodland northern hillside to native species incrementally (x% *per annum*). Control non-native fauna (cats) - by re-locating feeding station by 2005 or by introducing lethal control.

Note: These Annexes indicate by x or xxx etc targets which would need to be decided by the local managers.

Habitat restoration	1. The two basins were cedar-dominated swamps until the cedars were destroyed by fires. Some cedars still remain on the site but these are dying due to water level changes (see below). Restoration to original condition is unlikely to be achievable and seral progression (dependent on hydrology) is likely. 2. Woodland restorable to native vegetation over a long period. However, there is a valuable opportunity to restore some ecological continuity between the woodland and the wetland by closing and removing a section of the road round the northern edge of the eastern basin (leaving access to equestrian centre and houses at each end). 3. Scope to use central industrial section for native woodland planting (drier ground is suitable for native cedar).	Restore northern hillside to native woodland incrementally (x% *per annum*). Seek protected status (Woodland Reserve) under local planning regulations for northern hillside. Restore ecological continuity between marshland and northern wooded hillside by closing and removing northern perimeter road (where not required for access). Restore a native woodland element to central industrial section.
Land tenure / site protection	1. Whilst a few parts of the site are in conservation management (National Trust & Audubon Society), the remainder is in the hands of several private owners. Most owners are concerned with the potential future value of the land for development (encouraged by unopposed encroachment). Conservation management is thus inhibited. It is thus imperative that the wetlands are given clear protected status in development plans by Government so they can be acquired (or managed, *e.g.* by easements or management agreements) by conservation organisations at the open space value as opposed to development land price, as soon as possible.	Extend by acquisition or agreement the current reserves holdings to cover both peatland basins by [2010]. Give protected status to the wetlands in development plans as a priority (immediate).

Ramsar designation	1. The site seems to meet criterion 1 of the Ramsar convention for identification as a wetland of international importance. 2. This designation can seemingly not be applied on Bermuda unless the land comes into conservation management	Identify the site as a candidate wetland of international importance (Ramsar site) in local plans (immediate). Pursue Ramsar designation following reserve acquisition.
Uncontrolled fires	1. Major unplanned fires occur once a decade or so. Large fires originally responsible for shift in vegetation from cedar-dominated forest to fire-climax savannah vegetation now. Fires are left to burn out once they have started as impossible to control. Despite the damage they cause, at least one species (the endemic St Andrews cross) is only found after fires. Fire control / limitation may also have significant public safety benefits were any of these fires to spread beyond the marsh.	Reduce risk of uncontrolled fires on peatland basins (by creating fire ditches / open water).
Availability of open water	1. This is currently limited but could be expanded to increase the value of the site to breeding / passage and wintering waterbirds (especially given that Spittal Ponds are now less attractive to shorebirds than hitherto). Suitable wader scrapes could enhance the recreational value of the site to birdwatchers. Creation of open water in the mires could also act as firebreaks to limit damage from uncontrolled fires (or permit controlled burning if desired). Costs of machinery hire suggest this is best done in as few stages as possible – i.e. not piecemeal. It may be necessary to develop a floating ditch dredger for keeping fire breaks open (similar to sludge pumps in Norfolk Broads ditches ?).	Increase extent of open water habitat (scrapes for shorebirds, deeper firebreaks) – linked to objective above.

Hydrology (water abstraction / sea level rise)	1. Indications that with rising sea level the water-table is rising. Some cedars remaining on the marsh now dying (not clear if simply due to water-logging or to saline intrusion). Water is also abstracted from the margins of the site. Impacts of this activity are not known but are thought to be benign? Regardless, changes in hydrology likely over time (and if led by sea level rise then outside control) with implications for vegetation.	Monitor changes in hydrological character of the site (e.g. saline intrusion, water level rise, water abstraction) and associated vegetation change (ongoing / fixed intervals)
Rare species management	1. A number of rare species – sedges and ferns – occur on the site. These may require management individually tailored to their requirements. Maintenance of traditional grazing (or cutting) management vital for some species. Need to understand how their requirements relate to, grazing, burning, water levels and water quality. 2. Further survey is required for the site, especially less conspicuous species, and comparative study with other wetlands would be an advantage. 3. A small part of the eastern marsh is used as a native plant nursery by the National Trust. This is a valuable resource for ecological restoration throughout the island.	Maintain appropriate habitat for key rare species (sedges / St. Andrew's Cross / ferns?) and monitor population status and distribution. Undertake further survey of rare species on the site and determine autecological requirements. Maintain / regularise the use of the native species nursery in the eastern marsh.

Traditional grazing / fodder management	1. Low intensity grazing and fodder cutting around parts of the site are important in creating more diverse range of vegetation types (notably wet grassland), in suppressing the spread of some invasive aliens and in increasing the availability of open habitats for shorebirds and some of the rare sedges. A study of how these practices benefit wildlife would be useful. 2. Wet grassland is also listed as an under-represented habitat for Ramsar sites.	Maintain current extent of open wet grasslands (through traditional land management of grazing and fodder cutting). If necessary, support viability of traditional land management practices, for example by area payments similar to agri-environment schemes.
Recreational uses – birdwatching / quiet enjoyment / lack of access / environmental education	1. Little recreational use at present. Visitors constrained to walking / driving around the margins of the site. Closure of under-used road would enhance these facilities. 2. Birdwatching is popular but no facilities for either watching birds (e.g. hides / towers) or for attracting birds (e.g. scrapes). 3. No interpretation (signs, boards) or trails / boardwalks available to inform public of interest of the site. 4. No coherent identity for the site and site apparently not valued by much of the island. Scope to 'badge' the area and combine interests into a package combining conservation, education and enjoyment under a common theme: e.g. '*Dark and peaty heart of Bermuda*', '*Wild heart of Bermuda*'…. 5. Central industrial section originally earmarked as a playground / park for local children. 6. Scope to use Monarch butterfly *Danaus plexippus* as flagship species for western basin.	Create a coherent identity / badge for the site by xxxx. Enhance public awareness, understanding and enjoyment of the natural heritage features of the site. Replace central industrial use with a central public focus for the site (e.g. comprising car park, native woodland planting, playground, observation tower, interpretation…..) within 5 years. Enhance opportunities for quiet enjoyment of the site including : • create scrapes for shorebirds & hides for birdwatchers; • close northern perimeter road (where access not required) and convert to walking trail; • provide boardwalks and observation tower to enable better appreciation of marshland habitat; • provide training and materials for use by local birdwatching / nature guides; • identify possible natural wetland products for promotion of wetlands to islanders.

Research interest	1. Scope to increase research into the site, e.g. into development of vegetation through the Holocene, benefits of grazing / cutting to wildlife or autecology of rare species.	Undertake or encourage further research into: • vegetation development during the Holocene (through pollen analysis in peat cores taken from this and other peatlands on Bermuda); • autecology of rare species; • value of traditional land management to wildlife.
Industrial encroachment	1. Industrial section in eastern basin is being extended by illegal dumping in flagrant violation of planning regulations. This threatens the hydrological integrity of the eastern basin (if not the whole site) and will, if not controlled, split the eastern basin into two smaller (and thus more vulnerable) hydrological units. 2. Central industrial section is in National Trust ownership but has a sitting tenant. Lease expires soon giving opportunity to return to more favourable land use. There are various options that might arise: the group strongly felt that the strategic importance of the area for Bermudian nature conservation values was such that every opportunity should be taken to move the management of the site to one whose primary objective is nature conservation, rather than industrial or other uses. 3. Some industrial sites and major roads close to the wetland pose a pollution risk, especially oil. 4. Expansion of the equestrian centre potentially threatens further areas of the northern hillside woodlands.	Prevent further illegal encroachment (building / tipping) on to site (immediate). Require developer to restore, or fund restoration of, damaged areas to original condition (if feasible). Publicise the high cost of building stable structures on peat or remedying sinking warehouses. Replace central industrial use with a central public focus for the site (e.g. comprising car park, native woodland planting, playground, observation tower, interpretation…..). Undertake pollution risk assessment and put in place contingency plan for oil or other industrial pollution of the wetland. Constrain future expansion of the equestrian centre where this would have a further detrimental impact on the hillside woodland.

Fly-tipping / illegal dumping of rubbish	1. Fly-tipping and casual dumping of rubbish is a chronic problem rooted in traditional Bermudian view of wetlands as places to dispose of rubbish. Issue detracts from aesthetic value of the site. 2. The dumping of garden refuse also provides a conduit for the establishment of further alien plants in the site and so has the potential to rapidly undo alien species clearance work. 3. Scope to reduce this problem by closing road round northern edge of eastern basin (see above). However, this problem needs also to be addressed in an holistic Bermuda-wide approach to waste management / re-cycling etc.	Enhance public awareness, understanding and enjoyment of the natural heritage features of the site. Close northern perimeter road where access not required. Address waste disposal policy / education issues at Bermuda-wide level (especially fly-tipping, disposal of domestic rubbish & garden waste & re-cycling policy and practice).

Annex 2: Outline management plan – Devonshire Marshes

Ideal (long-term) management objectives

- To maintain / restore an intact, functional peatland system comprised of native vegetation
- To restore to native vegetation a large block of woodland (northern hillside) and to restore its ecological continuity with adjoining wetlands.
- To enhance the educational, recreational and research value of the site within a coherent identity

Operational objectives

Wetlands

- Extend, by acquisition or agreement, the current reserves holdings to cover both peatland basins by [2010].
- Formally identify the site as a candidate wetland of international importance (Ramsar site), and give protected status to the wetlands, in local development plans as a priority (immediate).
- Pursue Ramsar designation following reserve acquisition.
- Eradicate alien plants from eastern basin by xxxx.
- Initiate measures to control further spread of alien plants in west basin (ongoing).
- Maintain current extent of open wet grassland (through traditional land management of grazing and fodder cutting).

Fodder harvest (BP)

- If necessary, support viability of traditional land management practices, for example, by area payments similar to agri-environment schemes.
- Reduce risk of uncontrolled fires on peatland basins by creating fire ditches / open water (as soon as feasible).
- Increase extent of open water habitat (scrapes for shorebirds, deeper firebreaks) – linked to objective above (as soon as feasible).
- Monitor changes in hydrological character of the site (e.g. saline intrusion, water level rise, water abstraction) and associated vegetation change (ongoing / fixed intervals)

Pool area, important for birds (BP)

- Maintain appropriate habitat for key rare species (sedges / St. Andrew's cross / ferns) and monitor population status and distribution.
- Undertake further survey of rare species on the site and determine autecological requirements.
- Prevent further illegal encroachment (building / tipping) on to site (immediate).
- Require developer to restore, or fund restoration of, damaged areas to original condition (if feasible).
- Undertake pollution risk assessment and put in place contingency plan for oil or other industrial pollution of the wetland.
- Publicise the high cost of building stable structures on peat or remedying sinking warehouses.

Hillside woodlands

- Restore woodland on northern hillside to native species incrementally (x% *per annum*).
- Control non-native fauna (cats) - by relocating feeding station by 2005 or by introducing lethal control.
- Seek protected status (Woodland Reserve) under local planning regulations for northern hillside.
- Restore ecological continuity between marshland and northern wooded hillside by closing and removing northern perimeter road (where not required for access).
- Constrain future expansion of the equestrian centre where this would have a further impact on the hillside woodland.

Enjoyment / understanding / research

- Create a coherent identity / badge for the site by xxxx.
- Enhance public awareness, understanding and enjoyment of the natural heritage features of the site.
- Replace central industrial use with a central public focus for the site (e.g. comprising car park, native woodland planting, playground, observation tower, interpretation) by 2008.
- Restore native woodland element to central industrial section.
- Maintain/ regularise the use of the native species nursery in the eastern marsh.

Trust nursery (BP)

- Enhance opportunities for quiet enjoyment of the site including :
  - o create scrapes for shorebirds & hides for birdwatchers;
  - o close northern perimeter road (where access not required) and convert to walking trail;
  - o provide boardwalks and observation tower to enable better appreciation of marshland habitat;
  - o provide training and materials for use by local birdwatching / nature guides;
  - o identify possible natural wetland products for promotion of wetlands to islanders.
- Address waste disposal policy / education issues at Bermuda-wide level (especially fly-tipping, disposal of domestic rubbish & garden waste, re-cycling policy and practice).
- Undertake or encourage further research into:
  - o vegetation development during the Holocene (through pollen analysis in peat cores taken from this and other peatlands on Bermuda);
  - o autecology of rare species;
  - o value of traditional land management to wildlife.

Hungry Bay Mangrove Swamp

Leader: Andrew Syvret; rapporteur: Joseph Smith-Abbot; local expert: Annie Glasspool

Syvret, A., Smith-Abbot, J., Glasspool, A.F. & Stroud, D. 2003. Hungry Bay Mangrove Swamp. pp 212-216 in *A Sense of Direction: a conference on conservation in UK Overseas Territories and other small island communities* (ed. M. Pienkowski). UK Overseas Territories Conservation Forum, www.ukotcf.org

Background site description

View west, with sea to left and a glimpse of the Bay to right (MP)

Status
Ramsar site (classified 10 May 1999)
National Nature Reserve
Tree Preservation Order protects the mangroves

Ramsar criteria
The site is listed under the following criteria:

1 A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.

2 A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities.

3 A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.

4 A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.

8 A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.

(Note that a clearer justification of these importance features would be desirable for this site.)

Size: 2.01 ha

Principle biotopes
Tidal mangrove swamp at edge of shallow marine bay

Eastward view into the Bay with main mangrove area at right (MP)

Description and ecological features
(Information largely taken from Ellison, J.C. 1991. *Hungry Bay Mangrove Swamp, Bermuda. Present condition and future management.* Report of Bermuda Biological Station for Research, Inc. 27 pp. and Ramsar Information Sheet for Hungry Bay Mangrove Swamp)
Bermuda's largest tidal mangrove swamp located in a shallow (mostly c. 1 m deep) sea bay with a relatively narrow opening to the sea. It is the largest example in Bermuda of the most northerly mangrove swamps in the world. Hungry Bay has the longest continuous sequence of mangrove peat layers in the Atlantic and the first documented evidence of significant mangrove forest retreat caused by contemporary sea-level rise.

Closer view of mangrove in above photo (MP)

The swamp supports important populations of endangered native crabs (the last Bermudan refuge for several crustacea — including largest remaining population of Land Crab *Cenobita clypeatus* and Giant Land Crab *Cardisoma guahumi*), as well as wintering birds.

Noteworthy flora
Both the two mangrove species to occur on Bermuda are found here: Black Mangrove *Avicennia germinans* and Red Mangrove *Rhizophora mangle.* Surrounding woodlands have a range of other trees including Buttonwood *Conocorpus erectus,*

On the south-east edge of the mangrove swamp there are areas of marsh plants, with Large Marsh Rush *Juncus acutus,* Sea Purslane *Sesuvium portulacastrum,* Sea Ox-eye *Borrichia arborescens,* Sea Lavender *Limonium caroliniatum, Paspalum vaginatum, Sporobolus virginicus,* Woody Grasswort *Salicornia perennis* and West Indian Grass *Eustachys petraea*. These areas are not extensive, but are of interest as they illustrate the position of Bermuda on the northern margin of tropical mangrove distribution and on the southern margins of temperate saltmarsh distribution.

Noteworthy fauna
A wintering area for Great Blue Heron *Ardea herodias,* Yellow-crowned Night Heron *Nyctanassa violacea,* Snowy Egret *Leucophoyx thula,* Mallard *Anas platyrhynchus,* Belted Kingfisher *Ceryle alcyon* and Northern Waterthrush *Seirus noveboracensis.*

The swamp supports the only significant surviving populations on Bermuda of the Giant Land Crab *Cardisoma guanhumi* (two colonies on the upper fringes of the mangrove swamp) and is the only location in Bermuda for the Land Hermit Crab *Cenobita clypeatus* (total of 54 individuals in 1990). The Mangrove Crab *Goniopsis cruentatus* also occurs. A numbers of other mangrove-living crustacea occur.

Site vulnerability and management statement
The combination of sea-level rise, storms and human disturbance in the last few decades have caused the retreat of the mangroves and the future of the forest is threatened. Mangroves formerly extended some 80 m further into the bay than they do now, and the present seaward fringe of mangroves is dying due to peat erosion and wind-felling of trees during storms and hurricanes. Turbulent ocean water is affecting this sensitive mangrove zone through a new gap in the peninsula.


Mangrove forest floor swept by currents (MP)


Mangroves from the gap (MP)

Construction of mangrove creeks in the last 40 years (to enable boats to reach private properties bordering the swamp) has channelled and accelerated inter-tidal water movements within the forest. The ebb currents are particularly rapid and strip the mangrove peat surface of leaf litter that normally contributes to peat formation, and also causes creek bank erosion.

Human disturbance enhances creek bank erosion, particularly from the effects of motor propellers and the mooring of boats during stormy conditions to sensitive creek-fringing roots. Peat erosion from the inter-tidal mangrove swamp and sediment deposition sub-tidally in Hungry Bay are classic sedimentary responses to rising sea-levels. This has resulted in a shallowing of Hungry Bay.

Some suggested management responses include:

- Stabilisation of the eroding outer edge of swamp
- Replanting of mangrove propagules on eroding swamp edge and creek banks
- A ban on motorised boats and jet-skis in mangrove creeks
- Closure of the new gap in the peninsula to reduce water flows in bay
- Boom across creek mouth to increase litter retention within the swamp
- Infilling of creeks no longer used

Active management at this swamp will contribute to knowledge of how to assist global mangrove

Mangrove plantings in protective tubes (MP)

swamps during sea-level rises predicted for the next decades.

Possible management issues to explore on site:
Sea level rise and effects of storms – management response? Erosion of the protective peninsula potentially threatens whole habitat, yet this area is not included within the Ramsar site (boundary is drawn tightly around just the mangrove area). What are the implications in terms of management control?

What other off-site factors influence the management of the site? How might these be addressed?

Any significant disturbance from boat traffic using bay? Pollution from boats?

Channels have been cut through the mangroves to enable boats to reach private properties bordering the swamp — education and public awareness issues??

Erosive forces are less at higher levels in the swamp (MP)

Any invasive species issues and their management?

There is significant garbage pollution in the Hungry Bay swamp: at the seaward edge this derives from the ocean (flotsam and jetsam). At the north end of the swamp, there are areas of dumped household garbage. Management responses?

Monitoring needs for the various management responses?

Report of Field Workshop

Participants
Andrew Syvret, Joseph Smith-Abbot, Annie Glasspool, Roy Osborne, Tara George, Richard White, Lyda Varlack, Clive Petrovic, and others.

Conclusions
(Report on next page)

The field workshop team in action (FM)

Conservation Objectives
Policy: Protect mangroves at Hungry Bay for the foreseeable future

Feature of importance/issue	Approach to solving problems	Measurable conservation objective
Integrity of mangroves is breached through the formation of channels to increase boat access	Mangrove replanting within the channels in order to block incoming marine debris	Re-establish and conserve mangrove integrity
Areas of interest are outside of the Ramsar site. Impact of activities within and outside of the site require additional protection	Extension of the Ramsar site designation to include areas currently excluded, but which form an integral part of the wetland complex, in order better to conserve the ecological and hydrological integrity of the site. Areas to be included are a peninsula, a shallow area currently degraded as a result of increased tidal activity and areas adjacent to the mangrove within the bay	Prevent further erosion and restore mangroves to former condition and extent
Casuarina sp. are crowding areas within fringe of the mangrove swamp, potentially impacting giant land and hermit crabs. May also have an impact on endemic snails found within. Area provides habitat for the highest concentration of crabs on island	Removal of *Casuarina* and replanting with native succulent or fruity species which may provide food for local species of interest	Minimally maintain the crab population size and feasibly enhance in the future
Casuarina is widespread along the peninsula which was formerly intact and now is breached by the creation of a new inlet. This is promoting the loss of mangroves along portions of the bay and potentially the loss of longtail (= White-tailed Tropicbird *Phaethon lepturus*) nesting sites	Removal of *Casuarina* from the peninsula with ongoing maintenance subsequently to reduce further breakage of substrate and reduction of nesting sites	Promote values of the natural breakwater and conserve integrity of the site from further erosion
Feral pigeons are displacing tropic bird nest displacement within the site	Trapping in other places where it may be feasible to do so. Shoot pigeons within the area	Promote re-colonization and nesting
Public access to the site is limited and only possible through private lands. Debris and garbage found within limited areas within the site	Public access will not be encouraged. Periodic clean ups, education of adjacent landowners will be undertaken, plan for pollution control will be developed	Reduce rubbish accumulation and minimize pollution presently and in the future
There is built heritage presently covered by vegetation	Need to remove vegetation to expose ruins (this issue is viewed as a low priority)	Conserve and restore heritage. Secondarily, sea bird nesting may be encouraged
Dredging may have occurred resulting in the loss of sea grasses and potentially promoting the loss of mangroves along the western corner	Ban dredging in order to avoid continued deepening of bay, with consequent redistribution of sediments from shallow areas to deeper areas. Explore possible local replanting with mangroves from local stock (already experimentally demonstrated) to help retain sediments within bay.	Restoration of mangrove integrity and potentially, the restoration of seagrass community
Colonization by invasive large marsh rush (*Junctus acutus)* along the second largest salt marsh. *Casuarina* colonization along the fringe of the mangrove. Loss of rare endemic Bermudan palmetto trees *Sabal bemudana* from the site.	Phased removal of invasive species and replanting with local trees such as white cedar, palmetto and olive wood	Restore natural communities in lands adjacent to the mangrove swamp

Spittal Pond

Leader: Rapporteur: Sarah Sanders; local expert: Andrew Dobson

Sanders, S., Dobson, A. & Stroud, D. 2003. Spittal Pond. pp 217-222 in *A Sense of Direction: a conference on conservation in UK Overseas Territories and other small island communities* (ed. M. Pienkowski). UK Overseas Territories Conservation Forum, www.ukotcf.org

Background site description

Status
Ramsar site (classified 10 May 1999)
Nature Reserve under 1975 Protection of Birds Act & 1986 National Parks Act
Part of a larger National Park

Spittal Pond from the east (EC)

Ramsar criteria
The site is listed under the following criteria:

1 A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.

3 A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.

(Note that a clearer justification of these importance features would be desirable for this site.)

Size
Nature reserve = 36.4 ha
Ramsar site = 9.53 ha

Principle biotopes
A non-tidal permanent shallow brackish lagoon with fringing mudflats and salt marshes.

Description and ecological features
(Information from Ramsar Information Sheet for Spittal Pond and the Spittal Pond Management Plan 1988)

The only Bermudan example of a non-tidal permanent shallow brackish lagoon with fringing mudflats and salt marshes. The land area comprises a natural valley containing a brackish pond of 36.4 ha and some 1.4 km of rugged coastline. The site is subject to periodic sea flooding with mudflats exposed at low water levels. The water level fluctuates by about 75 cm with rainfall and periodic flooding. Two freshwater ponds were excavated in 1966.

Closer view of part of Pond (BP)

Coast and boiling reef at Spittal Pond (BP)

The Pond holds an extremely nutrient rich but unstable community with wide fluctuations in salinity. There is low species diversity in the pond but very high productivity in boom and bust cycles.

The most important Bermudan wetland for wintering waterfowl and migrant shorebirds.

Spittal Pond features some of the best representation of geological formations in Bermuda.

Noteworthy flora
Submerged beds of *Ruppia maritima* and fringing *Paspalum vaginatum*. Adjacent woodland and pasture.

Noteworthy fauna
The pond is a major refuge for passage shorebirds, notably species of *Tringa*, *Limnodromus* and

Bird-watching at Spittal Pond (EC)

Calidris. It is of principal importance as a wintering area for many species of north American heron, egrets, ducks, coot and moorhen: Pied-billed Grebe *Podilymbus podiceps*, Little Blue Heron *Egretta caerulea*, Louisiana (tri-colored) Heron, *E. tricolor*, Snowy Egret *E. thula*, Great Egret, *Casmerodius albus*, American Black Duck *Anas rubripes*, Teal *A. crecca*, American Wigeon *A. americana*, Blue-winged Teal *A. discors*, Ring-necked Duck *Aythya collaris*, Lesser Scaup *A. affinis* and American Coot *Fulica americana*.

The eel *Anguilla anguilla* is common, *Mugil sp.* occasionally become established.

The fish *Gambusia holbrooki* is abundant serving both as mosquito control and food for herons.

Social and cultural values
The site is one of Bermuda's most important passive recreation areas, used for both walking and birdwatching. The outstanding scenic, historic and natural history value of this area was recognised from the late 19th century, with the listing of the area in many early tourist guides to the island.

- Aesthetic
- Conservation education (birdwatching, natural history and schools tours)
- Livestock grazing
- Non-consumptive recreation (jogging, horse-riding, walking, kite-flying)
- Consumptive recreation (shoreline fishing)
- Tourism

Site vulnerability and management statement
There is some eutrophication as a result of runoff from adjacent dairy farm. Measures have been taken to reduce eutrophication by redirecting runoff from the farm, and introducing a valved pipe to the sea to control salinity. However, soil erosion and sheet run-off of manure into the pond causes eutrophication and increased biological oxygen demand, with impacts on wildlife.

Occasional occurrences of botulism occur in the summer. Domestic pigeons from the dairy farm nest in the coastal cliffs compete with the nesting White-tailed Tropicbirds *Phaethon lepturus*.

In 1954 a protective fence was erected around the perimeter of the pond. In 1955, following the loss of the dense cedar forest due to scale insect epidemic of the late 1940s, the government reforested the land south of the pond with non-native *Casuarina*.

The site has been notified for its nature conservation interest under several pieces of National Legislation. Part of the site was declared as a nature reserve under the Bermudan National Trust Act. It was designated as a nature reserve under the Protection of Birds Act 1975 along with the surrounding areas and scheduled as a nature reserve by the Bermudan National Parks Act, 1986. The Bermuda National Trust has improved the sanctuary by erecting two additional small ponds for waterbirds between the main pond and the sea in 1966 and 1986, and by installing a flushing pipe and valve at the east end of the pond to control water levels.

Current scientific research/survey/monitoring and facilities
No facilities. There has been a limnological study of the pond. Migrating and wintering birds have been monitored and recorded since 1950.

Current conservation education
There are regular field trips by conservation groups and schools.

Current recreation and tourism
The site is used for bird watching and walking by locals and tourists.

Possible management issues to explore on site:
What off-site factors influence the management of the site?

What are the causes and consequences of nutrient pollution from the adjacent dairy farm? How might this and other off-site issues be addressed? Have existing attempts to address this issue been successful? If not, why not?

Cows at the dairy farm beside the Pond (EC)

Can we learn from previous attempts to tackle the issue?

The site receives heavy recreation use. Are there disturbance issues arising and what are the impacts of such use?

Party at west end of Pond (BP)

What interpretive materials are available and how might these be further enhanced?

Any invasive species issues and their management?

The monoculture of *Casuarina* planted between the pond and the sea in 1955 has attained a dominance

Westward view along coast at Spittal Pond (BP)

and height which is uncharacteristic of Bermuda and is relatively sterile for birds and floral diversity. In particular, the forest is self-seeding and has colonised the coastal zone, blocking scenic views and shading out the native coast flora. The condition has inhibited the recovery or re-establishment of native flora. Elsewhere in the reserve non-native weed trees are blocking scenic views and trails. **What are the management options in this situation?**

Pigeons have multiplied in the reserve as a consequence of the "waste grain" on the dairy farm. They also nest on the coastal cliffs where they may be posing a treat to nesting tropic birds through nest -site competition. Evidence? **Solutions?**

Monitoring needs for the site?

How does one best balance management options on the site for biodiversity features against those for people (enhancement of recreational potential)??

Report of Field Workshop

Participants

Sarah Sanders, Andrew Dobson, Nicola O'Leary, Paul Edgar, Lisa Kitson, Ethlyn Gibbs-Williams, Sarita Francis, Erica Gibbs, Gerard Gray, Niall Moore

Importance

As noted above, some of the important features of Spittal Ponds are:

- the only Bermudan example of a non-tidal permanent shallow brackish lagoon with fringing mudflats and salt marshes;
- an extremely nutrient rich but unstable community with wide fluctuations in salinity - there is low species diversity in the pond but very high productivity in boom and bust cycles;
- the most important Bermudan wetland for wintering waterfowl and migrant shorebirds;
- some of the best representation of geological formations in Bermuda.

In addition, Jeffrey's Hole and the Spanish Rock inscription are of important cultural and historical significance.

Key Threats

1. Invasive species (pigeons, cats, goats, feral chickens, casaurina, asparagus fern, brazilian pepper)

Spanish Rock and inscription (MP, MP, BP)

- loss of longtailed tropicbird nesting sites
- reduction in skink habitat

2. Visitors
   - rubbish (pollution and attraction of rats etc.)
   - inappropriate activities (running, horseriding, mountain biking) cause disturbance
   - erosion of footpaths

3. Farm
   - nutrient runoff and eutrophication
   - feed attracts pigeons
   - goats

Dairy farm beside Pond (MP)

- numbers of cattle

4. Management
   - no signs (interpretive and directional)
   - fence in state of disrepair

Recommended Approaches and Objectives

An approach to these issues is tabulated on the next page.

Trail through Palmetto at Spittal Pond (EC)

Feature of importance/ issue	Approach to solving problems	Measurable conservation objective
Improvement/ restoration of water quality in ponds, and promotion of better environmental management of zones around the site	A catchment management approach is essential to the long-term conservation of this wetland. Adjacent to, and upslope of, the site is a farm stocked at high density with dairy cattle. This has resulted in widescale erosion of pastures (little grass was apparent in the fields at the time of the visit – with much trampled bare soil). The Ponds have been impacted by sediment inputs consequent upon this soil erosion, and probably more significantly, by direct nutrient inputs from the large quantities of cattle manure produced by the farm. These wastes leach into the wetland resulting in significant eutrophication — with associated ecological consequences. Possibly consider options such as management agreement with farm and demonstration-farm for agri-environmental farming practices. Immediate needs are to: • explore means of reducing the herd size to a level that is appropriate to the location and sustainable without causing degradation of the farmland or surrounding impacts; and • explore means of reducing and re-directing run-off from the farm away from the Ponds. Ideally these wastes should be physically contained on site (perhaps used to generate methane in a biogas plant). Alternatively, piping these to the sea might be feasible as long as wastes were discharged into an area of high water dispersal, and did not result in pollution of the inshore or beach environments.	Reduced levels of nutrient loading in the ponds to those more normally experienced in pond systems of this sort. Reduced incidence/ elimination of indicators of abnormally high nutrient loading (such as algal blooms and high biological oxygen demand).
Alien plants	There are significant numbers of alien plants in and around the site. A detailed plan should be prepared listing these, their impacts and assessing the degree to which it is possible to manage, contain or eliminate these species, with monitoring needs included.	Reduced impacts/extent of alien plant species on site
Alien birds (pigeons)	A significant flock of feral pigeons is associated with the cattle farm, presumably taking advantage of cattle food. These apparently compete for nest sites with White-tailed Tropicbirds and other species. There is a need for proactive management (with monitoring) to reduce or eliminate these pigeons. This might be undertaken by: • trapping and culling of pigeons near the farm; • reducing attractiveness of the farm buildings to pigeons; or • reducing food supplies for pigeons through modifying cattle feeding regimes so that spilt food is not readily available for the birds to exploit.	Elimination of feral pigeon flock within three years of commencement of control measures.
Exploitation of the sites significant education potential, and raise awareness of the value of the site	Spittal Ponds receives extremely high levels of recreation use, both for birdwatching but also for walking, jogging and other forms of quiet recreation. Accordingly, the site has a very significant potential for environmental education and public awareness. Whilst there is some signage near footpaths, this is limited and, for example, makes no reference to the status of the sites as a designated wetland of international importance. It would be appropriate to present information to the public on other conservation management being undertaken on or near the site, for example measures to improve water quality (above). Other possibilities include targeting decision-makers and improved nature-trails, as well as ranger work to undertake and oversee work suggested.	Progressive development in the use of the site for environmental education and to develop public awareness.

Pembroke Marsh East

Leader: Michael Brooke; rapporteur: Peter Ryan; local expert: Joseph Furbert

Brooke, M., Ryan, P., Furbert, J. & Stroud, D. 2003. Pembroke Marsh East. pp 223-225 in *A Sense of Direction: a conference on conservation in UK Overseas Territories and other small island communities* (ed. M. Pienkowski). UK Overseas Territories Conservation Forum, www.ukotcf.org

Background site description

Status
Ramsar site (classified 10 May 1999)

Ramsar criteria
The site is listed under the following criteria:

1 A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.

6 A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.

8 A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.

(Note that a clearer justification of these importance features would be desirable for this site.)

Size
7.82 ha

Principle biotopes
An extensive freshwater *Typha* marsh with some open water channels up to 3 m deep

Description and ecological features
(Information from Ramsar Information Sheet for Pembroke Marsh East and *The Pembroke Marsh Plan 1987)*

A freshwater marsh in a peat basin connected to the seas by a 2 km drainage channel. The quality of the water is very significantly adversely affected by leachate from the adjacent dump (although this is no longer actively used for domestic waste disposal). A good example of a *Typha* marsh that drains as an estuarine system into the sea and supports juvenile populations of certain fish species. It is Bermuda's only estuary.

The site regularly supports passage and wintering waterfowl and is an important breeding area for moorhen.

The large capacity of the marsh buffers flooding from Hamilton city runoff during heavy rains.

Noteworthy flora
The largest surviving cattail *Typha augustifolia* marsh on Bermuda, with some *Ceratophyllum demersum* and *Cladium jamaicensis.*

Noteworthy fauna
Formerly the most important breeding area in Bermuda for moorhen *Gallinula chloropus* (>6 pairs) and American Coot *Fulica americana* (1-2 pairs). A wide variety of waterfowl are recorded on passage and in winter, including Pied-billed Grebe *Podilymbus podiceps*. American Bittern *Botaurus lentiginosus*, Least Bittern *Ixobrychus exilis*, Black-crowned Night Heron *Nycticorax nicticorax*, Green Heron *Butorides virescens* (= *B. striatus*), Great Blue Heron *Ardea herodias*, Teal *Anas crecca*, Blue Winged Teal *A. discors*, Ring-necked Duck *Aythya collaris*, Lesser Scaup *A. affinis*, Sora Rail *Porzana carolina* and Purple Gallinule *Porphyrula martinicia*.

The introduced minnow *Gambusia affinus* occurs, and the marsh supports Bermuda's largest populations of North American eel and young tarpon, which gain access to the pond via a drainage ditch connecting to Mill Creek one mile to the west.

Site vulnerability and management statement
Site has been subject to a long history of land-claim and use as land-fill for rubbish. This was initially driven by desire to eliminate mosquito breeding habitats (as Yellow fever vectors). The marsh was included in a wide-scale scheme, launched in 1987, to rehabilitate the Pembroke Marsh Basin so as to improve local social and environmental conditions, especially through the relocation of rubbish disposal operations then occurring within the basin. A major development plan was been established for the basin but appears not to have been implemented?

Other issues include:

- Potential to increase open water habitat and flushing ability
- Expensive equipment needed to do this, but resulting soil and peat could be sold to offset costs
- Former waste dump
- Residents living behind a dump for decades

– stench *etc*.
- Currently dump for horticultural waste
- Ability for underlying rock to absorb and neutralise waste

Current scientific research/survey/monitoring and facilities
Not known

Current conservation education
Not known

Current recreation and tourism
Not known

Possible management issues to explore on site:

What off-site factors influence the management of the site? How might these be addressed?

In particular — what pollution implications arising from leachate from the adjacent rubbish dump? How might this be managed? Assessed?

Any invasive species issues and their management?

Monitoring needs?

Current status of Pembroke Marsh East under the Ramsar Convention

As a result of the severe pollution impacts at Pembroke Marsh East which have resulted in the ecological quality of the wetland having severely deteriorated, the group had doubts as to whether the site still qualified under Ramsar criteria. It seemed that the endemic Kilifish *Fundulus bermudae* and the clam population are probably already extinct (although surveys would be needed to confirm this).

Given the Government of Bermuda's demonstrated commitment to the sustainable and wise-use of the wetland apparent through its listing in 1999 as a Ramsar site, an appropriate next step would be to seek the listing of Pembroke Marsh East Ramsar site on the Convention's 'Montreux Record'. This would then facilitate the provision of further management guidance though the input of a visiting group under Ramsar's Management Guidance Procedure. Such a group could provide more in-depth analysis of problems and solutions than was possible by the short visit by the Conference participants. Such a visiting group might also be able to advise on problems at other Ramsar sites on Bermuda.

Report of Field Workshop: Pembroke East marsh aka "The Dump"

Participants
Michael Brooke
Peter Ryan
Joseph Furbert
Avon Carty
Mike Freeman
Thad Murdoch
Noni Georges

Features of importance/ issues, approaches and conservation objectives

These outputs from the workshop are summarised in the Table on the next page.

Pembroke Marsh and dump from the air

Feature of importance/issue	Approach to solving problems	Measurable conservation objective
Typha and saw-grass reedbeds (dump encroachment)	Stabilise the physical interface between the dump and wetland, stopping active dumping at the wetland edge which is currently resulting in encroachment on the site.	Wetland area constant or enlarged (note a need to monitor the extent of the wetland area so as to be able to assess.
Typha and saw-grass reedbeds (impacts from alien species)	Clearing vegetation and active restoration (through transplantation of native species *etc*.)	Reduce extent of aliens (in terms of coverage and species numbers); greater numbers/extent of native species (note monitoring requirement to be able to assess this)
Extent and quality of open water for birds and ?fish	Leachate from the adjacent road and rubbish dump is polluting the site with nutrient, heavy metals and oil-based chemicals. There is also increased sedimentation into the wetland encouraging reed encroachment in turn reducing the extent of open water. • Creation of an impermeable barrier is necessary to impede lateral leaching from the dump • Dredge parts of the marsh to extend open water areas to benefit of waterbird and fish populations. • Manage road and urban run-off. [Note: it is not clear if there are any remaining fish in the wetland owing to the high pollution levels. This needs to be assessed. In the event of extinction of fish, re-establishment from other sites might be an appropriate action once water quality has improved sufficiently.]	Reduced levels of key nutrients, heavy metals and pesticides in the wetland. Larger populations of birds and fish (see note). Constant or increased open water extent, with higher edge ratio.
'Green Lung' for Hamilton: including educational potential of wetland close to major population centres	Need to physically stabilise and physically plant the dump area. This will require an alternative location for the disposal of garden refuse. Initial steps will require stakeholder meetings to plan the reorganisation of the current garden refuse site. This might involve the use of chippers to create raw organic inputs for a biogas plant creating methane/methanol	Creation of open recreational space adjacent to the wetland, including boardwalk and hide within wetland, with associated signage. Close/reduce activity at the tip-sign to levels that are sustainable in context of long-term conservation of adjacent wetland.
Flood management and hydrological linkage of the marsh to the sea	The site is part of the only 'estuarine' system in Bermuda. It should be a long-term objective to re-establish the functional linkage between the marsh and the sea. Currently poor drainage leads to flooding. There is thus a need to clean-up the existing canal linkage to the sea, possibly through dredging. This activity might additionally involve: • creation of over-spill ponds within the catchment to contain floodwaters; • restoration of bank-side vegetation; • improvement of ecological conditions for fish populations; and • re-creation of a functional estuary.	Clean, flowing freshwater linkage between Pembroke Marsh East and the sea, used by fish populations and other wetland species. Reduced incidence of flooding.

Cooper's Island

Leader: Colin Clubbe; rapporteur: Madeleine Groves; local experts: Jeremy Madeiros, Drew Pettit & Julie Marshall

Clubbe, C., Groves, M., Madeiros, J., Pettit, D., Marshall, J. & Stroud, D. 2003. Cooper's Island. pp 223-230 in *A Sense of Direction: a conference on conservation in UK Overseas Territories and other small island communities* (ed. M. Pienkowski). UK Overseas Territories Conservation Forum, www.ukotcf.org

Background site description

Status
Part nature reserve (2.6 ha)

Ramsar criteria
Not currently applicable

Size: ca 40 ha

Principle biotopes
Former island now joined to St. David's Island

Description
(Information from Anon. *A cultural, education & environmental opportunity for Bermuda. Proposal for the enhancement of Cooper's Island Nature Reserve by the addition of the NASA Tracking Station lands.* 6 pp.)
Cooper's Island is located on the eastern side of Castle Harbour and juts out into the centre of the Castle Islands. It was a separate island of 31.4 ha until 1943 when it was connected to S. David's Island by dredged fill during the construction of the US Air Force base (now the international airport). Prior to its connection with St David's Island, Cooper's Island was Bermuda's largest, most isolated and ecologically diverse island. Even today it retains most of this diversity and ecological importance because the military and NASA installations have not altered the contours significantly and the superb beaches and coastline remain.

Currently the island comprises partly a limited nature reserve, and partly NASA Tracking Station lands - which will soon be handed back to Bermuda with the closure of that station. The reserve and its associated Clearwater Beach and public spaces are currently of great importance for both recreation and public understanding of the environment. Local people enjoy hiking through one of the last remaining wild and open spaces on the islands.

Bermuda now has the unique opportunity to reclaim the remainder of Cooper's Island as an extension to the current reserve. This may be the last opportunity for protecting the rare natural heritage of Bermuda on a scale sufficient to cater for cultural and eco-tourism, and local education.

There is potential to convert the NASA land and buildings to a national park, resulting in the creation of significant educational and visitor facilities, with associated cultural, environmental and socio-economic benefits.

Noteworthy flora
Several rare species occur, including Seaside Evening Primrose and Bermuda Cedar *Juniperus bermudiana*.

Noteworthy fauna
Proximity to breeding areas of critically endangered Cahow or Bermuda Petrel *Pterodroma cahow*, thought extinct until 1951 and since subject to an intensive recovery programme.

Several rare species occur, including West Indian Top Shells, Green Turtle *Chelonia mydas* and Yellow-crowned Night Heron *Nyctanassa violacea*.

Site vulnerability and management statement

- Proposal to create a nature reserve with paying visitors
- Proximity to Castle Harbour Islands/Nonsuch/Cahow breeding sites
- W & E and BLDC interested in developing area – hotel/cottage colony
- Existing buildings – what to do with them

Narrow strip connecting southernmost former islet to the artificial peninsula (MP)

Islets off Cooper's Island (MP)

Nonsuch Island, from adjacent Cooper's Island (MP)

- Disposal of existing waste
- Proximity to motor sports and noise issues
- Land given up by Bermudians originally – what are their wants/needs?

Current scientific research/survey/monitoring and facilities
Unknown/limited

Current conservation education
Great further potential for cultural and natural history education.

Current recreation and tourism
Considerable asset at present. Significant further potential, especially if NASA land were acquired for a national park.

Possible management issues to explore on site:
Desirable objectives for management of
a) island as a whole?
b) nature reserve component?

Practicality of recreating separation from St. David's Island?

What off-site factors influence the management of the site? How might these be addressed?

Disturbance and management of current visitors to site, and issues related to management of enhanced numbers in the future? Zoning of access? Possible/desirable?

How to integrate recreational values of the island with conservation needs?

Any invasive species issues and their management?

Monitoring needs?

The field workshop team at work at the southern end of the site, with Castle Harbour Islands to the west in the background (MP)

Report of Field Workshop

Participants
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Peter Drew
Sarah Manuel
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Conclusions
The site was fully explored with local and international expertise present. Lots of questions and lively debate ensued. Whilst a whole range of issues were discussed the overriding issue became very clear and everyone recognised the enormous importance of this site and the urgency with which it should be secured for the benefit of Bermuda's people and its biodiversity. The site represents one of the few remaining open spaces in Bermuda and acts as a buffer zone for the critically important offshore islands; within half a mile of the peninsular is the breeding habitat for 40-45% of Bermuda's population of White-tailed Tropicbird *Phaethon lepturus* and the whole world population of the critically threatened Cahow.The value of this site as a buffer zone for these islands cannot be over emphasised.

This site presents a unique opportunity to secure one of Bermuda's last remaining open spaces in perpetuity for both people and nature.

Recognising the specific needs of Bermuda's people, their cultural and natural heritage the future of the site was envisaged as comprising of three components:

1. The existing Cooper's Island Nature Reserve should be retained as a multi-access, recreational site, but restricting vehicular use to the car park and no further
2. The central component including the water catchment area and associated buildings could form the basis of exciting educational museum and visitor centre telling the story of Bermuda's links to NASA as well as showcasing the important biodiversity elements for many different audiences
3. The peninsula itself should act as a buffer zone for the offshore islands where access may require a permit and numbers limited at any one time. Activities should be limited to low-impact activities as bird watching, walking or quiet contemplation

Near northern end of existing reserve, with high volumes of public recreational access (MP)

This categorisation of use will allow a range of income generating possibilities, including car parking fees, museum entrance costs and purchases and permit fees from international and local visitors.

Specific issues raised on site by workshop participants that need to be considered for the future management of this site:

- Invasive animal and plant species
- Site contamination especially lead from spent bullets
- Ensuring the views of the Bermudian public are sought out and incorporated into management planning

Beach towards the southern (more remote) end of the peninsula (MP)

- The need for a full biodiversity survey and environmental impact assessment of the site
- The waters around this site are amongst the best in Bermuda providing the opportunity to link the waters, the peninsula and the offshore islands to ensure the biological integrity of these critical ecosystems
- Renovation of buildings
- Staffing issues
- Bunkers – a potential safety issue

Coney Island

Leader: Brendan Godley; rapporteur: Alison Duncan; local expert: Jack Ward

Godley, B., Duncan, A., Ward, J. & Stroud, D. 2003. Coney Island. pp 231-234 in *A Sense of Direction: a conference on conservation in UK Overseas Territories and other small island communities* (ed. M. Pienkowski). UK Overseas Territories Conservation Forum, www.ukotcf.org

Background site description

Status
National Park

Ramsar criteria
n/a

Size
6.4 ha

Principle biotopes
Marine pond fringed with mangroves
Rocky shoreline dominated by native plants with shallow bays and sandy beach
Seagrass beds surrounding most of the island
Degraded coastal hillsides with dense stands of *Casuarina*

Description and ecological features
This small island is located on the north side of Bermuda. The western shore faces the north lagoon and is regularly impacted by heavy wind and wave action. Near to this western shore is the remnant of the Bermuda railway track which passed over the island and formerly connected the mainland with St Georges Island. The construction of this railway caused a deep bay which was probably ringed by mixed stands of red and black mangroves (*Rhizophora mangle* & *Avicennia germinans*) to become isolated as an inland pond. Black mangroves dominate in the outer portion of this bay. The pond, which is tidal and fed by uncharted subterranean fissures, still supports mixed stands of mangroves and a seagrass community with numerous marine species. A second, smaller pond created from a sink hole is fed by water from the larger pond by fissures.

The bigger pond and causeway blocking the drainage (JW)

The island's topography is dominated by large, poorly consolidated dunes forming hillsides that

Invasive plant species (JW)

are largely covered by invasive plants, notably; *Casuarina*, Brazilian Pepper and Asparagus fern. The dunes on this island overlay Walsingham formation rock, some of the oldest Bermuda limestone, which is characterised by being very hard and riddled with caves.

Sites of Cultural Significance
At the northern end of the island there is a long breakwater formed of large quarried stone blocks. This site was used for a horse-drawn ferry that, for many years, was the principal connection for terrestrial transport from St Georges to the rest of Bermuda.

The ferry (JW)

Erosion caused by the track (JW)

Site Vulnerability and Management Statement
Despite being a national park, the island has been the site of a motocross track for approximately 30 years, an activity that has led to significant environmental degradation. Massive erosion and siltation of the ponds have resulted. The smaller of these ponds was once a classic marine sinkhole with crystal clear water and a wide variety of fish and crustacean. However, in the late 1980's, a heavy rainfall that followed the use of bulldozers on the track led to this ponds becoming contaminated with soil and fresh water leading to severe anoxia. The fish died and workers recovered dozens of large lobsters that attempted to crawl out of the pond. It is believed that the use of this heavy equipment caused the collapse of the main fissures that supplied the pond. The original conditions have never been restored.

The little pond (JW)

The former railway right of way is now the path of a heavy fuel line that provides all of the fuel to Bermuda's electrical generation plant. Other services including electricity, telephone and cable television cross the island connecting the main island to St Georges.

Large steel culverts that were laid down during construction of the railway in an effort to maintain a connection between the large pond and the ocean are now blocked and probably collapsed.

The buildings (JW)

Current scientific research/survey/monitoring and facilities
There are no known scientific surveys of this island. The island is home to a number of buildings which are home to the marine research and enforcement sections of the Departments of Conservation Services and Environmental Protection.

Current conservation education: None

Current recreation and tourism
The park is heavily used during the summer by campers who make the island their summer home by moving in for months at a time; bringing tents, electrical generators and even refrigerators. Inappropriate behaviour of campers and occasional vagrants has led to large litter problems.

The park is popular for fishing and a beach on the northern coast is heavily used for swimming.

The presence of the scrambling track has prevented the development of a management plan for this park.

Possible management issues to explore on site:
Relocation of the scrambling track – this is an imperative that largely controls all other management options.

Restoration of the water exchange to the smaller pond and/or through the culverts to the ocean.

Elimination of the major invasive plants.

Use of this site as a conservation education facility.

The relatively nice coastline (JW)

Report of Field Workshop

Participants
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Becky Ingham
Denise Dudgeon
Barbara George

Conclusions

Objective:
Environmental Community Park: to inspire Bermudian youth about their natural heritage

Feature of importance/issue	Approach to solving problems	Measurable conservation objective
Green open space, popular location for local people	Remove scramblers and regrade landscape	Develop a planting scheme. Replant X native trees to revegetate and stablise soil.
Enhance native vegetation	Hands on activity by children. Remove exotics and plant natives.	Remove X n° of trees/year and replant X n° native trees
Pond area, sink hole	Conduct a survey on biodiversity interest	Restoration of pond with mangrove, open the culverts
Coastline	Define usage patterns, garbage collection	Regular (quarterly) coastal clean-ups, camping strategy defined by summer next year
Old buildings	Renovate for environmental education centre	X n° of schools send X n° of students for environmental education course and planting scheme
Horse ferry – 200 years of use	Contact horse club/horse and coaches to explore possibility of reinstating the ferry Displace power boat racing	Restoration of a cultural heritage feature for use during the summer season
Scramble track	Establish agreeable alternative venue and complete for basic use before relocation commenced	Maintain PR profile with current user group
Camping use	Managed facilities regulated use	Minimal impact