Review of and Advice on Gorgon ERMP and Related Documents

Terrestrial Conservation Issues

Report prepared by:
Professor Richard J Hobbs
School of Environmental Science
Murdoch University

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UNIVERSITY
PERTH, WESTERN AUSTRALIA

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Review of and Advice on Gorgon ERMP and Related Documents

Objectives

The objective of this report is to provide an independent review of the documentation available regarding the proposed Gorgon development on Barrow Island.

Detailed objectives are:

Review the Gorgon ERMP, relevant appendices and related documents,

- generally in regard to the protection of conservation values on the Barrow Island Class A Nature Reserve, and
- particularly with regard to the likelihood of the proposed management plans adequately ensuring that those conservation values will not be compromised by the introduction of invasive species or diseases.

Provide advice as to the:

- adequacy of the proponent's information to enable proper assessment of any significant environmental impacts relevant to the conservation of biota on Barrow Island likely to arise as a result of the Gorgon proposal;
- likely effectiveness of management plans to mitigate potential impacts sufficiently to ensure the conservation values of Barrow Island are sustained;
- need for any other studies to adequately assess environmental impacts likely be significantly affect conservation values;
- need for any other management measures to secure the conservation values of Barrow Island from impacts likely to arise as a result of the Gorgon proposal;
- desirability of any significant changes to the Gorgon proposal to reduce likely impacts on the conservation values of Barrow Island, and
- overall likelihood of the conservation values of Barrow Island being sustained if the Gorgon proposal was to proceed.

EXECUTIVE SUMMARY

1. Barrow Island is a unique conservation resource with irreplaceable conservation values. These values have not been adequately accounted for in the analyses used to justify selection of Barrow Island as the location for development rather than other possible locations.

2. The risk assessment process used is limited by uncertainties and data gaps, and underlying assumptions are not always made clear.

3. The main risk assessment process (Chapters 9 and 10) does not make it clear that invasive species constitute a significant risk to the conservation values of Barrow Island, and concludes instead that no high risk stressors can be identified.

4. It is clear that invasive species pose the greatest actual and potential threat to the conservation values of Barrow Island. The proposed development significantly increases the likelihood of invasion by changing five of the six key phenomena affecting invasion probabilities.

5. The proposed Quarantine Management System is an ambitious attempt to reduce the potential for invasion to agreed acceptable levels. However, the information provided so far does not indicate that this system will achieve these goals, for the following reasons:
    a. To date, detailed analysis is available for only 3 out of 12 or more possible invasion pathways
    b. This analysis does not demonstrate that an acceptable level of risk is achieved
    c. There is no estimate of current infection rates on existing pathways
    d. The short timeframe under which development is scheduled militates against adequate quarantine measures being in place during construction.
    e. There is not adequate consideration of the possible introduction of harmful disease organisms
    f. There is not an adequate detection and eradication protocol to deal with species which evade quarantine barriers

6. A number of key areas where more information is required are identified, as are specific areas where other management measures may be appropriate.

7. Given the current status of the information provided in the Gorgon ERMP, it is not possible to conclude that the conservation values of Barrow Island will be sustained if the Gorgon proposal was to proceed in its current form.

1. Introduction

The proposed development of the Gorgon and other gas fields represents a significant opportunity in terms of economic and social returns to Australia, and Western Australia in particular. There seems little doubt that the development is likely to proceed. The main question to be considered, however, is whether Barrow Island is a suitable location for the development and whether it is possible to site the development on Barrow Island without significantly compromising its conservation values.

The Draft Environmental Impact Statement/Environmental Review and Management Programme for the Proposed Gorgon Development Main Report and supporting appendices and related documents (herafter referred to as the Gorgon ERMP) represents a significant body of work which aims to address, and develop management strategies for, the various environmental and other impacts of the proposed development of the Gorgon gas field and the use of Barrow Island as the location of the associated gas production facility.

This report considers only the elements of the Gorgon ERMP which are relevant to the protection of terrestrial conservation values on the Barrow Island Class A Nature Reserve.

2. Conservation values on Barrow Island

Review the Gorgon ERMP, relevant appendices and related documents,

- *generally in regard to the protection of conservation values on the Barrow Island Class A Nature Reserve*

2.1 Selection of Barrow Island over other potential locations

A key element that must be considered in relation to the protection of conservation values on Barrow Island is whether the rationale for siting the development there is sufficient. Barrow Island is internationally recognised as an area of outstanding conservation significance because of its almost unique faunal assemblages and virtual lack of non-native species. Butler (1987) commented that it “contains one of the richest assemblages of wildlife found on any Australian offshore island”. This must be set against the broader conservation picture, with Australia having the worst record of mammalian extinctions of anywhere in the world, largely as a result of inappropriate management regimes and the impacts of feral animals since European colonisation (Burbidge & Friend 1990; Burbidge & McKenzie 1989; Short & Smith 1994; Szabo 1995). The presence of a fauna which is representative of the terrestrial fauna which would have been present on the Australian mainland prior to European settlement makes the island’s conservation values amongst the highest in Australia. This, coupled with the possibility that some island fauna populations have developed distinct genetic traits which differentiate them from other populations elsewhere, means that the island is largely irreplaceable in any conservation

reserve network (e.g., Pressey et al. 1994; 2004). These values have been retained even in the presence of the existing oil industry activities.

The conservation significance of Barrow Island is therefore incontestable. The uniqueness of the island does not however show up clearly in the comparative analysis carried out of the biodiversity values of alternative locations (Main Report, Table 3.2, Table 3.4). The breakdown of the attributes of each location into individual components hides the more holistic viewpoint which would clearly place Barrow Island as of considerably more importance than any of the other potential locations.

A further major issue is that it is very difficult to place a monetary value on the conservation significance, and hence the underlying biodiversity and heritage value is not included in any financial analysis of the use of Barrow Island for development. Table 3.3 (Main Report) provides a comparison of key cost driver components across the alternative locations, which indicates that Barrow Island is the least cost alternative. This analysis, coupled with associated considerations of technical convenience, is the primary driver of the choice of Barrow Island as the site for development. There are growing attempts to build effective valuation systems which can take account of non-monetary values, and the value of living systems to humans is increasingly recognised (Costanza et al. 1997; Millennium Ecosystem Assessment 2005; Toman 1998). Despite this, it is still very difficult to build such considerations into financial balance sheets, and non-monetary values are frequently ignored or discounted.

A key consideration in this case is that the values of Barrow Island, as discussed above, are high and irreplaceable, and any loss of such values would be largely permanent and irreversible. This loss is not in terms of any given species, but relates to the loss of the unique set of circumstances which has maintained Barrow Island as an intact ecological community which is mostly free from harmful non-native species. This is the true cost which has to be considered in any risk analysis of the potential impacts of development. While the irreplaceability of Barrow Island's values has been noted in public submissions and commented on in passing in the economic analysis (Technical Appendix F1, p21), there was no real attempt to deal with the issue effectively. The statement "there may be little or possibly no demonstrable loss of environmental values" (Technical Appendix F1, p21) has to be matched by the opposite argument that there *is* the possibility of irreversible loss of irreplaceable values.

2.2 Risk assessment framework

The basis of the analyses in the Gorgon ERMP is risk assessment, as outlined in the Main Report, Chapter 9. While this is an acceptable and recognised approach, which has been developed in detail in the Gorgon ERMP, there are some important issues to be considered in judging its efficacy. The field of risk assessment is rapidly developing, and new ideas and techniques are increasingly available (e.g., Burgman 2005). However, certain limitations remain, as recently summarised by MacGill & Siu (2005):

1. People's knowledge is what determines the way they perceive, define and assess risk issues.
2. Risk issues are a combination of physical and social qualities and properties
3. Risk issues are pervaded by uncertainty and crises of trust
4. Risk issues are intrinsically dynamic, changing in profile over time and across geographical and cultural space
5. The effectiveness of risk management interventions rests on the quality of the knowledge (scientific and social) on which they are based, and on the internal congruence of that knowledge.

Wandall (2004) further emphasises that "risk assessment is subject to a number of methodological limitations causing uncertainties that are unlikely to be resolvable". Such limitations include uncertainties caused by data gaps and extrapolations, and Wandall suggests that in cases of uncertainty, "risk assessors will have to rely on assumptions, rather than facts".

Such issues underlie the approach undertaken in the Gorgon ERMP. A key element is ensuring that issues of uncertainty and the assumptions made in the face of that uncertainty are made transparent and accounted for in the process. In the sections that follow, areas where significant uncertainty remains or is not accounted for are highlighted.

2.3 Risk from invasive species

Chapter 10 of the Main Report (p302) indicates that no high risk stressors have been identified. However, the risks from invasive species are not given a mention here. Indeed invasive species are not listed in Chapter 9 as stressors associated with the proposed development activities. The introduction of non-native animals, plants and microorganisms nevertheless poses the greatest threat to the integrity of the biodiversity within the Barrow Island Nature Reserve. The risk to the island's biodiversity from quarantine failure is far greater than the risks posed by any of the other factors considered here. While this topic is considered in detail in Chapter 12 (and is discussed further in Section 3 below), it is somewhat misleading to claim in Chapter 10 that there are no high risk stressors identified. This section should be clearly linked to Chapter 12, and quarantine failure identified as the highest risk to the island's biodiversity.

3. Introduction of invasive species or diseases

Review the Gorgon ERMP, relevant appendices and related documents,

- *particularly with regard to the likelihood of the proposed management plans adequately ensuring that those conservation values will not be compromised by the introduction of invasive species or diseases.*

3.1 Importance of invasive species

As indicated in Section 2.3, the introduction of non-native animals, plants and microorganisms poses the greatest threat to the integrity of the biodiversity within the Barrow Island Nature Reserve. The importance of invasive species and their impacts on natural and managed ecosystems, and the ensuing costs, is increasingly recognised worldwide (Mooney et al. 2005; Pimentel et al. 2000). The Gorgon ERMP correctly recognises this and details a strategy for minimising the potential impacts of invasive species, mostly through a program of pre-border prevention.

3.2 Factors affecting likelihood of invasion

Successful invasion by a species not native to a given area depends on a number of factors, which include the transport of organisms or propagules (such as seeds), their successful establishment in the new area, subsequent growth and survival to reproductive maturity, followed by successful reproduction and spread. Carlton (1996) has identified six major ways in which opportunities for invasion are likely to increase, as outlined in Table 3.1. How each of these six phenomena may be affected by the proposed Gorgon development is indicated in Table 3.2. The key message from this table is that the development will almost certainly increase the likelihood of invasions occurring simply because of the increases in the number of donor regions, environmental changes during and after development, frequency of invasion windows, and increased numbers of vectors. This set of considerations differentiates the proposed development from the existing oil enterprise. The existing enterprise has resulted in the arrival and establishment of invasive species on the island (see Section 3.3), and the proposed enterprise greatly increases the probability that further invasions will occur.

Table 3.1. Phenomena likely to result in changed probability of invasion (DR = Donor Region, RR = Recipient Region) (From (Carlton 1996)

Phenomenon	**Processes involved**
Changes in donor region	Environmental changes in DR lead to: • Population increases of resident species making more individuals available for transport • Range expansion of local species into previously uninhabitable areas of DR, making these species available for transport *Resident and local species may be either native or introduced* New introductions of non-indigenous species occur within DR: • New species available for transport
New donor regions	New DRs become available: • New species available for transport • New genomes with different adaptive regimes than previously-transported populations of the same species from other DRs become available for transport
Changes in recipient region	Any environmental changes in RR that lead to altered ecological, biological, chemical or physical states, thus changing the susceptibility of the RR to invasions.
Invasion windows	Invasions occur when the proper combination of colonizing conditions occurs, followed by the proper combination of conditions that permit the long-term establishment of reproducing populations. These combinations may or may not be dependent on changes in the RR.
Stochastic inoculation events	The release of a very large number of inoculants into the RR, increasing (among other considerations) potential reproductive success.
Dispersal vector changes	Vector size, speed, and quality increase leading to: • Increase in inoculant species diversity • Increase in abundance of inoculated species • Increase in number of post-trasport “fit” individuals New vector emerges from same donor region

Table 3.2. How phenomena listed in Table 3.1 can be affected by processes relevant to Barrow Island

Phenomenon	**Processes relevant to Barrow Island**
Changes in donor region	• N/A
New donor regions	• Increased number of donor regions due to different supply origins of equipment, vehicles, materials, food supplies etc
Changes in recipient region	• Disturbances related to construction etc • Increased numbers of personnel • Increased vehicular traffic on island
Invasion windows	• More frequent transport of invasive organisms • More frequent quarantine breaches • More disturbance due to construction etc • Increased soil fertility through NO_x inputs
Stochastic inoculation events	• Unauthorised ballast water release • Undetected colonies of organisms in cargo • Bioterrorism
Dispersal vector changes	• Increased numbers of ships and aeroplanes visiting island • Increased numbers of personnel travelling to island • Increased amounts of cargo, packaging etc • Increased amounts of foodstuff

3.3 Adequacy of proposed measures

As outlined in the Gorgon ERMP, the proponent is attempting to develop a quarantine system which aims to be better than anything that currently exists anywhere in the world. This is a commendable aim, and the success of this quarantine system is essential to the maintenance of the biodiversity values of Barrow Island. However, a realistic assessment of the likelihood of success needs to be made.

Essentially, to achieve the stated aims of protecting the biodiversity of Barrow Island, the quarantine system needs to be fail-safe. However, it is unlikely that there is such a thing as a perfect quarantine system, and all systems will fail from time to time because of human error, smuggling, and the impossibility of preventing the transport and establishment of all organisms travelling with people, equipment, packaging etc under all circumstances. The failure rate can certainly be managed, and is dependent on the design and integrity of the system, the people running it, the effectiveness of treatment of all possible invasion routes, the sampling rate of cargo inspection and so on.

The Gorgon ERMP outlines an ambitious attempt to develop an effective quarantine system. However, the chances of doing this successfully in the first instance must be considered slim, given the short time available and the desire to work to tight construction deadlines. Although necessary for quarantine success, it is questionable

whether full implementation of potentially-restrictive quarantine measures will take precedence over construction timetables once the project gets underway. For instance, the proposed establishment of the pioneer camp for the project had a putative schedule for building to commence at the beginning of 2006, and this would certainly be prior to all of the quarantine management plans being completed yet alone approved. This suggests that the likelihood of early quarantine failures may be higher than indicated

The Gorgon ERMP details the known past quarantine incursions (Main Report p 543), indicating that a number of species have established on the island, some of which were subsequently eradicated. Of particular concern are the incursions of mice and black rats. Three records of incursions by house mice via food cargoes and drilling equipment provide an indication of the invasion potential of these rodents. Interpretation of the presence of black rats on the island includes (1) the suggestion in the Gorgon ERMP (Main Report p543) that they may have been introduced by pearlers in the late nineteenth century, (2) the possibility that they were introduced by oil field operations or (3) that they swam there from nearby islands (see Section 3.5, below). If (1) is true, this indicates that the monitoring system used on the island was insufficient to detect the species earlier, while (2) indicates the potential for inadvertent transport of this species.

Despite the further information provided in the Additional Information Package, the proponents have been unable to demonstrate to date that they will be able to meet the 'Community expectations for acceptable risk' developed under the guidance of the Quarantine Expert Panel (pp 555-556). The three 'priority' pathways detailed in the Additional Information Package all show final infection scores allocated by the experts above '1' (Additional Information Package, pp. 8-9, 12, and 18). In other words, the pathway analyses indicated that the expectation that "The introduction is extremely remote, highly unlikely" is not likely to be realised. This indicates that Scenario 1 (Figure 12-4) cannot be achieved, and also places the other scenarios in doubt. This is because:

(1) it is not possible to allocate a survival score of less than 8 for organisms which have been introduced (as there will always be a proportion of organisms that will survive on the island once they arrive, as already demonstrated by the range of weed species present, rats, mice, and the recently-discovered non-native ant species) and
(2) the proponent is unable to demonstrate that detection and eradication scores will be less than 4.

Only three 'priority' terrestrial pathways have been completed to the 'barrier design' stage, plus some progress on marine pathways. Progress on detailing these pathways was slow, with the information being delivered only in late October 2005. There are, however, at least 12 pathways in total, and it must be questioned whether there will be sufficient detail on all pathways, properly evaluated, in place and tested before construction commences. Of particular concern is equipment that will be shipped directly to Barrow from overseas.

While the emphasis has been on the most obvious pathways and species/groups likely to be transported, there also needs to be consideration of other possibilities. For instance, organisms have been found to be successfully transported in aircraft undercarriage, and

particularly invasive species such as the Brown Tree Snake, which has had very destructive impacts on the native biota on Guam (Rodda et al. 1997; Savidge 1987), have been detected in long-distance transport vectors on numerous occasions (Vice & Vice 2004).

3.4 Disease organisms

The Gorgon ERMP provides little information on the movement of microorganisms related to construction and development. There has been minimal effort to survey the island's biota for natural or invasive diseases, and little effort to determine the potential for movement and spread of potentially harmful microorganisms. The potential impacts of novel diseases on wildlife populations is currently being graphically illustrated in Tasmania by the devil facial tumour disease which is greatly reducing numbers of Tasmanian Devils (Bostanci 2005). The potential importance of disease organisms in the Barrow Island situation is reviewed in the Gorgon ERMP Technical Appendix D8, but very little of this information is considered in the main report.

3.5 Likelihood of detecting successful invasions

While most emphasis in the Gorgon ERMP has been placed on prevention of invasion via management of potential pathways, there remains a significant residual risk of invasion which must be taken seriously. Monitoring and early detection of invasions is essential if the potential threat that such invasions pose is to be adequately dealt with. Monitoring undertaken to date is likely to have been inadequate to address this issue fully, and proposed monitoring systems must take into account the difficulty in detecting rare and elusive species (Thompson 2004).

A recent salutary example of this has been provided by work from New Zealand, where an individual rat was released on a rat-free island to test detection and trapping efficiency. Despite intense trapping efforts, the rat evaded capture for 18 weeks and swam 400m across open water to a neighbouring island, before finally being captured (Russell et al. 2005). The authors conclude that "The exceptional difficulty of this capture indicated that methods normally used to eradicate rats in dense populations are unlikely to be effective on small numbers, a finding that could have global implications for conservation on protected islands".

Given the known effects of invasive species such as rats on island ecosystems and their fauna (Simberloff 2001; Thorsen 2000), there is a significant risk to the conservation values of Barrow Island arising from the increased invasion potential due to increased traffic to the island coupled with the difficulty of detecting and eradicating an invasion once it has happened. The longer a species goes undetected in the early stages of invasion, the less opportunity there is to intervene, the fewer options remain for its control or eradication, and the more expensive any intervention is (Mack 2000).

The risk based approach taken in the Gorgon ERMP scores infection, survival, detection and eradication. Almost all of the reported work has been on infection, with some

attention to survival, but little to detection and virtually nothing to eradication. There appears to have been no effort to develop protocols for eradication of invasives should they establish. Given the increased probability of a successful invasion occurring (Section 3.2) and the problems with detecting invasions outlined in this section, it is not possible to conclude that the proponents can confidently assert that they have adequately dealt with the issue of invasive species. Considerably more effort needs to go into developing sound and comprehensive protocols for detection and eradication.

4. Adequacy of proponent's information

Provide advice as to the:
adequacy of the proponent's information to enable proper assessment of any significant environmental impacts relevant to the conservation of biota on Barrow Island likely to arise as a result of the Gorgon proposal

4.1 Information on infection of existing pathways

The background work via the QEP and its recommendations, and the series of IMEA and QHAZ workshops on three major pathways, while very useful, has been wholly a paper-based study. Invited experts at the workshops had to suggest risk scores without any hard data. To date there has been no attempt by the proponent, despite recommendations from the QEP and experts at workshops, to measure infection of existing pathways. This is a relatively easy task, given the current volume of plane and sea travel to Barrow, and would provide some essential data with which to assess the increased risk posed by significantly increased volumes of traffic.

4.2 Biological survey expertise

The proponent does not appear to employ a biologist to coordinate surveys, despite early recommendations by the QEP. A small number of environmental scientists are employed, but there is apparently little "in-house" biological expertise, with the proponent relying instead on short term consultancies to conduct the necessary survey and monitoring work. While the experts employed in these consultancies undoubtedly have excellent credentials, there is a clear need for more adequate coordination of survey and monitoring efforts, especially if the necessary level of baseline survey and monitoring to allow early detection of invasive species is to be instigated.

4.3 Invertebrate data

Existing baseline data on invertebrate fauna that is present on Barrow are rudimentary. Terrestrial invertebrate fauna surveys have only recently started and have so far consisted only of a minor 'pilot' project. A problem with invertebrate survey is that results are often slow to accumulate since collections tend to be large and identifications take a long

time, with many groups having to be referred to experts elsewhere. The brief pilot study has already detected one introduced 'tramp' ant species (Jonathon Majer, personal communication), indicating that claims of lack of introduced species are based on very incomplete data. Baseline studies on terrestrial invertebrates seem to be a case of 'too little too late'. This is an important problem, since invertebrate invasions can have profound consequences for island biota, as illustrated by the crazy ant (*Anipolepis gracilipes*) on Christmas Island (Green et al. 1999; O'Dowd et al. 2003).

4.4 Baseline surveys of other groups

While extensive survey work has been undertaken for the Gorgon ERMP, this has largely concentrated on the areas directly impacted by the development, and has taken the form of "snapshots". It is questionable whether the level of survey undertaken so far can constitute an adequate baseline against which to measure change, particularly in relation to invasive species.

5 Likely effectiveness of management plans

Provide advice as to the:
likely effectiveness of management plans to mitigate potential impacts sufficiently to ensure the conservation values of Barrow Island are sustained

The key areas of concern have been discussed in detail in Section 3, and centre around the efficacy and sufficiency of the proposed Quarantine Management System. From the materials provided to date, the evidence suggests that the management system will not deliver the degree of quarantine protection agreed to through community consultation.

6 Need for further studies

Provide advice as to the:
need for any other studies to adequately assess environmental impacts likely be significantly affect conservation values

From previous sections, the need for further studies has been highlighted in the following areas:

1. Comprehensive analysis of the full range of pathways for invasive species incursion.
2. Design and testing of a suitable detection and eradication protocol, including the development of adequate baseline data and monitoring procedure
3. Analysis of infection rates in existing pathways
4. Detailed invertebrate sampling and analysis

5. More comprehensive analysis and treatment of disease organisms of potential importance

7 Need for other management measures

Provide advice as to the:
need for any other management measures to secure the conservation values of Barrow Island from impacts likely to arise as a result of the Gorgon proposal

7.1 Disease organisms
The potential importance of disease organisms in the Barrow Island situation is reviewed in the Gorgon ERMP Technical Appendix D8 and D9, and a number of possible management actions are outlined there (for instance, disinfecting foot baths at the airport). However, none of these management options has been included in the main report. It seems important that such measures are implemented if the stated goals of quarantine are to be achieved.

7.2 Specific management actions in relation to quarantine
A range of specific management options need to be considered if the proposed quarantine management system is to be effective. Examples include using rodenticide in containers, effective quarantine and inspection of food, and selection of products from Australian suppliers wherever possible.

7.3 Integration of management strategies for existing and proposed developments

While there is little reference in the Gorgon ERMP to the existing oil extraction operations and infrastructure on Barrow Island, it will be essential that management strategies and protocols for these existing operations be integrated with those for the proposed gas development.

8 Desirability of any significant changes to proposal

Provide advice as to the:
desirability of any significant changes to the Gorgon proposal to reduce likely impacts on the conservation values of Barrow Island

The main significant change to the proposal that would reduce the likely impacts to the conservation values of Barrow Island would be the reconsideration of locating the development elsewhere.

Other proposed changes have been outlined in other sections of this report.

9 Likelihood of conservation values being sustained

Provide advice as to the:
overall likelihood of the conservation values of Barrow Island being sustained if the Gorgon proposal was to proceed.

While the Gorgon ERMP goes to significant lengths to recognise the conservation values of Barrow Island and to devise management strategies to sustain these values, the underlying problem identified in Section 2 remains. This is that Barrow Island represents a unique conservation resource and any threats to its overall integrity and value should be minimised. The fact that the Gorgon development could proceed using a location other than Barrow Island is central to the decision of whether the development on Barrow should proceed or not. The decision to use Barrow Island is based almost entirely on economics and technical convenience, and cannot be justified in conservation terms.

While the proponents have provided considerable detail on all aspects of environmental management of the development, the primary threat to the integrity of Barrow Island remains – namely the risk of establishment, spread and ecosystem impact of invasive species. The proposed Quarantine Management System rightly concentrates on pre-border measures to reduce the likelihood of invasion, but the proponents have not adequately established that this system will be effective, and have provided little detail on measures to detect and eradicate successful incursions. Lessons from other parts of the world, including many islands, indicate that invasive species can have devastating effects on island biota and ecosystems. Hence it is not possible to conclude that the conservation values of Barrow Island will be sustained if the Gorgon proposal was to proceed in its current form.

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