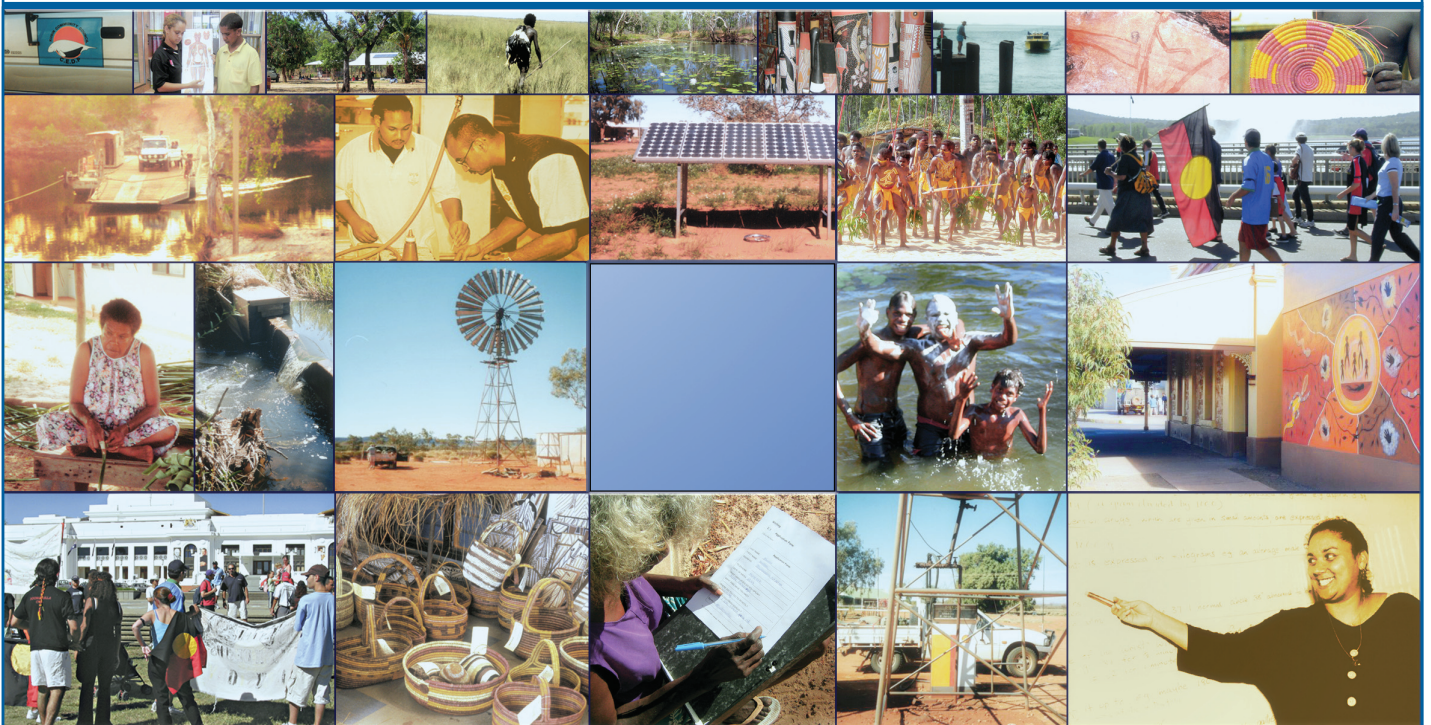


The Viability of Wildlife Enterprises in Remote Indigenous Communities of Australia: A Case Study

A. Fordham, W. Fogarty and D. Fordham

CAEPR WORKING PAPER No. 63/2010



SERIES NOTE

The Centre for Aboriginal Economic Policy Research (CAEPR) was established at The Australian National University (ANU) in April 1990. From 1990 to 2003 the Centre's main research partner was the Aboriginal and Torres Strait Islander Commission. Since 1 January 1999, CAEPR has operated as a University Centre and is currently funded from a variety of sources including the ANU, Australian Research Council, industry partners, and the Department of Families, Housing, Community Services and Indigenous Affairs.

CAEPR's principal objective is to undertake high-quality, independent research that will assist in furthering the social and economic development and empowerment of Aboriginal and Torres Strait Islander people throughout Australia. Its aim is to be a world-class centre undertaking research on Indigenous economic development issues that combines academic excellence with policy relevance and realism.

CAEPR is currently Australia's major dedicated research centre focusing on Indigenous economic and social policy from a national perspective. The Centre's publications, which include the CAEPR Working Paper series established in 1999, aim to report on Indigenous circumstance, inform public debate, examine government policy, and influence policy formulation.

Working Papers are often work-in-progress reports and are produced for rapid distribution to enable widespread discussion and comment. They are available in electronic format only for free download from CAEPR's website:

<www.anu.edu.au/caepr/>

Enquiries may be directed to:

The Centre for Aboriginal Economic Policy Research
Hanna Neumann Building #21
The Australian National University
Canberra ACT 0200

Telephone 02-6125 0587
Facsimile 02-6125 9730

As with all CAEPR publications, the views expressed in this Working Paper are those of the author(s) and do not reflect any official CAEPR position.

Professor Jon Altman
Director, CAEPR
College of Arts & Social Sciences
The Australian National University
February 2010

The Viability of Wildlife Enterprises in Remote Indigenous Communities of Australia: A Case Study

A. Fordham, W. Fogarty and D. Fordham

Adrian Fordham is Visiting Fellow and Bill Fogarty is a Research Scholar at Centre for Aboriginal Economic Policy Research, College of Arts and Social Sciences, The Australian National University, Canberra. Damien Fordham is a Postdoctoral Fellow at the Environment Institute, University of Adelaide.

ABSTRACT

Sustainable wildlife enterprises developed for commercial purposes are a potential source of economic and socio-cultural benefit for Indigenous people living in remote locations in Australia. This paper examines the viability of a wildlife enterprise in Arnhem Land (Northern Territory) that harvests three animal species for commercial sale: saltwater crocodiles (*Crocodylus porosus*), northern long-necked turtles (*Chelodina rugosa*) and tarantula spiders (*Selenotholus sp.*). Whilst the crocodile and turtle industries are well established, the tarantula spider industry is an emergent industry. Factors influencing the development of the enterprise and its on-going viability are identified, including the extent of collaboration between the local Indigenous community and western scientists; knowledge and skill requirements for a successful wildlife enterprise; and institutional constraints on the effectiveness of wildlife enterprises in remote localities. In examining the viability of the wildlife enterprise, suggestions are made to strengthen the continued operation of the enterprise and its potential to become commercially viable.

Keywords: Indigenous ecological knowledge, traditional knowledge, western science, collaborative research, remote Australia, wildlife enterprise viability, natural resource management, Indigenous education and training.

ACKNOWLEDGMENTS

We wish to thank the Bawinanga Aboriginal Corporation, especially Ian Munro, for providing their support in this research and open access to staff employed by the Wildlife Centre. In this regard special thanks are due to Ben Corey, Wildlife Centre Manager and his staff for their contributions to this research. We would also like to thank the many Indigenous people living in the Maningrida township and on outstations who freely gave their time to tell us about their knowledge of the local wildlife and environment. A very high level of cooperation for this research was received from Maningrida Community Education Centre staff, Charles Darwin University staff and staff from the Queensland Museum. Mason Scholes, Marion Devitt, Greg Williams and Robert Raven from these institutions all provided significant insights into the research and for this we are most grateful. Our thanks also go to CAEPR's Hilary Bek and John Hughes for editorial and layout expertise.

All errors and omissions remain the responsibility of the authors.

CONTENTS

Abstract	i
Acknowledgments.....	ii
Introduction	1
Setting the scene.....	2
Location of the study	2
The Djelk Ranger Programme.....	2
The BAC Wildlife Centre and Wildlife Enterprise.....	2
Success factors in developing a wildlife enterprise.....	5
Success factor: The wildlife enterprise as a collaborative enterprise.....	5
Success factor: Valuing both Indigenous knowledge and western science	7
Success factor: Education and training to support the wildlife enterprise.....	10
External and organisational influences upon the viability of the wildlife enterprises.....	12
External regulatory frameworks.....	12
Government policies and programmes.....	14
Seasonality and market variability	14
Illegal harvesting of wildlife.....	15
Organisational and other factors.....	15
Concluding comments: The commercial viability of wildlife enterprises.....	17
References.....	20

TABLES & FIGURES

Table 1. The major tasks for a sustainable turtle wildlife enterprise and associated western scientific knowledge and Indigenous ecological knowledge	8
Fig. 1. Factors influencing BAC Wildlife Centre productivity.....	11

INTRODUCTION

Sustainable wildlife enterprises developed for commercial purposes are a potential source of economic and socio-cultural benefit for Indigenous people living in remote locations in Australia. Wildlife enterprises can generate local employment and income, while providing Indigenous people with opportunities to continue their close connection with country and maintain customary wildlife harvesting practices (Altman & Cochrane 2003; Bawinanga Aboriginal Corporation (BAC) 2008). By actively involving Indigenous people in land, sea and wildlife management, wildlife enterprises also have the potential to produce social, health, and well-being benefits (Hunt, Altman & May 2009).

Wildlife enterprises have been developed for the production of Australian native foods, and the sale of animals such as freshwater turtles for the pet trade and saltwater crocodiles for their meat and skins. More recently, attention is being paid to harvesting wildlife, both plant and animal species, for pharmaceutical purposes. Wildlife enterprises are therefore becoming a natural extension of existing, well-developed land and sea management programmes that constitute much of the activity of Indigenous rangers in Northern Australia.

With recent increased interest in 'bush foods' among non-Indigenous Australians and the tourist industry, further growth in Indigenous wildlife enterprises through harvesting plant and animal species could be expected. The large number of plant and animal species used by Indigenous people for customary purposes suggests that a diverse range of species can be harvested at low levels without a substantial impact on population persistence (e.g. Fordham, Georges & Brook 2008). For example, a recent analysis of the use of wildlife species by Indigenous people across Northern Australia identified some 340 native animal species used for customary or commercial purposes (Gorman et al. 2008). A similar diversity of plant species is used by Indigenous people in the Northern Territory, many of which could be suitable for commercially viable enterprises (Gorman, Griffiths and Whitehead 2006).

The development of commercial wildlife enterprises in remote Indigenous communities has nevertheless been quite limited. The Senate Rural and Regional Affairs and Transport Committee (1998) concluded that while commercial utilisation of wildlife by Aboriginal people has an important role to play in the economic development of some Aboriginal communities, there are significant locational, financial and cultural constraints on wildlife enterprise development. The Committee identified distance from markets and a lack of experience and expertise in commercial enterprises as key constraints. Ten years later, Gorman et al. (2008) identified similar factors limiting the growth of wildlife enterprise development. There are other significant factors influencing the success of wildlife enterprise development, particularly regulatory controls administered by different layers of government and Indigenous organisations (Cooney & Edwards 2009), lack of community consultation and engagement (Dale 1996), and public perception of wildlife utilisation (Tisdell & Nantha 2008).

Questions of sustainability of species subject to enterprise development are often raised. For example, some conservationists and researchers argue that wildlife enterprises can never be sustainable and that they inevitably result in long-term population decline, threatening extirpation of targeted species, especially in regard to species with slow life histories (Congdon, Dunham & van Loben Sels 1993). Yet there is growing scientific evidence to support the sustainability of wildlife enterprises, even among long-lived vertebrates (e.g. Fordham, Georges & Brook 2008, 2009). This reflects advances in population modelling techniques and computational tractability, building on earlier approaches to modelling (Choquenot 1996). As a result there are more robust predictive tools to anticipate harvest impacts in the context of multiple human-driven threatening processes (Fordham & Brook 2009).

BAC:

Bawinanga
Aboriginal
Corporation

This paper reports on the development of a wildlife enterprise in the remote township of Maningrida in north central Arnhem Land, and has a particular focus upon those factors that have influenced its development. In so doing, the paper asks the basic question faced by Indigenous communities considering establishing wildlife enterprises: what are the key factors which determine the viability of wildlife enterprises in remote Australia?

IEK:

Indigenous
ecological
knowledge

The paper complements a second, more detailed paper by Fordham et al. (2010) that examines the knowledge foundations underpinning a successful wildlife enterprise and identifies the relative contributions made by Indigenous ecological knowledge (IEK) and western scientific knowledge.

ARC:

Australian
Research
Council

The paper draws upon field work undertaken during 2008–09 by staff from the Centre for Aboriginal Economic Policy Research at the Australian National University. The field work forms part of a larger Australian Research Council (ARC) funded project on the re-engagement of young people living in remote Indigenous communities in education, training and employment. Details of the methodology used to gather information for both papers are described in Fordham et al. (2010).

SETTING THE SCENE

LOCATION OF THE STUDY

The location of the study is Maningrida township and surrounding region. Maningrida is in north central Arnhem Land, some 500 kilometres east of Darwin at the mouth of the Liverpool River. At the 2006 Census, Maningrida township had a population count of 1,900 Indigenous people and about 200 non-Indigenous people (Australian Bureau of Statistics (ABS) 2007). Surrounding Maningrida is an administrative region of some 10,000 square kilometres, in which about 360 Indigenous people live on 32 outstations, although this number fluctuates quite widely depending on season (Fogarty & Paterson 2007).

ABS:

Australian
Bureau of
Statistics

Service delivery responsibility for the outstations in the region has been held by the Bawinanga Aboriginal Corporation (BAC), although the establishment of Shires in 2008 and government changes to outstation policy may affect this arrangement in the future. Nevertheless, one of the principal goals of BAC is to promote the sustainable economic development of the region's land and sea resources. The Djelk Ranger programme established by BAC is a major avenue for the creation of meaningful long-term employment while at the same time strengthening links with traditional Indigenous culture (BAC 2008; Cochrane 2005; Fordham, Hall & Georges 2004).

THE DJELK RANGER PROGRAMME

Traditional owners, through BAC, established the Djelk Rangers in 1991 with responsibilities initially for land management and then, since 2002, for sea management. These activities cover issues such as animal surveys, weed and feral animal control, fire management and coastal surveillance and include both men's and women's Ranger programmes (Cochrane 2005).

In 1998 BAC and the Djelk Rangers adopted as a priority the development of sustainable wildlife industries as a natural extension of land management activities, building on experience gained with Crocodylus Park in harvesting, incubation and sale of crocodile eggs. Shortly after, the development of a freshwater turtle industry commenced.

THE BAC WILDLIFE CENTRE AND WILDLIFE ENTERPRISE

The establishment of the Wildlife Centre by BAC in 2006 to promote the development of sustainable wildlife industries in the Maningrida region was seen as significant in formalising the BAC Wildlife Enterprise as a key commercial activity for BAC. In 2008 the Centre was staffed by three Indigenous wildlife Rangers and

a non-Indigenous Wildlife Centre Manager with specialist expertise in wildlife management, although the number of rangers reduced to two in 2009.

At the time of the field work in 2008, the BAC Wildlife Enterprise comprised:

- a well established saltwater crocodile (*Crocodylus porosus*) egg harvesting and hatchling industry, with hatchlings sold to a crocodile farm
- a well established freshwater turtle (*Chelodina rugosa*) egg harvesting and hatchling industry, with hatchlings sold to pet shops, and
- a fledgling tarantula spider (*Selenotholus sp.*) industry, with potential sales of spiderlings to the Australian domestic market and to pharmaceutical companies for venom extraction.

The crocodile industry

The saltwater crocodile industry quickly became well established as the foundation industry for the future BAC Wildlife Enterprise, drawing upon egg harvesting and incubation procedures that had already been set in place when working alongside staff from Crocodylus Park. In 1999–2000 some 1,400 crocodile eggs were harvested. With a 40–45 per cent hatching rate (including initial hatchling survival) 600 hatchlings were available for sale. Whilst there was a reduction in the numbers harvested during 2004–06, the number of crocodile eggs harvested in 2006–07—when a Parks and Wildlife Service of the Northern Territory (P&WS) quota of 2,000 eggs was in place—was again about 1,450.

Crocodile egg collection was interrupted for 18 months from mid-2007 to the end of 2008 due to access issues related to the determination of a Land Use Agreement (LUA) and egg harvest sites by the NLC. Consequently no crocodile eggs were collected in 2008. Following finalisation of the LUA in December 2008, P&WS allocated a 2009 quota of 700 eggs for collection in a small number of areas located on the Liverpool and Tomkinson Rivers. The 2009 harvest yielded some 350 eggs, which could be expected to produce about 150 hatchlings for sale.

The turtle industry

The freshwater turtle industry commenced in 1999. During its first year of operation in 2000, some 1,000 turtle eggs were collected. These eggs were incubated under experimental treatments to determine optimum incubation temperature—key knowledge needed to support the industry. The majority of subsequent hatchlings (about 375 hatchlings) were sold to the aquarium trade. The remaining hatchlings were maintained on-site and their growth rates recorded under different feeding regimes. Between 2001 and 2004, eggs continued to be harvested for both commercial and experimental purposes (500–1,000 eggs per year). The scientific knowledge needed to underpin the incubation of turtle eggs and turtle husbandry in Maningrida was established in 2005 (Fordham, Georges & Brook 2007), signalling the end of egg harvesting for experimental purposes. In 2006 and 2007 a combined total of approximately 900 eggs were harvested, resulting in 425 hatchlings for sale into the domestic market.

In 2008 there were some 400 eggs collected under a P&WS harvest quota of 1000, resulting in the sale of 250 hatchlings. Overall, the egg harvest and subsequent sale of hatchlings for 2006–08 was well under the annual P&WS quota and well under the level of demand from Darwin-based pet shops. Importantly, this does not reflect harvest impact—because egg harvesting can be undertaken at much higher levels without threatening persistence (Fordham, Georges & Brook 2008)—but rather a transitional state in the industry following the withdrawal of the collaborative research partner (Institute of Applied Ecology, University of Canberra). In 2009, egg harvesting yielded close to 850 eggs. With a 70–75 per cent hatching rate (including initial hatchling survival), there were about 650 viable hatchlings for sale into the

P&WS:

Parks and
Wildlife Service
of the Northern
Territory

LUA:

Land Use
Agreement

local domestic market by the end of 2009. An elevated hatching and survival rate reflects the long-term investment by BAC to determine optimum incubation and husbandry conditions.

The spider industry

MCEC:
Maningrida
Community
Education
Centre

The tarantula spider industry is still at an early stage. The development of the industry, which began in 2005 as a topic for the Maningrida Community Education Centre (MCEC) senior science curriculum, has largely been dependent upon the senior science teacher of MCEC in collaboration with the Queensland Museum as scientific partner. More recently the Wildlife Centre became involved as the business potential became evident. To date the 'business activity' has been more restricted to research and development activities and the first sales of spiderlings are not expected until early 2010. The status of this industry in late 2009 was as follows:

- P&WS had granted permits for the collection in 2009 of five female spiders with egg sacs and eggs to be hatched and grown up for sale. Each egg-sac bearing spider could be expected to produce 100-200 spiderlings. Permits were also obtained for collecting another seven female spiders and three male spiders for one-off breeding purposes.
- Permits were yet to be granted for the sale of venom to pharmaceutical companies due to issues associated with Intellectual Property and royalty payments.
- The necessary procedures for egg collection were being refined, as were animal husbandry requirements, including the establishment of laboratory and animal husbandry facilities.
- Marketing arrangements were still to be determined.

Future wildlife enterprise activity

There is a very wide range of species located in the Maningrida region that potentially could be harvested for enterprise purposes.

In determining candidate species for the development of wildlife industries, it is important to assess:

- the existing scientific knowledge-base regarding biology, ecology and husbandry
- species abundance and the potential risk to future population viability
- incubation and animal husbandry requirements, and
- market value.

On the basis of such factors, the Wildlife Centre has P&WS permits in place to expand its operations to include a further 22 species of non-venomous snakes (pythons and file snakes), lizards, geckoes, and freshwater crocodiles (BAC 2007).

Further expansion of enterprise activities beyond these species could include the bush food industry (billy goat plums and sugar bag), the nursery industry (cycads) and the aquaculture industry (aquarium fish and related products). Whilst there has been some limited commercial activity in bush foods and cycads by BAC over recent years (Cochrane 2005), it is still to be developed to a point where it could be considered an on-going industry.

SUCCESS FACTORS IN DEVELOPING A WILDLIFE ENTERPRISE

The successful development of the BAC Wildlife Enterprise has been largely due to three factors that have underpinned its development since first proposed:

- a high degree of collaboration between Indigenous organisations, Indigenous communities and scientific institutions
- recognition of the importance of both IEK and western science, and
- delivery of education and training directly relevant to wildlife management, resulting in a skilled workforce.

This paper deals with each of these success factors, before examining external and organisational influences upon the viability of these industries (for more detail of the second and third success factors see Fordham et al. 2010).

SUCCESS FACTOR: THE WILDLIFE ENTERPRISE AS A COLLABORATIVE ENTERPRISE

The collaborative approach

The economic, cultural and social benefits of a collaborative approach to natural resource management have been well established (e.g. Baker, Davies & Young 2001; Hunt, Altman and May 2009; Nesbitt et al. 2001). A collaborative approach to wildlife enterprise development involving Indigenous organisations, Indigenous communities and scientific institutions is similarly critical to both its implementation and its longer-term community benefits. It is more likely to lead to increased community engagement and ownership of the enterprise, more successful and appropriate implementation and longer-term viability of the business. Through the involvement of all stakeholders in the development process, existing and new local capacities become mobilised and job readiness increased.

However there is often reluctance by scientists to develop a collaborative approach to natural resource management (Sheil & Lawrence 2004). This is due to concern about a lack of objectivity among local people (and consequent data quality), insecurity about departing from mainstream scientific methods of investigation, and the need to adopt a more flexible and time-consuming approach which may conflict with tight timelines for project completion. There may also be general discomfort about interacting within the socio-cultural context.

Principles of collaboration underpin the many Caring for Country projects that have been implemented. For example, integral to the Burdekin Dry Tropics Natural Resource Management Plan 2005–2010 is a Caring for Country plan, developed by traditional owners and requiring the development of strong partnerships with all stakeholders and participation of traditional owners and Indigenous people both in decision-making and implementation (NQ Dry Tropics 2005). The Caring for Country project for the Garawa Aboriginal Land Trust (Northern Land Council (NLC) 2005) is another example of a highly participative approach involving key stakeholders, including Indigenous peak organisations such as the NLC, government and non-government agencies and traditional owners.

At a legislative level, the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) strongly supports a collaborative approach to land, sea and wildlife management. The Act (s3(2)(g)9iii):

... promotes a partnership approach... recognising and promoting indigenous peoples' role in, and knowledge of, conservation and ecologically sustainable use of biological resources.

However, the application of collaborative research and development involving scientific and Indigenous communities (as well as government and other non-government agencies) is not straightforward

NLC:
Northern Land
Council

(Gillespie, Cooke & Taylor 1998; Webb 1996). Collaboration requires more than consultation about broad development goals and access issues. Rather, collaboration provides opportunity for active participation of all partners throughout the research and development process: planning and design, data gathering or field work, data analysis and interpretation, and decision making about future developments (Birkhead, Klomp & Roberts 1996; Carter 2008).

Collaborative model for the wildlife enterprise

The development of the crocodile, turtle and spider industries has been underpinned by a high degree of collaboration between BAC as the key Indigenous stakeholder and scientific research institutions such as the former ARC Key Centre for Tropical Wildlife Management, Institute for Applied Ecology at University of Canberra, Environment Institute at University of Adelaide, the University of Queensland, the Queensland Museum, and Crocodylus Park in Darwin. At this institutional level, collaboration occurred in terms of developing research and business proposals, applying for funding, seeking relevant wildlife approvals, providing skills training and determining access to country.

The development of the BAC wildlife industries has also been founded upon a high degree of collaboration at an individual level, including Indigenous people living in the Maningrida township and on outstations. It is this operational, day-to-day collaboration between Indigenous people and scientists which has proven critical in influencing the success of the wildlife industries.

We examined the extent to which stakeholders participated in five key stages in the development and continuing operation of the BAC wildlife enterprise, with particular reference to the turtle industry. These five stages are:

- planning and design processes
- data gathering and field work
- data analysis and interpretation
- modifying wildlife management practices, and
- decisions about future directions.

The *planning and design processes* for the turtle industry were time-consuming, occurred over a five year period, and involved frequent, regular 'consultations' or discussions between scientists and traditional owners living on outstations and in the Maningrida township, as well as between scientists, Djelk Rangers and BAC. These discussions cut across both scientific and Indigenous knowledge systems and covered wildlife management issues and related cultural matters, including access to country. This was a highly flexible process, recognising diversity among the Indigenous clans of the Maningrida region, and one which was reliant on continual feedback and a much more incremental approach to planning than might usually be the case in western science.

Data gathering and field work such as mapping wildlife refugia, harvesting wildlife and wildlife husbandry involved Djelk Wildlife Rangers wherever possible. The value of Indigenous outstations contributing local IEK, particularly around seasonality, distribution and harvesting techniques was well recognised by the scientific community. Effective data gathering and fieldwork was dependent on strong personal relationships between scientists and outstation residents, built upon a mutual respect for cultural obligations and knowledge. However, the extent to which Indigenous outstation residents were directly involved in data gathering and field work was limited, owing primarily to the absence of a committed long-term interest in data gathering, procedures that take months to years. This is an issue which needs to be addressed to ensure a continued sense of ownership among all the Indigenous families living across the region where harvesting occurs.

Data analysis and interpretation was a feature of the wildlife enterprise development but one which required specialist skills, generally not held by Indigenous people such as the Djelk Wildlife Rangers. However, several Rangers were responsible for quite significant analytical tasks, which led to increased skill levels and capacity development to take on additional responsibilities. Unfortunately, the low literacy and numeracy levels of many Djelk Rangers restricted their active participation. This is a key area for future development. However it needs to be recognised that a high level of expertise is required and, in practice, such tasks may need to be outsourced.

Modifying wildlife management practices to increase productivity and ensure sustainability has largely been the responsibility of the scientists, operating within an experimentally-based adaptive management framework. As this is dependent upon well-developed analytical skills, the involvement of Djelk Rangers has been limited to minor adjustments of wildlife management practices rather than directly involved in decisions about more complex design issues.

Decisions about future directions have been the responsibility of BAC and the scientific community and hence are reliant upon strong governance arrangements to ensure outstation residents and individual townspeople are adequately represented.

The research and development strategy used for establishing the turtle industry is also being used to establish the tarantula industry.

In summary, a well-developed collaborative model involving the scientific community, the regional Indigenous governance organisation (BAC), the Djelk Wildlife Rangers, traditional owners and Indigenous outstations has underpinned the development of the turtle and tarantula wildlife industries in Maningrida. As a result there is a high level of Indigenous engagement and ownership for the BAC Wildlife Enterprise.

Nevertheless, the extent of Indigenous community participation and the participation of the Wildlife Rangers themselves was limited by the skill levels required and time constraints. There are opportunities for greater participation, especially for the Djelk Rangers in data analysis, interpretation and adaptive management strategies. Capacity building associated with monitoring, evaluation and the development of future directions for the enterprise would appear to be of particular importance for an increased collaborative effort. At this stage, the responsibilities of outstation communities are more limited, although this need not necessarily be the case. Rather, it has arisen out of the necessity for tight scientific and regulatory controls over these wildlife enterprises during their development phases, not only to maintain scientific rigour but also to ensure a high level of accountability, especially in regard to numbers harvested.

SUCCESS FACTOR: VALUING BOTH INDIGENOUS KNOWLEDGE AND WESTERN SCIENCE

Whilst in the past land, sea and wildlife management has generally been reliant solely on western science, there is increasing recognition of the important role IEK plays, especially in regard to management practices in remote areas. This is evidenced by the increased reference to IEK in the scientific literature (Brook & McLachlan 2008; Scott 2004) and the priority accorded to the utilisation of IEK in government programs such as Caring for Our Country (Caring for Our Country 2008). Nevertheless, despite its importance, there has been little or no research attempting to quantify the actual importance of Indigenous knowledge to the development of such management practices.

The application of IEK and western science to the development of the BAC turtle and spider industries has been reported in detail (Fordham et al. 2010).

Table 1. The major tasks for a sustainable turtle wildlife enterprise and associated western scientific knowledge and Indigenous ecological knowledge

Major task	Relevant western scientific knowledge	Relevant Indigenous ecological knowledge
Identification and access to traditional lands	Maps of the topography of the region	Cultural practices & beliefs of traditional owners
Collection of individuals from wild	Ecology of savannah billabongs and wetlands etc. Life cycle and physiology of <i>C. rugosa</i> Animal trapping & handling techniques	Species distribution and species abundance Knowledge of <i>C. rugosa</i> biology Harvesting regimes Harvest techniques
Wildlife husbandry	Facility management Measurement and description of captive turtles, including record keeping and trend analysis Incubation techniques Hatchling husbandry	
Maintaining sustainable wildlife populations	Ecological principles of population maintenance Understanding past and future variability within landscapes using historical records and forward projections of regional climates Captive breeding and release programs	Long-term and short-term knowledge of environmental impacts Wildlife refugia Spatial and temporal rotations of harvesting Spatial and temporal understanding of variability within landscape (year to year changes)

Source: Fordham et al. 2010.

In the case of the turtle industry, there was already an extensive scientific literature on the physiology and life cycle of the northern long-necked turtle. IEK was able to determine localised distribution, abundance and seasonal harvesting regimes much more quickly and without heavy reliance upon technical resources as would have been the case if there was sole reliance upon western science.

Western science was more focused upon identifying optimal incubation and animal husbandry conditions, and on undertaking complex modeling to determine the parameters required for sustainability of turtle populations.

The situation with the development of the tarantula spider industry presented different challenges. There was little scientific knowledge available about the tarantula spider, as scientists had only recently discovered its existence in the region. From an Indigenous perspective, people out on country had very little interaction with tarantula spider as it was not used for customary purposes, perhaps due to the spider's painful bite.

As a result, there was a much greater need for the scientists and Indigenous people to work together to establish baseline information about the local tarantula spider such as abundance and distribution, habitat, life cycle information and seasonal adaptations. Once this baseline information was established, attention could turn to determining optimal incubation and animal husbandry conditions, and population monitoring for studying sustainability.

The success of the BAC Wildlife Enterprise has been very much dependent on recognising the legitimacy of each knowledge system, and valuing the relative contributions each can make to enterprise development (see Table 1). As a result, there has been:

- knowledge and skills flowing between scientists, Djelk Rangers, traditional owners and other outstation residents, and
- strengthening of the collaborative approach underpinning the enterprise, leading to the development of a solid knowledge-base upon which to build the wildlife enterprise.

Combining IEK with western scientific knowledge has led, firstly, to development of less resource-heavy and time-consuming wildlife management practices for the enterprise and, secondly, to much stronger links between the BAC Wildlife Centre, scientists and the Indigenous community.

To give an indication of the tasks and skills required for those Djelk Rangers involved in the BAC Wildlife Enterprise, as well as demonstrating the complementarity of IEK and western science, we have summarised the tasks associated with the turtle industry in Table 1.

The success of the BAC Wildlife Centre enterprise has been dependent on recognising the legitimacy of each knowledge system, the relative contributions each can make and the extent to which the two knowledge systems complement each other in enterprise development. The next step, from a research perspective, will be to develop a methodology, based upon Bayesian analysis, which will enable the quantification of the relative contributions of western science and IEK to biodiversity assessment.

The two-way transmission of knowledge between scientists, Djelk Rangers, traditional owners and outstation residents has been a further factor in the success of the enterprise. Not only has it strengthened collaboration, this two-way transmission of IEK and western science challenged existing knowledge systems, resulting in both adapting to new information. By accepting the legitimacy of Indigenous knowledge, scientists examined the extent to which particular pieces of Indigenous knowledge could add value to the scientific knowledge required for the task. On occasion, the Indigenous knowledge not only complemented existing scientific knowledge but challenged its validity. Similarly, Djelk Wildlife Rangers assimilated western scientific concepts to their own understanding of the environment, which necessitated a review of existing Indigenous knowledge.

Knowledge exchange: an essential feature of collaboration

The interdependence of these first two success factors critical to the viability of the BAC Wildlife Enterprise is evident in both the major tasks and responsibilities associated with the turtle and spider industries and the flow of knowledge between scientists, traditional owners, outstation residents and Wildlife Rangers. Without a collaborative approach to the research and development required for establishing the two industries, there could be no opportunity for knowledge and skills transfer and the development of a solid knowledge-base upon which to build the wildlife enterprise. Conversely, without recognition of the legitimacy of both forms of knowledge it would be highly unlikely that the collaborative approach to undertaking the required research and development would be effective.

SUCCESS FACTOR: EDUCATION AND TRAINING TO SUPPORT THE WILDLIFE ENTERPRISE

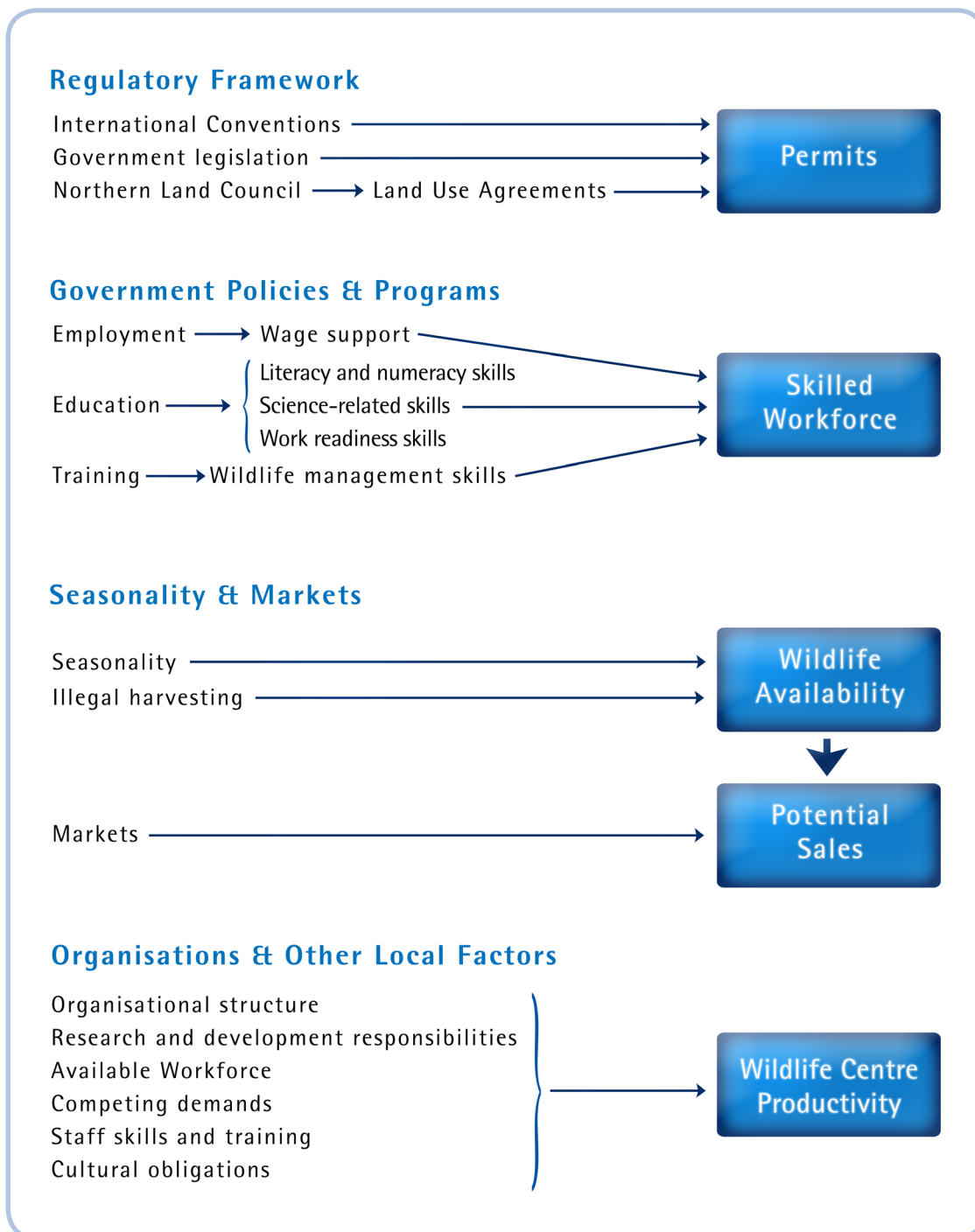
Training provision and the development of a well-skilled workforce have been identified as key impediments to the commercial viability of wildlife enterprises in Northern Australia (Gorman et al. 2008). Not only is a skilled workforce necessary to establish a commercially viable enterprise but an ongoing programme of staff training is required for its long-term viability. The success of the enterprise is also dependent upon a clearly articulated employment pathway between the local educational institution and the enterprise to ensure continuing availability of staff with the necessary foundation skills. Both the Ministerial Council for Education, Employment, Training and Youth Affairs (2004) and the Northern Territory Department of Education and Training (2006) recognised the importance of developing effective pathways to on-going meaningful employment in remote Australia and the special role vocational education can play in this regard. The need for innovative education and training strategies was highlighted—to be effective these strategies needed to be culturally appropriate, be focused upon the capabilities and potential of Indigenous students, lead to high expectations and outcomes, and be based on curricula relevant to the students.

Formal training of Rangers and the education of Indigenous secondary school students in land, sea and wildlife management skills and knowledge has been critical to the success of the BAC Wildlife Enterprise. Ranger training during the late 1990s and up until about 2005 ensured a skilled workforce was available during the developmental stages of the crocodile and turtle industries. This has been followed during 2005–2009 by the education of senior secondary students at MCEC in science-related knowledge and skills. In this way, an employment pathway has been created from school to potential employment with the Djelk Rangers, and the BAC Wildlife Centre.

Both Certificate level training delivered up until 2005 by Charles Darwin University and the senior science courses offered by MCEC since 2005 had several important features which made those courses an effective means of developing a skilled workforce for the Wildlife Enterprise. These courses:

- directly related to the actual work being performed by the Djelk Rangers. The courses of study addressed knowledge and skills underpinning land, sea and wildlife management and learning outcomes were achieved which were immediately transferable into the work situation.
- comprised topics of study which were 'real' issues of significance to the Aboriginal people of the Maningrida region and which were consistent with the overall strategic directions and business planning of BAC. As a result there was a high level of community engagement in the courses.
- utilised 'teaching' resources beyond those of the training and education provider. These included traditional owners on country, Djelk Rangers and external agencies such as the Queensland Museum and Crocodylus Park.

Fig. 1. Factors influencing BAC Wildlife Centre productivity



- had much of the 'teaching' occurring on country and at outstations and involved a two-transmission of knowledge, including both Indigenous knowledge and western science. Not only were the knowledge and skills of 'students' increased but so too were those of the 'teachers' and others such as outstation residents and external agency participants. This added to the level of community engagement and general community interest in the courses being delivered.

A detailed account of the courses is contained in Fordham et al. (2010).

As noted above, training of Djelk Rangers since the late 1990s was critical during the developmental stages of the crocodile and freshwater turtle industries and the recent employment of several secondary school science graduates has ensured the ongoing operation of the Wildlife Centre. However, the research identified several areas of training need which require urgent attention if the initial gains are to be maintained:

- leadership and work practices
- programme monitoring, financial management, budgeting and accountability
- website development and marketing
- Geographic Information System (GIS) and cybertracking (<http://www.cybertracker.co.za/>), the application of more technical approaches to wildlife management and computational skills; and,
- if the range of species is extended, then the development of wildlife skills associated with new species.

Additionally, there is a quite different training and development opportunity—to assist the Wildlife Rangers develop their own perspectives on wildlife sustainability and related wildlife management issues, combining their existing IEK with western science.

Finally, there are significant training implications that flow from direct participation of outstation communities in the harvesting and animal husbandry of wildlife. Young people from outstations wanting to come into the Wildlife Centre and work alongside the Rangers have tended to have very low literacy levels and required intensive bridging training, prior to further training in animal handling.

EXTERNAL AND ORGANISATIONAL INFLUENCES UPON THE VIABILITY OF THE WILDLIFE ENTERPRISES

The long-term viability of wildlife enterprises in remote areas is also dependent upon external forces beyond the direct control of the enterprise—such as regulatory frameworks, government employment policies and seasonality— and organisational factors that relate more directly to the enterprise. Organisational factors might include management arrangements, staffing and succession planning, training, business planning and marketing strategies.

The extent to which these factors influence the long-term viability of the turtle industry is examined below, as well as their likely impact upon the fledgling spider industry established in 2009. This is particularly important in terms of the turtle industry, which initially showed much promise as a commercially viable enterprise; however productivity quickly peaked well below market expectations.

Information on these external influences and organisational influences upon the viability of the BAC Wildlife Enterprise was gathered during interviews with the Wildlife Centre Manager and staff of the Centre and are summarised in Fig. 1

EXTERNAL REGULATORY FRAMEWORKS

Regulatory frameworks for the development of wildlife enterprises in remote Indigenous communities deal with wildlife conservation issues, access to country and the protection of IEK through intellectual property rights. They may operate at international, national or State/Territory levels and include non-government agencies such as the NLC, as well as government agencies.

Regulatory frameworks have directly limited recent harvesting activities by the BAC Wildlife Centre. For example, considerable delays were incurred in finalising harvesting quotas for turtle eggs for 2009 and beyond due to lengthy LUA consultations between the NLC and traditional owners on whose country harvesting was to occur. Approval from P&WS, being dependent on finalisation of these consultations, was consequently delayed.

A 2009 permit for the turtle industry was finally granted in October 2009. This was despite NLC consultations with traditional owners on the development of a suitable LUA commencing in May 2008, and close consultations between traditional owners and Djelk Rangers on land access issues having occurred annually since 2000. Such a lengthy delay made it difficult for the Wildlife Centre to achieve its 2009 sales target of 650 turtle hatchlings.

Similar delays occurred in regard to crocodile egg harvesting, preventing egg collections in 2007–08—and therefore no crocodile hatchling sales for this period. Once the NLC consultations were completed, the 2009 quota for crocodile egg harvesting was heavily reduced from 2,000 eggs in 2005 to 700 eggs in 2009. This was due to permits being granted to other organisations not located in Maningrida. The areas where Djelk Rangers could harvest the eggs were also heavily reduced.

Apart from the issue of NLC consultations, the significant resource implications for the Wildlife Centre in seeking permits for enterprise activities is best seen in the number of separate permits required by the P&WS. Separate permits are required for:

- the collection, housing, handling, breeding and commercial trade of native wildlife species
- the trade of wildlife species to interstate buyers
- the keeping of a wildlife species on site such as a wildlife centre, and
- undertaking scientific research on the wildlife species.

Finally, permits must be sought from P&WS each year; LUAs that apply to the BAC Wildlife Enterprise are of either two or five years duration; and annual reporting to P&WS is required.

Gaining approval for collecting tarantula spider venom for sale to pharmaceutical companies for bioprospecting purposes has been much more difficult, requiring extensive consultations between the Wildlife Centre and both the NLC on behalf of traditional owners and the Northern Territory Government. For the Wildlife Centre this has been very much 'uncharted territory', requiring specialist knowledge and considerable staff resources. Initial consultations commenced during 2009 and are likely to continue well into 2010 in order to develop a draft Benefit Sharing Agreement, which could serve as the basis for negotiation with interested pharmaceutical companies. Unless the Wildlife Centre is able to negotiate a significant fee for venom collection and associated animal husbandry, a revenue stream remains unlikely, due to the low probability of venom providing pharmaceutical benefits in the short term. Furthermore, should there be a pharmaceutical benefit from tarantula venom, royalties will mainly flow to traditional owners. For this reason, bioprospecting cannot be considered by the Wildlife Centre as a likely source of income from a business planning perspective.

A related issue that is not taken into account in the regulatory framework is that of intellectual property associated with the use of IEK to assist in collecting turtle and spider specimens (and eggs) for domestic sales. Such knowledge and associated research may have significant commercial value in the future to other parties should they seek to establish similar, competitive industries in other locations. The same issue applies to western science developed during the course of enterprise development. To date, such knowledge derived from the BAC Wildlife Enterprise has remained highly accessible. However there is a business case for such knowledge being treated as 'commercial in confidence'. With regard to western scientific

knowledge, the scientific partners in the enterprise may consider this possibility as highly restrictive and unwarranted as it could limit access to research results by the research community.

In summary, the regulatory framework in which the Wildlife Centre operates has proven time-consuming and onerous, requiring substantial staff resources and a level of specialist expertise that may go beyond the capacity of existing staff. This has been heightened by the need to meet regulatory requirements of both government and the NLC, in an environment of often competing priorities such as mining applications. Finally, there is a lack of robust legislation to clearly address issues of intellectual property (O'Bryan 2004).

Most importantly, the regulatory framework has resulted in lengthy delays in the granting of permits and, in the case of crocodiles, the reduction of quotas. As such, it has had a direct impact on productivity.

GOVERNMENT POLICIES AND PROGRAMMES

The establishment of the BAC wildlife industries and on-going operation of the Wildlife Centre has been reliant upon government funding for services being delivered. Such funding in the past has been under the Community Development Employment Projects programme and the Natural Heritage Trust, both administered by the Commonwealth Government. Current funding is reliant upon the Caring for Our Country and Working on Country programmes. The enterprise has also benefited from research funding from the Australian Research Council. As a result the BAC Wildlife Enterprise—as with much Indigenous land, sea and wildlife management activity—is particularly susceptible to shifts in government policy and funding priorities.

Training and education programmes of the sort delivered to Djelk Rangers and MCEC senior secondary students — critical to maintaining a skilled workforce—are also susceptible to changes in government policy.

There is no government policy or programme with the sole purpose of supporting Indigenous wildlife enterprise development, and this area hardly rates a mention in current government programmes (see also Cooney & Edwards 2009). In practice, this means that the existing activities of the BAC Wildlife Centre are reliant on funding for other purposes, and so priority must be given to meeting the requirements of those funding agencies rather than the core business of the enterprise.

One may ask whether it is possible for wildlife enterprises to comprise a totally self-funding employment stream in remote communities, without dependence on significant levels of government funding. While there appears to be an expectation that the Wildlife Centre would become economically viable and staff positions would be fully funded through commercial sales (BAC 2007), progress to date suggests that this is unlikely in the near future.

SEASONALITY AND MARKET VARIABILITY

Wildlife enterprises reliant upon gathering eggs, egg-bearing adults or juveniles from the wild are susceptible to unexpected seasonal variations. For example, low rainfalls occurring during 'wet seasons' and lengthy dry seasons will impact on ephemeral billabongs, resulting in low turtle egg harvesting rates. Higher than usual flooding of river systems may result in drowning of large populations of tarantula spiders and spiderlings dwelling on the floodplains. To date, such seasonal fluctuations have had only minor impact on productivity.

Wildlife enterprises are also reliant upon available markets. There is strong demand for long-necked turtles as evidenced by the inability of the Wildlife Centre to meet the demand in the pet trade in Darwin. Websites support the strong demand for turtles and other reptiles, as does the BAC business plan (BAC 2007). There is a similarly strong market for adult tarantula spiders and spiderlings in Australia (Raven

pers. comm.). Despite the high level of market demand, marketing wildlife is not a straightforward process and enterprises such as the BAC Wildlife Centre require significant business and marketing support to maximise their commercial viability, particularly as a relatively new 'player' in a highly competitive market. This includes a need for training in business and marketing skills relevant to the commercialisation of wildlife, a need which was identified during this research.

ILLEGAL HARVESTING OF WILDLIFE

Illegal harvesting of wildlife in areas where the Wildlife Centre has permits to harvest individuals or eggs directly reduces the capacity of the Centre to meet its business targets. This is particularly the case where permits place tight limits on the numbers of individuals or eggs to be collected and the areas from which those collections can be made are heavily restricted. It is claimed that poaching of crocodile eggs by non-Indigenous 'trespassers' has placed considerable pressure on the Wildlife Centre to meet its 2009 targets (BAC 2009).

Illegal harvesting may threaten the continued existence of local populations of species. In the current study, the unique characteristics of the tarantula spider found in the Maningrida region (such as its adaptation to living under water for a period), make it commercially very attractive. Yet due to the very restricted range of the tarantula spider in the region and its high abundance concentrated within that range, gathering specimens is not difficult and illegal harvesting can quickly threaten the tarantula spider populations. The principal scientist responsible for developing the tarantula spider industry believed that, should the sites where these spiders were discovered be publicly identified, then illegal harvesting would quickly follow and result in a rapid decline of population numbers. For this reason the precise location of tarantula populations in the Maningrida region have not been identified in this paper.

In addition, wildlife enterprises using species that can be bred easily in captivity are especially sensitive to illegal harvesting. Illegal capture of a few specimens may place the commercial viability of the enterprise in jeopardy due to additional market pressures.

ORGANISATIONAL AND OTHER FACTORS

Governance and management

Indigenous community organisations, such as BAC, have a wide range of responsibilities. The development of wildlife enterprises, whilst seen as important, may not receive the level of attention required to establish a valuable and viable industry.

This research suggests it is of critical importance when establishing a wildlife enterprise to review existing governance arrangements and develop suitable structures and processes to meet the business needs of the specific enterprise. For example, a management board comprising collaborative partners, capable of negotiating solutions and future directions with the responsible peak Indigenous organisation, in this case BAC, would appear an essential feature of the governance arrangements for the wildlife enterprise. A management board could build on the collaborative nature of the enterprise, help in developing realistic business planning, and assist in generating business partnerships.

Effective management arrangements at the operational level are of particular importance when ongoing research and development is required for continued enterprise development (see below). Such arrangements need to ensure scientists, on-ground managers and Wildlife Rangers jointly define the scope of the issue, monitor progress made, modify wildlife management practices, and evaluate effectiveness. Without clearly defined responsibilities and an effective management structure, there may be a blurring of responsibilities with scientists playing a dominant role, due to their level of specialist knowledge, and possibly out of necessity to ensure progress is made.

The organisational structure

The BAC Wildlife Centre is organisationally separate from the land and sea management functions of the Djelk Rangers, and the Wildlife Centre Manager is directly responsible to the BAC Chief Executive Officer. This 'flat' organisational structure has advantages in that it places major management responsibility with the Wildlife Centre. However the absence of a strong organisational link between the three Djelk Ranger functions has presented several difficulties for the Wildlife Centre achieving business efficiency:

- the capacity to draw upon other Land or Sea Rangers to meet Wildlife Centre staff absences during critical periods of business activity is limited by lack of a business plan for all Djelk Ranger activities.
- Wildlife Centre staff funded through Working on Country are required to undertake land management activities (e.g. buffalo culling and weed control) as well as Wildlife Centre activities. This creates tension regarding Wildlife Ranger responsibilities and may disrupt planned enterprise activities. This is especially the case with more routine, mundane tasks such as animal husbandry. When there is an opportunity for Wildlife Rangers to be involved in more interesting land and sea management activities, critical Wildlife Enterprise activities may be left unfinished.
- opportunities for staff training and career development have been restricted due to the small number of Wildlife Rangers. Training has been dependent upon 'informal' arrangements with the larger group of Land and Sea Rangers, rather than there being a more coordinated approach to Djelk Ranger training.

There may be value in reviewing how best the related Djelk Ranger functions of land and sea management and the operation of the BAC Wildlife Enterprise can best be managed so that expected business outcomes of each can be achieved.

Research and development responsibilities

The establishment of wildlife enterprises is not only reliant upon a solid and extensive body of scientific knowledge, but requires ongoing research and development, well after the first sales are made. For example in 2009–10, the maintenance and indeed growth of the turtle industry necessitates further scientific research on issues such as strategies to control the high level of pig predation at billabongs which locally threatens turtle population viability, and the impact of changing weather patterns upon ephemeral billabongs used for turtle harvesting.

Balancing operational and on-going research and development responsibilities places considerable strain on the limited resources available to manage the Wildlife Centre and meet commercial targets to achieve viability. This would appear to be one area where the complexity of sustainable wildlife management has not been appreciated by government or by governing organisations. Even where research and development funds have been made available, the extent to which such activities can be seamlessly integrated into mainstream enterprise activity cannot be assumed. In remote Indigenous communities skilled staff may not be available to be employed to meet such additional demands.

Existing staff skills, training requirements and workplace development

Productivity is dependent upon a well-trained and motivated workforce. The research reported here identified a set of training needs to build on existing skills and, if addressed, would provide staff with opportunities to be responsible for more complex tasks and accept more management roles. Staff would continue to be challenged in the workplace, remain motivated and more likely to stay in the job. This is particularly important in remote Indigenous communities where the number of literate, skilled workers is

small and there is constant pressure for them to consider other employment options. The high profile of the recently proclaimed Indigenous Protection Area for the Maningrida region is likely to produce a strong competing demand for the limited supply of skilled staff.

As a consequence it would seem imperative that the Wildlife Centre develops a training and development plan to underpin the existing wildlife industries. This includes a better articulation of the roles and responsibilities of staff, including potential outstation workers, and issues of succession planning to address the problem which arises when staff members leave and the enterprise becomes commercially vulnerable. Importantly, such a training and development plan will need to continue to challenge staff in new areas of responsibility.

Consideration could be given to recognising MCEC and potential training providers such as Charles Darwin University as essential partners to the on-going operation of the Wildlife Enterprise, providing a skilled work force and ensuring long-term viability. Current ad hoc arrangements do not lend themselves to creating enduring employment pathways and skill development. Such strong partnership arrangements may also alleviate the difficulties faced by remote Indigenous communities in accessing training providers, who are more likely to deliver services when there is a longer-term commitment from the community for training—in this case from BAC, the Wildlife Centre and associated Djelk Rangers.

Work practices, family commitments and cultural obligations

Wildlife industries may often require extensive periods in the bush when harvesting specimens or gathering eggs for incubation, in order to maximise economic viability. They also require a strict maintenance regime during incubation and animal husbandry to maximise the number of hatchlings available for domestic sale.

The research found that despite the high level of work required 'on country' it cannot be assumed that Indigenous young people are well trained in bushcraft and actually interested in spending a lengthy time out in the field. This is especially the case where they may have no family connection to country on which they are harvesting. Ceremonial obligations and family commitments also frequently compete with work responsibilities.

There may be other cultural influences that have limited the extent to which the wildlife enterprise has developed. As Davies et al. (1999) noted, existing Indigenous harvesting practices for customary or subsistence purposes may not lead to an interest by Indigenous communities in commercial harvesting. Indigenous people may not assess the tangible benefits of wildlife enterprise activities in the same way as a non-Indigenous person, who is more likely to focus upon the economic benefits as a prime motivator. For these Indigenous people the wildlife enterprise as an income-generating activity is but one aspect of the hybrid economy in which they operate.

CONCLUDING COMMENTS: THE COMMERCIAL VIABILITY OF WILDLIFE ENTERPRISES

The primary purpose of our research has not been to determine commercial viability but rather to understand better the knowledge foundations underpinning the development of sustainable wildlife enterprises (see Fordham et al. 2010). However the study provided valuable insights into the potential of such enterprises to be commercially viable and independent of government funding.

The successful development of the saltwater crocodile and the northern long-necked turtle industries has been largely due to three underlying factors:

- a high degree of collaboration across industry partners
- recognition of the potential contributions to wildlife enterprises that can be made by both IEK and western science, and
- the development of innovative training and science education courses that deal with 'real' issues, are job related and draw upon the knowledge and skills of teachers, specialists and the Indigenous community.

However growth in the turtle and crocodile industries during the 1999–2009 period has been limited and this appears due to supply rather than demand factors. In the case of the turtle industry these have mainly been staff-related, such as the capacity of staff to meet work demands due to staff availability, skill levels and a recent lack of training opportunity, work readiness and competing demands. In relation to the crocodile industry, the regulatory framework has had a dramatic impact on the commercial viability of the enterprise.

The type of species itself has impacted upon the level of staff resources required. For example, harvesting of crocodile eggs can be achieved rather quickly compared to harvesting long-necked turtle eggs, incubation periods are less (because eggs are often partly incubated in the wild and do not require a period of inundation) and sales of hatchlings occur soon after hatching, thereby reducing animal husbandry requirements. Also crocodile clutch sizes are much larger than those for turtles, although this is partly offset by the relatively lower hatching rate of crocodile eggs compared to turtle eggs.

For the turtle industry, the pressure for ongoing research and development has strained existing staff resources and placed heavy time constraints on the capacity to meet more routine tasks such as egg harvesting and animal husbandry. It has also limited the extent to which additional markets could be identified and accessed. This has been exacerbated by the recent expansion of the Wildlife Enterprise to include the fledgling tarantula spider industry and additional reptile species, both of which require substantial research and development prior to income being generated. In contrast, research and development responsibility for the crocodile industry is held by the industry partner, which is also the sole purchaser of hatchlings.

The very nature of wildlife industries in remote locations means that the 'set-up' time is considerable, both in terms of infrastructure but more importantly in terms of the time required to develop suitable animal handling regimes such as egg incubation and husbandry. Different locations present different challenges. A typical three-year set-up time to reach operational capacity for a particular industry adds considerably to set-up costs that must be covered, a point that is generally not appreciated.

Recruiting skilled staff for the BAC Wildlife Enterprise will continue to place a significant constraint on commercial viability and one that must be addressed. As noted above, the competing labour demand for land and sea management activities will shortly be augmented by a greater range of activities associated with the newly proclaimed and high profile Indigenous Protected Area for the Maningrida region.

Commercial viability is not only influenced by improved business management practices, staff expertise and availability, quotas and market availability—it is also influenced by the level of royalties paid to land owners. Market competition determines the price received for crocodile and turtle hatchlings and spiderlings, and the consequent level of income received from sales. Where royalties paid to traditional owners are high (e.g. the crocodile industry) insufficient income may flow through to the enterprise to support its operations.

It is clear that the viability of wildlife enterprises is dependent upon the effective contribution of multiple factors, and that the failure of any one of these could result in significantly reduced productivity.

Whether wildlife enterprises such as the BAC Wildlife Enterprise have the potential to become commercially viable is still an open question and may require an economic value being placed upon related wildlife and land management benefits.

The conclusion reached in a recent study of Indigenous commercial use of wildlife in northern Australia sums up the current situation:

Enterprise development in indigenous communities may not be profitable or successful by Western standards of business efficiency, yet may meet community expectations and needs through non-economic benefits that are hard to evaluate in dollar terms (Gorman et al. 2008: 248).

Although the value of monitoring and evaluation of wildlife enterprises cannot be underestimated, there is little evidence that this is a regular activity across wildlife enterprises. If one is to argue that the effectiveness of wildlife enterprises in remote Indigenous communities goes beyond economic outcomes, then evaluation becomes all the more important. Otherwise the success of wildlife enterprises will be judged solely in terms of simple economic indicators of commercial viability. It is therefore critical that priority be attached to the development of strong evaluation methodologies so that a thorough cost-benefit analysis can be undertaken, and one which includes a broad range of social, cultural and environmental indicators as well as economic indicators.

Whilst we recognise that there are external factors, such as regulatory frameworks and government policy, which significantly affect viability, there are several key lessons for the viability of wildlife enterprises that can be learnt from this case study and which are the responsibility of those seeking to establish the enterprise. Firstly, the establishment of a collaborative management structure needs to occur at an early stage in the development of the enterprise and its relationship to the local governing Indigenous organisation defined. Secondly, a strong business focus with realistic, medium-term business planning appears essential, one that balances short-term outcomes to generate immediate income with continuing research and development requirements to ensure longer-term viability. Thirdly, the enterprise must maintain a focus on its core business to ensure a flow of revenue rather than expanding too rapidly—remote locations heighten the fragility of wildlife enterprises, whether in terms of maintaining harvesting levels and animal husbandry practices or in ensuring delivery of products to markets. Finally, such requirements must be matched by the implementation of staff training and organisational development to increase local capacity.

In summary, there is clearly potential for the BAC Wildlife Enterprise to increase its productivity and to maintain its important role in the Maningrida community. Whether it can do so on a full cost-recovery basis without reliance on government funding is less certain, a conclusion that could apply to many existing wildlife enterprises operating in remote Indigenous communities of Australia.

REFERENCES

- Australian Bureau of Statistics (ABS) 2007. 'Usual place of residence', 2006 Census, ABS, Canberra.
- Altman, J.C. and Cochrane, M. 2003. 'Innovative institutional design for sustainable wildlife management in the Indigenous-owned savanna', *CAEPR Discussion Paper No. 247*, CAEPR, ANU, Canberra, available at <<http://www.anu.edu.au/caepr/discussion.php>>.
- Bawinanga Aboriginal Corporation (BAC) 2007. Djelk Wildlife Enterprises Business Plan 2007-2008/09, BAC, Maningrida.
- 2008. Djelk Wildlife Enterprises: Application for a Permit to Take or Interfere with Wildlife 2008-2009, BAC, Maningrida.
- 2009. Bawinanga Aboriginal Corporation Annual Report 2008-2009, BAC, Maningrida.
- Baker, R., Davies, J. and Young, E. (eds) 2001. *Working on Country: Contemporary Indigenous Land Management of Australia's Lands and Coastal Regions*, Oxford University Press, Melbourne.
- Birckhead, J., Klomp, N., and Roberts, A., 1996. 'Protocols for the participation of Aboriginal communities in research and monitoring' in *Sustainable use of wildlife by Aboriginal peoples and Torres Strait Islanders*, Bureau of Resource Sciences, AGPS, Canberra.
- Brook, B.W., Sodhi, N.S. and Bradshaw, C.J.A. 2008. 'Synergies among extinction drivers under global change', *Trends in Ecology & Evolution*, 23 (8): 453–60.
- Brook, R.K. and McLachlan, S.M 2008. 'Trends and prospects for local knowledge in ecological and conservation research and monitoring', *Biodiversity Conservation*, 17: 3501–12.
- Caring for our Country 2008. *Caring for Our Country Outcomes 2008-2013*, Commonwealth of Australia, viewed 15 December 2009, <<http://www.nrm.gov.au/publications/books/pubs/caring-outcomes.pdf>>.
- Carter, J., 2008 'Thinking outside the framework: equitable research partnerships for environmental research in Australia', *The Geographical Journal*, 174 (1): 63–75.
- Choquenot, D., 1996. 'The ecological basis of wildlife harvesting', in M. Bomford and J. Caughley (eds), *Sustainable use of wildlife by Aboriginal peoples and Torres Strait Islanders*, AGPS, Canberra.
- Cochrane, M.J., 2005. 'The Djelk Ranger Program: An outsider's perspective', *CAEPR Working Paper No. 27*, CAEPR, ANU, Canberra, available at <<http://www.anu.edu.au/caepr/working.php>>.
- Congdon, J.D., Dunham, A.E. and van Loben Sels, R.C., 1993. 'Delayed sexual maturity and demographics of blanding's turtles (*Emydoidea blandingii*): Implications for conservation and management of long-lived organisms.' *Conservation Biology*, 7 (4): 826–33.
- Cooney, R. and Edwards, E. 2009. 'Indigenous wildlife enterprise development: The regulation and policy context and challenges', Report to North Australian Indigenous Land and Sea Management Alliance (NAILSMA) , Darwin.
- Dale, A. 1996. 'Community-based planning in establishing wildlife projects', in M. Bomford and J. Caughley (eds), *Sustainable use of wildlife by Aboriginal peoples and Torres Strait Islanders*, AGPS, Canberra.

- Davies, J., Higginbottom, K., Noack, D., Ross, H. and Young, E., 1999 'Sustaining Eden Indigenous community wildlife management in Australia', Evaluating Eden Series No. 1 International Institute for Environment and Development, London.
- Fogarty, W. and Paterson, M. 2007 'Constructive engagement: Impacts, limitations and possibilities during a national emergency intervention', Report to Bawinanga Aboriginal Corporation, Maningrida.
- Fordham, A., Fogarty, W., Corey, B. and Fordham, D. 2010. 'Knowledge foundations for the development of sustainable wildlife enterprises in remote Indigenous communities of Australia', *CAEPR Working Paper No. 62*, CAEPR, ANU, Canberra, available at <http://www.anu.edu.au/caepr/working.php>.
- Fordham, D.A., Hall, R. and Georges, A. 2004. 'Aboriginal harvest of long-necked turtles in Arnhem Land Australia', *Turtle and Tortoise Newsletter*, 7: 20–21.
- and Brook, B.W. 2009. 'Why tropical island endemics are acutely susceptible to global change', *Biodiversity and Conservation*, viewed 20 December 2009, <http://www.springerlink.com/content/313236602p757107/>.
- , Georges, A. and Brook, B.W. 2007. 'Density dependent responses to indigenous harvesting and predation of snake-necked turtles in tropical northern Australia', *Journal of Animal Ecology*, 76(6): 1231–43.
- , Georges, A. and Brook, B.W. 2008. 'Indigenous harvest, exotic pig predation and local persistence of a long-lived vertebrate: managing a tropical freshwater turtle for sustainability and conservation', *Journal of Applied Ecology*, 45: 52–62.
- , Georges A. and Brook B.W. 2009. 'Experimental evidence for density dependent responses to mortality of snake-necked turtles', *Oecologia*, 159: 271–78.
- Hunt, J., Altman, J.C. and May, K. 2009 'Social benefits of Aboriginal engagement in natural resource management', *CAEPR Working Paper No. 60*, CAEPR, ANU, Canberra, available at <http://www.anu.edu.au/caepr/working.php>.
- Gillespie, D., Cooke, P. and Taylor J. 1998. 'Improving the capacity of Indigenous people to contribute to the conservation of bio-diversity in Australia', A report commissioned by Environment Australia for the Biological Diversity Advisory Council, Biological Diversity Advisory Council, Canberra.
- Gorman, J.T., Griffiths, A.D. and Whitehead, P.J. 2006, 'An analysis of the use of plant products for commerce in remote Aboriginal communities of Northern Australia', *Economic Botany*, 60 (4): 362–73.
- , Whitehead, P.J., Griffiths, A.D. and Petherman, L. 2008. ' Production from marginal lands: Indigenous commercial use of wild animals in northern Australia', *International Journal of Sustainable Development & World Ecology*, 15 (3): 1–11.
- Ministerial Council for Education, Employment, Training and Youth Affairs 2006. *Australian Directions in Education 2005–2008*, Senior Officials Working Party on Indigenous Education, http://www.mceetya.edu.au/verve/_resources/Australian_Directions_in_Indigenous_Education_2005–2008.pdf.

- Nesbitt, B., Baker, L., Copley, P. et al. 2001 'Cooperative cross-cultural biological surveys in resource management: Experiences in the Anangu Pitjantjatjara Lands', in R. Baker, J. Davies and E. Young (eds), *Working on Country: Contemporary Indigenous Land Management of Australia's Lands and Coastal Regions*, Oxford University Press, Melbourne.
- Northern Land Council 2005. 'Garawa Aboriginal Land Trust Caring for Country Project', Consultation Documentation, prepared by Caring For Country Unit, Northern Land Council, Darwin.
- Northern Territory Department of Education and Training 2006. *Indigenous Education Strategic Plan 2006-2009*, Northern Territory Department of Education and Training, <http://www.det.nt.gov.au/education/indigenous_education/strategic_directions/strategic_plan/index.shtml>.
- NQ Dry Tropics 2005 'Burdekin Dry Tropics Natural Resource Management Plan 2005-2010', available at <http://www.bdtmrm.org.au/resources/nrm_plan/>.
- O'Bryan, K. 2004 'The Appropriation of Indigenous Ecological Knowledge: Recent Australian Developments', *Macquarie Journal of International and Comparative Environmental Law*, 1(1).
- Scott, G. 2004. 'A Bibliography of Indigenous Ecological Knowledge in Northern Australia, School of Australian Indigenous Knowledge Systems', Charles Darwin University, <http://www.cdu.edu.au/centres/ik/pdf/IEK_bibliography.pdf>.
- Senate Standing Committee on Rural and Regional Affairs and Transport 1998. *Commercial Utilisation of Australian Native Wildlife*, Commonwealth of Australia, <http://www.aph.gov.au/Senate/committee/rrat_ctte/completed_inquiries/1996-99/wild/report/contents.htm>.
- Sheil, D. and Lawrence, A. 2004 'Tropical biologists, local people and conservation: new opportunities for collaboration', *Trends in Ecology and Evolution*, 19 (12).
- Tisdell, C. and Nanyha, H.S. 2008. 'Public attitudes to the use of wildlife by Aboriginal Australians: Marketing of wildlife and its conservation', *International Journal of Green Economics*, 2 (1): 108-22.
- 2008. 'Indigenous ecological knowledge for land management', <http://savanna.cdu.edu.au/research/projects/kimberley_ecological_knowledge.html>.
- Webb, T. 1996 'Co-management of wildlife resources by Indigenous peoples', in M. Bomford and J. Caughley (eds), *Sustainable use of wildlife by Aboriginal peoples and Torres Strait Islanders*, AGPS, Canberra.