

FALKLAND ISLANDS INVERTEBRATES CONSERVATION PROJECT REPORT

Volume 3 Conservation Plan

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Invertebrates Project Officer

March 2009



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Summary

This third volume of the FIICP report is divided into two sections.

Section 1 looks at the necessity for invertebrate conservation in the Falklands, identifies who the stakeholders are, and the reasons why they should be concerned. It further examines what the perceived major conservation threats to Falkland terrestrial invertebrates are, discusses the need for an 'adaptive' conservation response and highlights the need for long term monitoring as the foundation for all future conservation action.

Section 2 of this volume considers the components of an invertebrate conservation strategy for the Falkland Islands, discussing the role of and relationships between Falkland Conservation and Falkland Islands Government. One possible practical strategy plan in line with these recommendations is presented in Appendix 5

1. Why do we need an invertebrate conservation strategy?

When considering the conservation value of specific taxa it is considerably more difficult to have empathy with a tiny fly than a majestic black-browed albatross. Part of this problem of perception is due to the size of invertebrate species. Whilst many are actually brightly coloured, fantastically formed creatures when observed under a microscope, when seen by the naked eye they are often no more than annoying black specs. The philosophical arguments pervading the science of conservation are many, and to argue the relative conservation value of one species compared to another depends a lot on personal aesthetics. However, there are two unequivocal biological statements pertaining to the Falkland Island invertebrate assemblage species that may be used to argue that their conservation value is of great significance. Firstly, in terms of species numbers and biomass invertebrate species make up the bulk of the Falkland Islands native fauna. Secondly, in terms of ecosystem functioning, invertebrate species are far more important than the vertebrates.



Figure 1. Austral thrush feeding on beetle larvae

While this recognition of the biological importance of the Falkland invertebrate fauna is a compelling moral argument for conservation, it is perhaps more pertinent to look at stakeholders in the Falklands invertebrate biodiversity and identify the primary practical reasons they should be interested in invertebrate conservation.

1.1 Who are the Stakeholders?

Stakeholders in invertebrate conservation in the Falkland Islands can be divided into those based in the Islands and those overseas, and further divided into Government agencies, NGO's, and private interests. The following section identifies these stakeholders and lists the reasons for their interest. It can be argued that virtually everybody in the Falkland Islands is a stakeholder in the native invertebrate biodiversity of the archipelago.

Falkland Islands Stakeholders

Government Agencies with responsibilities for the local environment:

The Environmental Planning Office (EPO) is concerned with invertebrate conservation issues because:

- i. It is a basic component of their organisational mandates and responsibilities. In particular this pertains directly to: the Falkland Islands Biodiversity Strategy; the EPO's regulation of export licences for biological material; the EPO's management of government nature reserves; the EPO's role in land designation of protected areas and its advisory role to Falkland Island Government
- ii. It is a consideration in the EPO's commitments within the Falkland Islands Environmental Charter, and the Islands Plan
- iii. It pertains to current multilateral environmental agreements including: RAMSAR Convention, CITIES and the Bonn Convention
- iv. It is required to enable and support ratification of future international agreements such as the Convention on Biodiversity (CBD)
- v. It pertains to relevant domestic legislation e.g. The Conservation of Wildlife and Nature Ordinance (1999)

The Department of Agriculture (DOA) (including Veterinary Services) are concerned with invertebrate conservation issues because:

- i. Invertebrates are key species in the ecology (and therefore productivity) of farmland as a result of their roles in nutrient recycling and soil formation.
- ii. It pertains to their responsibility to safeguard the both the local economy, and environment, from potential threats to agriculture, native species, and human health resulting from the introduction of non-native species including invertebrates
- iii. It is a consideration in the DOA's commitments within the Falkland Islands Environmental Charter, and the Islands Plan
- iv. It pertains to relevant domestic legislation e.g. The Conservation of Wildlife and Nature Ordinance (1999)

The Customs & Immigration Department. are concerned with invertebrate conservation issues because:

- i. It pertains to their responsibility to safeguard the both the local economy, and environment, from potential threats to agriculture, native species, and human health resulting from the introduction of non-native species including invertebrates.

FI Government Agencies benefiting from local biodiversity

The Department of Agriculture (DOA) (including Veterinary Services) are concerned with invertebrate conservation issues because:

- i. Invertebrates are key species in the ecology (and therefore productivity) of farmland as a result of their roles in nutrient recycling and soil formation.
- ii. It pertains to their responsibility to safeguard the both the local economy, and environment, from potential threats to agriculture, native species, and human health resulting from the introduction of non-native species including invertebrates
- iii. It is a consideration in the DOA's commitments within the Falkland Islands Environmental Charter, and the Islands Plan
- iv. It pertains to relevant domestic legislation e.g. The Conservation of Wildlife and Nature Ordinance (1999)

Education Department (including Community School, Infant & Junior School and Camp Education) are concerned with invertebrate conservation issues because:

- i. It is part of the taught curriculum which enrich local culture and personal lives through the cultivation of a knowledge and appreciation of native biodiversity

The Falkland Islands Government Air Service are concerned with invertebrate conservation issues because:

- i. Protection of a rich local biodiversity encourages revenue from eco-tourism

Non-Government Organisations (NGO's) **Falklands Conservation (FC), New Island Conservation Trust, Falkland Islands Museum & National trust** are concerned with invertebrate conservation issues because:

- i. The conservation of native species is implicit in their organisations conservation mandates and ethics, and all have active projects in the Falkland Islands
- ii. Increasing their own experience in invertebrate issues will better place them to aid/advise FIG with its compliance with international/local legislation and conservation agreements, treaties and conventions
- iii. Their experience in invertebrate conservation can be used to enable society to better protect its natural heritage while enriching local culture and personal lives through the cultivation of knowledge and appreciation of native biodiversity

Private sector companies & private individuals benefiting from local biodiversity

Falkland Island Tourist Board, cruise ship companies, tour guides, taxi firms, hotels, guest houses, bars, pubs, restaurants, cafés, gift/souvenir shops, artists are concerned with invertebrate conservation issues because:

- i. Protection of a rich local biodiversity encourages revenue from eco-tourism

Private sector companies & private individuals that are custodians of local biodiversity

Landowners, farmers are concerned with invertebrate conservation issues because:

- i. Invertebrates are key species in the ecology (and therefore productivity) of farmland as a result of their roles in nutrient recycling and soil formation.
- ii. Protection of a rich local biodiversity encourages revenue from eco-tourism and fosters a deeper connection with their land

Any Islander who takes a pleasure in local biodiversity is concerned with invertebrate conservation issues because:

- i. It enriches local culture and their personal lives as a result of protection of native biodiversity

Overseas Stakeholders

UK Governmental Agencies

The Foreign and Commonwealth Office (FCO) are concerned with invertebrate conservation issues because:

- i. It has an overarching responsibility to ensure good governance of all the UKOT's, including the environment
- ii. It administers the Overseas Territories Environmental Programme (OTEP) which has invested in various conservation projects in the Falkland Islands including invertebrate conservation

The Department of Environment, Food and Rural Affairs (DEFRA) (including the Joint Nature Conservation Council (JNCC)) are concerned with invertebrate conservation issues because:

- i. It is the UK Government department responsible for all invertebrate conservation in the UK and its Territories
- ii. It administers the Darwin Initiative which has directly invested in a large invertebrate conservation project in the Falkland Islands

The Ministry of Defence are concerned with invertebrate conservation issues because:

- i. Eco-tourism provides one of the main recreational activities for service personnel stationed in the islands

Overseas NGO's

Antarctic Research Trust (ART), Sub-Antarctic Foundation for Ecosystems Restoration (SAFER), Wildlife Conservation Society, Royal Society for the Protection of Birds, Birdlife International, Plant Life are concerned with invertebrate conservation issues because:

- i. Species conservation is implicit in their organisational mandates and ethics, and all have active conservation interests in the Falkland Islands
- ii. Increasing their own experience in invertebrate issues will better place them to aid/advise FIG with its compliance with international/local legislation and conservation agreements, treaties and conventions
- iii. Their experience in invertebrate conservation can be used to enable society to better protect its natural heritage while enriching local culture and personal lives through the cultivation of knowledge and appreciation of native biodiversity

Overseas private sector companies & private individuals benefiting from local biodiversity ***Cruise ship companies, overseas tour guides/companies*** are concerned with invertebrate conservation issues because:

- i. Protection of a rich local biodiversity encourages revenue from eco-tourism

Overseas private sector companies & private individuals that are custodians of local biodiversity

Landowners, farmers are concerned with invertebrate conservation issues because:

- i. Invertebrates are key species in the ecology (and therefore productivity) of farmland as a result of their roles in nutrient recycling and soil formation.
- ii. Protection of a rich local biodiversity encourages revenue from eco-tourism and may fosters a deeper connection with their land

Anybody who takes a pleasure in Falkland biodiversity is concerned with invertebrate conservation issues because:

- i. It enriches local culture and their personal lives as a result of protection of native biodiversity

1.2 What are the conservation threats?

Globally there are three main threats to invertebrate biodiversity: habitat loss/degradation, climate change and alien introductions (human mediated spread of non-indigenous species). Though habitat loss/degradation is not a significant problem in the Falkland Islands; historically the arrival of Europeans and their farming practices from the late 1700's extensively altered the Falklands. Since then about 81% of tussac grassland habitat, important for several endemic invertebrates including camel crickets, salpingid beetles and tussac moths, has been lost as a result of grazing practices (Strange, 1987). Future habitat loss and/or degradation as a result of man's activities remains a major conservation threat.

The threats from climate change and alien introductions are considered to be the greatest threat to invertebrate biodiversity in the Southern Ocean islands (Jones et. al. 2003). Each of these issues is considered in turn, starting with that of introductions.

Alien Introductions

Insular faunas are perceived to be amongst the most vulnerable to the threat of introductions (Elton, 1958; Vitousek, 1988) and alien species are well documented as conservation threats on many Southern Ocean islands (Wace, 1986b; Bonner, 1984; Bloomer and Bester, 1992; Chapuis et al., 1994; Dingwall, 1995; Ernsting et al., 1995; Bergstrom and Chown, 1999; Bester et al., 2000; Chown and Gaston, 2000; Chown et al., 2001; Gremmen et al., 2002). Such species have been found to have direct effects on the diversity of indigenous species through predation (Ernsting et al., 1995), herbivory (Leader-Williams et al., 1987) and competition (Gremmen, 1997; Gremmen et al., 1998; Frenot et al., 2001). In addition, introductions can exert indirect threats, such as the modification of local nutrient cycles leading to long-term changes in local community structure and biodiversity (see Smith and Steenkamp, 1990, Williamson, 1996). As with invertebrates on other South Atlantic islands (see Jones et al., 2003) the invertebrates of the Falkland Islands may be under threat from two main classes of introduction: other introduced invertebrates and introduced rodents. Looking first at the invertebrates, many non-native insects are widespread in the Falkland Islands. The blue buzzer (*Calliphora vicina*) for example, is one of the largest and, through its tendency to swarm wherever meat is hung, most annoying flies in the archipelago. As a result, this animal is arguably the best known and certainly the most often seen of all the Falkland insects. However, they have only been present in the islands since 1886 when they were introduced at Port Howard on a ship transporting mutton to the UK.



Figure 2. The blue buzzer (*Calliphora vicina*), Carcass Island 2006

While the blue buzzer is merely annoying, its close relative the green bottle (*Lucilia sericata*), another alien introduction from Europe, is a potential threat to sheep. This fly often lays its eggs in open wounds/orifices, its maggots feeding on flesh. In severe cases such 'fly-strike' can contribute to the death of lambs and injured sheep.



Figure 3. The green bottle (*Lucilia sericata*), Hill Cove 2006

While these blue and green flies are undoubtedly a nuisance to man they are not considered a direct threat to native insect biodiversity. However, there are two common introduced insect species that may be. Both of these can be found in Stanley gardens where they prey on garden pests. But while one is tolerated and even encouraged, the other is seen as a nuisance.

These two species are the eleven spot ladybird (*Coccinella 11-punctata*), and the European earwig (*Forficula auricularia*). Both species prey on garden pests, though the earwig has a wide dietary range including rotting plant material. While the bright colour of the ladybird is considered attractive, the earwigs alarming pincers (totally harmless) and tendency to enter homes in search of food, do not endear them to the islands residents. Of the two species it is the more predatory ladybird that is likely to kill more native insects (particularly native aphids), making the ladybird the greater conservation threat.

The apparent ease with which these species have been able to establish and spread may reflect climate matching and/or a lack of biotic resistance (see e.g. Gabriel et al., 2001). Certainly, the European origins of many of the introduced species have meant that they are well adapted to the environmental conditions encountered on the Islands. Indeed, the relatively restricted seasonality in climate (resulting from the strong maritime influence) may well mean that populations have escaped the marked reductions in numbers that they would experience as a result of severe winter conditions in their native ranges. Whilst much recent evidence from other areas and systems has supported the over-riding importance of climate matching in determining the success of introductions (Lodge, 1993; Chown et al., 1998a; Pyšek, 1998; Gabriel et al., 2001), the likelihood remains that the successful spread of so many introduced invertebrate species may, at least in part, arise from the depauperate nature of the indigenous fauna and the opportunities that this provides. Indeed, a number of the species, such as some of the lumbricid worms and predatory staphylinid beetles, fill ecological roles that previously seem to have been empty.

In the absence of detailed historical information, it is difficult to determine what effect the introduced invertebrates are having on the Falkland Islands indigenous species. Nevertheless, there are worrying signs. For example the introduced predatory beetle *Trechisibus antarcticus* on South Georgia has had a detrimental effect on indigenous species (Ernsting et al., 1995). In areas *T. antarcticus* has colonized, its main prey species, the indigenous perimylopid beetle *Hydromedion sparsutum* has not only declined in abundance but has also shown changes in body size owing to alterations in food availability (Ernsting et al., 1999).

Looking at the rodents, mice and rats both threaten native invertebrate species, although it is mice that are likely to be the greatest threat. Mice have been shown to have significant impacts on the terrestrial ecosystems of Southern Ocean islands through predatory (Gleeson and Van Rensburg, 1982; Crafford and Scholtz, 1987; Rowe-Rowe et al., 1989; Crafford, 1990) and herbivorous activities (Chown and Smith, 1993), and by influencing patterns of nutrient cycling through predation on detritivores (Smith and Steenkamp, 1990; Huyser et al., 2000). While we lack direct data on the effects of the mouse population on invertebrates in the Falklands the circumstantial evidence is persuasive. Comparing the invertebrate species present on mouse free Grand Jason Island and Steeple Jason Island where mice are present, the sheer numbers of invertebrates seen on Grand Jason in the space of a one hour visit was greater than that seen on Steeple Jason after two days field collecting.

There is evidence that mice are having a similar effect on other southern ocean islands. For example, at Marion Island, *Mus musculus* feeds predominantly on invertebrates and has become one of the most important predators in the terrestrial ecosystem (Gleeson and

Van Rensburg, 1982; Crafford and Scholtz, 1987; Rowe-Rowe et al., 1989; Crafford, 1990). Indeed, Crafford and Scholtz (1987) suggested that low densities of certain invertebrate species on Marion Island, compared to nearby Prince Edward Island (only 22 km distant), are a consequence of the presence of mice on the former, but not on the latter. Similarly, Chown and Smith (1993) showed that on Marion Island, mice are causing a reduction in body size of the indigenous weevils on which they feed. Smith and Steenkamp (1990) noted that the impacts of mice on invertebrates could also lead to a change in nutrient cycling on Marion Island because the preferred prey of mice are flightless moth larvae and earthworms, the two most significant decomposers in a system dominated by saprophagy (see also Holdgate, 1977; Vernon et al., 1998; Bergstrom and Chown, 1999).

Without the most draconian and economically impractical quarantine procedures, the complete prevention of future alien introductions is extremely unlikely. However, sensible quarantine action will minimise the rate new species introductions. Once an invasive species has colonised and spread in a new locality it is often prohibitively expensive and impractical to completely remove them. Therefore, in terms of conservation effort against introductions, the best investment of time and money is minimising the risk of new alien arrivals that might cause far greater conservation threats in the future. The one exception to this rule is the eradication of rodents from offshore islands. Whilst still a difficult and expensive operation, the successful eradication of rodents through the use of poisoned bait has been carried out successfully on numerous islands to the proven benefit of many native species (see Howland et al 2007 for a review).

Climate change

While there is still considerable argument as to the magnitude of global climate change, the scientific consensus is that the world is rapidly warming as a result of mans activities. Climate change is likely to be the single most significant influence on global biodiversity in the 21st century. Evidence is growing that islands of the Southern Ocean are experiencing human-induced climate change (IPCC, 2000) and the Falkland Islands is no exception. Climate change has been implicated in changes in population size, range, phenology and ecology for a variety of Antarctic and Southern Ocean island species, including invertebrates (Smith and Steenkamp, 1990; Chown and Smith, 1993; Kennedy, 1994; Block and Convey, 2001). The modes through which climate change may influence terrestrial ecosystems are diverse and complex. At one end of the scale, warming of the Southern Ocean is likely to influence marine primary productivity, and in particular phytoplankton and krill populations (see Priddle et al., 1992, and Naganobu et al., 2000), which will in turn affect marine mammals and seabirds, and through them, nutrient input to island ecosystems. At a more local level, climate change may directly favour the spread of certain species over others, changing the structure of the local communities. In addition, climate change can have direct effects on the environment and it is possible that global warming might make the Falkland Islands more susceptible to peat fires (Wace and Holdgate, 1976).

Perhaps one of the greatest threats is the influence of climate change on introduced species. If invasive ability is associated with robust physiological limits, climate change might favour introductions over native species adapted to cooler physiological optima (Walther et al., 2002). There is good evidence that current and predicted climate change on several of the Southern Ocean Islands is favouring the spread of introduced species to the detriment of native species in just such a way (Bergstrom and Chown, 1999; Gabriel et al., 2001). The indirect effects of introductions have also been shown to be magnified by climate change on Southern Ocean Islands, leading to changes in ecosystem functioning. For example, increasing temperature on Marion Island favours the introduced mouse population, increased predation from which will further reduce numbers of indigenous *Pringleophaga* caterpillars and therefore the rate of nutrient recycling (Smith and Steenkamp, 1990; Chown and Smith, 1993). This may also lead to a further reduction in *C. minor* numbers as described previously. The potential impacts of continued warming in the Falklands are considerable. For example, there may be an increase in the winter density of mice leading to the extinction of indigenous invertebrates, and then perhaps the birds that feed on them. Alternatively, commensal, or rare, invertebrate introductions may undergo range expansions, competitively excluding, or predated indigenous species.

The United Nations Intergovernmental Panel on Climate Change (IPCC) estimates that average global temperatures will rise by ca. 1.5 – 6 degree Celsius by 2100. All other things being equal, a 1°C rise would require native Falkland invertebrate species to migrate 150 km in latitude to stay in the same temperature regime. A 5°C rise in temperature would require a shift of 750 km! Warming climates are likely to favour introduced species that are more capable of adapting to changing conditions than native species.



Figure 4. The European earwig (*Forficula auricularia*) is an introduced species currently restricted to Falkland settlements that might undergo range expansion to native habitats if temperatures rise

Besides increased temperatures, climate change is likely to have numerous effects on a wide range of other environmental variables such as weather patterns. One of the most critical outcomes of climate warming will be its influence on eustatic sea-level (the total amount of water in the sea) via melting ice. The IPCC predicts a sea-level rise of 110 to 880 mm by 2100 and it is feared that continued warming might lead to irreversible changes in the Earth's glacial systems. For example, were Greenland's ice sheet to melt, sea-levels might rise as much as 7 metres. As much of the Falkland Islands are relatively low-lying even a small rise in sea-level will have significant implications to both total land area and the number of islands in the archipelago. The maps below highlight in red the areas of the Falklands that would be submerged by the year 2100 if sea-levels rose by: about 1 m. in line with IPCC predictions, or 7m as predicted if the Greenland ice sheet melted. This shows that even the 1 m. rise would split both East and West Falkland in half, submerging dozens of important wildlife habitats.

The potential impacts of continued warming in the Falklands are considerable and varied. There may be an increase in winter numbers of house mice (an introduced species) leading to the extinction of indigenous invertebrates, and then perhaps the birds that feed on them. Alternatively invertebrate introductions may undergo range expansions, competitively excluding, or predated on native species.



Figure 5. Falkland Island land submergence in red if sea-levels were to rise 1 and 7 metres

1.3 Aims of a conservation strategy

Assuming a reasonable prior knowledge of any flora or fauna, a successful strategy for its conservation should facilitate:

- ***The identification of conservation threats***
- ***Conservation action in response to conservation threats***
- ***Prioritisation of conservation action based on the perceived 'value' of the species or areas/habitats involved and the perceived level of conservation threat***
- ***The protection of invertebrate species and areas/habitats from possible future conservation threats***

A desirable secondary aim should be to:

- ***Identify and ameliorate conservation threats to other taxa related to changes in the biodiversity of the target taxa/habitat***

Of all these points the most crucial is the primary need to identify conservation threats. This is best achieved through monitoring programs.

Long term monitoring

Before we can take any conservation action we need to identify a clear problem. While it is likely that introduced species and climate change are detrimental to native invertebrate species in the Falkland Islands, population data recorded over time is required to identify this. Accepting both a changing environment and an invertebrate fauna that is only just being described, the most important focus for invertebrate conservation should be to commence regular monitoring of species presence at defined sites via surveys, such that conservation threats may be identified, and responded to at the earliest opportunity. Table 1 identifies the enabling stages that need to be attained to allow conservation action to be implemented in response to a conservation threat. While the focus of volume 2 of this report is on stage 1 of the table, stages 2-5 should be the main focus of any long term conservation strategy developed. A specific monitoring strategy is described in more detail in Section 2.1.

Table 1: The five enabling stages for conservation action

	Action	Prerequisites
Stage 1	Determine what species are present in the islands	-
Stage 2	Set up monitoring sites in areas representing important habitat types and make baseline recordings of species presence and relative abundance	A knowledge of the species present in the islands
Stage 3	Monitor changes in species presence/absence and abundance at regular intervals (e.g. every year/ 2 years)	Baseline information of species presence/absence and abundance at monitoring sites.
Stage 4	Identify native species with increasing absence or declining abundance, and identify introduced species with increasing presence/abundance then determine likely causes	A series of monitoring events
Stage 5	Where possible take direct action to counter conservation threats	A knowledge of species ecology resulting from observation made at the monitoring sites

1.4 The adaptive approach

With respect to terrestrial conservation in the Falklands the future will undoubtedly bring many challenges. If current models of climate change prove correct no conservation strategy can prevent long term changes in habitats/species assemblages. A similar argument holds for future introductions of invasive species. Economic development, should offshore oil wells to become economically viable, may cause direct habitat modification/degradation within the islands influencing local biodiversity. Some species will undoubtedly become locally extinct, while new species will colonise. This uncertainty about the future argues for a more 'adaptive' approach to conservation issues, focusing more on general biodiversity value within the region and less on maintaining current species distributions.

Even in the light of changing conditions, habitats of important conservation value today are still likely to be those important in the future (all be it perhaps for different organisms). By implementing a more 'adaptive' approach to conservation and reacting to changing conditions it should be possible to maintain (and even increase) levels of biodiversity native to the region. We have to be 'adaptive' in realising that species assemblages are inevitably going to change. An adaptive approach to conservation should not be used as an excuse for inaction thought. Rather it should be implemented as a tool for proactive action to predicted threats.

For example, paying particular attention to conserving higher altitude sites today may help maintain high levels of biodiversity in the archipelago if temperatures rise in the future. A 100 m. migration in upwards in altitude is roughly equivalent to a 1°C drop in temperature, so mountain tops are likely to become important as refugia as temperatures rise. Some species might become extinct in their current range, migrating to higher altitude sites previously outside its known distribution. Alternatively, rising temperatures may allow new species to naturally colonise from South America. Although these species may be thought of as non-native, it is more than likely some of them would have bred in the Falkland Islands in past warmer periods during the last few hundred thousand years. Working to adaptively conserve as large a shifting regional biodiversity as possible is likely to be easier and more valuable than fighting to maintain current species distributions in the light of a changing environment.

1.5 Conclusion

- Falkland Island terrestrial invertebrates are an important aspect of the archipelagos native biodiversity and worthy of conservation
- Virtually all Falkland Islanders, and numerous overseas individuals/organisations, are stakeholders in Falkland Island invertebrate biodiversity
- To conserve Falkland Island terrestrial invertebrates requires a conservation strategy enabling the identification of conservation threats is required
- The most important component of a Falkland Islands invertebrate conservation strategy is a long-term monitoring program via site surveys
- To best conserve native biodiversity in a changing environment an 'adaptive' approach is desirable

2. A Falklands Invertebrate Strategy

This section outlines the components of an invertebrate conservation strategy for the Falkland Islands. It is intended as a set of working recommendations to be developed and modified as required. One possible practical strategy plan in line with these recommendations is presented in Appendix 5

2.1 Components of the strategy

Long term monitoring

The basis of any invertebrate conservation strategy should be a long-term monitoring program. In order for monitoring to be useful it needs to be carried out with a degree of regularity at defined sites, allowing for both geographic and temporal comparisons in the data collected. We should think of such a strategy as an activity to be continued ad infinitum; quite simply the longer monitoring continues, the more valuable the data is. In more practical terms, we should plan for an annual monitoring program to continue for a minimum of 10 years.

When considering where, how, and when to monitor, a compromise must be made between our desire for a complete knowledge of species populations and the obvious logistic and economic constraints of carrying out large scale monitoring programs. As some data is better than no data at all, it is much better to plan for a simple monitoring program, carried out annually at easily worked localities; than a more ambitious program that may fail because of difficulties in a lack of time/money/manpower or future problems in access.

At this point it is useful to make a distinction between monitoring locality and monitoring site. From this point onwards the following definitions will be adhered to.

- i. a 'locality' is a region in which monitoring sites are located
- ii. a 'site' is an area defined by its specific habitat type in which a monitoring event is carried out

Simple survey protocol

As we wish to monitor as many invertebrate species as possible, yet keep the survey work as easy as can be, it is suggested that a simple record of species presence/absence at a site be made. To this extent we suggest an annual basic monitoring program for a site that requires only two days fieldwork and 1 or 2 days to sort the samples collected. This protocol is as follows

- Day 1: Field work - Set up a Malaise trap and 20 pitfall traps. Carry out 2 man hours of hand collecting
- Day 2 – 7: Leave the traps running
- Day 8: Field work - Retrieve the Malaise trap and pitfall traps
- Day 9-10 Sort the samples collected into morphospecies (specimens which look the same) separated into orders. Preserve samples as required

(Details of all field work techniques, species identification keys and protocols for sample preservation can be found in Volume 1 of this report)

Experience has taught that where several sites are in close proximity (>30 minutes walking distance) it should be possible to carry out the protocol given above for sites in the same day. This basic plan can be expanded on by the addition of further survey techniques and by increasing the size of the survey in terms of the numbers of traps deployed and unit-time effort in hand collecting. It is important to record the protocol followed each year so that comparisons can be made between survey events. As part of this process, weather data (obtainable from the met office at MPA) should also be collated so that trends can be correlated to climate change. Any alterations in vegetation and habitat type should also be recorded.

In terms of species identification, sort the samples to morphospecies categorised by order level and preserved correctly (see Volume 1 for techniques on species identification and preservation). The equipment and resources to carryout the survey work and identify the species are available at Falklands Conservation. It is likely that many of the samples collected will not be able to be easily identified to species level and the collections made at each survey event will eventually need to be examined by an expert.

When and where to monitor

In choosing when to monitor, we would ideally like to monitor as regularly as possible at a site. In practical terms this would be prohibitive in both cost and time. As a minimum compromise an annual monitoring event at a site is suggested. In order for these events to be compared they should occur at roughly the same time each year. To maximise the data collected monitoring events should be carried out when invertebrates are the most abundant, this being the austral summer. This has the added benefit that the weather conditions for fieldwork are also better. Taking this into consideration the best months for survey work are Nov-Feb.

In choosing where to monitor a number of factors must be considered. Firstly, does the site represent a habitat type you are interested in monitoring. That is, does the site represent an important native habitat for invertebrates? In terms of Falkland native terrestrial habitats, three crude categories can be identified as important for invertebrates, coastal habitats (extending to the top of the splash zone), tussac grassland, and native heath (comprising acid grasslands and dwarf shrub). It is suggested that any long term monitoring program contain a least 1 coastal site, 1 tussac grassland site and 1 heath site (see Appendix 1 of Volume 1 list the habitat types of the Falkland Islands). Secondly we must consider whether it is logistically possible to survey the site on an annual/biannual basis.

Based on these considerations we have selected the Gypsy Cove locality as an ideal area to set up monitoring sites. The benefits of Gypsy Cove are:

- i. it contains a diversity of important habitat types including: a variety of coastal habitats; tussac grassland; both dwarf shrub heath and acid grassland; and even exposed fieldmark areas
- ii. it is easily accessible from Stanley
- iii. it is owned by Falkland Islands Government and currently managed by the Environmental Planning Department
- iv. it has already been surveyed by the FIICP and so baseline data for species presence/absence is available (see volume 2 of this report)

Although the obvious benefits of Gypsy Cove make it a prime candidate for long term monitoring, this should not be seen as an argument for not monitoring elsewhere. In fact, where resources permit, long-term monitoring sites should be set up in as many localities as possible across the archipelago. Any wish list of monitoring localities should be prioritised to cover as wide a geographic area as possible, whilst also including as many unique habitats as possible. In addition, rodent free localities should also be monitored; such that we might determine the real influence of rodents should they ever arrive. On the same lines any islands where future rodent eradication is planned would also be an excellent candidate for long term monitoring as long as it can commence prior to the eradication event.

The following prioritised list is a suggested order for choosing monitoring localities:

- i. An locality in East Falkland – we suggest Gypsy Cove (for the reasons given above)
- ii. A locality in West Falkland – we suggest Hill Cove as it is easily accessible and allows access to high altitude habitats in the Hill Cove national park and to the Hill Cove plantation
- iii. A rodent free island – we suggest Carcass Is. as it is easily accessible and has a good variety of native habitats
- iv. An island due for future rodent eradication
- v. Any other island not yet surveyed

The suggested basic survey

Putting this all together we suggest the following basic annual monitoring program covering three sites in the Gypsy Cove locality.

Locality: Gypsy Cove

Sites:

- i. Rocky shoreline
- ii. Tussac grassland
- iii. Dwarf shrub heath

Monitoring date: Annually in January

Predicted time taken: 3-4 days (based on 2 people working)

Species identification and data management

At some point the morphospecies collected by each monitoring event will need to be thoroughly examined by an expert and the resulting identification data added to a database for the monitoring site and also to the 'Recorder' database of Falkland Invertebrate species. Ideally this should be carried out as soon as possible after each survey is finished, although; as long as the samples are correctly preserved they can be safely stored prior to identification for many years. Due to the tiny size and cryptic nature of many species of Falkland invertebrate, it is unlikely that species identification for all the samples collected at a site will be able to be carried out in the Falkland Islands. This means that at some stage samples will need to be sent to overseas experts.

In the course of the FIICP, Falklands Conservation has developed a net-work of experts who are working on the identification and description of Falkland invertebrate species. Should long term monitoring for invertebrate species commence Falklands Conservation is already well placed to co-ordinate the identification of the samples collected.

Threat assessment and response

There are two main approaches to identifying threats to Falkland invertebrate biodiversity. The first is by making the sensible assumption that known threats to a specific habitat type are also likely to threaten the invertebrate species therein. Events large enough to threaten specific habitat types are likely to be obvious, threaten non-invertebrate taxa, and elicit an appropriate response from the appropriate government departments and conservation NGO's. However, even when all seems well on a macro-scale, individual invertebrate species may, unnoticed, be going extinct. The second way to identify threats to Falkland invertebrate biodiversity, and the only real way to pick up cryptic threats is through direct observations of changing species presence/absence at a site resulting via long term monitoring.

To identify these threats requires an annual analysis of species presence at long term monitoring sites, the utility of which increases with the number of years monitoring has been carried out. Thus, not only must we monitor species presence annually, but we must also look for trends in the data collected.

Applying Red List criterion to Falklands Invertebrates

The International Union for the Conservation of Nature and Natural Resources (IUCN) Red List Categories are an easily and widely understood system for classifying species at high risk of global extinction (see Hilton-Taylor 2000 or visit the Red List webpage at <http://www.iucnredlist.org/> for more information). The general aim of the system is to provide an explicit, objective framework for the classification of the broadest range of species according to their extinction risk. Figure 6 shows the different Red List categories. For listing as Critically Endangered, Endangered or Vulnerable there is a range of quantitative criteria; meeting any one of these criteria qualifies a taxon for listing at that level of threat. The relevant factor is whether any one criterion is met, not whether all are appropriate or all are met. Because it will never be clear in advance which criteria are appropriate for a particular taxon, each taxon should be evaluated against all the criteria, and all criteria met at the highest threat category must be listed. Appendix 2 describes these categories in full and details the criteria followed to classify a species as Critically Endangered, Endangered, or Vulnerable).

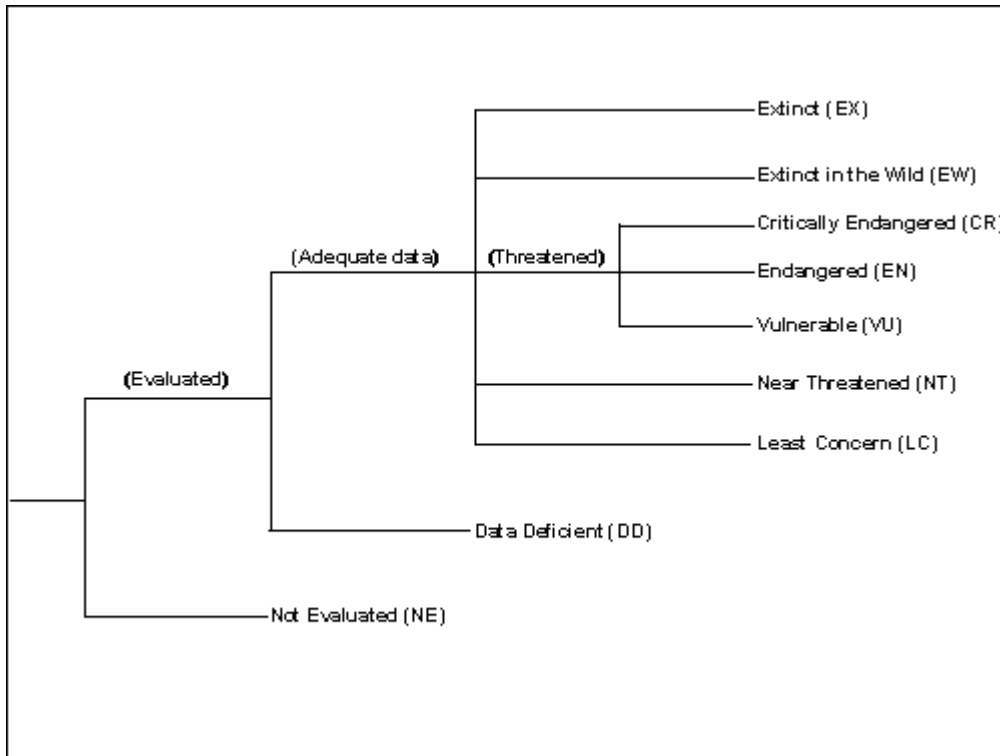


Figure 6. Structure of the categories

'Red Lists' play an important part in global conservation by concentrating attention on those species most in danger. With respect to Falkland Island species, a number of birds are listed on international red lists (Hilton-Taylor 2000), while a Red Data list of vascular plants was published in 2002 (Broughton and McAdam, 2002). As yet none of the Falkland terrestrial invertebrates have been listed. In fact, relatively few invertebrate species are listed on global Red Lists. This is a result of two things. Firstly, there is a bias to conserve larger more beautiful and anthropomorphic species. Secondly, while it is relatively easy to make observations on the dwindling population size of larger animals, such as 5000kg elephants in 100km² of savannah, it is virtually impossible to count all the members of a 2cm species of beetle from the same area. In order to compile an invertebrate Red List for the Falkland Islands, included species would have to be shown to be either; very rare indeed and have significantly declining populations and/or diminishing geographic ranges. This information is currently not present, and its collection is dependant on continued monitoring programs and species specific investigations based on the recommendations of those monitoring observations.

It is suggested that after 5 years of annual monitoring at a series of monitoring site, enough information will be available to identify those species that are candidates for inclusion in a Falkland Red List. At this stage we recommend that the Queen of the Falklands Fritillary be a priority for investigation as a potential Red List species due to its apparent rarity in the islands.

Site protection and habitat management / improvement

When assessing sites for their conservation importance, invertebrate surveys should be carried out along with those for plants, birds and mammals, and all future terrestrial conservation assessments should include an invertebrate's component. This relates to production of management plans, Environmental Impact Assessments, and reports advising on development proposals. Invertebrate biodiversity should be considered in the designation of any defined areas benefiting from protective legislation. Surveying invertebrate biodiversity in private reserves, National Nature Reserves (NNR's), Important Bird Areas (IBA's) and Ramsar sites will add to the recognized conservation worth of these sites and contribute to the creating of a network of Key Biodiversity Areas for the Falkland Islands. In addition invertebrate data should be referenced in terms of the planning of protected areas portfolios, such that future reserves are selected to maximise the biodiversity benefit across a range of taxa.

With respect to site management, before any management / site improvement practices aimed at other taxa are implemented, their potential influence on invertebrates should be considered. Likewise, any management action implemented for the direct benefit of invertebrate species should consider the other taxa in the area. Basic habitat management for Falkland Islands native invertebrates is simple and comprises two steps:

- i. Protect the habitat from human influence. This includes fencing off areas and/or removing grazing animals, and the cessation of any other farming practices such as burning or the use of fertilisers
- ii. Restore habitat from human mediated damage. This includes the removal of non-native species, such as rodents or invasive plants, and the reintroduction of native species such as replanting Tussac.

Education and Awareness

Public education and awareness raising activities on invertebrate conservation, both within and outside the Falkland Islands are essential in gaining public support for the strategy. Such campaigns may involve literature such as press articles, newsletters and other publications, radio interviews, talks and demonstrations, and field trips and events. Working to engage the local population with invertebrate conservation will greatly aid the long term success of the strategy.

It is also important that individuals and organisation working to the benefit of Falkland Islands invertebrate species have easy access to all the information available. Therefore any strategy should also include a component governing the dissemination of information.

Strategy Development

A final, and often overlooked, component of a successful conservation strategy is a reactive ability allowing development and improvement. In order to keep any strategy successful and focused on its desired outcomes, we need to be able to identify where the strategy is succeeding and/or failing, and then be able to change the strategy in response. In order to do this we suggest that any invertebrate strategy (or wider strategy having an invertebrate component) be subjected to annual review, with recommendations passed on to the strategy managers. One aspect of strategy development is the identification and instigation of brand new initiatives within the strategy. Appendix 4 list several potential new research projects that would support an invertebrate conservation strategy.

2.2 Putting it all together

We now summarise the main components of a Falkland Island terrestrial invertebrate conservation strategy in terms of what is required:

- Long term monitoring for the presence of invertebrate species is to be carried out at defined sites
- The samples collected are to be identified and data on species presence compiled for each site
- An annual report on the species present at each site is to be made and circulated to the appropriate parties
- A two yearly report on the state of invertebrate biodiversity conservation in the Falkland Islands is to be produced. This report should detail any perceived conservation threats, particularly identifying native species declining in abundance and introduced species increasing in abundance
- Based on the biannual invertebrate report, any appropriate conservation action should be identified and actioned
- After 5 years of annual monitoring, a potential Red List for Falkland terrestrial invertebrate species should be drawn up along with a plan to collect any remaining data needed to confirm or deny their place on such a list. Once a local Red List has been produced it should be published in an international peer reviewed journal as soon as possible.
- Invertebrate surveys should be carried out as part of all classifications of site status relating to conservation protection/importance and invertebrate biodiversity data referred to in the planning of new protected areas and reserves.
- Invertebrate conservation should be incorporated as a core element of habitat management and improvement
- Invertebrate conservation issues should be an integral part of all education and awareness programs concerning Falkland Islands wildlife, with easy access to data and resources for those carrying out invertebrate conservation work
- A procedure for strategy review and development should be put in place and followed

Appendix 1: Stakeholders contact details

Falkland Islands Government and associated bodies

The Environmental Planning Department

PO Box 611
Stanley
Falkland Islands
Tel: (+500) 27390
Fax: (+500) 27391
E-mail: hotley.planning@taxation.gov.fk

The Department of Agriculture

Stanley
Falkland Islands
FIQQ 1ZZ
Tel: (+500) 27355
Fax: (+500) 27352
E-mail: doa.fig@horizon.co.fk

Falkland Islands Immigration Service

Customs & Immigration Department
3 H Jones Road
Stanley
Falkland Islands
Tel: (+500) 27340
Fax: (+500) 27342
E-mail: customs.fig@horizon.co.fk

Falkland Islands Community School

Stanley
Falkland Islands
Tel: (+500) 27147
Fax: (+500) 27148

Falkland Islands Government Air Service (FIGAS)

Port Stanley Airport
Stanley
Falkland Islands
Tel: (+500) 27219
E-mail: fwallace@figas.gov.fk

Falkland Island Tourist Board

Jetty Visitor Centre
Stanley
Falkland Islands
South Atlantic Ocean
FIQQ 1ZZ
Tel: (+500) 27019
Fax: (+500) 27020
E-mail: jettycentre@horizon.co.fk

APPENDIX 1

United Kingdom Government and associated bodies

Department for Environment, Food & Rural Affairs (DEFRA)

Nobel House
17 Smith Square
London
SW1P 3JR
UK
Tel: 020 7238 6000

Ministry of Defence

Main Building
Whitehall
London
SW1A 2HB
UK

Foreign and Commonwealth Office (FCO)

Old Admiralty Building
London
SW1A 2PA
UK
Tel: 020 7008 1500

Joint Nature Conservation Committee (JNCC)

Monkstone House
City Road
Peterborough
PE1 1JY
Tel: 01733 562626
Fax: 01733 555948
E-mail: comment@jncc.gov.uk

Non-Governmental Organisations

New Island Conservation Trust

Ian J. Strange
The Dolphins
Snake Hill
Stanley
Falkland Islands
FIQQ 1ZZ

Falkland Islands Museum and National Trust (FIMNT)

Holdfast Road
Stanley
Falkland Islands
Tel: (+500) 27428
Fax: (+500) 22727
E-mail: falklands.museum@horizon.co.fk

APPENDIX 1

Antarctic Research Trust (ART)

Benno Lüthi
General-Guisanstr
5CH-8127
Forch
Switzerland
Tel: +41 44 918 25 54
Fax: +41 44 919 02 06

Sub-Antarctic Foundation for Ecosystems Research (SAFER)

9 Cypress Garden Ct.
Cincinnati
OH 45220
U.S.A
E-mail: peter@subantarctic.com

The Wildlife Conservation Society (WCS)

2300 Southern Boulevard
Bronx
New York 10460
USA
Tel: (+718) 220-5100

Plantlife International

The Wild Plant Conservation Charity
14 Rolleston Street
Salisbury
Wiltshire
SP1 1DX
UK
Tel: +44 (0)1722 342730
Fax: +44 (0)1722 329035
E-mail:enquiries@plantlife.org.uk

BirdLife International

Wellbrook Court
Girton Road
Cambridge
CB3 0NA
UK
Tel: +44 (0)1223 277 318
Fax: +44 (0)1223 277 200
E-mail: birdlife@birdlife.org

The Royal Society for the Protection of Birds (RSPB)

The Lodge
Potton Road
Sandy
Bedfordshire
SG19 2DL
UK
Tel: 01767 680551

APPENDIX 1

Falklands Travel Operators

Falkland Islands Holidays

Stanley Services Offices
Bypass Road
Stanley
Falkland Islands
FIQQ 1ZZ
Tel: (+500) 22622
Email: info@falklandislandsholidays.com

International Tours & Travel

1 Dean Street
Stanley
Falklands Islands
FIQQ 1ZZ
Tel: +500 22041
E-mail: se.itt@horizon.co.fk

Penguin Travel

Crozier Place
Stanley
Falkland Islands
FIQQ 1ZZ
Tel: (+500) 27630 and (+500) 27631
E-mail: ficagents@horizon.co.fk

Sullivan Travel

Davis Street
Stanley
Falkland Islands
FIQQ 1ZZ
Tel: (+500) 22626 and (+500) 22627
E-mail: sullivantravel@horizon.co.fk

International Travel Operators

Thika Travel

Kerkplien 6
PO Box 34
3628 ZN
Kockengen
Holland
Tel: +31 346 244 070
E-mail: arjan.westhoff@thikatravel.com

Natural World Journeys

Via dei Rododendri 1
28804 San Bernardino
Verbano (VB)
Italy
Tel: +39 0323 571293

APPENDIX 1

Patagonia World

Via Villar
2-10147
Torino
Italy
Tel: +39-011-2293200
E-mail: mauro@patagoniaworld.it

Adventure World New Zealand

101 Great South Road
Remuera
Auckland
New Zealand
Tel: + 64 9 524 5118
E-mail: discover@adventureworld.co.nz

Dorado Latin Tours

Albisstrasse 33
8134 Adliswil
Switzerland
Tel: +41 44 712 60 00
E-mail: info@dorado-latintours.ch

Audley Travel

New Mill
New Mill Lane
Witney
Oxfordshire
OX29 9SX
Tel: +44 (0) 1993 838 600
E-mail: latina@audleytravel.com

Cox & Kings Travel

10 Greencoat Place
London
SW1P 1PH
Tel: +44 (0) 207 873 5000
E-mail: sales@coxandkings.co.uk

Discover the World

Arctic House
8 Bolters Lane
Banstead
Surrey
SM7 2AR
Tel: +44 (0) 173 721 8810
E-mail: enquiries@discover-the-world.co.uk

HOLTS Battlefield Tours

Aviation House
Crossoak Lane
Redhill
Surrey
RH1 5EX
Tel: 0845 375 0430 (in UK) / +44 1293 455 300 (outside UK)
E-mail: info@holts.co.uk

Journey Latin America

12 & 13 Heathfield Terrace
Chiswick

APPENDIX 1

London
W4 4JE
Tel: +44 20 8747 8315
E-mail: tours@journeylatinamerica.co.uk

Leger Holidays

Sunway House
West Bawtry Road
Rotherham
S60 2XR
Tel: 0845 458 4885 (in UK) / +44 1709 839 839 (outside UK)
E-mail: reservations@leger.co.uk

Ramblers Worldwide Holidays

Lemsford Mill
Lemsford Village
Welwyn Garden City
Herts
AL8 7TR
Tel: +44 (0) 1707 331 133
E-mail: info@ramblersolidays.co.uk

South American Experience Ltd (part of Western & Oriental)

38-44 Gillingham Street
Victoria
London
SW1V 1HU
Tel: +44 (0) 870 499 0683
E-mail: info@southamericanexperience.co.uk

Adventure Life

1655 S 3rd St. W
Ste 1
Missoula
MT 59801
USA
Tel: +1 406 541 2677
E-mail: b.morgan@adventure-life.com

Ladatco Tours

2200 S Dixie Highway
Suite 704
Coconut Grove
FL 33133
USA
Tel: 1-800-327-6162 (ext 8405)
E-mail: mds@ladatco.com

APPENDIX 1

Cruising operators (with vessels visiting the Falkland Islands)

Discover the World (United Kingdom)

Arctic house
8 Bolters Lane
Banstead
Surrey
SM7 2AR
Tel: + (44) 0870 060 3288
E-mail: enquiries@discover-the-world.co.uk

Natural World Journeys

Via dei Rododendri 1
28804 San Bernardino
Verbano (VB)
Italy
Tel: +39 0323 571293

Patagonia World

Via Villar
2-10147 Torino
Italy
Tel: +39-011-2293200
E-mail: mauro@patagoniaworld.it

Appendix 2: IUCN Red list categories and criteria

Categories (IUCN. 1994)

EXTINCT (EX)

A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

EXTINCT IN THE WILD (EW)

A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

CRITICALLY ENDANGERED (CR)

A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered and it is therefore considered to be facing an extremely high risk of extinction in the wild.

ENDANGERED (EN)

A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild.

VULNERABLE (VU)

A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild.

NEAR THREATENED (NT)

A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now,

but is close to qualifying for or is likely to qualify for a threatened category in the near future.

LEAST CONCERN (LC)

A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

DATA DEFICIENT (DD)

A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

NOT EVALUATED (NE)

A taxon is Not Evaluated when it has not yet been evaluated against the criteria.

Criteria for Critically Endangered, endangered and Vulnerable categories

CRITICALLY ENDANGERED (CR)

A taxon is Critically Endangered when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing an extremely high risk of extinction in the wild:

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of $\geq 90\%$ over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of the following:

(a) direct observation

(b) an index of abundance appropriate to the taxon

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(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

(d) actual or potential levels of exploitation

(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected population size reduction of $\geq 80\%$ over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

3. A population size reduction of $\geq 80\%$, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.

4. An observed, estimated, inferred, projected or suspected population size reduction of $\geq 80\%$ over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 100 km^2 , and estimates indicating at least two of a-c:

a. Severely fragmented or known to exist at only a single location.

b. Continuing decline, observed, inferred or projected, in any of the following:

(i) extent of occurrence

(ii) area of occupancy

(iii) area, extent and/or quality of habitat

(iv) number of locations or subpopulations

(v) number of mature individuals.

c. Extreme fluctuations in any of the following:

(i) extent of occurrence

(ii) area of occupancy

(iii) number of locations or subpopulations

(iv) number of mature individuals.

2. Area of occupancy estimated to be less than 10 km^2 , and estimates indicating at least two of a-c:

a. Severely fragmented or known to exist at only a single location.

b. Continuing decline, observed, inferred or projected, in any of the following:

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- (i) extent of occurrence
 - (ii) area of occupancy
 - (iii) area, extent and/or quality of habitat
 - (iv) number of locations or subpopulations
 - (v) number of mature individuals.
- c. Extreme fluctuations in any of the following:

- (i) extent of occurrence
- (ii) area of occupancy
- (iii) number of locations or subpopulations
- (iv) number of mature individuals.

C. Population size estimated to number fewer than 250 mature individuals and either:

1. An estimated continuing decline of at least 25% within three years or one generation, whichever is longer, (up to a maximum of 100 years in the future)
OR
2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a-b):
 - (a) Population structure in the form of one of the following:
 - (i) no subpopulation estimated to contain more than 50 mature individuals, OR
 - (ii) at least 90% of mature individuals in one subpopulation.
 - (b) Extreme fluctuations in number of mature individuals.

D. Population size estimated to number fewer than 50 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or three generations, whichever is the longer (up to a maximum of 100 years).

ENDANGERED (EN)

A taxon is Endangered when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing a very high risk of extinction in the wild:

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of $\geq 70\%$ over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of the following:
 - (a) direct observation
 - (b) an index of abundance appropriate to the taxon

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(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

(d) actual or potential levels of exploitation

(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected population size reduction of $\geq 50\%$ over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

3. A population size reduction of $\geq 50\%$, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.

4. An observed, estimated, inferred, projected or suspected population size reduction of $\geq 50\%$ over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 5000 km², and estimates indicating at least two of a-c:

a. Severely fragmented or known to exist at no more than five locations.

b. Continuing decline, observed, inferred or projected, in any of the following:

(i) extent of occurrence

(ii) area of occupancy

(iii) area, extent and/or quality of habitat

(iv) number of locations or subpopulations

(v) number of mature individuals.

c. Extreme fluctuations in any of the following:

(i) extent of occurrence

(ii) area of occupancy

(iii) number of locations or subpopulations

(iv) number of mature individuals.

2. Area of occupancy estimated to be less than 500 km², and estimates indicating at least two of a-c:

a. Severely fragmented or known to exist at no more than five locations.

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b. Continuing decline, observed, inferred or projected, in any of the following:

- (i) extent of occurrence
- (ii) area of occupancy
- (iii) area, extent and/or quality of habitat
- (iv) number of locations or subpopulations
- (v) number of mature individuals.

c. Extreme fluctuations in any of the following:

- (i) extent of occurrence
- (ii) area of occupancy
- (iii) number of locations or subpopulations
- (iv) number of mature individuals.

C. Population size estimated to number fewer than 2500 mature individuals and either:

1. An estimated continuing decline of at least 20% within five years or two generations, whichever is longer, (up to a maximum of 100 years in the future)
OR

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a-b):

(a) Population structure in the form of one of the following:

(i) no subpopulation estimated to contain more than 250 mature individuals,
OR

(ii) at least 95% of mature individuals in one subpopulation.

(b) Extreme fluctuations in number of mature individuals.

D. Population size estimated to number fewer than 250 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or five generations, whichever is the longer (up to a maximum of 100 years).

VULNERABLE (VU)

A taxon is Vulnerable when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing a high risk of extinction in the wild:

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of $\geq 50\%$ over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are: clearly reversible AND understood AND ceased, based on (and specifying) any of the following:

(a) direct observation

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- (b) an index of abundance appropriate to the taxon
 - (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
 - (d) actual or potential levels of exploitation
 - (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.
2. An observed, estimated, inferred or suspected population size reduction of $\geq 30\%$ over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.
3. A population size reduction of $\geq 30\%$, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.
4. An observed, estimated, inferred, projected or suspected population size reduction of $\geq 30\%$ over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.
- B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:
1. Extent of occurrence estimated to be less than 20,000 km², and estimates indicating at least two of a-c:
- a. Severely fragmented or known to exist at no more than 10 locations.
 - b. Continuing decline, observed, inferred or projected, in any of the following:
 - (i) extent of occurrence
 - (ii) area of occupancy
 - (iii) area, extent and/or quality of habitat
 - (iv) number of locations or subpopulations
 - (v) number of mature individuals.
 - c. Extreme fluctuations in any of the following:
 - (i) extent of occurrence
 - (ii) area of occupancy
 - (iii) number of locations or subpopulations
 - (iv) number of mature individuals.
2. Area of occupancy estimated to be less than 2000 km², and estimates indicating at least two of a-c:
- a. Severely fragmented or known to exist at no more than 10 locations.

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b. Continuing decline, observed, inferred or projected, in any of the following:

- (i) extent of occurrence
- (ii) area of occupancy
- (iii) area, extent and/or quality of habitat
- (iv) number of locations or subpopulations
- (v) number of mature individuals.

c. Extreme fluctuations in any of the following:

- (i) extent of occurrence
- (ii) area of occupancy
- (iii) number of locations or subpopulations
- (iv) number of mature individuals.

C. Population size estimated to number fewer than 10,000 mature individuals and either:

1. An estimated continuing decline of at least 10% within 10 years or three generations, whichever is longer, (up to a maximum of 100 years in the future)
OR

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a-b):

(a) Population structure in the form of one of the following:

(i) no subpopulation estimated to contain more than 1000 mature individuals,
OR

(ii) all mature individuals are in one subpopulation.

(b) Extreme fluctuations in number of mature individuals.

D. Population very small or restricted in the form of either of the following:

1. Population size estimated to number fewer than 1000 mature individuals.

2. Population with a very restricted area of occupancy (typically less than 20 km²) or number of locations (typically five or fewer) such that it is prone to the effects of human activities or stochastic events within a very short time period in an uncertain future, and is thus capable of becoming Critically Endangered or even Extinct in a very short time period.

E. Quantitative analysis showing the probability of extinction in the wild is at least 10% within 100 years.

Appendix 3: Protocol for ship-to-shore transfer of materials to offshore islands

Potential introductions of alien flora and fauna poses the greatest threat to the native species of offshore islands in the Falklands archipelago. It is strongly advised that all ship to shore transfer of materials should only take place under the supervision of a designated conservation officer. In order to minimize the risk of unwanted faunal and floral introductions in such cases the following protocol is proposed.

1. If possible avoid all unnecessary transfer of materials onto any island. In particular avoid bringing any fresh produce (i.e. vegetables and fruits) or poultry products ashore
2. Where advance notification is given of ship to shore transfer, advise the sender of the restrictions on transferring materials to the island. Politely request that any items to be sent ashore are checked for pest species and soil prior to shipment.
3. A quarantine area should be designated for the receipt and containment of materials. Where possible this should be a closed room as close to the point of entry as possible. The quarantine area should be equipped with sealable bags and containers, insecticide spray and fumigation tablets.
4. If fresh produce or poultry products come ashore they should be placed immediately in sealed containers at the point of entry and frozen if possible. These items should then either (i) be returned to the sender with a polite explanation, (ii) in the case of fresh produce incinerated in sealed bags, or (iii) in the case of poultry products removed from the island at the soonest opportunity. On no account should fresh produce or poultry products be left anywhere other than in sealed containers.
5. Other materials coming ashore must also be placed in sealed containers at the point of entry. Those materials which can withstand cold temperatures should be stored in a freezer (if available) for several hours in order to kill any invertebrates which may be present. After which they can be taken to the quarantine area for examination. Items that might be damaged by freezing (e.g. electrical equipment, bottled/canned goods etc) should be taken straight to the quarantine area. If the size of items coming ashore precludes them being sealed in a container they should be taken immediately to the designated quarantine area and examined first.
6. When sorting through the materials that have come ashore check carefully for rodents, invertebrates, seeds/spores, fungus, vegetation and soil (this may contain invertebrates and seeds). It is advised that at least 2 people are present during the sorting procedure. It is a good idea to open containers,

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spray inside with insecticide spray, and reseal for 5 minutes before reopening and beginning to unpack.

7. Any alien species that are found should be killed and stored in a 70% ethanol solution for future reference. Any soil found on the packaging, along with vegetative material and fungus should be placed in a sealed bag and incinerated. All packaging should also be incinerated if possible (especially cardboard). As a further precaution it is advised that the quarantine area be fumigated following sorting and before any items are taken into the main base.

8. Any humans who come ashore should be asked to clean their footwear and check their clothes for adhered soil or plant seeds before leaving the ship/helicopter/plane. If possible ask visitors to wear clean clothes. Buckets of warm water and disinfectant should be placed at the point of entry and visitors asked politely to again scrub their boots clean. Explain to all visitors the necessity for the procedures used.

Appendix 4: Proposed strategy initiatives

i. Identification of potential indicator species

As invertebrate records are compiled over time, certain species may emerge as having key roles in the ecosystem or as being indicator species. As these species become apparent effort should be applied in discovering more of their ecology.

The Queen of the Falklands Fritillary: One species that might be useful as an indicator species is the Queen of the Falklands fritillary (the only butterfly known to breed in the islands). Experience around the world has shown that of all invertebrates the public has the greatest fondness for butterflies. The Fritillary may therefore be an excellent species with which to engage the public in invertebrate conservation issues. As little is currently known about the species, a project specifically investigating the biology and phenology of this species would be extremely useful. Research should be undertaken to identify its important breeding areas/sites and to rear animals from eggs to adult on its food plant (not fully confirmed, but believed to be the native violet). Efforts should be made to identify whether there is more than one host plant and the seasonality of the species. This information could then be used to improve our knowledge of its distribution and develop an action plan for its protection. An assessment of this species as an 'indicator species' should determine: whether the distribution of the species correlates with geographic variation in any other aspect of the environment, and whether the range/population size of the species is changing with global climate change. If the Queen of the Falklands fritillary can be shown to act as an indicator species in anyway it would be an excellent flagship insect for invertebrate conservation in the Falkland Islands.

Water quality indicators: In freshwater systems the larvae of stoneflies and caddisflies are potential indicators of water quality. While there is currently little chemical pollution in the islands, this may not be the case in the future where new industries may come to the islands (e.g. oil refineries). In this situation the absence of these species might indicate a chemical contamination of the water system.

ii. Commensal species projects

Many invertebrate species in the Falkland Islands are more or less restricted to human settlements. Recording the species in as many settlements as possible would be useful in identifying potential conservation threats. Action could then be taken to eradicate these species prior to their potential spread to native habitats.

iii. Habitat management projects

Farming processes such as the introduction of new grass/fodder plants, grazing density and the use of artificial fertilisers etc can influence invertebrate biodiversity. A project to access the best management practices for native invertebrate conservation could involve setting up small enclosures within grazing land to compare different practices.

iv. Rodents as a Conservation Threat for Invertebrates

Rodent species should be trapped in numbers across a variety of habitat types throughout the year. These animals should be dissected, sexed and have their stomach contents analysed to record what they are eating at different times of the year. This information could be used to assess any species particularly vulnerable to rodent predation, perhaps highlighting islands upon which rodent eradication may be a priority.

Appendix 5: Copy of 'A Future Strategy for Terrestrial Invertebrate Conservation in the Falkland Islands' (A. Jones)

The following report was initially submitted to Falklands Conservation trustees in January 2007

Summary

This Report sets out future plans for invertebrate conservation work and identifies resources or changes which might be required to implement an effective legacy following completion of the Darwin Initiative Falkland Islands Invertebrates Conservation Project (FIICP) in August 2007.

Key outputs from the FIICP are:

- Written reference information
 - Final project report comprising:
 - Training and instruction manuals
 - Conservation reports (including criteria for areas of importance for invertebrates)
 - FI invertebrates check lists and species keys
 - Additional scientific papers
- Electronic reference material
 - Invertebrates information on website
 - A revised and expanded FI invertebrates database (on Recorder)
- Falkland Islands Invertebrates Collection, in Stanley
- FC ownership of specialist invertebrate equipment
- FI based Volunteer Invertebrates Monitoring Group (VIM)

The Invertebrates Plan contains the following elements:

- Invertebrate monitoring: long term monitoring of populations enabling identification of conservation threats
- Management and protection: new site assessments and the identification of important habitats/conditions for invertebrate biodiversity (integrating invertebrates work with other FC programmes)
- Development of new research initiatives
- Education and awareness initiatives (maintaining a strong invertebrates profile)
- Strategy Management (monitoring, reporting, development and funding)

Essential to implementing this Plan are the following:

- Continued access to identified long term monitoring sites
- Identification of staff with responsibility for invertebrate issues (equipment, communication, database, fieldwork)
- An agreed location and manager for the Invertebrates Collection
- An active VIM Group keen and able to undertake monitoring work
- External support available to advise and actively input, particularly taxonomic expertise
- Publicising/circulating future scientific papers produced after the end of the FIICP
- Funds identified/raised for invertebrate related projects

1. Introduction

1.1 Purpose

Falklands Conservation is currently carrying out a survey of the terrestrial invertebrates of the Falkland archipelago called the '*Falklands Islands Invertebrates Conservation Project*' (FIICP). Funding for this 3 year Project comes from a Darwin Initiative grant administered by the UK's Department of the Environment Food and Rural Affairs (DEFRA) and the Falkland Islands Government, with support from the Natural History Museum (London) and the University Museum of Zoology Cambridge. Grant funding and the Project terminate on 31st August 2007.

A primary aim of the FIICP is to enable continuation of recording and monitoring the terrestrial invertebrate species and their enhanced conservation. This Report addresses how this can be achieved.

1.2 Background

The FIICP project was developed due to inadequate knowledge of the terrestrial invertebrates of the Falkland Islands archipelago, which precluded identification of any conservation threats and development of invertebrate Biodiversity Action Plans (BAPs). A conservation review of the OTs in 1996 identified the necessity to prepare updated invertebrate species inventories and records of geographic distribution in order that the data was available to inform the process of CBD ratification (UKDTCF, 1996). The FIICP is addressing this need by undertaking systematic surveys of the invertebrates. In addition to simply cataloguing the invertebrate species, the Project work has been designed to produce outputs and resources so that FC will be able to continue to investigate and develop its invertebrate conservation remit.

As a sub-Antarctic archipelago, the Falkland Islands are naturally depauperate in terrestrial invertebrate species when compared to temperate and tropical regions. A combination of fewer species and relatively little habitat variation leads to wide species distributions. Most invertebrate species of the Falkland Islands are mobile and can be found at most locations from sea level to mountain tops. Some habitat preference is apparent, with rodent free tussac grassland being a particularly important habitat type for native species. However, as a rule the wide distribution of most species will preclude the identification of suites of 'indicator' species. While we can determine important habitat types (e.g. tussac grassland) and conditions (e.g. rodent free) these are likely to be important wherever they are found, and there is no indication that any of the islands/region of the Falkland Islands are more important than others.

1.3 Why FC needs 'an invertebrate strategy'

- To protect important/key invertebrate species and undertake further research/investigation/surveys if necessary
- To identify important invertebrate areas and incorporate these in key biodiversity areas for the FIs allowing prioritisation of conservation action
- To continue to maintain profile built up by the 3 year FIICP
- To put in place a structure to enable taxonomic work to continue on material that will not be identified by the end of August 07

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- To help identify and ameliorate conservation problems of non-invertebrate species resulting from changes in invertebrate biodiversity

1.4 Content

Proposals for invertebrate conservation are covered under three headings:

- **The FIICP Project Legacy**
- **A Strategy for 20011-2030**
- **Action Plan and Recommendations**

2. FIICP Project Legacy

A comprehensive review of the work carried out by the FIICP can be found in the Project reports (Jones 2005, 2006). The outputs of the FIICP that will facilitate the development of future and ongoing invertebrates' conservation programmes are:

2.1 Written Reference Information

2.1.1 Project report comprising:

- Training and Instruction Manuals detailing:
 - Habitat type determination and assessment techniques
 - Basic monitoring and conservation techniques
 - Collection protocols
- Conservation reports including:
 - Key habitat assessments and the criteria for identification of Important Invertebrate Areas
 - Specific site reports covering East Falkland (primarily the Gypsy Cove region), West Falkland and Carcass Island
 - Reports to landowners from survey locations
 - Report to FIG on protection measures for species, key sites and general conservation
- Taxonomic check lists of known species (identifying species meeting Red List criteria)
- Basic species identification keys

2.1.2 Scientific papers

2.1.3 Laminated identification chart

2.2 Electronic Reference Information

2.2.1 An Invertebrates Database All data on species presence/absence and distribution will be entered into the *Recorder* electronic database programme being developed for Falkland Conservation

2.2.2 Invertebrates Section on FC Website There will be a new section on Falkland invertebrates on the FC website

2.3 A Falkland Islands Invertebrates Collection

A Falklands Invertebrates Collection, currently being assembled, is to be located in Stanley (at FC's offices), as a taxonomic reference for local people and interested visitors. It is a cabinet (95 cm x 60 cm x 40 cm) with 12 glass-topped drawers containing fragile pinned specimens. A wet (in vials of Ethanol) collection of samples will be in a couple of the drawers. A species catalogue and curation manual will be provided with the collection. The Natural History Museum (London) will house the primary collection.

2.4 Specialist Equipment

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Equipment from the Project will be available for ongoing invertebrate work. This includes: a microscope, light traps, malaise traps, pitfall traps, Tullgren funnels, pinning boards, pinning equipment, vials, ethanol, and dissection equipment.

2.5 A Trained Volunteer Invertebrates Group

By the end of the Project 30 Islanders and FC staff will have received instruction in the identification and monitoring of Falkland invertebrates. These people are being encouraged to form a group (Volunteer Invertebrates Monitors' - known as VIM) to assist with the long term monitoring effort.

3. Strategy for 2011-31

3.1 Invertebrate Monitoring: long term monitoring of populations enabling identification of conservation threats

Specific sites must continue to be surveyed so that temporal changes in Falkland invertebrate species assemblages can be monitored and conservation threats identified. As part of this process, weather data (from MPA) should be collated so that trends can be correlated to climate change and any alterations in vegetation and habitat recorded.

The FIICP has begun a five stage plan extending beyond the time period of the FIICP (Jones, 2005) - see Table 1 below. By the end of the FIICP Stages 1 and 2 will be completed. Fifteen long term monitoring sites, split 5 each between East Falkland, West Falkland and Carcass Island, and covering all main habitat types, have already been identified and baseline surveys of those sites commenced (see Jones (2005) for the rationale behind these choices). The protocols for monitoring procedures, full site descriptions with baseline data, and photographs of the species to be found at these sites will be presented in the final FIICP report.

Table 1: The five stages maximising successful conservation action for invertebrate species

	Action	Prerequisites
Stage 1	Determine what species are present in the islands	-
Stage 2	Set up monitoring sites in areas representing important habitat types and make baseline recordings of species presence and relative abundance	A knowledge of the species present in the islands
Stage 3	Monitor changes in species presence/absence and abundance at regular intervals (e.g. every year/ 2 years)	Baseline information of species presence/absence and abundance at monitoring sites.
Stage 4	Identify native species with increasing absence or declining abundance, and identify introduced species with increasing presence/abundance then determine likely causes	A series of monitoring events
Stage 5	Where possible take direct action to counter conservation threats	A knowledge of species ecology resulting from observation made at the monitoring sites

3.1.2. Monitoring at specific sites

Long term monitoring sites are located as follows: 5 in or near Gypsy Cove, near Stanley; 5 near Hill Cove on West Falkland; and 5 on Carcass Is. (Jones 2005, 2006).

Gypsy Cove

The Gypsy Cove region is logistically by far the easiest of these localities to monitor. It should be surveyed on an annual basis in the austral summer at the same date every

year to enable annual comparisons (see table 2). It could be undertaken by VIM/ FC members, under the supervision of the FC staff member with responsibility for terrestrial invertebrates. The protocol for this survey will be outlined in full in the final FIICP report and is simplified in table 3. The survey will require traps to be set up and left for 7 days. At the end of the survey all the samples collected are to be separated into Order, correctly preserved and safely stored; the process being supervised by trained FC staff.

Hill Cove and Carcass Island

Due to the logistic problems these localities should be surveyed on a biannual basis on alternate years (see table 3). As a degree of cost is associated with visiting these sites (air travel and accommodation) it must be recognised that ongoing surveys such as those proposed for the Gypsy Cove region are unlikely to be maintained. A mini-survey of the most important site for each locality should be run over a three-day bank holiday weekend. Due to the fact that less time will be spent at these sites than at Gypsy Cove the survey work has had to be reduced (see table 3). The rationale for these choices and full protocols for the surveys will be provided in the final FIICP report. These surveys should be run as an annual event for VIM/FC members, organised by FC who should provide the equipment and vehicles (if required), with the volunteers paying for accommodation and transport. As with the Gypsy Cove surveys the Carcass/Hill Cove surveys should be carried out on the same date every year to enable annual comparisons. At the end of the surveys all the samples collected are to be separated into Order, correctly preserved and safely stored with the process supervised by trained FC staff.

Collected Specimens

The samples collected from all these surveys are to be stored by FC in the Falkland Islands until every fourth year (beginning 2011, see table 2). At this point the samples will either be shipped to the UK to be analysed or collected by an expert in the Falkland Islands. The FIICP final report will detail a procedure to be implemented in cases where monitoring projects identify new conservation threats.

Table 2: Site survey schedule for the period 2011 – 2030

Year	7 Day Surveys*	3 Day Surveys	Taxonomy
2011	Gypsy Cove sites survey	Carcass Is.	-
2012	Gypsy Cove sites survey	Hill Cove Region	-
2013	Gypsy Cove sites survey	Carcass Is.	-
2014	Gypsy Cove sites survey	Hill Cove Region	Sample curation
2015	Gypsy Cove sites survey	Carcass Is.	-
2016	Gypsy Cove sites survey	Hill Cove Region	-
2017	Gypsy Cove sites survey	Carcass Is.	-
2018	Gypsy Cove sites survey	Hill Cove Region	Sample curation
2019	Gypsy Cove sites survey	Carcass Is.	-
2020	Gypsy Cove sites survey	Hill Cove Region	-
2021	Gypsy Cove sites survey	Carcass Is.	-
2022	Gypsy Cove sites survey	Hill Cove Region	Sample curation
2023	Gypsy Cove sites survey	Carcass Is.	-
2024	Gypsy Cove sites survey	Hill Cove Region	-
2025	Gypsy Cove sites survey	Carcass Is.	-
2026	Gypsy Cove sites survey	Hill Cove Region	Sample curation
2027	Gypsy Cove sites survey	Carcass Is.	-
2028	Gypsy Cove sites survey	Hill Cove Region	-
2029	Gypsy Cove sites survey	Carcass Is.	-
2030	Gypsy Cove sites survey	Hill Cove Region	Sample curation

* Only 3 actual field work days. Traps are set up on day 1, there is an additional day for hand collecting and traps are collected on day 7.

Table 3: Basic site survey protocol for long term monitoring sites

LOCALITIES		SITES			
		Boulder/ Rocky Beach	Tussac Grassland	Oceanic Heath	Feldmark (mountain)
Mainland + Rats and Mice)	Gypsy Cove	Malaise Trap / Hand Collecting	Malaise Trap/ Hand Collecting/ Tullgren extraction from <i>P. flabellata</i>	Malaise Trap / Hand Collecting / Tullgren extraction from <i>E. rubrum</i>	Malaise Traps / Hand Collecting
	Hill Cove	-	-	Malaise Trap / Hand Collecting / Tullgren extraction from <i>E. rubrum</i>	Hand Collecting
Island (- Rats and Mice)	Carcass Island	-	Malaise Trap/ Hand Collecting / Tullgren extraction from <i>P. flabellata</i>	-	Hand Collecting

3.2 Management and protection: new site assessments and the identification of important habitats/conditions for invertebrates biodiversity (integration of invertebrates work with other FC programmes)

All future terrestrial conservation assessments should include an invertebrate's component where possible. When assessing sites for their conservation importance, invertebrates should be included alongside plants, birds and mammals. This relates in particular to production of management plans, for Environmental Impact Assessments, and development proposals. In addition, Falklands Conservation should assess invertebrate data and their conservation importance when making decisions for nature reserve land purchase and in its decisions and plans for existing land holdings. The protocols for invertebrate survey and simple conservation assessments will be described in the final FIICP Report. These will allow sites to be graded upon a simple scale of importance for invertebrates based on the data available. Such a reference scale will be of utility to both conservation NGO's and the Falklands Government Environmental Planning Department.

It should be the responsibility of a member of FC's core staff to alert via letter all members of the VIM (and perhaps local FC / senior watch group members) to upcoming site surveys or census work for other species (especially when visiting remote locations) and solicit volunteers to survey as much of the invertebrate fauna at

the locality as time/logistics will allow. The staff member will furnish the volunteer with correct equipment and a survey plan, and will supervise the sorting and preserving of returned samples. Survey results will form part of the sites conservation assessment. In situations where surveys are not possible (e.g. where no volunteers/staff are available or where survey work would be logistically impossible), the potential conservation relevance of a site to terrestrial invertebrates should be recorded, based on the habitat types present and in line with recommendations given in the FIICP final report.

Integration of Invertebrates work within other FC Programmes will make invertebrate records available for FC reserves, IBA's, NNR's and Ramsar sites; allowing identification of new important/key invertebrate areas to be incorporated into the network of Falklands Islands Key Biodiversity Areas. Identification of locations where important/key invertebrate areas correspond to key areas for other species such as birds will add to the recognized conservation worth of these sites.

3.3 Development of new research initiatives

In order to maintain a dynamic invertebrates policy progressing forward from the work of the FIICP future initiatives must be realised. Potential themes that might be developed include:

3.3.1 Identification of potential indicator species

As invertebrate records are compiled overtime, certain species may emerge as having key roles in the ecosystem or as being indicator species. As these species become apparent effort should be applied in discovering more of their ecology.

3.3.1.1 The Queen of the Falklands fritillary. One species that might be useful as an indicator species is the Queen of the Falklands fritillary (the only butterfly known to breed in the islands). Experience around the world has shown that of all invertebrates the public has the greatest fondness for butterflies. The Fritillary may therefore be an excellent species with which to engage the public in invertebrate conservation issues. As little is currently known about the species, a project specifically investigating the biology and phenology of this species would be extremely useful. Research should be undertaken to identify its important breeding areas/sites and to rear animals from eggs to adult on its food plant (not fully confirmed, but believed to be the native violet). Efforts should be made to identify whether there is more than one host plant and the seasonality of the species. This information could then be used to improve our knowledge of its distribution and develop an action plan for its protection. An assessment of this species as an 'indicator species' should determine: whether the distribution of the species correlates with geographic variation in any other aspect of the environment, and whether the range/population size of the species is changing with global climate change. If the Queen of the Falklands fritillary can be shown to act as an indicator species in anyway it would be an excellent flagship insect for invertebrate conservation in the Falkland Islands.

3.3.1.2 Water quality indicators. In freshwater systems the larvae of stoneflies and caddisflies are potential indicators of water quality. While there is currently little chemical pollution in the islands, this may not be the case in the future where new

industries may come to the islands (e.g. oil refineries). In this situation the absence of these species might indicate a chemical contamination of the water system.

3.3.2 Commensal species project

Many invertebrate species in the Falkland Islands are more or less restricted to human settlements. Recording the species in as many settlements as possible would be useful in identifying potential conservation threats. Action could then be taken to eradicate these species prior to their potential spread to native habitats.

3.3.3 Habitat management project

Farming processes such as the introduction of new grass/fodder plants, grazing density and the use of artificial fertilisers etc can influence invertebrate biodiversity. A project to assess the best management practices for native invertebrate conservation could involve setting up small enclosures within grazing land to compare different practices.

3.3.4 Rodents as a Conservation Threat for Invertebrates

Rodent species should be trapped in numbers across a variety of habitat types throughout the year. These animals should be dissected, sexed and have their stomach contents analysed to record what they are eating at different times of the year. This information could be used to assess any species particularly vulnerable to rodent predation, perhaps highlighting islands upon which rodent eradication may be a priority.

3.4 Education and awareness initiatives (maintaining a strong invertebrates profile)

A continued effort to maintain awareness of invertebrate issues should be made. These should include:

- Regularly updating the FC invertebrates website
- An annual invertebrates newsletter detailing any recent developments
- At least 1 annual watch group meeting on invertebrates
- At least 1 annual FC magazine article
- At least 1 annual radio interview concerning invertebrates
- At least 1 additional promotion every 5 years (e.g. new invertebrate posters)

In addition FC should also provide invertebrates information to advise FIG on policies (e.g. Conservation Strategy, CBD) and should advise FIG on the need for invertebrate surveys.

3.5 Strategy Management (monitoring, reporting, development and funding)

An annual meeting should be organised between the FC Director, UK Executive Officer and staff member with responsibilities for Terrestrial Invertebrates to produce a short report on any developments concerning invertebrate issues of the last 12 months and to discuss potential new initiatives such as those presented in section 3.3 and 3.4. A core aim of these meetings should be to identify funds, and plan fund raising, for current and future invertebrate initiatives. A short report from this meeting

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should be circulated to the FC Trustees and other interested parties. Invertebrate issues should be on the agenda for each trustees meeting with the question asked as to what developments have occurred. In addition each annual report should have an invertebrates section.

4. ACTION PLAN AND RECOMMENDATIONS

Execution of the proposed strategy 2011-2030 has a number of implicit requirements, which are discussed below with the required actions. The strategy elements described in section 3 are referenced against these required developments in table 4.

4.1 Continued access to identified long term monitoring sites

Action: The landowners of sites in the Gypsy Cove, Hill Cove are Carcass Is. localities must be approached for permissions to survey these sites at the planned times.

4.2 Identification of Staff with responsibility for Invertebrate Issues

The most important development FC needs to realise is to determine the staff member/job description with responsibility for invertebrate conservation issues. The job responsibilities for this person would be to: insure tools to support invertebrate work are available (i.e. curate the invertebrates collection, be responsible for the survey/laboratory equipment including requisition of consumables when required, maintain the invertebrates database), co-ordinate future invertebrate surveys including provisioning the required equipment, both at long term monitoring sites and at new sites, co-ordinate correspondence on invertebrate issues, deal with any invertebrates issues that arise either directly or by knowing the correct 'expert' to contact regarding the issue. This being the case the individual will need to be trained in: field work techniques, basic taxonomy to the level of being able to sort samples to Order, sample curation techniques, microscopic techniques including the production of digital images to be emailed back to the UK when necessary, and will also need to be familiar with the long term monitoring sites.

Action: Write in the role of 'Invertebrates Officer' into the job description of a FC staff position.

4.3 Agreed location and manager for the Invertebrates Collection and collection access rules

In order to maintain an organised collection, access will have to be supervised by a member of FC staff. While the samples can be viewed under glass in the cabinet draws, removal for closer examination should require specific permission from FC. Samples should never be removed from the room in which the collection is housed (where a microscope should also be available). Any scientists wishing to borrow material should be directed to apply to the Natural History Museum (London) where the primary collection will be housed. Protocols for the curation and management of the collection will be provided in the final FIICP project report.

Action: Identify an invertebrates collection manager and the location where the collection will be housed

4.4 An active VIM Group keen and able to undertake monitoring work

A group of volunteer invertebrates monitors (VIM) will be set up by the end of the FIICP, drawing its members from those individuals who have completed the invertebrate course, FC members and senior watch group member. A questionnaire assessing the enthusiasm and support for such a group has been circulated to graduates of the invertebrate course and awaits analysis. For the group to be functional an enthusiastic group leader/coordinator needs to be found in the Falkland Islands (perhaps the FC Staff member with responsibility for invertebrate issues?).

Action: Analyse returned questionnaires and write to those who expressed enthusiasm for the VIM group asking them to join the group. Identify potential group leaders.

4.5 External expert support available to advise and actively input, particularly taxonomic expertise

Strong links must be maintained with taxonomic expertise in the UK and elsewhere (particularly Dr. A. Jones and the NHM). The first contact for all invertebrates enquires/correspondence should be the FC staff member with responsibility for invertebrate issues. Dr Jones will maintain a database of expert taxonomists and will act as an intermediate contact to these individuals. In some cases it may be useful to have experts visit the Falklands. The possibilities for funding such visits might include Shackleton scholarship money. Other organisations that should be kept informed of invertebrates developments include Buglife and the South Atlantic Working Group of the OTCF.

It would be of great benefit to future invertebrate work, and indeed all future FC projects, were FC to have an acknowledged link to a UK Academic Institution. Such a link would provide for collaboration on proposals for research funding (unattainable by FC alone), with the potential to fund Ph.D. students. Falklands Conservation should actively court suitable UK universities with such a proposal. An obvious choice here is the Zoology Department of Cambridge University as it has large conservation and ornithology groups, has close links with BAS, the Scott Polar Research Institute, FFI, the RSPB and Birdlife International, and is already involved in the FIICP project.

Action: Produce a written liaison protocol for invertebrate issues whereby the most appropriate contact for a specific enquiry can be easily identified. Approach Cambridge University with a proposal for Association to the Conservation Group.

4.6 Publicising/circulating future scientific papers produced after the end of the FIICP

FIICP project output subsequent to the official project termination should be made available to FC and circulated appropriately.

Action: Any individuals working on FIICP material will be asked to disseminate all published works to FC where it will be the job of the FC staff member with responsibility for invertebrate issues to circulate the information to relevant people/organisation, update the FC web site with any new developments/discoveries and update the invertebrate database.

4.7 Funds identified/raised for invertebrate related projects

Funding for future invertebrate related work needs to be identified and raised. This should be the responsibility of the Chief Executive and UK Executive Officer of FC

Action: *Invertebrate funding should be sought on an annual basis, with an annual review meeting between the Chief executive of FC and the UK Executive Officer.*

APPENDIX 5

Table 4. Developments required to achieve the planned strategy (Key: ✓✓✓ - critical ✓✓ - very useful ✓ - useful)

APPENDIX 5

Required developments (for description see the number reference in the text)	Strategy 2011-2030 (for description see the number reference in the text)				
	3.1 Invertebrate monitoring	3.2 Management and protection	3.3 New research initiatives	3.4 Education and awareness	3.5 Strategy management
4.1 Continued access to identified long term monitoring sites	✓ ✓ ✓	-	-	✓	-
4.2 Identification of Staff with responsibility for Invertebrate Issues	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓
4.3 Agreed location and manager for the Invertebrates Collection	✓ ✓	✓ ✓	✓	✓ ✓	-
4.4 An active VIM Group, keen and able to undertake monitoring work	✓ ✓	✓ ✓	✓ ✓	✓	-
4.5 External support available to advise and actively input, particularly taxonomic expertise	✓ ✓	✓ ✓	✓ ✓	✓	✓ ✓
4.6 Publicising/circulating future scientific papers produced after the end of the FIICP	✓	✓	✓ ✓	✓ ✓	✓
4.7 Funds identified/raised for invertebrate related projects	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓	-

5. CONCLUSIONS

This document provides a framework upon which to implement a future FC invertebrates conservation strategy. Much of the material contained within this report refers to FC policy issues and may have implications wider than that of merely continuing invertebrate conservation work. As such the development of this document will now involve discussion within and between FC and FC Trustees, who together must take subsequent decision on how to proceed.

REFERENCES

Jones, A. G. 2005. Falkland Islands Invertebrates Conservation Project Project Report. No.1.

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