Looking After Country

The NAILSMA I-Tracker story

NAILSMA
NORTH AUSTRALIAN INDIGENOUS LAND AND SEA MANAGEMENT ALLIANCE

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Aboriginal and Torres Strait Islander readers are advised that this publication may contain images of people who have died.

Foreword

Across north Australia, stretching from the towns and communities of the Cape York Peninsula, through the Top End and to the coast of Western Australia, Indigenous people continue to occupy, own and use the vast majority of marine and terrestrial landscapes. Added to this is a rich history of thousands of generations of traditional wisdom, language, knowledge and spiritual connection to practically every square kilometre of the region. This is the reality which makes north Australia very much an Indigenous domain.

Indigenous people have demonstrated extraordinary resilience in maintaining use and occupation of their physical, social and cultural environments. Despite cultural and social strengths, colonisation and associated historical acts over generations have challenged the capacity of Indigenous communities to pursue their traditional and customary obligations. There is, however, growing recognition of the importance of applying traditional Indigenous knowledge, skills and systems to manage traditional estates. This recognition must be reinforced in both public and private sectors, so that the preservation of Indigenous estates becomes pivotal in the management of the 'national estate', for all Australians.

As shown throughout the stories in this volume, NAILSMA's I-Tracker program is unique for its ability to bring together the use of western science and technology with traditional knowledge systems, to develop appropriate modern methodologies that can respond to contemporary challenges and opportunities, and build greater resilience in our natural and built environments for future generations.

North Australia—its people, cultural traditions, landscape, and biodiversity—is of global significance. There are few landscapes on earth where traditional Indigenous societies and their physical environments have survived relatively intact. However, regardless of the circumstances that Indigenous people find themselves in within their particular regions or nation-states, there is a universal connection. Through the sharing of our stories we can both celebrate our survival and achievements as well as benefit from the lessons learned by the accomplishments of others. By working together, we can build on our contributions to a resilient and prosperous future that benefits the entire community.

This publication is a testament to the unique collaboration between the Traditional Owners who have provided their knowledge and support for this publication, and the committed and dedicated individuals who through their service with NAILSMA have made this book possible, both in terms of their research and editorial contribution. NAILSMA would like to particularly acknowledge Joe Morrison, Rod Kennett, Micha Jackson, Erica McCreedy, Vanessa deKoninck, Christy Davies, Billee McGinley and Leonie Molloy.

Peter Yu
NAILSMA Chair

Indigenous land and sea rangers

Approximate locations of the head offices of the ranger groups who are featured in this book

Indigenous land and sea rangers are collectively responsible for over 25 million hectares of land and sea country across north Australia. The collective experience of these rangers, and the numerous partnerships and exchanges facilitated by their involvement in the I-Tracker network, are central to the ongoing success of NAILSMA's I-Tracker program.

Rangers across north Australia collaborate with the I-Tracker program as a key component of their resource management planning and activities on a wide range of environmental issues. Through the program, rangers receive access to tools, training and support that have been developed in close partnership with Indigenous rangers, scientists and natural resource management experts. This ensures scientifically robust processes and protocols meet the specific needs of people doing on-ground work on their country.

In preparing this book, an invitation was extended to all of the ranger groups who work with the I-Tracker program to submit stories that showcase their land and sea management activities. This section profiles those ranger groups who contributed content to the book.

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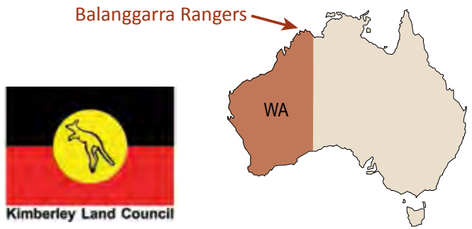
Apudthama Rangers

The Apudthama Land Trust Land and Sea Rangers look after land and sea business in the far north of Cape York, in an area known as the Northern Peninsula Area. They represent the Traditional Owners of Gudang, Yadaigana, Anggkamurthi and Atambaya, and manage expansive coastal areas and sea country that extends to the outer limits of the Great Barrier Reef.

Balanggarra Rangers

The Balanggarra Rangers, based out of Wyndham, look after the country within their Native Title Claim in the East Kimberley region. Five big rivers of the North Kimberley (the King, Forest, Durack, Pentecost and Ord Rivers) run within their coastal and inland claim area. They manage country that is listed for National Heritage values, as well as a declared Indigenous Protected Area. The full-time rangers conduct patrols of their country by boat, helicopter and car. The Balanggarra Rangers are part of the Kimberley Land Council's Kimberley Ranger Network.

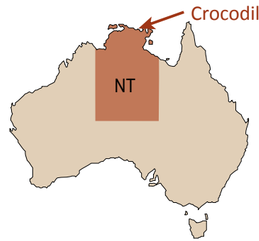


Bardi Jawi Rangers

The Bardi Jawi Rangers, established in 2006, are based at Ardyaloon (One Arm Point), on the Dampier Peninsula in the West Kimberley region. The rangers manage approximately 1100 km^2 of land and over 2000 km^2 of sea country, including the northern tip of the Dampier Peninsula, the islands of the Sunday Archipelago, and over 200 km of coastline. The Bardi Jawi Indigenous Protected Area was declared in 2013, and will guide the management of Bardi Jawi country for years to come. The Bardi Jawi Rangers are part of the Kimberley Land Council's Kimberley Ranger Network.

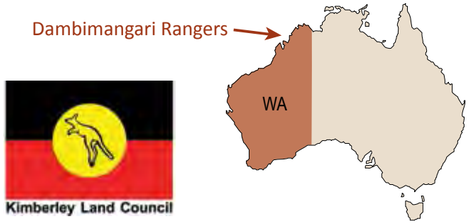
Crocodile Islands Rangers

The Crocodile Islands Rangers were established in 2010 by the Yan-nhangu Traditional Owners of the remote Crocodile Islands area in north-east Arnhem Land, through support from Traditional Owner Laurie Baymarrwangga. The rangers, based on Milingimbi Island, comprise nine Indigenous rangers and numerous volunteers who are responsible for protecting their land and sea country, including nearly 10,000 km^2 of sea country and 250 km^2 of registered sacred sites. All ranger activities are directed and approved by an Executive Committee of local Traditional Owners.



Dambimangari Rangers

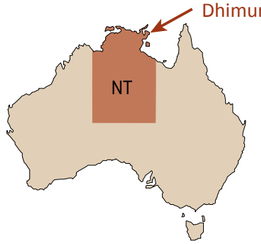
The Dambimangari Rangers are based in Derby, in the West Kimberley, with satellite ranger bases being developed at Cone Bay and Freshwater Cove. Funded through the Dambimangari Aboriginal Corporation and part of the Kimberley Ranger Network, the Dambimangari Rangers manage the natural and cultural values of Dambimangari country. The significant values of the Dambimangari traditional lands have been recognised through the West Kimberley National Heritage Listing as well as a declared Indigenous Protected Area.



Kimberley Land Council

Dhimurru Aboriginal Corporation

Dhimurru is an incorporated Aboriginal organisation established in 1992 by Yolngu landowners in north-east Arnhem Land. Based in Nhulunbuy (Gove), the Dhimurru Rangers manage an Indigenous Protected Area (IPA) that includes 5500 km² of land and sea country containing twenty Designated Recreation Areas and 300 km of coastline. Dhimurru's sea country IPA extends up to 40 km out from the coastline and includes 4500 km² of marine estates. Dhimurru manages this country on behalf of 17 Yolngu clans.

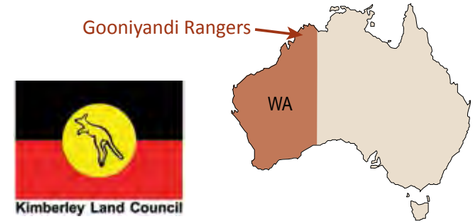


Djelk Rangers

Established in 1991, the Djelk Rangers of Maningrida in Arnhem Land represent over 102 clans and 12 language groups. The Djelk Indigenous Protected Area (IPA) was created in 2009 to manage and monitor country on behalf of the Traditional Owners. The Djelk Rangers are also working to declare a Marine Protected Area. Managing over 14,000 km² of land and sea, the Djelk Rangers have 30 male and female land and sea rangers on salaried employment.

Gooniyandi Rangers

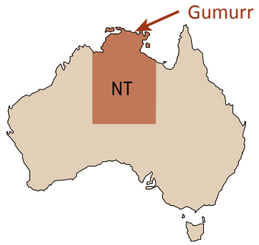
The Gooniyandi Rangers are based out of Fitzroy Crossing, and look after their traditional lands in the Fitzroy Valley. The rangers undertake activities including cultural heritage management, fire management, biodiversity surveys and invasive species management. The Gooniyandi Rangers work closely with the pastoral industry within their Native Title boundaries, and the rangers are increasing their capacity to offer environmental services to other partners and stakeholders in the Fitzroy Valley. The Gooniyandi Rangers are part of the Kimberley Land Council's Kimberley Ranger Network.



Kimberley Land Council

Gumurr Marthakal Rangers

The Gumurr Marthakal Rangers are based at Galiwin'ku (Elcho Island), in north-east Arnhem Land. The rangers were established in 2004, and manage an area of approximately 20,000 km^2 on behalf of 25 Traditional Owner groups. As of 2013, they are in the process of declaring an Indigenous Protected Area and developing a related management plan.



Kalan Land Management

The Kalan Land Management Officers are based in Coen, on the Cape York Peninsula. They look after the Mount Croll Nature Refuge, with management activities covering over 50 km^2 of Aboriginal Land within the Toolka Land Trust. The officers work in divisions which include maintenance, cultural heritage, and flora and fauna. They also work with the local primary school to pass on Indigenous knowledge, to ensure that cultural activities such as making spears and dillybags are taught appropriately.

Lama Lama Rangers

The Lama Lama Rangers are based out of Port Stewart, 60 km east of Coen in the Princess Charlotte Bay area of the Cape York Peninsula. In 1990, the Lama Lama community were given formal recognition of a small parcel of land at Port Stewart, and by 2008 they had obtained ownership of almost all of their traditional country, which is now actively managed by the Lama Lama Rangers. The Lama Lama Land Trust and the Yintjingga Aboriginal Corporation work together to implement programs and coordinate activities across the Lama Lama Traditional Estate, guided by the Lama Lama Strategic Plan.

Ii-Anthawirriyarra Sea Rangers

The Ii-Anthawirriyarra Sea Ranger Unit operates in the south-west Gulf of Carpentaria. A community initiative, the Unit is responsible for looking after Yanyuwa country, which encompasses the Sir Edward Pellew Islands and surrounding coastline and delta areas. All Ii-anthawirriyarra activities are guided by Ii-Wirdiwalangu (senior Yanyuwa people) in accordance with Barni-Wardimantha Awara (Don't Spoil the Country), the Yanyuwa Sea Country Plan. The rangers and elders work together to ensure that successive generations of Yanyuwa children find gainful employment looking after country properly, the Yanyuwa way.

Mapoon Land and Sea Rangers

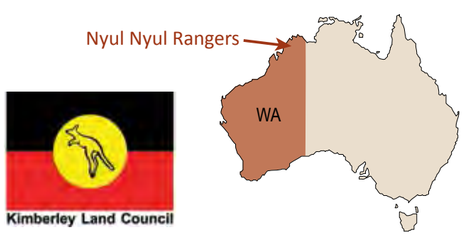
The Mapoon Land and Sea Rangers began in 2005, and are based in Mapoon, on the western coast of the Cape York Peninsula. The rangers manage the Mapoon Aboriginal Freehold lands, which include the traditional lands of the Yupungathi, Taepithiggi and Mpakwithi, and the traditional lands of Tjungundji and Warrangku clans. The rangers engage in a variety of land and sea management activities over this 1800 km^2 of country, which includes 70 km of coastline and five main river catchments.

Nanum Wungthim Land and Sea Rangers

The Nanum Wungthim Land and Sea Rangers are based at Napranum near Weipa, on the western coast of the Cape York Peninsula. They are responsible for managing the Napranum Deed of Grant of Land in Trust (DOGIT) covering an area of 2000 km^2. They look after several rivers, 70 km of nesting beach for flatback and olive ridley turtles and surrounding sea country. The rangers work in conjunction with the Napranum Aboriginal Shire Council, and were a founding member of GhostNets Australia in 2004.

Nyul Nyul Rangers

The Nyul Nyul Rangers are based out of Beagle Bay, about 100 km north of Broome. They look after nearly 2000 km^2 of land and sea country across the Nyul Nyul Native Title Claim on the Dampier Peninsula. The rangers undertake strategic fire management and weed mapping and management, as well as wetland monitoring and management and crocodile and turtle monitoring. The Nyul Nyul Rangers play a central role in implementing Traditional Owner, state and national management priorities to conserve and protect their lands. The Nyul Nyul Rangers are part of the Kimberley Land Council's Kimberley Ranger Network.



Pormpuraaw Rangers

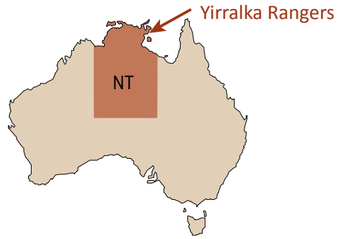
The Pormpuraaw Land and Sea Management Rangers were established in 2007, and are based in the Pormpuraaw community on the western coast of the Cape York Peninsula. The rangers manage the Pormpuraaw Deed of Grant of Land in Trust (DOGIT), which covers over 4600 km^2. Their management area encompasses several major river systems including the Holroyd/Kendall River, Christmas Creek, Balurga River, Edward River, Mungkan River, Chapman River, Mellenan River and Coleman River.

Uunguu Rangers

The Wunambal Gaambera Aboriginal Corporation's Uunguu Rangers manage country between Napier Broome Bay and the Prince Regent River in the North Kimberley, with their office at Kalumburu. They are arguably the most remote Aboriginal ranger group in Australia. They implement their Wunambal Gaambera Healthy Country Plan across some 25,000 km^2 of land and sea country, including hundreds of large and small islands in the Bonaparte Archipelago. Six full-time rangers who work with cultural advisors, Traditional Owners, staff and partners make up the Healthy Country Team.

Yirralka Rangers

The Yirralka Rangers were established in 2003 and represent the Yolngu Traditional Owners of north-east Arnhem Land. The Yirralka Rangers manage the land and sea in the Laynhapuy Indigenous Protected Area, which extends from Gove Peninsula to Blue Mud Bay and covers about 4500 km^2 of land and 480 km of coastline. The Yirralka Rangers employ 50 Yolngu staff who are based at 14 homelands throughout the Laynhapuy IPA.



Kimberley Ranger Network

Frank Weisenberger (KLC)

The Kimberley Land Council facilitates 14 Indigenous ranger groups, employing more than 80 men and women across the Kimberley Ranger Network. The Kimberley Ranger Network is supported by the Australian Government and works to realise Indigenous aspirations to look after country while providing real jobs, training and education, as well as improving socio-economic standards and community wellbeing.

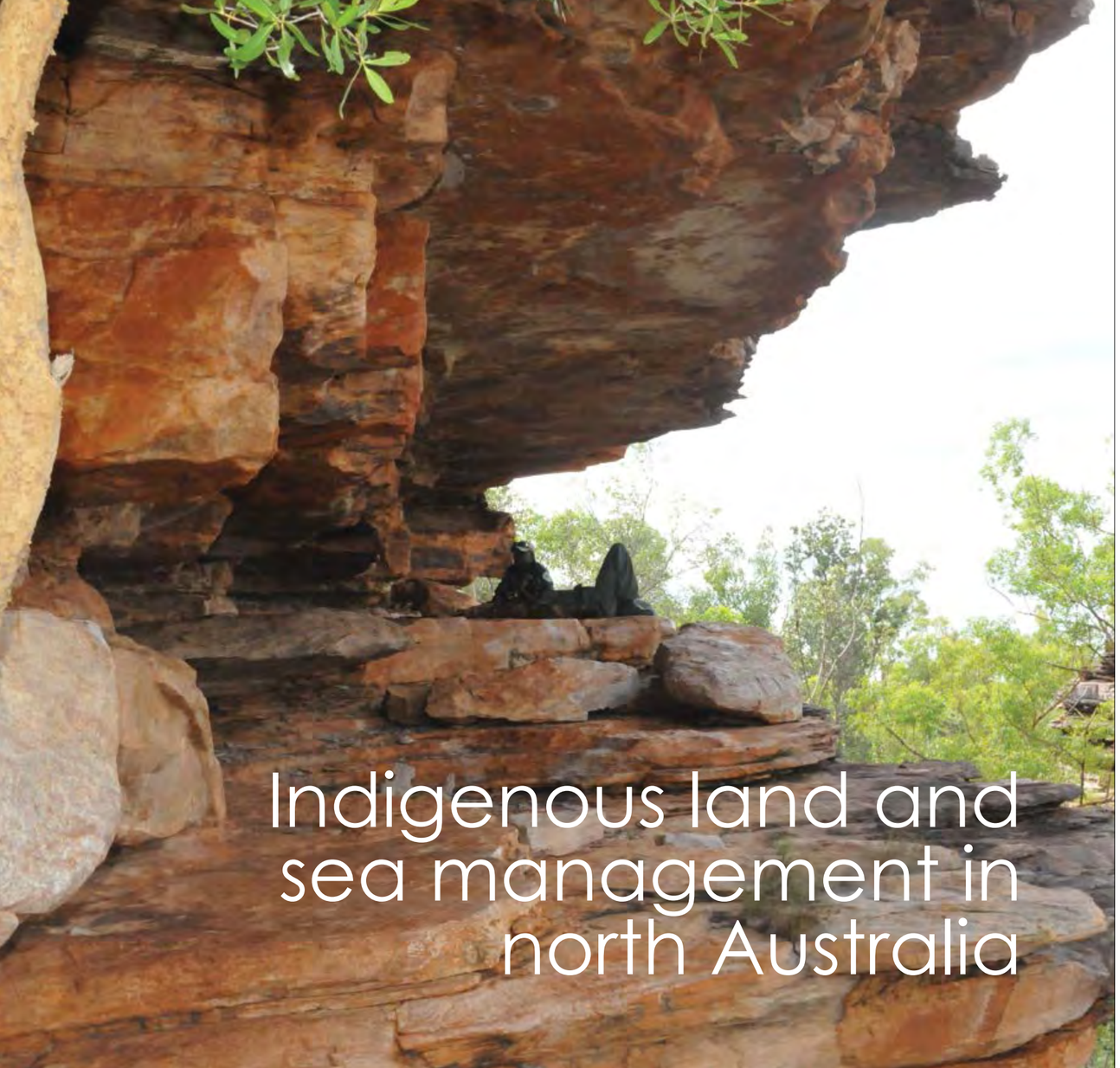
The I-Tracker program helps the Kimberley Ranger Network achieve its vision by providing access to robust tools, skills, and training that promote the use of both traditional ecological knowledge and western science. The I-Tracker program and CyberTracker technology have assisted Kimberley Indigenous rangers to look after and enhance their country for many years. The Nyikina Mangala Rangers were one of the first groups in the Kimberley to trial CyberTracker technology, using it to record information collected as part of bilby surveys conducted in 2003 and 2004.

The Bardi Jawi Rangers were the first Kimberley Ranger Network group to use the I-Tracker Saltwater Country Patrol Application in the management of saltwater country activities, initiated as part of their participation in NAILSMA's Dugong and Marine Turtle Program in 2006. Since then, the Kimberley Ranger Network's centralised approach in program management has resulted in the extension and expansion of I-Tracker applications to groups throughout the region.

After the first Kimberley Ranger Forum at Home Valley in 2009, coastal ranger groups gained access to the hands-on tools and training developed by the I-Tracker program to support their saltwater country management. Two years later, intensive consultations with all Kimberley ranger groups at the second Kimberley Ranger Forum identified the specific requirements needed to develop a Land Patrol Application. NAILSMA and KLC staff also trained more than 40 rangers and coordinators in field data collection and management at the forum.

With the subsequent release of the I-Tracker Land Patrol Application and the Cultural Sites Application, the program was expanded to include all ranger groups across the Kimberley. Both coastal and inland groups can now use I-Tracker applications for a range of activities conducted as part of their ranger work plans to look after country.

Through funding from the Australian Government and NAILSMA's Saltwater People Network, additional training events were held in Broome, while KLC and NAILSMA staff made multiple training visits to each of the Kimberley ranger groups. Parallel to that training, appropriate data sharing and data management structures were developed, allowing ranger groups across the Kimberley Ranger Network to follow best practice approaches to using I-Tracker technology.



Indigenous land and sea management in north Australia

The growing numbers and authority of Indigenous people employed in land and sea management is one of the great success stories in contemporary Australia. This success is built on Indigenous traditional knowledge and skills developed over millennia, and on strong interconnected cultural and spiritual relationships to land and sea.

North Australia is economically, ecologically, socially and culturally different from the rest of Australia. The region is home to the world's oldest continuous living cultures, and its immense biological and cultural diversity is unique in the world.

With about 60% of the nation's freshwater runoff, and many of its remaining intact landscapes and areas rich with biodiversity, north Australia is vital to the future of the nation. A significant number of these outstanding areas are within the expansive lands and waters owned and managed by Indigenous people. Indigenous leadership, practices and decision-making are essential to achieving sustainable conservation and management outcomes across north Australia.

Over their long history of custodianship of the land and seas of Australia, Indigenous people have developed a detailed body of knowledge and practices centred on their homelands, or 'country' as it usually called. Indigenous people have retained their connections to country despite the cumulative effects of displacement and dispossession, the legal fiction of *terra nullius* and a multitude of social, cultural and economic barriers to Indigenous ownership of land. The long-held rights and obligations that people have to their country are maintained through interconnected spiritual, cultural, and environmental practices and beliefs, which continue to be significant to this day.

Indigenous people across the north have been drawn together by the shared history, circumstances, threats and opportunities they face in the recognition and management of their vast land and sea estates. As they have regained control of their traditional estates through land claims, Native Title and other processes, Traditional Owners have moved swiftly to reassert their land and sea management rights and regimes.

While critical early work largely focused on getting people back to their estates, or simply put, the lands of their parents, it also laid the groundwork for the more recent emphasis on building sustainable livelihoods on country. Formal recognition of, and support for, Indigenous land and sea management is a central component of these efforts.

Background

NAILSMA has long advocated the importance of Indigenous people managing their lands and seas as the rightful and inherent owners of country. This is especially critical in north Australia, as the region presents an opportunity to get the balance between conservation, development, and the broader demands and expectations of the nation correct.

During the early 1990s, the concept of community-based land and sea management by Indigenous people began to emerge in the Top End as a new post-land rights beginning. An emerging ideology equipped for the 21st century, called 'caring for country', was proposed by a Gurrgoni man, Dean Yibarbuk, then leader of the Djelk Rangers based at Maningrida. Based on the use of two sets of knowledge systems—Indigenous and Western—caring for country sparked a level of enthusiasm rarely seen in remote Northern Territory communities.

This Indigenous ideology led to the creation of what are now popularly referred to as 'ranger programs' or just 'rangers'. The majority of Indigenous people involved in ranger work at the time were on the Community Development Employment Projects scheme (CDEP), a 'work for the dole' program that arose during the mid-1970s from a discrete project at Barunga in the Northern Territory. These programs initially occurred in the Top End of the NT, but rapidly spread to most states throughout Australia.

In 1999, the Djelk Rangers hosted a historic gathering at Nimirrili, a small outstation on the banks of the Blyth River in central Arnhem Land. The meeting was attended by approximately 70 people, the majority of whom were Indigenous rangers from surrounding communities. In the following years, meetings were held at Wuyagiba in south-east Arnhem Land, attended by approximately 140 people, and then at Gulkula, in north-east Arnhem Land, attended by well over 200 people including many interstate and international representatives.

At these events, Indigenous rangers networked, communicated and opened lines of dialogue—something that had never happened outside attendance at some regional cultural gatherings. Rangers also developed partnerships and strategies to examine new economic opportunities. These 'bush conferences' also reinvigorated cultural alliances between communities to deal with shared issues, such as managing fire across vast expanses of country. The meetings also spurred ranger involvement in activities of national significance including the provision of quarantine and customs surveillance services along the northern coastline.

At the same time, some groups voluntarily dedicated portions of their country into the national reserve estate as Indigenous Protected Areas. Others got involved in managing significant species of native wildlife, such as marine turtles and dugongs, and managing important waterways, including those that are essential for a functional commercial, recreational and tourism-based fishing industry in north Australia. A few groups even developed commercial opportunities by managing wildfires to offset the greenhouse gas emissions that are generated from industrial development. In each case, Indigenous people began to perform an innovative and crucial role in maintaining healthy and resilient ecosystems in the face of emissions reductions, water scarcity, dwindling global biodiversity, and pending climate change.

All of these events and developments have been the making of caring for country as a uniquely Indigenous product—one that provides environmental and cultural services backed by 50,000 years of occupation and knowledge of the environment founded on the inherent responsibilities that contemporary Indigenous people have for the management, use and development of their country.

It is timely that the values and aspirations held by Indigenous people are taken seriously as legitimate means of managing the north. Indigenous rangers are in the unique position of having the social, cultural, linguistic and site-based skills to conserve the north's outstanding natural and cultural resources.

For too long the language of conservation privileged outside agendas, and overlooked the potential to include Indigenous landowners and managers as central agents for managing their country. Recognition that Indigenous rights and responsibilities to their country are embedded in the landscape has been a long time coming. There is great promise in the new and innovative livelihood options that are being created by the on-ground presence of Indigenous land and sea managers with the capacity and professional skills to manage a host of research, land management and biosecurity issues in the remote and sparsely populated landscape of north Australia.

The North Australian Indigenous Land and Sea Management Alliance

The North Australian Indigenous Land & Sea Management Alliance Ltd (NAILSMA) is an Indigenous-led not-for-profit company that operates across north Australia. The origins of NAILSMA can be traced back to the 1990s, when a growing northern Indigenous estate and population meant a change in how the north was viewed by both Indigenous people and the wider Australian nation.

NAILSMA was established to help promote strong and sustainable Indigenous communities across north Australia by supporting Indigenous people with the management and development of their traditional estates. Indigenous people have substantial land holdings and interests across north Australia; some estimates suggest that around 40% of north Australia constitutes the Indigenous land estate through lands acquired under the Northern Territory Aboriginal Land Rights Act, Native Title Determinations, pastoral leases, joint management and other purchased or leased lands. In the Northern Territory, Indigenous people own just under 50% of the terrestrial land mass and around 87% of the coastline. Furthermore, it is estimated that the total population across the whole of the north will comprise 50% Indigenous people by 2030.

The lands and seas where Indigenous people have interests and legal ownership are home to considerable linguistic and cultural diversity, extensive Indigenous knowledge systems, and unique ecosystems. NAILSMA works to assist Indigenous people to manage their country sustainably for all future generations, creating a vibrant region where Indigenous knowledge, cultural values and responsibilities to the land and waters are embedded in all environmental, economic and resource management policies and practices.

NAILSMA focuses on facilitating large-scale and complex projects that combine research and practical support, and integrate Indigenous knowledge, biological and social sciences, and innovative land and sea management activities to improve the social and economic wellbeing of Indigenous people in north Australia. NAILSMA works with diverse stakeholders to realise its philosophy of 'Looking after our country...our way', to empower Indigenous people to take control of their land and sea country.

NAILSMA was formed in 2001, as a member of the Cooperative Research Centre for Tropical Savannas Management under a memorandum of understanding between the Kimberley Land Council, the Northern Land Council, and Balkanu Cape York Development Corporation. Their joint goal was to support emerging Indigenous land and sea management efforts in a regionally coordinated way.

Meetings provide opportunities for Indigenous rangers to develop partnerships and strategies to deal with shared land and sea management issues

Joe Morrison commenced as the convenor of the alliance and along with Peter Yu, established a robust dialogue across the region and in places such as Canberra, quickly changing the views of how Indigenous management of country could be considered as a legitimate employment opportunity for rural and remote locations in the north. Reaching internationally, NAILSMA also forged many partnerships with philanthropic organisations and Indigenous peoples, taking a rights-based approach to the management and development of north Australia.

The organisation operated as an unincorporated joint venture until 2012, when NAILSMA became an independent not-for-profit charitable organisation. In 2014, NAILSMA became the first Indigenous-led Australian IUCN Member organisation: a reflection of NAILSMA's long-standing ability to deliver high-level research, policy and practical projects centred on the sustainable and equitable use and management of natural resources.

NAILSMA promotes an innovative model of engagement and robust partnerships centred on Indigenous livelihoods from a culture-based economy, which NAILSMA considers vital to the sustainable development of the north. NAILSMA works across a number of thematic program areas, including:

- Indigenous knowledge
- Water resource management
- Carbon
- Youth leadership
- the Saltwater People Network
- Livelihoods
- the North Australian Indigenous Experts Forum
- I-Tracker.

NAILSMA has delivered well over $35 million worth of projects across north Australia, partnering with Indigenous Australians, private and corporate sectors, and the public. NAILSMA is also regularly selected through competitive processes to implement and deliver land and sea management projects for Federal and State governments.

Among early groundbreaking projects, NAILSMA successfully won a tender to manage a North Australian Marine Turtle and Dugong project that critically changed the way saltwater people were viewed: from 'hunters' to 'managers'. Under the leadership of Dr Rod Kennett, this project eventually led to the creation of a new tool that has evolved into a crucial support program for Indigenous rangers across the north: the I-Tracker program.

The I-Tracker program plays a key role in NAILSMA's efforts to foster equitable partnerships that support Indigenous innovation and excellence, and create opportunities to access new technologies, resources and relationships that support Indigenous land and sea management. The program is underpinned by NAILSMA's commitment to promote and facilitate evidence-based research, and to spearhead the concept of an Indigenous culture-based economy that builds on Indigenous culture, knowledge and connection to country. With a growing workforce of over 700 Indigenous rangers across some of the most remote and biodiverse environments in the world, the work of Indigenous rangers is essential to sustainable futures and livelihoods in the north, and the I-Tracker program is central to NAILSMA's vision of increasing awareness and recognition of the rights and capacity of Indigenous people to own and manage their outstanding land and sea resources.

The NAILSMA I-Tracker program

Indigenous rangers, working together with Traditional Owners to undertake natural and cultural resource management activities, are one of the most visible aspects of contemporary Indigenous land and sea management. One of the key challenges for these rangers is that the landscapes restored to Indigenous ownership and now under Indigenous management have changed significantly since colonisation. With new and emerging threats such as invasive species, altered fire regimes, climate change and resource extraction impacting on the biodiverse landscapes of north Australia, Indigenous rangers must forge new pathways and develop new tools, skills and knowledge to look after their traditional lands and seas.

The NAILSMA I-Tracker program developed in response to demands from Indigenous land and sea managers for tools to support the collection, use and analysis of data. Too often in the past, data was collected about Indigenous people or their lands but it remained inaccessible to them—owned by others. With the technology of research largely unavailable to Indigenous people, their own research and management priorities were disregarded.

At the core of the I-Tracker program is a commitment to ensuring that knowledge and data remain in Indigenous hands and can be used to address Indigenous priorities. The sustainability of the management of north Australia's land and seas requires a significant portion of the business of land and sea management to be under Indigenous direction. The ownership of data and information generated by Indigenous communities is central to their capacity to make informed decisions about land management and resource use options.

The I-Tracker program is a major contribution to the Indigenous land and sea management sector that has quickly become a crucial source of livelihoods in remote Australia, where opportunities are otherwise limited. The program gives rangers access to tools that are user-friendly and culturally, scientifically and physically robust. The I-Tracker program has developed regionally consistent practices and data collection applications, allowing data to be aggregated to address landscape-scale issues such as migratory species, biosecurity threats and climate change. Applications can be customised to suit local needs such as language, species distribution and management requirements. Rangers are provided with training and technical support, and are embedded in a communication network that encourages and facilitates the sharing of knowledge and skills across north Australia and around the world.

Background

The I-Tracker program has its roots in the Dugong and Marine Turtle Project (DMTP) coordinated by NAILSMA from 2005 to 2009. One of the largest and most successful Indigenous land and sea management initiatives in north Australia, the DMTP involved communities from the Kimberley, the Northern Territory, the Queensland Gulf, the Cape York Peninsula and the Torres Strait, and secured over $4.5 million in funding from government and philanthropic organisations. The DMTP won a prestigious Banksia Environmental award in 2008, and was independently evaluated as an 'outstanding success' that 'exceeded expectations'.

The Dugong and Marine Turtle Project was successful because it gave support to Traditional Owners to identify their priorities and develop programs to implement them. Participants used the DMTP to pursue a wide range of sea country issues—they created ranger groups, conducted research, mapped and protected habitat, instituted community management plans for hunting, recorded Indigenous Knowledge, embarked on local and international scientific and cultural exchanges, worked with the Carpentaria Ghost Nets Programme (CGNP, later renamed GhostNets Australia) to clean up tons of marine debris, and much more.

2008 Banksia Award presentation for the NAILSMA Dugong and Marine Turtle Project

This enormous burst of activity by rangers and communities generated an abundance of information which gave rise to a new challenge for the participating groups and communities: how to record and manage the information to better inform, conduct and evaluate the work they were doing. As one ranger coordinator put it, 'data management is a luxury', especially in the busy, resource-strapped schedule of a ranger program. Rangers urgently needed new tools to help them collect, collate and map data, to use it in reports to funding agencies and, more importantly, to inform Traditional Owners and local decision-making processes.

Through the DMTP workshops, rangers identified their central requirements: transferring written data into digital formats (or collecting digital data directly), establishing data collection protocols for the many new activities they were engaging in, and gaining access to ongoing technical support and training. In response, the I-Tracker program was conceived as a network of rangers using state-of-the-art, handheld touch screen computer-based technology and scientifically robust, standardised data-recording protocols to monitor, record, analyse and report on a range of environmental and cultural data. The sophisticated tools and technology of the I-Tracker program had a simple goal at their heart—to make Indigenous rangers' jobs easier.

NAILSMA chose CyberTracker software to build the I-Tracker data collection tools, because it is easy to use, free to download, and was specifically developed for users with limited literacy and numeracy skills. NAILSMA staff use CyberTracker to create customised data entry and help screens, which are organised into screen sequences known as 'applications'. These applications are then loaded on to mobile devices such as rugged PDAs (Personal Digital Assistants) and tablets, which rangers use to collect data in the field. Back in their offices, rangers can easily upload the data to the database component of CyberTracker on their own computers, and from there the data can be viewed, analysed, mapped, or exported in a range of formats.

At the time that the I-Tracker program was developed, CyberTracker had already been used by many groups including community and Indigenous organisations in over 70 countries, and was confirmed through that wide range of applications to be reliable, robust, and appropriate. CyberTracker was first trialled in north Australia by the Djelk Rangers, NAILSMA, and CGNP, who worked together to develop an application for rangers to record observations during their sea country patrols. The application, known as the 'Djelk Sea Rangers Patrol Database', reflected the leading role of the Djelk rangers at the time. It delivered digital data recording tools for the management and monitoring of sea country priorities including turtles and dugongs, marine debris (including ghost nets), fishing activity, boat traffic, and dead, sick or injured wildlife. Northern Territory Fisheries, Australian Customs, and Australian Quarantine and Inspection Service (later renamed DAFF Biosecurity) also contributed to the development of the application, ensuring that their reporting requirements were included.

Right: NAILSMA has produced a number of publications about the Dugong and Marine Turtle Project, and the I-Tracker program. Many of these can be downloaded from the resources page of the NAILSMA website (nailsma.org.au/hub/resources).

I-Tracker applications

In 2008, NAILSMA and the Carpentaria Ghost Nets Programme (CGNP) expanded the Djelk CyberTracker trial with the first I-Tracker application, distributing a version of the Djelk Sea Rangers Patrol Database application. This first I-Tracker trial involved sixteen Indigenous sea ranger groups managing areas spanning the north of Australia from the Kimberley to the Torres Strait. Each group was provided with a ruggedised mobile device, CyberTracker software, digital maps, training and technical support. A data-sharing agreement between NAILSMA and each participant group allowed the data to be pooled from across all locations. Over the course of the trial, rangers collectively logged 343 patrol days and recorded 5893 observations including marine debris and ghost nets, live and injured turtles, turtle nests, live dugongs, commercial fishing nets and foreign fishing vessels.

The trial clearly demonstrated the extensive efforts rangers were making to manage their sea country, and the volumes of data being collected during their patrols on country. It also highlighted the enthusiasm of rangers for the skills and capabilities provided by the I-Tracker program. With the I-Tracker concept now proven through the experience of the Djelk Rangers and the wider trial, NAILSMA was well on the way to establishing the new I-Tracker program across north Australia.

Participants in the NAILSMA Dugong and Marine Turtle Project undertake satellite tracking of marine turtles

The Dugong and Marine Turtle Program made it clear that dugong and turtle management must be based within the bigger business of looking after saltwater country. NAILSMA formalised its ongoing commitment to advancing this aim with the launch of the Saltwater People Network (SPN) in 2009, with funding from the Australian Government's Caring for our Country program. One of the SPN priorities was to make I-Tracker applications widely available, and in late 2009, a new I-Tracker Saltwater Country Patrol Application was developed that included many of the additional requirements identified in the 2008 trial. NAILSMA staff also developed new training materials and courses including a computer skills course and field training programs.

Through forums, workshops and on-ground use of the application, the growing network of I-Tracker participants mapped the way forward and helped the I-Tracker program grow and thrive. As more and more people used the application in their saltwater country patrols, an exciting new potential emerged: the development of an I-Tracker application to support land-based ranger work.

In 2011, NAILSMA secured additional resources to develop an I-Tracker application to support land-based activities, as the northern hub of the Australian Government-funded National CyberTracker Network. A working group of rangers, Traditional Owners, researchers and government experts was established, and after an extensive on-ground trial and modifications to the application based on the experiences and feedback of rangers, the I-Tracker Land Patrol Application was launched in early 2012.

The Land Patrol Application allows rangers to collect data on issues including fire, weeds, feral animals, native plants and animals, visitors and habitat health. As is the case with the I-Tracker Saltwater Country Patrol Application, the Land Patrol Application meets the reporting requirements of fee-for-service government contracts such as biosecurity surveillance for the Department of Agriculture, Fisheries and Forestry. The application also meets cultural requirements as indicated by rangers and members of the working group, for example by separating the cultural sites mapping and monitoring component into a discrete, stand-alone application, to ensure that cultural data is never accidently included in reports sent to external agencies. Customised reporting templates with cut-and-paste features have also been developed to help rangers quickly and easily produce high-standard reports from their patrol data.

Bardi Jawi and Nyul Nyul Rangers participate in the I-Tracker Land Patrol Application trial 2011

Djelk Rangers participate in the I-Tracker Land Patrol Application trial 2011

A set of principles developed by participants in the I-Tracker program ensure that the program meets the priorities of Traditional Owners. These principles are:

1. Participants work under approved local plans and have the authority of local Traditional Owners to complete their work
2. Participants have a clear understanding of why data are being collected and have identified I-Tracker applications as an appropriate tool to collect, manage and share their information
3. Data are being collected for the purpose of informing local community priorities such as community-based management plans, day-to-day ranger operations, fee-for-service agreements with external stakeholders, and reporting requirements to funding organisations
4. Agreements and protocols are in place to ensure that Traditional Owners of the target area have given their informed consent for data collection to occur
5. Traditional Owners have discussed how data are to be used, stored, analysed and shared with others
6. Ownership of data has been clearly defined and agreed.

Under the I-Tracker program, data remain the intellectual property of the ranger group, who negotiate and manage the processes that must be followed before it is provided to external parties. To protect the intellectual property of Indigenous participants, NAILSMA negotiates formal data-sharing agreements based on free, prior and informed consent of data owners. These agreements allow NAILSMA to use data for reporting to funding agencies and to promote the work of rangers (such as in this book).

Community-based management plans, developed through participatory planning processes involving the local community, are fundamental documentation of Traditional Owner priorities, and guide the work of both local rangers and supporting organisations such as NAILSMA. For example, many communities are engaged in Healthy Country Planning, a process supported by The Nature Conservancy (TNC) that assists groups to produce community-based plans based on international best practice and adaptive management principles. NAILSMA's partnership with TNC ensures that the I-Tracker program and Healthy Country Planning align to provide coordinated support for the implementation and evaluation of Healthy Country Plans.

Mapoon Cultural Heritage Rangers with the 2013 Mapoon Country Plan

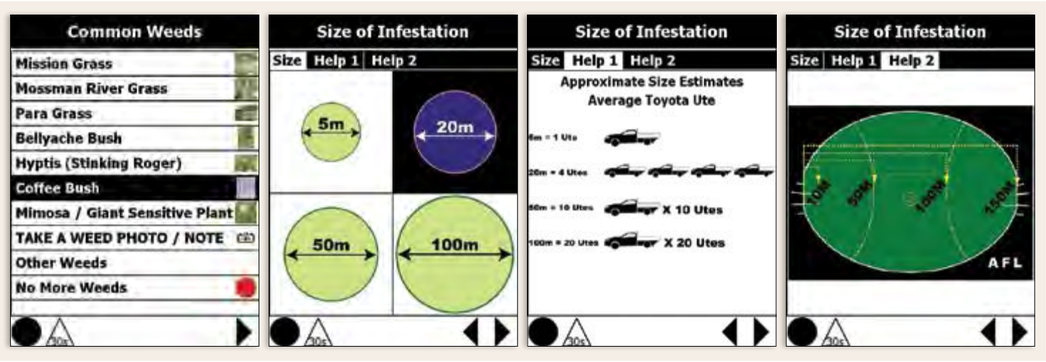
Similar strategies are used to support other community-based management plans such as Sea Country Plans, Traditional Use of Marine Resources Agreements, and Indigenous Protected Area management plans.

I-Tracker applications enable rangers to collect detailed information on their effort (for example, time, travel, man-hours and ranger names). This capacity allows communities to analyse the cost of implementing management strategies, and better estimate and incorporate these costs into their ongoing land and sea management plans.

The I-Tracker program also promotes the intergenerational sharing of knowledge, with young people working together with elders to ensure that the program respects cultural protocols and uses Indigenous knowledge appropriately. In addition, the applications contribute to the recording of information for future generations—decades from now, the great-grandchildren of today's rangers will be able to print a map of the places their grandparents worked, access detailed environmental records, and examine the seasonality and scope of ranger efforts at any point in the past.

The I-Tracker program uses a variety of methods to provide training and technical support to rangers. Applications usually include help or reference screens; for example, photos and keys help identify species, piles of marine debris can be measured in 'Toyota ute loads', and diagrams of football fields assist in estimating distance. As with local names and species lists, the help screens are also customised for local conditions: the Northern Territory version of the I-Tracker Land Patrol Application uses an Australian Rules football ground to help rangers estimate distance while the Queensland version uses a Rugby League playing field.

Rangers also regularly access technical support from NAILSMA by telephone and email, and updated applications, technical bulletins and other material are made available on the NAILSMA



These four screenshots show some of the data input and help screens from the weed management section of the I-Tracker Land Patrol Application, as they display on the mobile devices that Indigenous rangers use in the field

website. I-Tracker computer skills workshops, supported by a manual and interactive DVD, are consistently booked out by rangers, as are field-based training sessions. Partnerships with training organisations allow I-Tracker applications to be used in conservation and land management certificate training and specialist literacy and numeracy courses.

The demand from rangers for additional I-Tracker applications has created valuable partnerships between rangers and scientists and provided new skills, resources and perspectives. Some examples to date include an aerial survey and control application for feral buffalo, developed with the Yirralka Rangers and the Commonwealth Scientific and Industrial Research Organisation; a crocodile survey application, developed with the Northern Land Council, the Wanga Djakamirr Rangers and the Gurruwiling Rangers; a shorebird field identification application and shorebird survey count application, developed with Birdlife Australia and Gulf of Carpentaria ranger groups; and a seed and plant harvest application, being developed with the Yirralka Miyalk (women) Rangers.

The growing confidence of rangers working in close collaboration with scientists means they often specifically request that scientists use CyberTracker applications such as the I-Tracker applications for field data collection. The rangers have seen firsthand how these data tools eliminate many of the problems associated with using paper data sheets, and allow the data to be immediately incorporated into their databases. In turn many scientists embrace the value of the I-Tracker applications and other aspects of the program, and the potential the program offers for the broader and more detailed participation of Indigenous people in their research.

The I-Tracker program has become a key support service for Indigenous land and sea managers, particularly for ranger programs and those developing or administering Indigenous Protected Areas. The program has significantly improved the capacity for consistent, professional data collection and management across the Indigenous estate in north Australia. This has been achieved through multiple facets of the program. NAILSMA staff maintain a strong on-ground presence with

regular field visits, extensive training, and remote technical support. I-Tracker applications themselves comprise a diverse suite of scientifically robust and culturally appropriate data collection, analysis and mapping tools that can be used for a wide range of natural and cultural resource management issues. And through the I-Tracker program, Indigenous rangers, Traditional Owners, researchers, and government and non-government representatives across north Australia are linked into a robust network that facilitates the exchange of knowledge and experience for better land and sea management outcomes.

In addition to supporting local-scale operations, the use of standardised protocols across north Australia allows I-Tracker participants to share data regionally and therefore monitor environmental issues at larger spatial scales. The I-Tracker program is filling major gaps in knowledge about species, habitats and environmental change, and providing a level of regional and national coordination not previously possible.

The multi-award winning I-Tracker program has set new standards for the delivery of services to Indigenous land and sea managers in north Australia. By bringing together Indigenous knowledge and the best of natural resource management and scientific knowledge and skills, the I-Tracker program puts the power of data ownership and effective data collection and management firmly into the hands of north Australian Indigenous land and sea managers.

Yirralka Rangers participate in the I-Tracker Land Patrol Application trial 2011

How does the NAILSMA I-Tracker program work?

NAILSMA staff design and build I-Tracker applications using CyberTracker software to meet the data collection needs of Indigenous rangers and Traditional Owners.


Applications are installed onto mobile devices, which rangers use to collect data while undertaking land and sea patrols.


Rangers download collected data to their CyberTracker database for storage, reporting, analysis and land management planning.


A team of NAILSMA staff provide on-the-job training, technical help, workshops and skills development for rangers.


A network of Indigenous rangers use I-Tracker applications to collect data for land and sea management across north Australia. Scientists and other experts work with NAILSMA and ranger groups in the development of the applications.

Skills development and training

Implementation of the I-Tracker program has required innovative approaches to assist rangers to gain competency in the use of CyberTracker software and other digital data collection and management tools. Indigenous rangers have varying levels of computer skills competency, and they sometimes face additional challenges with English literacy and numeracy. By developing and delivering training that addresses these challenges, the I-Tracker program is contributing to substantial skills advancements for Indigenous rangers, enhancing not only the outcomes of their land and sea management activities, but also their individual opportunities into the future.

The most formal skills development that takes place as part of the I-Tracker program occurs during periodic I-Tracker Computer Skills workshops. These training workshops are structured skills development events focused on building a foundational proficiency in the use of CyberTracker and associated software. The workshops are run over 2 to 3 days, depending on the initial skill level of the participants, and are held regionally across the Top End to help ensure that rangers throughout the I-Tracker network have access to these valuable learning opportunities.

Rangers attend an I-Tracker Computer Skills workshop in Broome, WA, in 2012

At a workshop, NAILSMA staff take participants through a number of training exercises using the latest version of CyberTracker software. This includes training in managing databases, extracting data, creating and importing data layers, creating maps, writing reports, exporting data into other software such as Microsoft Word, and interfacing with other mapping applications such as Google Earth. There is also discussion of the technical process required to develop field data collection applications.

The participatory training sessions at the workshops are supported by a printed I-Tracker Computer Skills Manual, which is customised and updated before each workshop. There is also a Computer Skills DVD that covers many of the skills developed during the workshops. The manual and DVD are produced in-house at NAILSMA, and are significant reference resources for rangers both during and after the workshop.

In addition to these training workshops, NAILSMA staff also undertake targeted technical training with rangers during regular field visits. These visits are an opportunity to conduct on-ground training with rangers on their own country that addresses the specific needs of each particular group, such as support for the implementation and ongoing activities associated with community management plans. The visits allow participants to extend the knowledge and capacity they have gained during previous workshops and training, while addressing actual challenges and questions that face them on the ground in their own work.

NAILSMA staff are also available for telephone and email-based support at any time in between their field visits to ranger groups. Between 2010 and 2013, NAILSMA staff responded to over 250 requests for technical support outside of designated training and forum events. Having this capacity to provide responsive ongoing technical support for rangers is crucial to maintaining the successes that rangers have achieved through working with the I-Tracker program to date, and to ensuring that any technical problems with the software or applications can be identified and resolved by NAILSMA staff or the CyberTracker programmers.

The I-Tracker program also provides a periodic newsletter to ranger partners, with technical updates on software and hardware issues, recommendations on keeping software updated, tips on making the most of software and I-Tracker application capabilities, and tutorials on new features of CyberTracker software and the I-Tracker applications. These periodic, plain language technical updates are sent by email and made available on the NAILSMA website. In some cases, such as multi-step tutorials or those features which require specialised knowledge such as GIS skills, the technical updates are supplemented by an in-depth tutorial technical support document that is available as a separate download. As of early 2014, nearly 30 of these higher-level, standalone technical support documents have been produced, making them key additional learning resources for rangers using CyberTracker and the I-Tracker applications.

The breadth of computer skills that rangers acquire from working with the I-Tracker program are a direct result of this multi-faceted and responsive approach to technical skills development, training and support. The capacity that rangers attain is also transferable to a wide variety of working environments, since they gain proficiency not only with CyberTracker but with a broad range of computer software. Rangers also build experience in hardware management, desktop data analysis, and fundamental principles of digital file management. These valuable skills are applicable well beyond the I-Tracker program, ensuring that the experience acquired through Indigenous land and sea ranger employment contributes to the broader development of human resources in remote north Australia.

CyberTracker™

CyberTracker Conservation is a non-profit organisation whose vision is to promote the development of a worldwide environmental monitoring network. CyberTracker software was developed in 1996, when Louis Liebenberg, the founder of CyberTracker, teamed up with computer scientist Justin Steventon.

Together with the help of Indigenous trackers Karel Benadie and James Minye, they tracked the highly endangered black rhino in the Karoo National Park in South Africa, recording its movements and behaviour in detail with the very first CyberTracker prototype.

Since then, CyberTracker has grown immensely and is used by many groups including community and Indigenous groups, in over 150 countries around the world. This free software is easy to use and was specifically developed for community users with limited literacy and numeracy skills. CyberTracker is an efficient way to gather large quantities of georeferenced data and field observations, even by non-literate users, at a speed and level of detail not possible before.

CyberTracker Conservation's mission is to improve environmental monitoring for the benefit of biodiversity conservation. CyberTracker is in use in various sectors including education, forestry, organic farming, social surveys, crime prevention and disaster relief. Users benefit from the icon interface, which enables significantly faster data collection than text interfaces or written methods. By combining Indigenous knowledge with state-of-the-art computer and satellite technology, CyberTracker links the efforts of scientists and local communities to advance key areas of biodiversity conservation.

NAILSMA's relationship with CyberTracker has grown over the years, and NAILSMA has contributed significantly to the continuing growth of CyberTracker by roadtesting new versions of the software, broadening the scope of CyberTracker applications, demonstrating its wider applicability, and commissioning a range of new software features. These enhancements to the capacity of the software benefit not only the Indigenous rangers who work with the I-Tracker network, but also all of the other CyberTracker users across the globe. This relationship is formalised in I-Tracker's registration as part of the CyberTracker Worldwide Network, by agreement with the CyberTracker organisation.

From left: Louis Liebenberg and Justin Steventon visit Kakadu National Park during their trip to Australia to attend the 2012 NAILSMA I-Tracker Forum

Towards a new science

Louis Liebenberg (CyberTracker Conservation)

From its origins in the Kalahari, CyberTracker has found its way into conservation projects worldwide. Most users simply use CyberTracker to record data. But the art of tracking also represents an incredibly sophisticated and refined form of human observation.

A fleeting glimpse of a small bird disappearing into a thick bush is closer to a sign of a bird than a clear sighting. A distant sighting of a whale in rough seas can be just as difficult to identify as an indistinct track. A dried out twig, with no flowers or green leaves, can make identification of a plant as difficult as identifying the faintest sign in the sand. Whether looking at birds, butterflies, plants, whales, tracks or signs, humans have a tremendous capacity for making observations that are detailed, insightful, and complex.

The CyberTracker story is captured in the powerful image of Karoha holding the CyberTracker unit (photo right), with his hunting bag slung over his shoulder. The image is striking, with its contrast of tools from the traditional bow and arrow to the modern handheld computer. But Karoha's story also represents a profound hope for the future: that the ancient art of tracking can be revitalized and developed into a new science to monitor the impact of climate change on biodiversity. This new science can potentially help us solve one of the most complex challenges of the future, and from the master trackers of the Kalahari we can find inspiration to develop our own increasingly refined observation skills that give us a more complete picture of the natural world we all share.

www.cybertracker.org/background/our-story

Karoha holding the CyberTracker unit © *Rolex/Eric Vandeville*

Saltwater Country Patrol Application

The I-Tracker Saltwater Country Patrol Application is a suite of customised CyberTracker data input and help screens that equips Indigenous rangers to digitally record information during coastal and marine patrols.

The I-Tracker Saltwater Country Patrol Application supports Indigenous rangers in their work on a range of sea country issues. This chapter highlights the following key sections of the application:

- marine animal sightings
- marine turtle nesting
- ghost nets and marine debris
- coastal surveillance.

The application also has the capacity to record information about other specific sea country issues such as:

- commercial and recreational fishing activity
- dead, sick or injured wildlife, including fish kills
- illegal fishing activity
- quarantine information.

The Djelk Rangers first demonstrated the benefits of using a digital field tool for sea ranger work with their successful trial of a CyberTracker-based patrol application. In 2008, NAILSMA and the Carpentaria Ghost Nets Programme trialled the first I-Tracker Saltwater Country Patrol Application, providing the application, handheld mobile devices, and a support package of materials to Indigenous ranger groups across the north for a trial of the application.

Since then, the I-Tracker Saltwater Country Patrol Application has been rapidly adopted by other groups across north Australia. The application is available as a free download from the NAILSMA website and is regularly updated to new versions.

In the years since its initial trial, the I-Tracker Saltwater Country Patrol Application has been modified to accommodate new advice and requirements from Indigenous ranger groups across north Australia, as well as from Traditional Owners, government and non-government organisations, scientists and researchers, and natural resource managers.

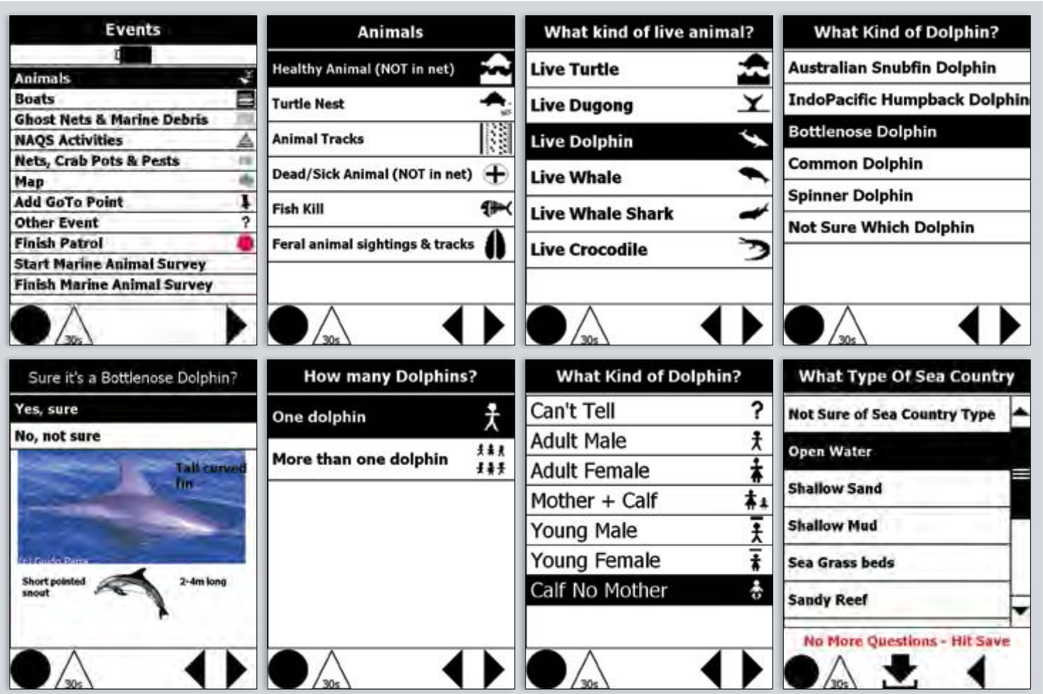
Many organisations and individuals have made valuable contributions to the application over this time, and NAILSMA acknowledges and thanks these contributors, including:

- Indigenous rangers and ranger coordinators
- Australian Customs and Border Protection Service
- Australian Marine Mammal Centre
- Charles Darwin University
- Commonwealth Scientific and Industrial Research Organisation
- CyberTracker
- GhostNets Australia
- Department of Agriculture, Fisheries and Forestry: Biosecurity (formerly AQIS)
- NT Fisheries.

As the stories in this chapter show, Indigenous rangers across north Australia are using the I-Tracker Saltwater Country Patrol Application to help them look after their sea country in diverse ways. In each case though, the application is equipping Indigenous rangers to collect environmental and cultural data in a way that is more efficient, consistent, and methodologically sound than was previously possible. In addition, rangers benefit from easier data uploading and analysis back in the office, as well as simplified reporting and increased data sharing and pooling capacities, all while retaining ownership and control over their own databases of information.

NAILSMA staff and attendees at a three day intensive I-Tracker Computer Skills Workshop, Cairns 2013

The Uunguu Rangers use the I-Tracker Saltwater Country Patrol Application to monitor their sea country

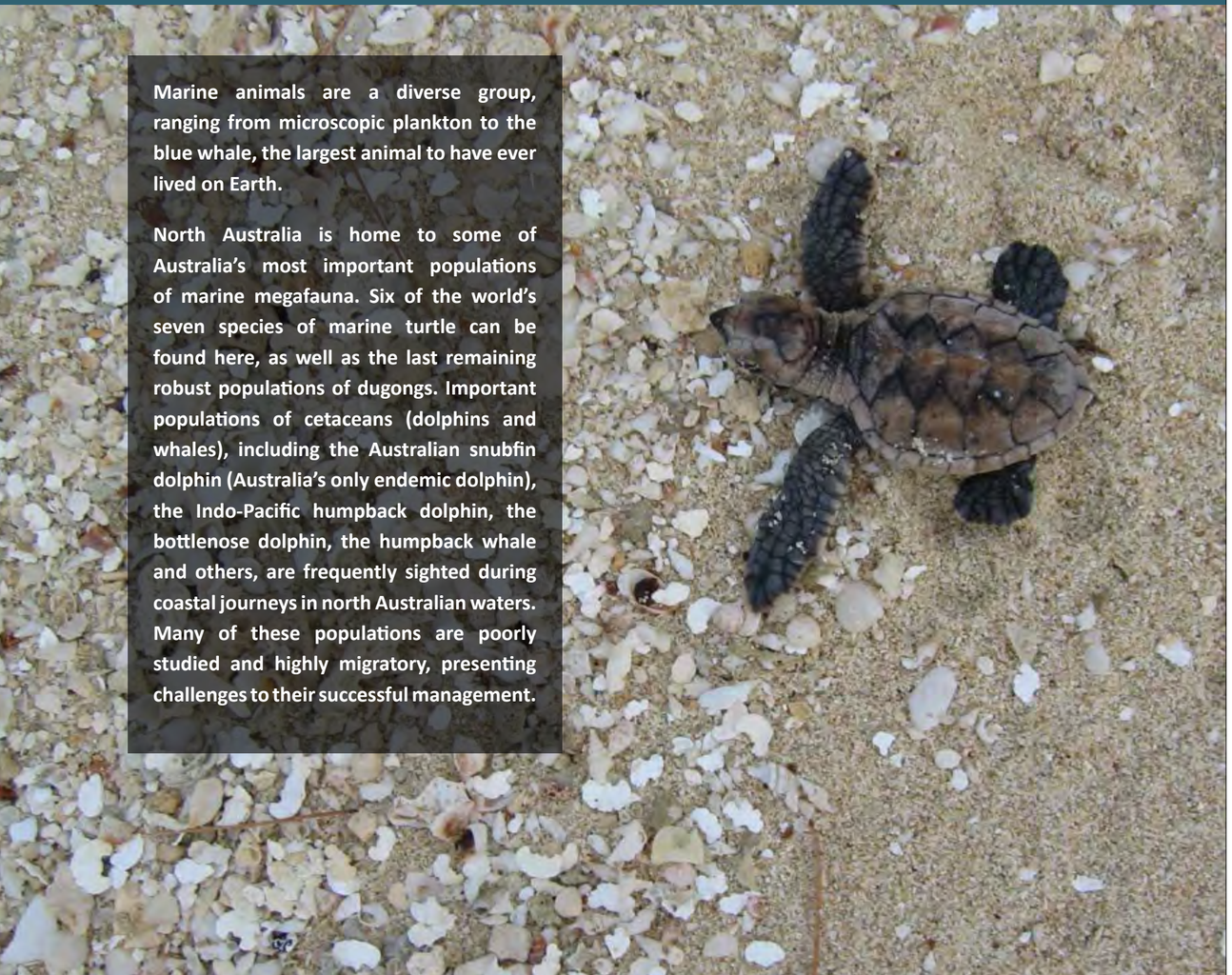


These eight screenshots show some of the data input and help screens from the I-Tracker Saltwater Country Patrol Application, as they display on the mobile devices that Indigenous rangers use in the field. These screens are from the marine animals section of the application, and demonstrate how rangers progress through this section of the application by making selections on the mobile device. As a ranger records information related to the animal sighting, the application progresses on to the next screen, until the end of the sequence is reached and the ranger is prompted to save the sighting information (in this case, of a bottlenose dolphin calf in open water).

Saltwater Country Patrol Application:

Marine animal sightings

I-Tracker



Marine animals are a diverse group, ranging from microscopic plankton to the blue whale, the largest animal to have ever lived on Earth.

North Australia is home to some of Australia's most important populations of marine megafauna. Six of the world's seven species of marine turtle can be found here, as well as the last remaining robust populations of dugongs. Important populations of cetaceans (dolphins and whales), including the Australian snubfin dolphin (Australia's only endemic dolphin), the Indo-Pacific humpback dolphin, the bottlenose dolphin, the humpback whale and others, are frequently sighted during coastal journeys in north Australian waters. Many of these populations are poorly studied and highly migratory, presenting challenges to their successful management.

Indigenous rangers and their local communities have a strong cultural interest in the health of marine species. Rangers are often the only people travelling within vast areas of sea country, and their observations of marine animal sightings are a valuable source of information. Being able to easily record animal sightings while engaged in other ranger work expands the scope of data rangers can collect during their marine patrols, and helps rangers maximise the value of their time spent on the water.

The I-Tracker Saltwater Country Patrol Application allows rangers to record opportunistic sightings of marine turtles, dugongs and cetaceans during coastal patrols (other I-Tracker applications have been developed for dedicated surveys of these animals; see the 'Marine Turtle and Dugong Monitoring Project' section of the Working Together chapter for further details). These sightings capture important distribution information, and assist rangers to keep track of local sightings of these significant animals.

A NAILSMA staff member conducts on-ground training with Gumurr Marthakal Rangers

Dhimurru Rangers: Dolphin surveys

Wurrulnga Marika, Banula Marika, Djalinda Ulamari and Vanessa Drysdale (Dhimurru Aboriginal Corporation)

Dolphins are a very strong symbol for the Yolngu of north-east Arnhem Land. The strength, speed and intelligence of the dolphin are seen as admirable traits, and to be named after the dolphin is a privilege and honour. The connection of people to the land and sea is no more evident than the connection people have with this particular species.

People talk of hearing the dolphin *gurraykurrayun dhangguryun* (cry) and of some Yolngu being able to communicate with them. Other people tell of hearing a mother and father dolphin speaking to their youngsters, teaching them and showing them how to hunt, swim and survive.

The deep connection to dolphins is especially evident at funeral ceremonies where people sing a dolphin *manikay* (song) to assist the spirit of the person who has passed away to travel to their ancestral resting place.

Recently, the Dhimurru Rangers have started working with scientists to survey the resident populations of inshore dolphins in Gurkuwuy (Melville Bay) and Bawuka (Port Bradshaw). These surveys are conducted aboard the Dhimurru vessel and use I-Tracker technology to record sightings of dolphins. The rangers record the details of each sighting using the I-Tracker Saltwater Country Patrol Application, which are then downloaded in the office for collation and interpretation.

The technology allows the rangers to quickly and effectively collect scientifically robust data on the occurrence of inshore dolphins in a standardised format, including GPS position and photographs.

Humpback dolphin in Melville Bay *© Isabel Beasley*

Clockwise from left: Marine animal sightings around Nhulunbuy, NT, collected by the Dhimurru Rangers using the I-Tracker Saltwater Country Patrol Application (map supplied by Dhimurru Aboriginal Corporation)

Dhimurru Rangers work with marine scientists to survey local dolphin populations *© Dhimurru Aboriginal Corporation*

The Dhimurru Rangers' sea country patrol boat *© Dhimurru Aboriginal Corporation*

Djelk Rangers: Marine turtle sightings

The Djelk Rangers, based in Maningrida, NT, see multiple turtle species feeding and travelling through their coastal waters. The most commonly observed species are green turtles, flatback turtles and hawksbill turtles. The Djelk Rangers use the I-Tracker Saltwater Country Patrol Application to record these opportunistic turtle sightings.

In October 2011, the Djelk Rangers spotted a sea turtle splashing around on the surface of the water during a sea country patrol. As they got closer, the rangers could see a turtle repeatedly trying to dive down but unable to get more than half its body below the surface.

The large green turtle (*Chelonia mydas*) was lifted on to the boat for examination. Information about the location and the turtle was recorded using the I-Tracker Saltwater Country Patrol Application. Less than an hour later, the turtle died on the boat.

Given the unusual nature of the turtle's death, the rangers decided to keep the animal and investigate further. When they got back to the ranger station they contacted an expert from the University of Queensland's Moreton Bay Research Station and, with assistance, performed an autopsy. During the autopsy, the rangers employed their traditional knowledge and detailed understanding of turtle anatomy to thoroughly examine the animal and note any unusual features. A naturally occurring infection called spirorchiid fluke was discovered, and determined to be the most likely cause of death.

Spirorchiid fluke is a naturally occurring parasite in marine turtles. Usually a turtle becomes infected, gets a bit sick and then recovers. But in this instance the fluke infection caused a blockage of the digestion tract. The resulting build-up of faeces and gas caused bloating and prevented the creature from being able to dive, feed or process food.

A sick green turtle, spotted by the Djelk Rangers during a sea country patrol

Above: Turtle sightings recorded by the Djelk Rangers in 2008 and 2009 using the I-Tracker Saltwater Country Patrol Application

Left: Djelk Rangers work with a resident NT Government scientist to perform an autopsy on a green turtle discovered during a routine patrol

Lama Lama Rangers: Sea patrols

The Yintjingga Aboriginal Corporation's Lama Lama Rangers manage a large sea country area in Princess Charlotte Bay, on the east coast of North Queensland.

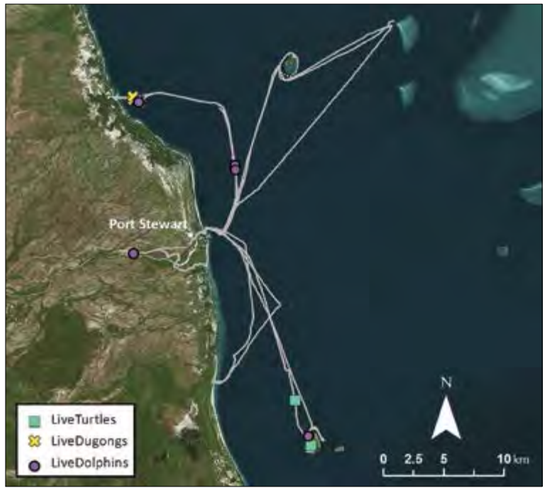
Over years of working together, they have built a strong relationship with the Great Barrier Reef Marine Park Authority (GBRMPA), and have worked in partnership with GBRMPA to develop their 'Sea Country Management Strategy', including the declaration of a Traditional Use of Marine Resources Agreement (TUMRA). This agreement outlines how Lama Lama and GBRMPA will work together to manage and protect sea country resources.

In 2013, the rangers conducted 'at sea' surveys with GBRMPA and research scientists as part of their Sea Country Cultural Heritage Week. Two NAILSMA I-Tracker officers were invited to attend as an opportunity for on-ground training in recording sightings and ranger effort. It was also a chance to explore with rangers the role that the I-Tracker Saltwater Country Patrol Application can play in fulfilling TUMRA requirements between the Lama Lama Rangers and GBRMPA.

The Lama Lama Rangers are building a strong base of skills and tools for managing their sea country. Acquisition of their boat, named the *Marrpa Chaos*, and training in essential boat safety and management skills is equipping the rangers to spend more time on country conducting regular sea patrols. Using the I-Tracker Saltwater Country Patrol Application to record their activities on country is a key component of their secure future in sea country management.

Lama Lama Rangers on patrol at the mouth of Breakfast Creek

Lama Lama Rangers monitor marine turtles during sea country patrols



Clockwise from above: Lama Lama Rangers and Junior Rangers, using the I-Tracker Saltwater Country Patrol Application, recorded four turtles (including both green turtles and a hawksbill turtle), four dugongs, and five dolphins (including bottlenose dolphins and an Australian snubfin dolphin) during a sea patrol in 2013

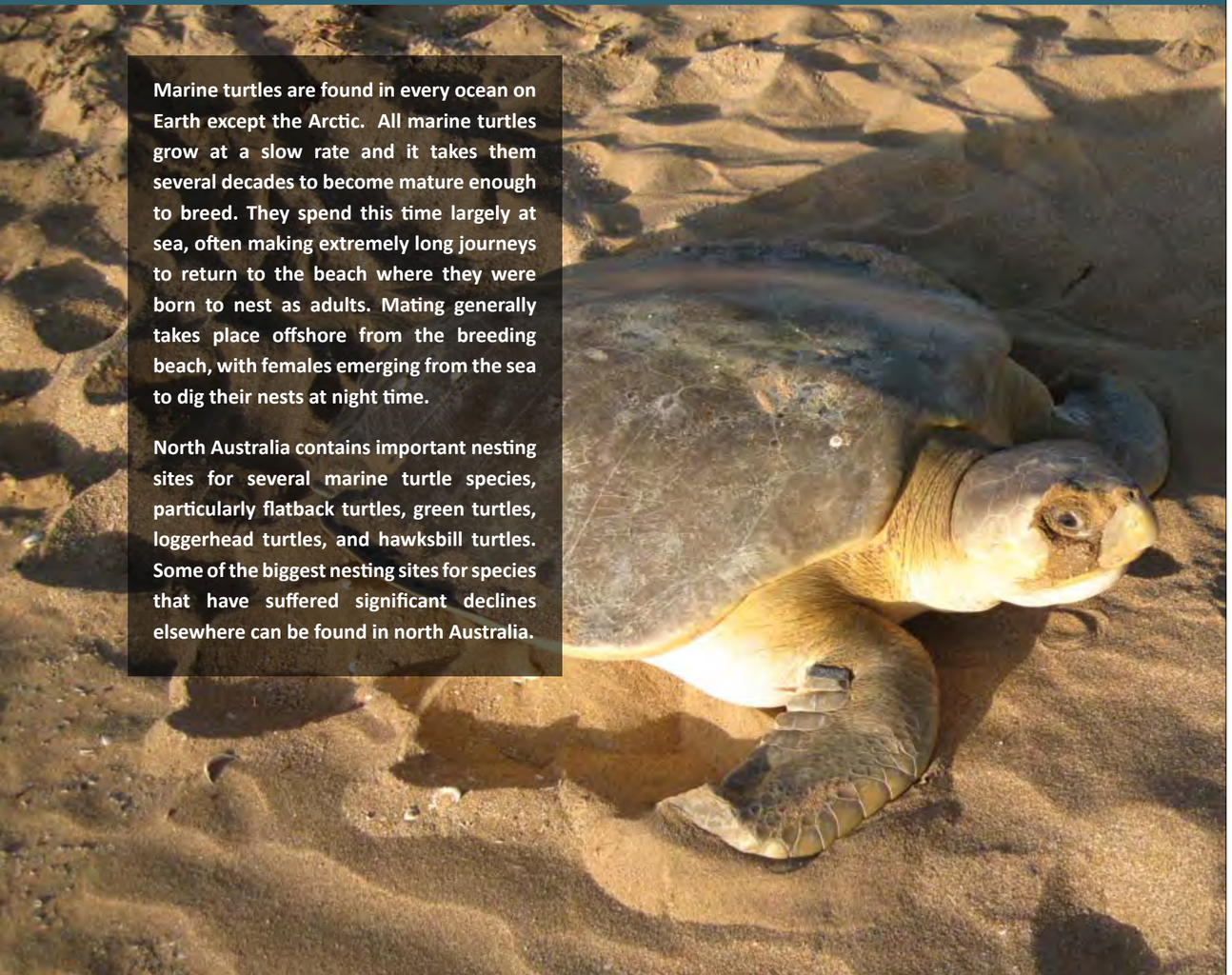
Lama Lama Rangers use the I-Tracker Saltwater Country Patrol Application to record information on their marine turtle monitoring

Turtle tracks on a beach

Saltwater Country Patrol Application:

Marine turtle nesting

I-Tracker

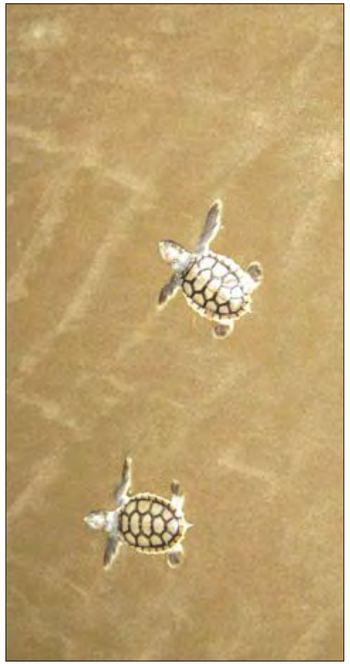


Marine turtles are found in every ocean on Earth except the Arctic. All marine turtles grow at a slow rate and it takes them several decades to become mature enough to breed. They spend this time largely at sea, often making extremely long journeys to return to the beach where they were born to nest as adults. Mating generally takes place offshore from the breeding beach, with females emerging from the sea to dig their nests at night time.

North Australia contains important nesting sites for several marine turtle species, particularly flatback turtles, green turtles, loggerhead turtles, and hawksbill turtles. Some of the biggest nesting sites for species that have suffered significant declines elsewhere can be found in north Australia.

While marine turtles can lay eggs at any time during the year, there is generally a 'peak season' on large nesting beaches when the majority of turtles come ashore to lay eggs for that year. This season usually lasts from several weeks to a couple of months. Monitoring turtle nesting during these peak times is logistically challenging, especially in remote areas. It involves camping on nesting beaches for anywhere from two to six weeks, and recording information about female turtles and nests laid on a nightly basis during that time. This information must be collected consistently for many years in order to reveal trends in nesting, as nesting numbers can naturally vary significantly from year to year because females do not nest every year.

Marine turtles are culturally significant for many Indigenous communities living in coastal north Australia, and indeed around the world. A number of Indigenous ranger programs across north Australia have established yearly 'turtle camps' where they monitor marine turtle nesting at peak times. They may also tag turtles for mark-recapture studies, and samples can be taken to assist with the genetic identification of populations of marine turtles within Australian waters (in other words, how populations of marine turtles are genetically related and where they travel). Ranger groups may receive technical and funding support from a variety of scientific, government and non-government agencies and record turtle nesting data in a variety of ways.



The I-Tracker Saltwater Country Patrol Application provides the ability to capture detailed information about nesting turtles including:

- location of the nest
- species that laid the nest
- nest age and condition
- conditions and number of eggs in the nest
- nest predation
- live turtles including species and measurements
- turtle tagging
- genetic samples taken from nesting turtles.

Ii-Anthawirriyarra Sea Rangers: Turtle camp

Since 2003, Ii-Anthawirriyarra Sea Rangers have been running a highly successful turtle camp. It takes place each year for two weeks during September and October on West Island, part of the Sir Edward Pellew Group near Borroloola, NT. The rangers count, tag and record hundreds of mostly flatback turtles, working through the night and catching some sleep in the hot afternoon hours. Equipment, food and people are ferried between the island and the mainland by boat or barge on a daily basis.

The rangers use the marine turtle nesting section of the I-Tracker Saltwater Country Patrol Application to capture detailed information about the turtle count and nest recordings.

The rangers also provide opportunities for members of the public to attend the turtle camps, making them a valuable activity for cross-cultural learning and environmental education.

Ii-Anthawirriyarra Rangers tag a nesting green turtle

Clockwise from above: Map showing the location of the turtle camp (inset) and the location of the 104 turtle nests that were recorded with the I-Tracker Saltwater Country Patrol Application over four days on West Island in 2010

Recently emerged flatback turtle hatchlings

Ii-Anthawirriyarra Sea Rangers watch turtle hatchlings emerge

Apudthama Rangers: Turtle camp

The Apudthama Rangers, based in the Northern Peninsula Area at the very tip of Cape York, have extensive stretches of beaches that are heavily used by nesting marine turtles. In 2012, they held their first turtle camp from late July until late August on Jardine Beach, and used the I-Tracker Saltwater Country Patrol Application to record turtle nests.

A total of 932 nests were recorded during 24 days. While this averages out to nearly 40 nests per night, the number of nests recorded on any given night varied substantially, with more than 70 nests recorded in a single night on five occasions and a record 99 nests recorded on 24 August 2012.

The vast majority of the nests recorded were flatback turtles and most were fresh, intact nests. However, 15 nests were recorded as already dug up, and four nests were recorded as already hatched. This effort involved about 140 hours of data recording during extensive treks up and down the beach.

Using the I-Tracker Saltwater Country Patrol Application helped the Apudthama Rangers record these time and distance aspects of their efforts, as well as the actual turtle nesting survey data.

Apudthama Rangers record turtle nests during their 2012 turtle camp at Jardine Beach

Above: Apudthama Rangers used the I-Tracker Saltwater Country Patrol Application to record 932 turtle nests during their 2012 turtle camp, which took place in July and August

Left: An Apudthama Ranger uses the I-Tracker Saltwater Country Patrol Application to record a nesting flatback turtle

Saltwater Country Patrol Application:

Ghost nets and marine debris

I-Tracker

Marine debris is human-created litter that has been accidentally or intentionally deposited in a marine or freshwater environment. It often includes plastic bags and bottles, polystyrene, and lost or discarded fishing nets (known as ghost nets). Marine debris tends to accumulate around focussed areas either in the water or on certain stretches of coastline. Marine debris in the water poses significant threats to wildlife through ingestion or entanglement, while coastal marine debris threatens beach-nesting species like marine turtles and shorebirds, and their habitats.

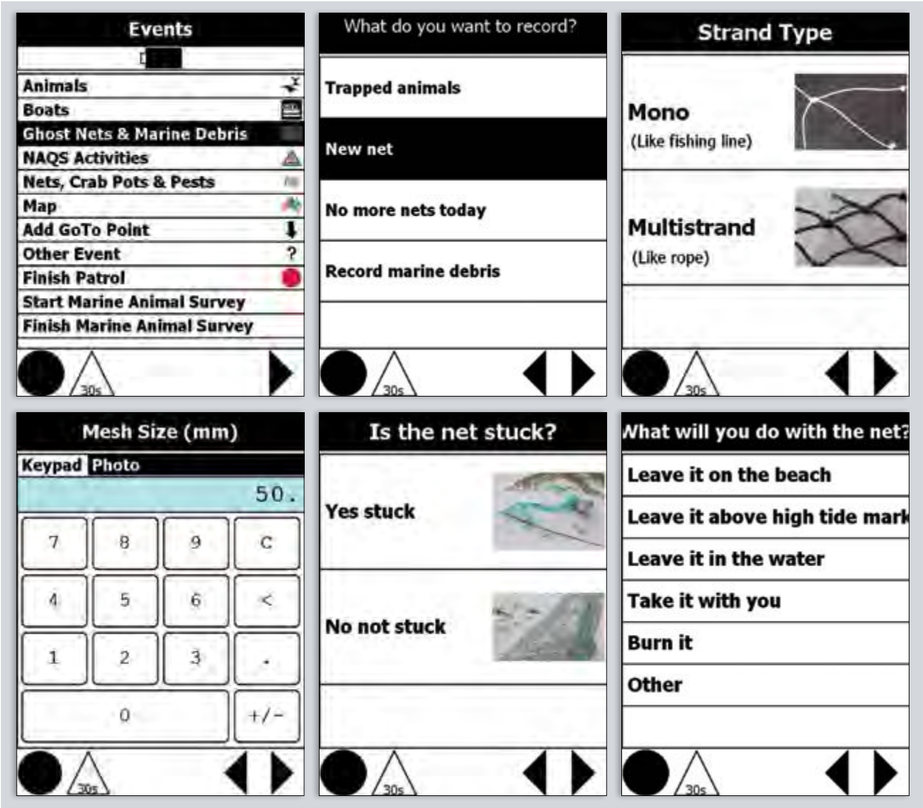
Yirralka Rangers collect a ghost net from a beach near Yilpara while conducting a patrol

North Australia has particularly severe problems with marine debris due to intensive fishing operations in the waters off the coast, and ocean currents that cause 'hotspots' of significant concentrations of marine debris along the vast north coastline. Discrete events such as illegal dumping of waste from ocean-going vessels further compound the problem. Regular monitoring is difficult due to the sparse human population and lack of surveillance and enforcement agents.

Indigenous ranger groups have a strong interest in the issue of marine debris, both in terms of their land and sea management, and the impacts it creates on beaches utilised by communities across the north Australia coastline. Marine debris threatens environmentally and culturally important species, and the quantity of foreign debris on beaches causes great concern to Indigenous communities. As a result, many Indigenous land and sea managers and communities have taken an active role in the monitoring and removal of marine debris on the north Australian coast.

Since 2009, NAILSMA has been working closely with GhostNets Australia (GNA) to include up-to-date data collection requirements for marine debris, and very detailed information for ghost nets specifically, within the I-Tracker Saltwater Country Patrol Application. The application is frequently revised so that ranger groups who work with GNA can collect data using the application and contribute this information to the GNA database.

Marine debris threatens environmentally and culturally important species. The quantity of foreign debris on beaches causes great concern to Indigenous communities. This photo shows some of the plastic rubbish collected by Indigenous rangers during a beach clean-up.



These six screenshots of data input and help screens from the I-Tracker Saltwater Country Patrol Application show some of the detailed information that can be captured about ghost nets. Information captured about strand type and mesh size helps identify the sources of the ghost nets. This part of the application was developed and is maintained in collaboration with GhostNets Australia.

GhostNets Australia

In the early 1990s, communities in the Gulf of Carpentaria started to notice increasing amounts of mostly foreign ghost nets washing up on their coastline. This was of major concern not only to local Indigenous land managers, but also to environmentalists, government and non-government agencies, and researchers because of the large numbers of turtles and other animals found entangled in the nets, as well as other environmental and cultural impacts. In 2004, a project was created that evolved into GhostNets Australia (GNA), bringing together the many disparate groups with an interest in reducing ghost nets and their impacts to find a solution to this extensive problem.

GNA operates across much of north Australia, supporting Indigenous rangers and other community members to implement what was coined at the first steering committee meeting as the '6R Program'. This title encapsulates the diversity of the work involved, which is:

- REMOVE nets
- RESCUE turtles
- RECORD data to support RESEARCH
- REPORT on activities beyond the community
- RE-USE nets as 'GhostNet Art'.

Implementation of the 6R Program is primarily through negotiated fee-for-service arrangements with ranger groups, who conduct regular patrols as detailed in their annual work plans. GNA also trains rangers in the collection of ghost net data, as this requires a complex set of skills including net identification, measurements in a variety of scales, spatial positioning and photography.

Originally this data was collected in paper-based surveys and copies were posted or faxed to the GNA Project Officers, who then manually entered the data into a combined online database. Photos were usually sent separately via email.

However, many substantial quality issues arose with this system, including:

- limits on the scope of information that could be collected, as the data categories had to fit on one page for field recording
- loss or damage of survey sheets during field work
- difficulties in correlating photos with data, due to their separate transmission
- conversion between the variety of positioning systems used in spatial data collection
- double handling of data, creating errors
- instances where no GPS position or photos were taken as equipment was sometimes forgotten during preparations for patrols.

In 2009, GNA was keen to partner with NAILSMA in trialling the newly developed I-Tracker Saltwater Country Patrol Application, as this one-stop tool held the promise of resolving all of these data quality issues. Through the course of the trial, GNA and rangers found that the tool achieved that and far more. Using the I-Tracker Saltwater Country Patrol Application allowed rangers to provide tracks of patrols where no nets were found. Spatial data became more accurate and reliable, and rangers became increasingly enthusiastic about collecting the data.

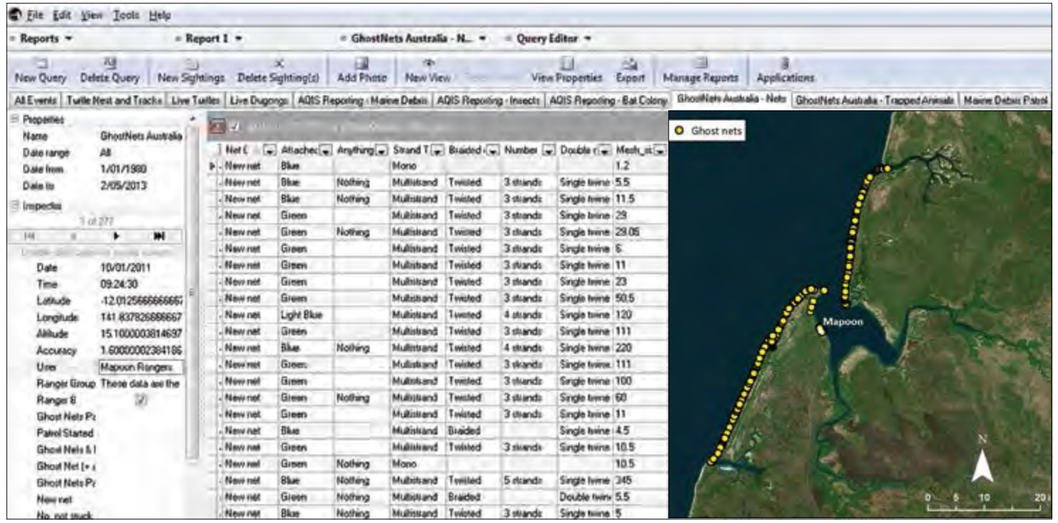
GNA continues to work with NAILSMA, providing computer skills workshops, on-ground training for rangers, and up-to-date data collection requirements for the I-Tracker Saltwater Country Patrol Application.

GhostNets Australia™
saltwater people working together

Since partnering with NAILSMA on the I-Tracker program in 2009, 26 ranger organisations have gathered nets and information for GNA. In 2012, 93% of participating groups collected and submitted their information electronically. This represents a remarkable uptake of this data collection method, and a critical tool to assist the network of north Australian communities working across a distance of over 2500 km on this single global issue.

The data collected by rangers in partnership with GNA has not only confirmed understandings of where ghost net hotspots occur, but is also being used to enhance models of marine debris movement and distribution, as the recorded locations of ghost nets are more specific than were previously recorded when using paper data sheets. This equates to over 6000 records of exact point data collected since 2010, a vast resource that is aiding the global effort against ghost nets. Data recorded on animal entanglements also feeds into the larger picture about the impact of derelict fishing nets on ecologically threatened and endangered species such as marine turtles.

Information gathered from this database has been the backbone of two scientific publications, and is helping GNA develop an understanding of where the nets are coming from, so that efforts and resources can be better targeted to stop the issue at its source.



This screenshot of a CyberTracker ghost nets database shows a sample of data collected by the Mapoon Rangers using the I-Tracker Saltwater Country Patrol Application

The north Australian communities that have collected and submitted data about ghost nets and animal entanglements (map supplied by GNA)

Two Wellesley Islands Rangers log information about a ghost net washed up on a local beach. The information, collected using the I-Tracker Saltwater Country Patrol Application, is sent to GNA.

Ghost net samples collected by rangers are sent to GNA for quality control and record keeping

Crocodile Islands Rangers: Marine debris patrols

The 10,000 km^2 of saltwater and islands managed by the Crocodile Islands Rangers are listed as a site of national significance for marine turtles, with considerable numbers of vulnerable flatback, green and endangered olive ridley turtles using the sandy beaches for nesting. These turtles are listed under Australia's Environment Protection and Biodiversity Conservation Act as being negatively impacted by ingestion of, and entanglement in, marine debris.

The Crocodile Islands community is working to improve marine turtle protection in a number of ways. The rangers are tackling the issue of marine debris on two levels: by providing community education on the impacts and prevention of marine debris, and by conducting regular marine debris and ghost net patrols on Murrungga, Rapuma, Nilpawa and Gurriba Islands. The rangers are active participants in the GhostNets Australia program.

A Crocodile Islands Ranger removes a ghost net from the shallow coastal waters of the Crocodile Islands *© Crocodile Islands Rangers*

In addition to removing dangerous waste through patrols, Traditional Owners have been working with the rangers to create a turtle sanctuary on Gurriba Island and the surrounding seas, where restrictions on traditional harvest are being trialled.

The map above was produced from data collected during a Crocodile Islands Rangers marine debris patrol. Red circles display all records of marine debris, including ghost nets (map supplied by Crocodile Islands Rangers).

With vast stretches of coastline spread across the twenty Crocodile Islands, and large expanses of water where deadly ghost nets may be drifting, there is an extensive area in which marine debris can potentially accumulate. By using the I-Tracker Saltwater Country Patrol Application to map data from their patrols, the Crocodile Islands Rangers can clearly show where ghost nets and other marine debris concentrate. Turtle sightings and nest data, which are also captured in the Saltwater Country Patrol Application, can be viewed together with the marine debris information. These mapping processes allow the rangers to visualise turtle management hotspots, which assists in planning future patrols to make the most effective use of limited resources.

Crocodile Islands Rangers use the I-Tracker Saltwater Country Patrol Application to record the details of a ghost net washed up on one of the Islands' many beaches *© Crocodile Islands Rangers*

Mapoon Land and Sea Rangers: Ghost net patrols

The Mapoon Land and Sea Rangers look after 70 km of coastline on the western coast of Cape York in Queensland. This area of the Cape is known as a ghost net hotspot and receives a very large volume of ghost nets and other marine debris that washes up annually on its shores. A big area of work for the Mapoon Rangers over the last nine years has been removing ghost nets from beaches to prevent them from re-entering the ocean and continuing to entrap turtles, crabs, fish and other wildlife.

The Mapoon Rangers have been participating in and collecting data as part of the GhostNets Australia program since 2005. A positive part of their involvement in the GhostNets program has been the provision of data, and feedback from GhostNets on the quality of this information. This has greatly improved the quality of data being collected using the I-Tracker Saltwater Country Patrol Application for ghost nets work, and has also supported overall data collection on land and sea management activities in the region. The ranger coordinator for the Mapoon Land and Sea Rangers noted, 'there has been no other relationship like that' with agencies with whom they share data. The partnership has worked both ways, with rangers also being very accommodating to changes in data collection methodology over time.

The Mapoon Rangers have recorded 1071 ghost nets since July 2010 using the I-Tracker Saltwater Country Patrol Application. These ghost nets were all removed or destroyed. The nets vary in size from a small bundle the size of a football, to nets that would fill a ute. The effort data recorded using the application shows that 119 patrols that included the recording and removal of ghost nets were undertaken in the three year period from 2010 to 2013. The Mapoon Rangers also released nine live turtles from ghost nets during that time, which is an encouraging result given that most animals found in ghost nets are already dead.

The map above shows the extent of the sea country that the Mapoon Rangers patrolled collecting data on ghost nets. The yellow circles show the locations where ghost nets were found.

Above: These photos were taken by the Mapoon Rangers using a mobile device's built-in camera. The rangers use the ghost nets and marine debris section of the I-Tracker Saltwater Country Patrol Application to record information while conducting patrols. Recordings such as these photos and other relevant data are stored using CyberTracker and are available for the rangers to use in their reporting and monitoring.

Photo Cecile Williams

Ghost net art

Disposal of the huge amount of rubbish found on the beaches in north Australia has placed an enormous burden on local refuse systems. Local artists with traditional weaving skills can use this waste material to make stunning artworks. Here, artist Gayangwa Lalara from Groote Eylandt, NT, displays one of her sculptures made from ghost nets and other beach debris at the Anindilyakwa Arts and Cultural Centre workshop 2011 organised by GhostNets Australia.

Saltwater Country Patrol Application:

Coastal surveillance

I-Tracker

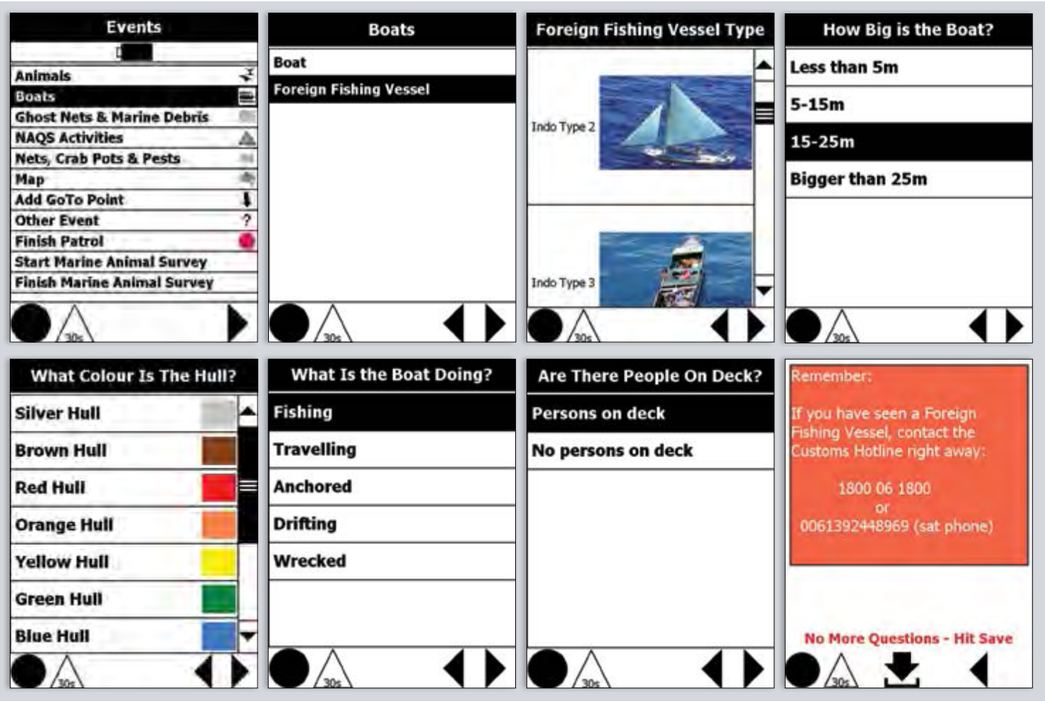
The vast and sparsely populated coastline of north Australia presents substantial challenges for surveillance and enforcement issues. Major international fisheries operate in waters north of Australia and can illegally enter and fish Australian waters undetected. Enforcing regulations on domestic commercial and recreational fishing across large distances is also challenging. In addition, Australia is at risk from introduced pest species and disease that can arrive through illegal fishing boats and gear, marine debris, and driftwood.

The Djelk Rangers' sea country capacity is supported by a fleet of four boats

Indigenous land and sea managers are uniquely situated to make significant contributions to the coastal surveillance of north Australia. Coastal Indigenous communities depend on the sea and its resources, and take a strong interest in managing the marine environment. Indigenous rangers are often the only active on-ground management presence in remote coastal areas, and their services are increasingly being recognised as a cost-effective way to patrol coastal areas and maintain an active surveillance presence on the water. Their extensive local knowledge and social networks also give them a unique advantage in detecting intruders and illegal activities.

Since 2002, ranger groups have received fee-for-service contracts from agencies such as Australian Customs and Northern Territory Fisheries to perform monitoring and surveillance activities, and report any suspicious activities or breaches of regulations to enforcement authorities. NAILSMA has worked closely with these organisations to incorporate data collection requirements for contracts with these agencies, and ensure that data collection is robust enough to assist with prosecutions of illegal activities reported by Indigenous land and sea managers.

The Djelk Rangers have been using CyberTracker applications to record surveillance effort and sightings for several years, and played an important role in developing the I-Tracker Saltwater Country Patrol Application



These eight screenshots show some of the data input and help screens from the boats section of the I-Tracker Saltwater Country Patrol Application. NAILSMA has worked closely with surveillance and enforcement agencies such as Australian Customs and Northern Territory Fisheries to incorporate data collection requirements for reporting illegal activities, such as sightings of foreign fishing vessels.

Djelk Rangers: Sea country patrols

The Djelk Rangers manage some 4000 km^2 of sea country, including a large number of marine sacred sites. For more than two decades, the Djelk Rangers have undertaken a range of land and sea management activities across the pristine coastline and waters around Maningrida, where the rangers are based.

Most coastal surveillance activities since 2008 have been supported by the use of CyberTracker applications, and more recently by the I-Tracker Saltwater Country Patrol Application. Applications created using CyberTracker allow the rangers to track and map all of their effort on surveillance patrols, and accurately report all sightings to a very high standard.

The sea ranger component of Djelk has developed its capabilities through the expansion of its fleet, its use of technology, and the training and skills of rangers themselves. As of 2013, the rangers boast a fleet which includes two Stabbi craft, a Formosa and the pride of its fleet, *Djelk II*, an 8300 Ocean Cylinder. As a result, Djelk has the infrastructure to respond to most events in all ocean conditions.

The Djelk Rangers carry out numerous activities across their sea country including:

- fee-for-service contracts for sea country management
- monitoring of commercial and recreational boats
- search and rescue operations
- monitoring of sacred sites
- research and monitoring of marine species, including turtles, dolphins and fish stocks
- surveillance of marine debris to detect invasive pests
- removal of ghost nets and other marine debris
- crocodile surveys and management
- coastal weed surveys and control
- knowledge sharing with other ranger groups locally and internationally.

From 2008 to April 2013, the Djelk Rangers recorded 8052 sightings relating to sea country management on 770 different days, covering almost 59,000 nautical miles. These tremendous results quickly demonstrate the constant and far-reaching effort the rangers put into maintaining an active presence on sea country.

One of the key factors in the success of the Djelk Sea Rangers has been their pioneering development of CyberTracker applications as a data collection tool. Digital data collection has enabled the Djelk Rangers to quantify their diverse range of activities and use that information to secure funding and support for operations and program development.

From the in-house development of the first Djelk applications through to the adoption of the current I-Tracker Saltwater Country Patrol Application, Djelk has embraced the use of technology and digital solutions, and taken full advantage of their ability to clearly document and quantify ranger activities.

The Maningrida/Junction Bay area has historically been a high-risk area for entry by illegal Foreign Fishing Vessels (FFVs), and small sea and air craft. The Djelk Rangers' intimate knowledge of their coastline, and the access options afforded by their fleet, enable them to provide a consistent presence out on the sea. This comprehensive coverage, together with the professional reporting capability underpinned by CyberTracker and I-Tracker applications, has led to the establishment of a fee-for-service agreement between Australian Customs and Border Protection Services, and Djelk's host organisation, Bawinanga Aboriginal Corporation.

The rangers' capacity has also led to service contracts and joint research with Northern Territory (NT) Fisheries. The partnership with NT Fisheries specifically targets illegal activities and marine pests that can harm the local and wider Australian community, and engages Indigenous rangers in

protecting country for the benefit of all Australians. It also benefits the rangers by providing opportunities for them to enhance their skills, and through the economic benefits associated with fee-for-service contracts.

During NT Fisheries monitoring, Djelk Rangers look for and report on a range of concerns including:

- exceeded fishing quota limits and protected species
- dead fish floating or washed up on shore
- vessels in creeks at night
- people operating in prohibited areas, such as sacred sites or inside fisheries closure lines
- nets or crab pots that are illegally set or have no markings or floats
- suspicious sale of fish and crab species
- community fishing patterns
- suspicious or unknown marine species located in strange places or in large numbers (potential marine pests).

The rangers are also part of a Top End research project with NT Fisheries to monitor the health of a number of reef fish species across the whole NT coastline. This involves catching certain species at regular intervals, and measuring and collecting bone and tissue samples that are used to sex and age the fish. These data, together with data collected by other research partners, are informing and enhancing the management of fish stocks and the coastline.

The map above shows the expansive effort of the Djelk Rangers, who recorded sea country patrols on 770 days from 2008 to mid-2013 (map supplied by Djelk Rangers)

Djelk Rangers photographed this saltwater crocodile while on a sea country patrol

Ii-Anthawirriyarra Rangers: Sea country patrols

For many years, Ii-Anthawirriyarra Sea Rangers have maintained a highly successful sea ranger program. They look after an extensive area of country on the Northern Territory (NT) side of the Gulf of Carpentaria, which includes long coastal stretches near Borroloola as well as many of the islands in the Sir Edward Pellew Group of Islands north of Borroloola.

The skills and capacity of the ranger group to conduct on-ground activities and collect high-quality data, together with the access options provided by their fleet of boats, have allowed Ii-Anthawirriyarra Sea Rangers to win fee-for-service contracts from NT Fisheries and the Marine Safety Branch.

The rangers use the I-Tracker Saltwater Country Patrol Application to record their management practices and activities on sea country, and have contributed to the ongoing review and updating of the application over time. Since 2008, they have recorded an impressive 4234 sightings and logged over 40,000 km using the I-Tracker Saltwater Country Patrol Application.

Ii-Anthawirriyarra Sea Rangers regularly patrol an extensive coastal area around Borroloola and the Sir Edward Pellew Group of Islands

Ii-Anthawirriyarra Sea Rangers have logged over 4000 sightings since 2008 using the I-Tracker Saltwater Country Patrol Application

Land Patrol Application

The I-Tracker Land Patrol Application is a suite of customised CyberTracker data input and help screens that equips Indigenous rangers to digitally record information during terrestrial patrols.

The I-Tracker Land Patrol Application supports Indigenous rangers in their work on a range of land management issues. This chapter highlights the following key sections of the application:

- fire
- weeds
- feral animals
- freshwater quality
- native plants and animals
- visitors
- biosecurity surveillance.

The I-Tracker Land Patrol Application was developed in response to requests from Indigenous ranger groups for additional patrol applications, following the widespread adoption of the I-Tracker Saltwater Country Patrol Application.

Prior to the development of the I-Tracker Land Patrol Application, some ranger groups were using CyberTracker applications to collect information on their land management activities, but these applications were specifically developed for use in local regions and were not immediately applicable to groups in other areas.

From its development, the I-Tracker Land Patrol Application has been rapidly adopted by groups across north Australia. The application is available as a free download from the NAILSMA website and is regularly updated to new versions.

Since its initial trial in 2011, the I-Tracker Land Patrol Application has been modified to accommodate new advice and requirements from Indigenous ranger groups across north Australia, as well as from Traditional Owners, government and non-government organisations, scientists and researchers, and natural resource managers.

Many organisations and individuals have made valuable contributions to the application over this time, and NAILSMA acknowledges and thanks these contributors, including:

- Indigenous rangers and ranger coordinators
- Aboriginal Areas Protection Authority
- Carpentaria Land Council Aboriginal Corporation
- Commonwealth Scientific and Industrial Research Organisation
- CyberTracker
- Darwin Centre for Bushfire Research
- Environs Kimberley
- Howley Environmental Consulting
- The Nature Conservancy
- Department of Natural Resources, Environment, the Arts and Sport (NT)
- North Australian Quarantine Strategy
- Department of Agriculture, Fisheries and Forestry
- Environment Centre NT
- South Cape York Catchments
- Tropical Rivers and Coastal Knowledge
- University of Western Australia
- Weeds Branch (NT).

As the stories in this chapter show, Indigenous rangers across north Australia are using the I-Tracker Land Patrol Application to help them look after their country in diverse ways. In each case though, the application is equipping Indigenous rangers to collect environmental and cultural data in a way that is more efficient, consistent, and methodologically sound than was previously possible. In addition, rangers benefit from easier data uploading and analysis back in the office, as well as simplified reporting and increased data sharing and pooling capacities, all while retaining ownership and control over their own databases of information.

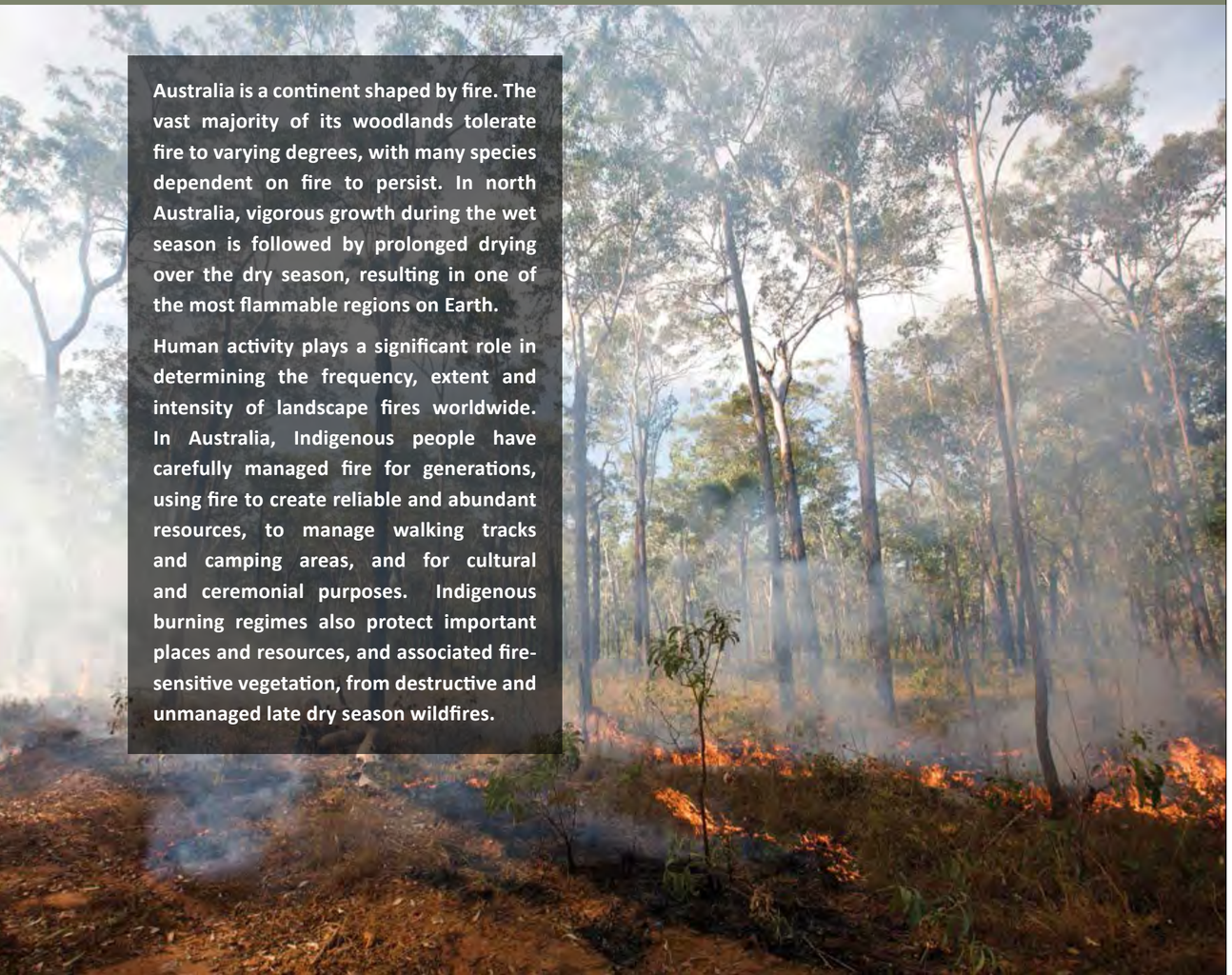
I-Tracker Land Patrol Application working group Darwin 2012

These eight screenshots show some of the data input and help screens from the I-Tracker Land Patrol Application, as they display on the mobile devices that Indigenous rangers use in the field. These screens are from the native plants and animals section of the application, and demonstrate how rangers progress through this section of the application by making selections on the mobile device. As a ranger records information related to the animal sighting, the application progresses on to the next screen, until the end of the sequence is reached and the ranger is prompted to save the sighting information (in this case, of a young female Mertens' water monitor).

Land Patrol Application:

Fire management

I-Tracker

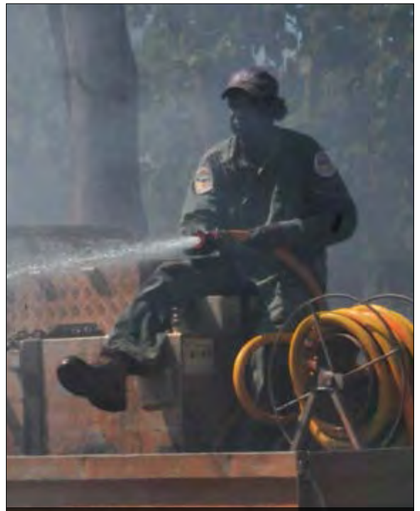


Australia is a continent shaped by fire. The vast majority of its woodlands tolerate fire to varying degrees, with many species dependent on fire to persist. In north Australia, vigorous growth during the wet season is followed by prolonged drying over the dry season, resulting in one of the most flammable regions on Earth.

Human activity plays a significant role in determining the frequency, extent and intensity of landscape fires worldwide. In Australia, Indigenous people have carefully managed fire for generations, using fire to create reliable and abundant resources, to manage walking tracks and camping areas, and for cultural and ceremonial purposes. Indigenous burning regimes also protect important places and resources, and associated fire-sensitive vegetation, from destructive and unmanaged late dry season wildfires.

Over time, with colonisation, changing land use, and depopulation, fires in many areas have shifted from Indigenous burning regimes to more destructive late season wildfires. In north Australia, however, numerous Indigenous land managers still work to progressively burn throughout the dry season, creating a mosaic of fire breaks and unburnt patches in regions that would otherwise be burnt by large, intense fires late in the dry season.

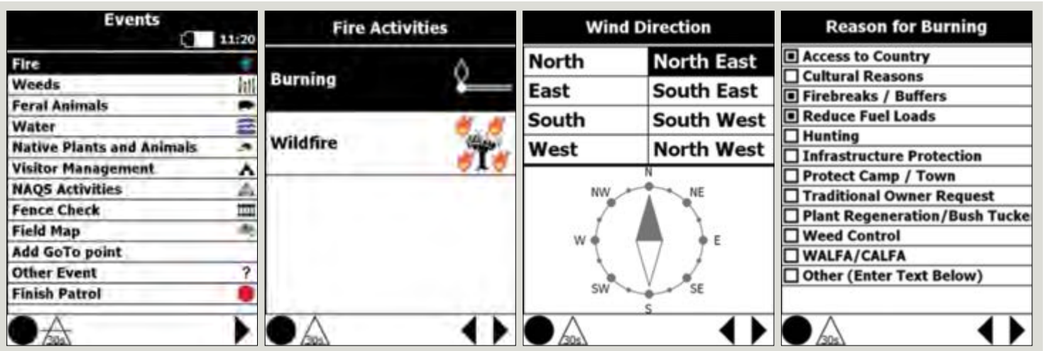
Indigenous rangers are key to the successful management of fire in the north Australian landscape. Of central importance to continuing and expanding Indigenous burning regimes is the capacity to fully integrate Indigenous practices with conservation and land management science. Knowledge of the occurrence of fire, best practices in the use of fire, and local fire history are essential to the work of all land managers. The I-Tracker Land Patrol Application enables Indigenous rangers to record their knowledge and activities in a robust and standardised way, helping land managers to work together across north Australia.



A Djelk Ranger secures a wildfire within the Djelk IPA

The fire management section of the I-Tracker Land Patrol Application equips rangers to collect detailed information on their fire management activities. The controlled burn option records a range of fire information including who was present, reasons for burning, burn method, travel method and spatial data about the burning track. The fire survey option allows rangers to monitor a fire and survey burnt and unburnt areas for management planning, ground truthing, and review purposes. The firefighting option records information about how the fire started (if known), the result of the suppression effort and whether follow-up is required. All sections of the application record a spatial track of all movements, the geographical location of recorded events, and effort data.

A NAILSMA staff member works with Djelk Rangers during an I-Tracker training session in 2012



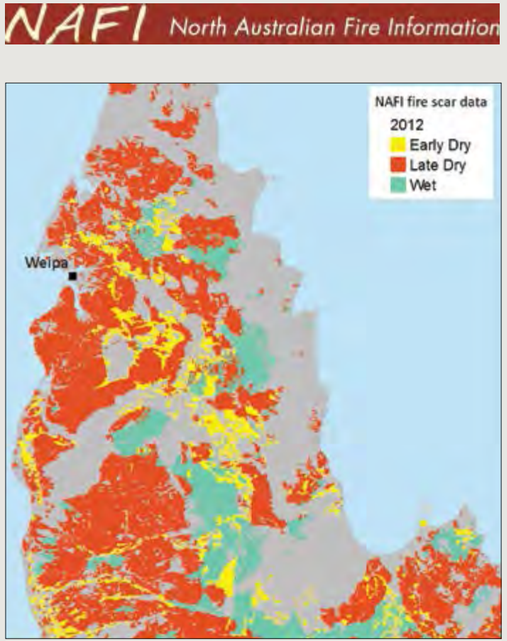
These four screenshots show some of the data input screens from the fire management section of the I-Tracker Land Patrol Application. Rangers on a fire management patrol select options to accurately enter data that can be accessed back at their ranger base.

North Australian Fire Information

The North Australian Fire Information (NAFI) website is the leading source of fire data and information for north Australian land managers. Since 2003, NAFI has been supplying fire management data detected by satellites, including locations of recent fires and maps of recently burnt country, via a web-based mapping interface. With data sourced from Landgate Western Australia (from NOAA and NASA satellites), Geoscience Australia (from NASA satellites), Darwin Centre for Bushfire Research (for NT and northern WA fire scars), and Cape York Peninsula Sustainable Futures (for Queensland), NAFI is a significant source of tailored information that assists north Australian fire managers to perform their role over vast areas.

Indigenous land managers routinely use NAFI information to help plan their controlled burns, to monitor burnt and unburnt areas, and as a base layer to view the field data they collect with I-Tracker applications. NAFI fire data is available online as a file to view in the freely-available Google Earth software, and it is also possible to export I-Tracker data from CyberTracker to Google Earth to overlay this information.

NAFI data is mostly derived from satellite imagery, using an automated process to detect fires. Data is cross-checked and validated through a process called *ground truthing*, where data collected on-ground is compared to the satellite imagery results. Indigenous land managers are a significant resource for the collection of ground data because they are the only on-ground land managers in many parts of north Australia. In order to make full use of this potential, I-Tracker staff have collaborated with NAFI to develop the I-Tracker NAFI Fire Ground Truthing Application. This application enables rangers to record burnt and unburnt sites, and data collected by rangers can be provided to NAFI to improve the accuracy of their overall mapping and help generate more fine-scale mapping in local areas.



NAFI fire scar data for North Queensland 2012, showing early dry, late dry and wet season fire scars. This data can be downloaded from the NAFI website for free, in a format suitable for Google Earth and other Geographic Information System software.

Djelk Rangers: Fire management

Burning-off on country serves a number of land management purposes. By regularly burning, fuel loads are reduced, preventing large, hot and devastating late dry season fires. Further, early dry season burning combined with a reduction in the extent of late dry season fire reduces greenhouse gas emissions.

The Djelk Rangers also burn as part of their commitments to the West Arnhem Land Fire Abatement (WALFA) project.

The WALFA project operates on over 28,000 km^2 of remote, biodiverse and culturally-rich Aboriginal land adjoining the World Heritage-listed Kakadu National Park. The project was initiated in 1996 to address chronic fire management problems in the savanna landscapes of western Arnhem Land. The project is a 17-year tripartite agreement between ConocoPhillips Australia (Darwin Liquefied Natural Gas), ranger groups, and the Northern Land Council.

Through the WALFA project, rangers are paid to abate 100,000 tonnes of carbon dioxide equivalent greenhouse gas emissions each year through the renewed application of customary fire management practices and the implementation of new prescribed burning operations. In 2012, the Djelk Rangers spent approximately 1600 hours undertaking burning activities covering 6800 km of roadside burning and 9766 km of aerial burning.

The Djelk Rangers build on their experiences in previous years, and work to include senior land owners in both planning activities and land management activities with rangers as they burn in the air and on the ground. More rangers are learning to master burning equipment such as the aerial incendiary machine and slip-on incendiary launcher, as well as developing their skills in planning and conducting controlled burns, and building and maintaining firebreaks.

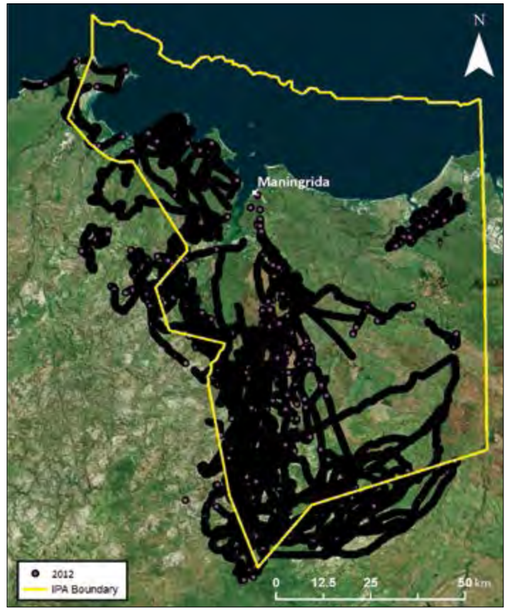
Remote on-ground burning operations are conducted through regular extended field trips, enabling greater consultation with Traditional Owners and community members. This has proved invaluable in facilitating the intergenerational transfer of knowledge and reaffirming the support of senior landowners. The presence of senior Traditional Owners also gives the younger rangers much needed confidence in knowing where and when to conduct burning operations and in accessing country.

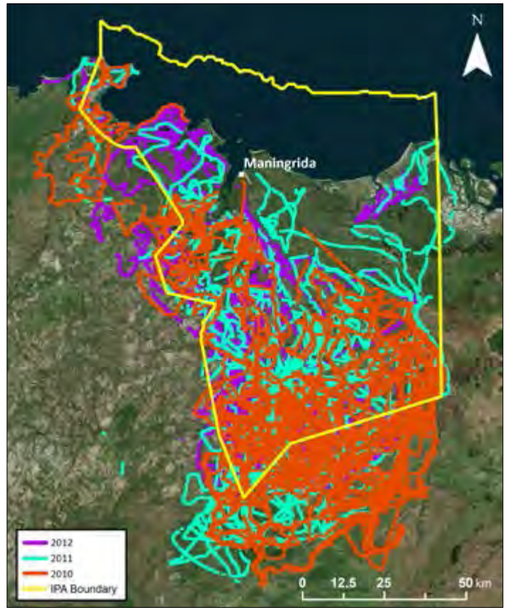
The Djelk Rangers championed the use of the Raindance incendiary machine in north Australia to increase the efficiency of aerial prescribed burning practices. Djelk commissioned CyberTracker to create a customised feature that would enable the Raindance data to be recorded in CyberTracker. The feature enables rangers to record the route flown, the GPS location of each incendiary dropped, and names of individuals present during each aerial burning operation. This information can then be overlaid on top of North Australian Fire Information (NAFI) layers to produce highly detailed maps of fire management operations.

Firefighting is also an important part of the Djelk Rangers fire management practices. Successfully controlling wildfires to protect people, assets and native bushland is an important aspect of their work. Djelk also work with neighbouring ranger groups in their firefighting efforts, including the Warddeken Rangers, highlighting the importance of partnerships between ranger groups in managing fire in the landscape.

Djelk Rangers on a fire management patrol

Djelk Rangers conduct controlled aerial burns within the Djelk IPA





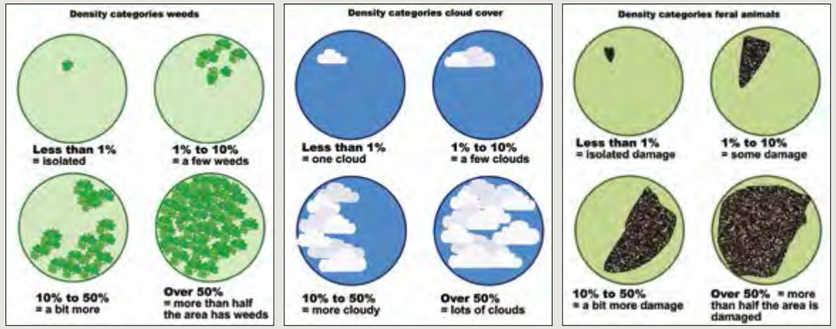
Clockwise from above left: 2012 Djelk aerial incendiary points

Djelk Rangers aerial prescribed burning operations from 2010-2012 using their CyberTracker application and a Raindance incendiary machine

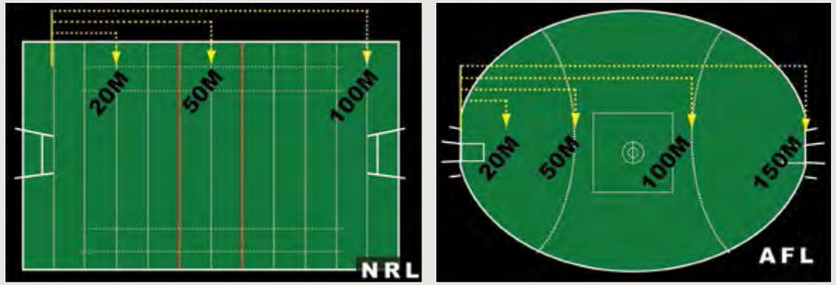
Djelk Rangers, a resident NT Government scientist and a NAILSMA staff member practice using the I-Tracker Land Patrol Application

I-Tracker Land Patrol Application help screens and field sheets

Numeracy and literacy levels vary among Indigenous land and sea managers. Since data collection methods are traditionally text based, it is important to incorporate icons, images and photographs into I-Tracker applications where possible. Help screens are included throughout the I-Tracker Land Patrol Application to help explain scientific monitoring concepts, with extensive use of illustrations (to represent animals, animal tracks and land management activities) and photographs (for identification of weed species and native animals). Using images has been well received by Indigenous land and sea managers. NAILSMA staff also produce related training materials, including field reference sheets, based on the graphics used in the application.



A selection of visual aids developed for the I-Tracker Land Patrol Application to explain the concept of density



National Rugby League (NRL) and Australian Football League (AFL) playing fields are used to illustrate distance and size of infestation when measuring an area of weed infestation while using the I-Tracker Land Patrol Application. The playing field used depends on which sport is most popular in each State or Territory.

Land Patrol Application:

Weed management

I-Tracker

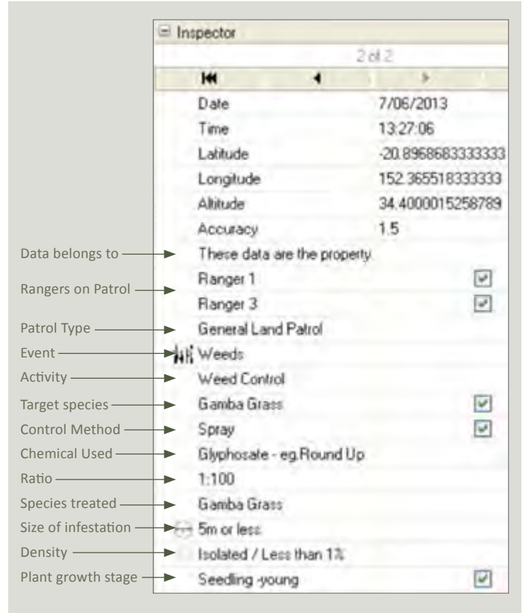
Weeds are any plants that establish and spread outside of their native habitat, and they can have devastating effects on the landscape. Weeds often outcompete native species for essential resources, altering ecosystems and destroying native vegetation and habitats essential for the health and survival of native animals. Because of their far-reaching effects, they have significant implications for natural and cultural resource management.

Weed infestations are a common threat to land management practices across north Australia. Weeds can restrict access to country, impacting on cultural activities and traditional use of the land including hunting and burning practices. The health of culturally and ecologically important freshwater systems is particularly threatened by impacts from weeds, and management of these significant zones presents a major challenge for the region.

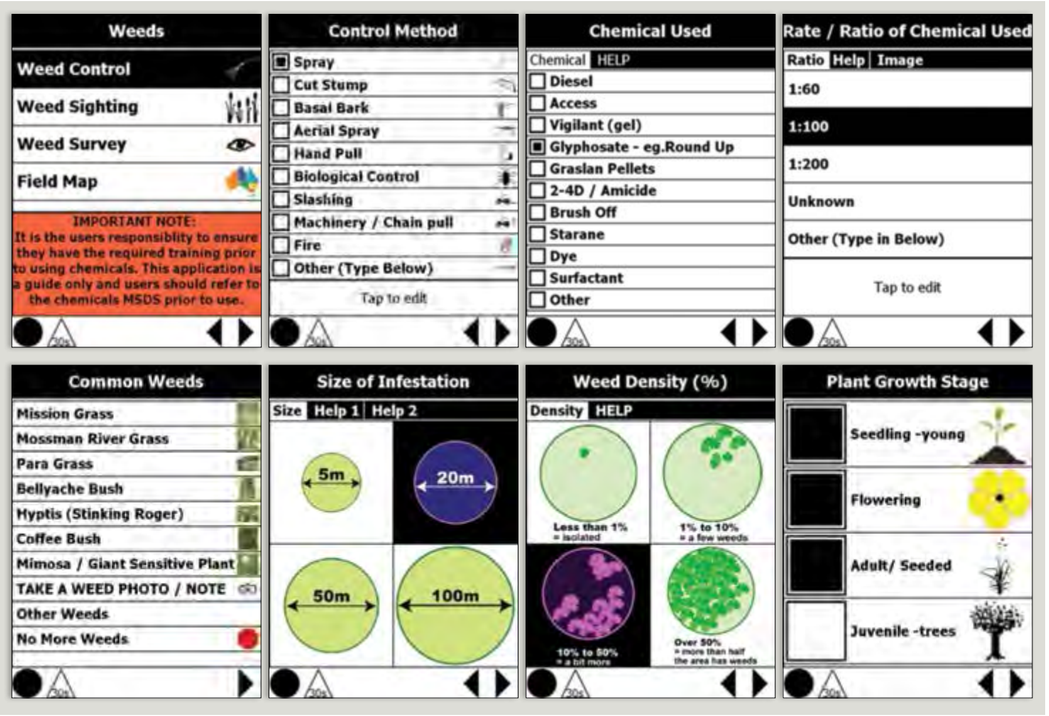
An Apudthama Ranger sprays gamba grass. Information on this weed management activity is recorded in the I-Tracker Land Patrol Application

Many Indigenous land managers have established weed management plans that aim to locate, identify and manage weed species within their country. Rangers target their management efforts to control current weed infestations, and monitor for undetected or new infestations of high priority weeds.

The weed management section of the I-Tracker Land Patrol Application allows rangers to collect data on opportunistic weed sightings, dedicated weed surveys and weed control events. All sections of the application have the capacity to record weed species identification, size of infestation, weed density and plant growth stage. A weed identification section contains photos of over 90 weed species to assist in the accurate identification and recording of weeds. Best practice methods for appropriate weeds data collection are incorporated into the I-Tracker Land Patrol Application, making this section applicable across the north.



Above is an example from the weed management section of the I-Tracker Land Patrol Application of the type of data recorded for a weed infestation site (in this case, chemical control of gamba grass). The information recorded includes the size of infestation, density, the plant's stage of growth, and control method and chemical applied.



These eight screenshots show some of the data input and help screens from the weed management section of the I-Tracker Land Patrol Application. Rangers select options as they progress through the screens, recording data that can be downloaded onto their computers once they have completed a patrol.

The map above shows various weed management work undertaken by four ranger groups across the NT: Djelk Rangers, Crocodile Islands Rangers, Yirralka Rangers, and Dhimurru Rangers.

This map is an example of how CyberTracker data can be combined across a region. The I-Tracker program provides standardised data collection applications that can be customised to suit local requirements, such as locally relevant weeds. Despite the customisations, the data collected can be combined to gain regional perspectives of issues such as invasive species, and help to encourage regional management approaches.

Apudthama Rangers: Weed management

The Apudthama Rangers have improved their access and insight into some out of the way areas of their country through a novel approach: conducting patrols on horseback. The rangers spend about five days doing each horseback patrol, with time to rest incorporated into their schedule. This allows them to keep an eye on areas that are normally not accessed regularly, to look for any suspicious activities and complete a variety of patrol activities, including weed management activities.

Between November 2012 and May 2013, the Apudthama Rangers recorded and treated close to 600 gamba grass infestations across approximately 2500 km^2 of country located on the northern tip of Cape York. Gamba grass is classified as a Weed of National Significance, and its high biomass can fuel intense bushfires, damaging ecosystems and threatening the safety of people and property.

Apudthama Rangers spraying gamba grass on Pajinka Road

The control of gamba grass and other weed species is a high priority for the Apudthama Rangers. The rangers use the I-Tracker Land Patrol Application to keep records of their weed management activities, allowing them to assess the rate of spread of target weeds, monitor the success of their management programs, and adapt their management plans accordingly. From November 2012 to May 2013, 67 weed patrols covering 5900 km were undertaken by the Apudthama Rangers. During the patrols, 582 weed sightings were recorded and 590 patrol hours were logged.

The Apudthama Rangers chemically treated nearly 600 sites of gamba grass from November 2012 to May 2013

Apudthama Rangers conduct patrols on horseback

Apudthama Rangers receive I-Tracker computer skills training on downloading data collected on land patrols and generating reports

Crocodile Islands Rangers: Weed management

Like many Indigenous ranger groups managing weeds in north Australia, a key goal of the Crocodile Islands Rangers is to survey, treat and monitor infestations of invasive Weeds of National Significance and other local weeds. With a vast land and sea country spread over 20 islands, the Crocodile Islands Rangers use a community action approach to successfully patrol and manage an expansive area with limited resources.

The Crocodile Islands Rangers work with groups such as the Junior Rangers, as well as the wider community, to inspire, educate and promote positive action to combat weeds. The first step in enlisting community support is to establish the community's understanding of, and attitudes towards, weeds. This is achieved by rangers conducting face-to-face interviews with community members.

A Crocodile Islands Ranger sprays weeds at Murrungga Island *© Crocodile Islands Rangers*

The Traditional Owners of Murrungga Island, part of the Crocodile Islands, recognise the biodiversity conservation value of this remote offshore island. The island is currently free from feral animals and has the potential to be free from declared weeds, making it an ideal wildlife sanctuary. *© Crocodile Islands Rangers*

These discussions are an important step in advancing local weed management, as many plant species that are now considered weeds have some desirable attributes as well.

By increasing environmental knowledge amongst the community, the rangers play a key role in educating people about the significance of the islands as biodiversity refuges, while helping to consolidate the community's efforts towards minimising the high impact that weeds can have on these unique small island habitats. The rangers engage with the community to encourage individuals to identify and report weed infestations, and moreover, to empower them to remove the weeds themselves.

The Crocodile Islands Rangers use the I-Tracker Land Patrol Application to record key information that aids their fight against weeds, including locations of individual plants and details of weed management activities. This is particularly useful for monitoring the success of weed control activities, because the mapping capabilities of the application allow rangers to easily identify and revisit sites where weeds have previously been treated, to assess and record the effectiveness of the treatment and inform planning of further action.

Sites of weed management activity during 2012 (map supplied by Crocodile Islands Rangers)

Land Patrol Application:

Feral animals

I-Tracker

Feral animals are introduced species that have spread beyond human control to establish wild populations. Feral animals contribute significantly to the degradation of native habitats, for example by encouraging the spread of weeds, degrading waterways, altering soils, and impacting on the survival and health of native plants and animals. Feral animal species vary by region, but are known to have contributed to the decline and extinction rate of native species across Australia.

In north Australia, feral animals are a common threat to native plants, animals and ecosystems. Indigenous land managers across the region have concerns about the impacts of feral animals on natural and cultural resources, and how these impacts affect traditional management practices.

Feral animal damage around waterways within the Laynhapuy Indigenous Protected Area

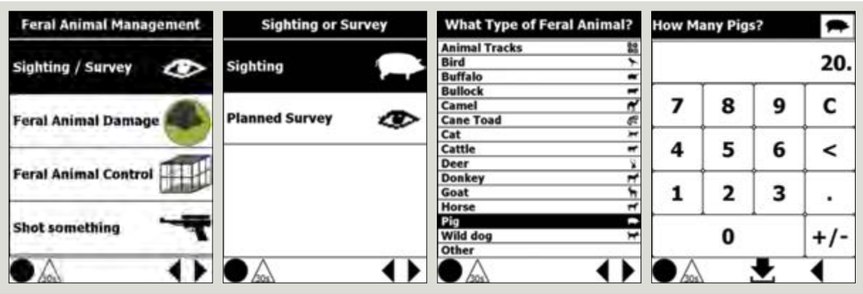
Of particular concern are hoofed animals, such as buffalo, pigs, cattle and donkeys, and the effects these animals are having. These include altering freshwater habitats, putting grazing pressure on vegetation, and fragmenting healthy ecosystems through erosion and saltwater intrusion.

Many Indigenous ranger groups have developed feral animal management plans to monitor and control the impacts of invasive species. To support these efforts, rangers need to be able to record information on the number and species of animals seen or controlled, the control methods used (for example, trapping, culling, monitoring, mustering or exclusion fencing), and the extent of feral animal damage seen on country, in order to inform their planning and activities, and monitor the success of their programs.

The feral animals section of the I-Tracker Land Patrol Application is used by ranger groups across north Australia to record data on opportunistic feral animal sightings, dedicated ground and aerial feral animal surveys, feral animal control measures, and feral animal damage. These data contribute to comprehensive efforts to control feral animals and reduce their impacts across the region.

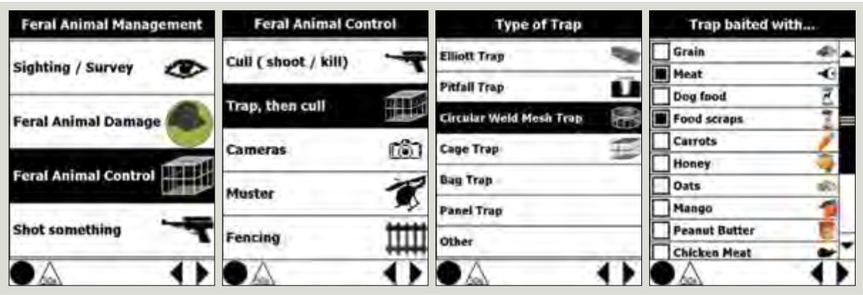
Feral buffalo grazing in the bush near Ramingining

Yirralka Rangers construct a temporary feral pig trap



Four of the data input screens from the feral animal management section of the I-Tracker Land Patrol Application (in this case, for recording information on feral pig sightings)

Four of the data input and help screens for assessing and recording data on feral animal damage



These four screenshots show some of the data input screens for recording data on feral animal control. In this example, rangers are setting a trap for pigs. The data collected includes GPS information for the location of the trap, type of trap and bait, date and time, and which rangers are present.

Yirralka Rangers: Feral buffalo management

Feral animals are an ongoing concern in the Laynhapuy Indigenous Protected Area (IPA), and population control and impact monitoring is a major focus of the Yirralka Rangers' work. Over the last few years, the rangers have been implementing their comprehensive management plans for both buffalo and pigs.

The Laynhapuy IPA was declared in 2006, and by 2008 Traditional Owners were making it clear that one of their most significant concerns was the increasing impact that introduced species were having on their natural resources. The Traditional Owners of the area enlisted the Yirralka Rangers to work towards better understanding and reversing these impacts.

Initial monitoring throughout the 4500 km² of IPA country showed marked areas of deterioration in floodplains, billabongs, and waterways, and an accompanying reduction of species such as magpie geese, freshwater turtles and various important plant species.

To assist in efforts to better manage buffalo and pigs within the IPA, the Yirralka Rangers and NAILSMA worked together to develop an I-Tracker buffalo aerial survey application. Consultations with Parks NT and CSIRO scientists provided the methodology for counting buffalo from the air to determine buffalo population densities.

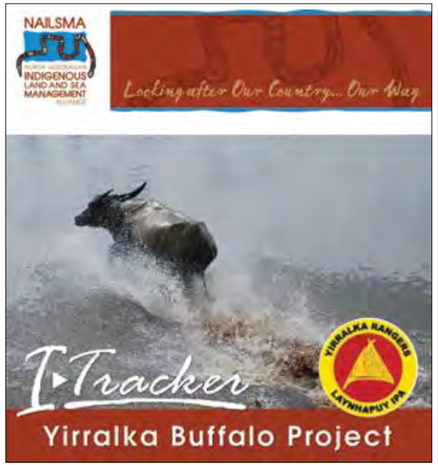
The application has been successfully used by rangers to record sightings of buffalo and pigs. During a survey in 2012, approximately 8000 buffalo were counted, and high density areas were targeted for further management and monitoring.

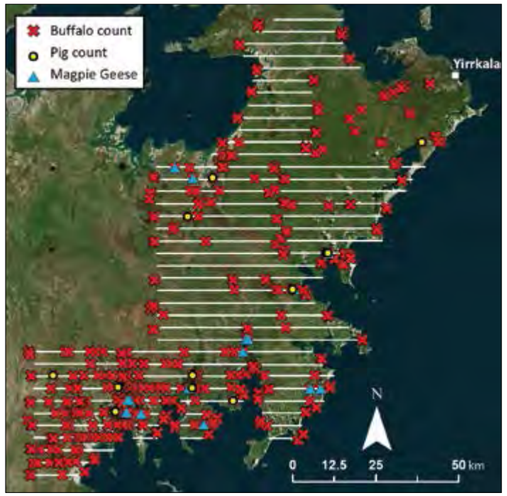
Aerial culling techniques are recognised by experts as by far the most cost-effective and humane form of control for buffalo and pigs when numbers are of high density. In 2012, the Yirralka Rangers had four fully qualified and experienced aerial marksmen who carried out culls targeting buffalo and pigs in areas of high conservation and cultural values. A total of 3500 animals were removed with plenty of meat provided to the surrounding communities.

The rangers monitor the effects of culling through experimental plots scattered throughout the Laynhapuy IPA. Their monitoring shows that the level of culling they engage in dramatically improves the condition of the wetlands and other water systems, reduces the erosion that contributes to saltwater intrusion, and increases the abundance of natural resources.

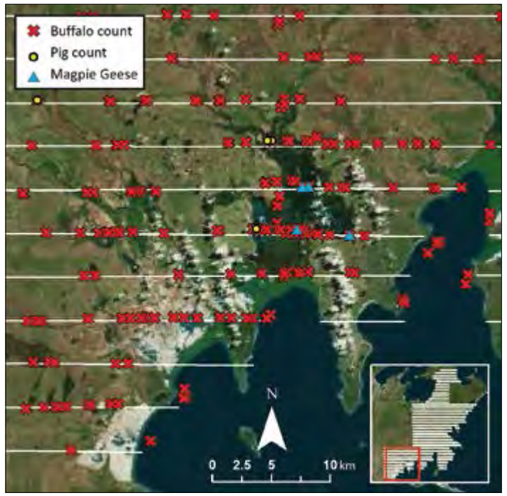
As with many feral animals, managing buffalo in the Laynhapuy IPA is complex, in part because rangers and Traditional Owners have to strike a balance between beneficial uses of buffalo such as safari businesses, and protecting natural resources. Despite these challenges, homeland leaders have indicated that they are thankful that the rangers are taking action towards a healthier future for the environment, people and culture.

Contributions from Manman Wirrapanda, cultural advisor and senior leader of Dhuruputjpi, and Dhukal Wirrapanda, 2nd senior leader of Dhuruputjpi.

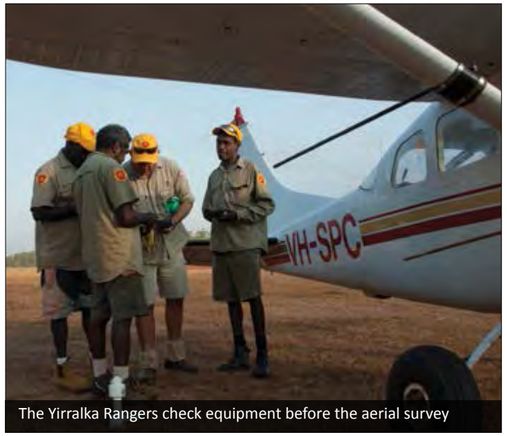




Animal sightings within the buffalo aerial survey area



Detail of recorded sightings of buffalo, pig and magpie geese near Balma



The Yirralka Rangers check equipment before the aerial survey

The Yirralka Rangers plan the day's aerial survey

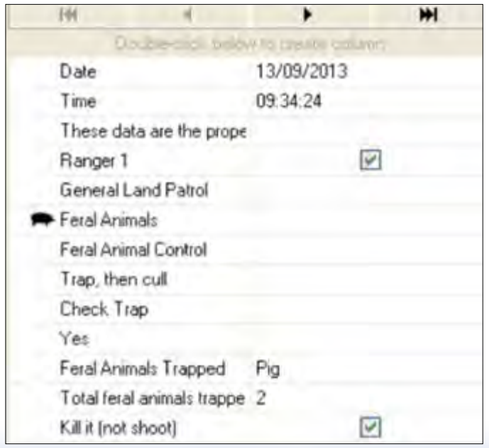
Kalan Land Management: Feral animal management

The Kalan Land Management Officers work with elders and young people from six clan groups based around Coen, on the Cape York Peninsula. Traditional Owners meet regularly to plan and guide activities in accordance with their cultural priorities. Working with the Kalan Land Management Officers, Traditional Owners and elders are passing on their knowledge of bush medicine and tucker, flora and fauna, ways of caring for country, and their traditional language.

The Kalan Land Management Officers work in divisions that include maintenance, cultural heritage, and flora and fauna. A particularly high priority for the officers is managing the impacts of feral animals. The officers conduct on-ground patrols across their country to detect and monitor damage from feral animals, and use the I-Tracker Land Patrol Application to record data on animals spotted, areas of damage, feral animal control activities, and other relevant aspects of their work.

Kalan Land Management Officers record feral animal damage around one of the waterholes within the Toolka Nature Refuge

The officers also regularly monitor freshwater springs, creeks and waterholes in order to protect these culturally and environmentally significant sites. They have worked to install and maintain fencing around their waterways to protect them from being damaged by feral animals, including cattle and pigs. They regularly monitor the fence lines to make sure that they are secure, and to check for any damage caused to the fence by feral animals.



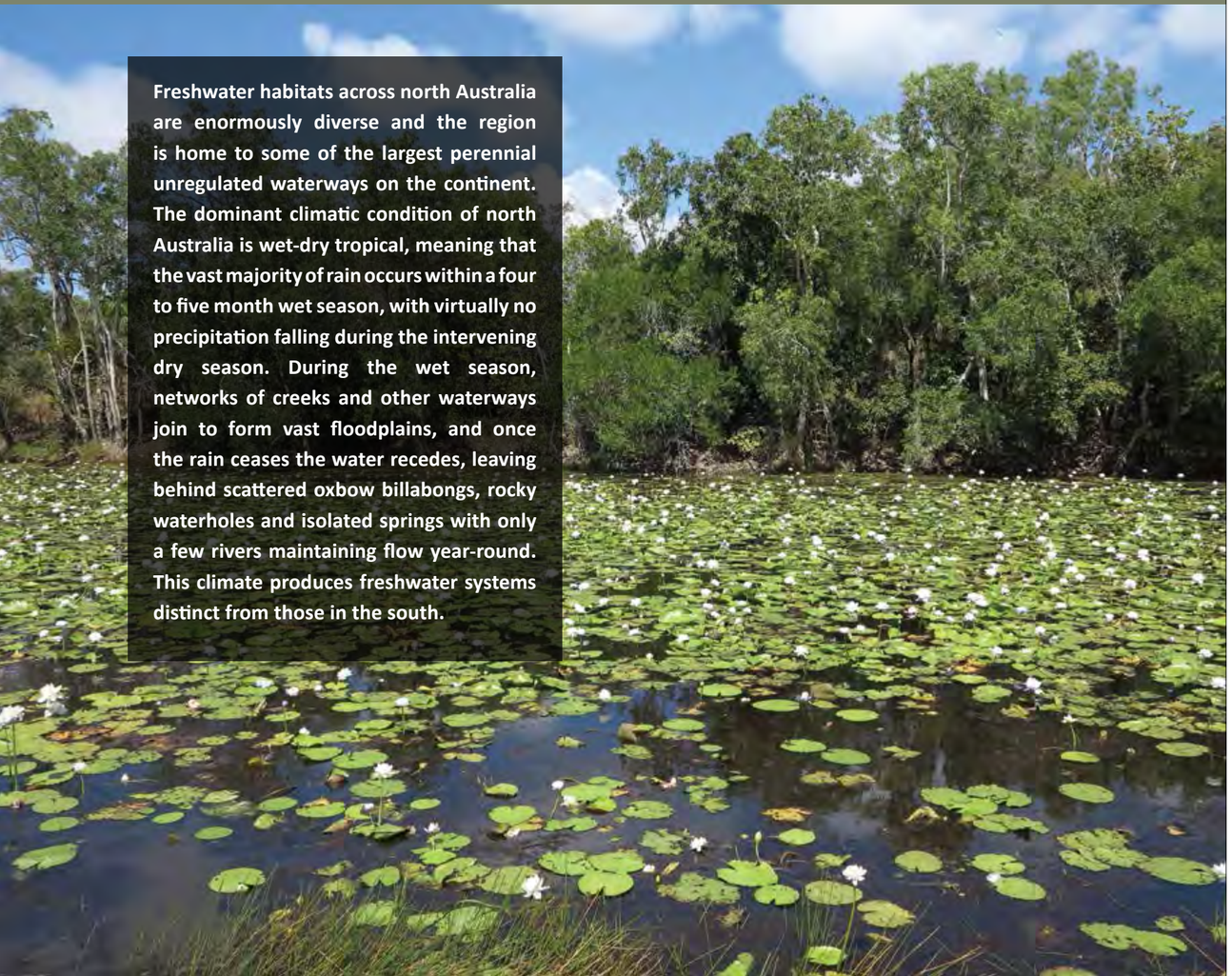
An example of a data record from checking a pig trap

Kalan Land Management Officers look out over their country

Land Patrol Application:

Freshwater monitoring

I-Tracker



Freshwater habitats across north Australia are enormously diverse and the region is home to some of the largest perennial unregulated waterways on the continent. The dominant climatic condition of north Australia is wet-dry tropical, meaning that the vast majority of rain occurs within a four to five month wet season, with virtually no precipitation falling during the intervening dry season. During the wet season, networks of creeks and other waterways join to form vast floodplains, and once the rain ceases the water recedes, leaving behind scattered oxbow billabongs, rocky waterholes and isolated springs with only a few rivers maintaining flow year-round. This climate produces freshwater systems distinct from those in the south.

Many catchments in the north have escaped the impacts of large-scale development that have devastated freshwater habitats across much of the rest of Australia. However, there are significant threats within the region, which will only increase as population and infrastructure expand.

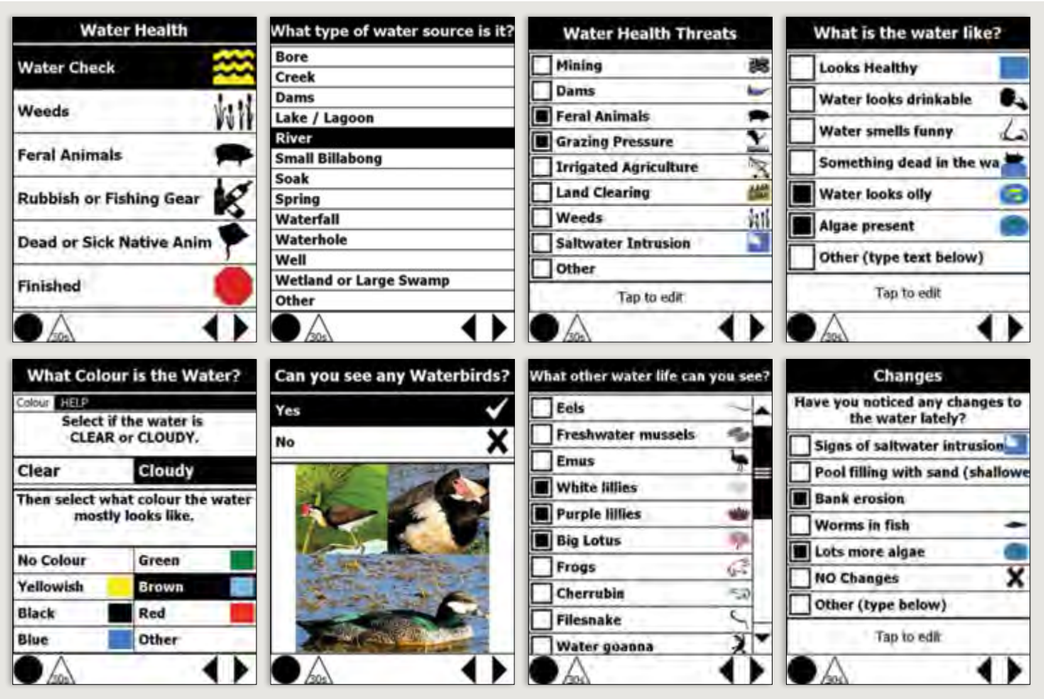
Across the region, soils have been impacted by a long history of small-scale mining activities and pastoralism, with gully erosion stripping away fragile soils. Further, many modern mining operations require large volumes of water for processing, and any future development of broad-scale agricultural and horticultural projects will also require significant water allocations to keep crops watered during the long dry season.

Many Indigenous communities are concerned about the health of fresh water on their country. Waterbodies are being impacted by introduced mammals and invasive fish species, weeds, and activities such as illegal fishing, pollution and littering by tourists and visitors. Indigenous rangers undertake management activities around waterbodies, such as weed and feral animal control and protective burning, to look after sensitive vegetation and water resources.

Two sections of the I-Tracker Land Patrol Application record information about freshwater areas and activities.

The water health section has been designed to collect observational information about the waterbody and the environment around it. This includes whether the water looks drinkable, the presence of aquatic life including fish and birds, potential threats to the ecological health of the area (such as mining or land clearing), and information about observed changes (such as an increase in algae). This section can be used on a quick visit to a site, with options to record as much or as little information as the rangers would like.

The water quality monitoring section is designed for groups who have access to scientific equipment to measure water quality parameters such as electrical conductivity, dissolved oxygen, and turbidity. In addition to quantitative water quality data, this section can also capture associated environmental information about the site such as time since last rainfall, current water level, water flow, density of weed infestations, and signs of feral animal damage.



These eight screenshots show some of the data input and help screens from the water health section of the I-Tracker Land Patrol Application. In this example, rangers collect data about the quality of the water including the visible presence of fish and birds. The data collected includes the GPS location, date and time of the observations, and environmental information such as bank erosion. By conducting regular surveys, rangers record comparative information over a number of years to build a long-term database of environmental information.

Lama Lama Rangers: Water health

The Lama Lama Rangers, based at Port Stewart, 60 km east of Coen in the Princess Charlotte Bay area of the Cape York Peninsula, look after both land and sea country, and work in partnership with the Queensland Parks and Wildlife Service to jointly manage Lama Lama and Marpa Island National Parks (Cape York Peninsula Aboriginal Land).

The Lama Lama Rangers undertake regular patrols across their country, and use the I-Tracker Land Patrol Application when conducting baseline flora and fauna sampling, freshwater monitoring, frog surveys, fire management activities, feral animal and weed control, and management of cultural sites.

Lama Lama Rangers use the I-Tracker Land Patrol Application to record information on water health

The rangers are also responsible for the management of a number of significant freshwater sites across their country, and have engaged in freshwater monitoring since 2009. Managing freshwater sites is a high priority for the Lama Lama Rangers, as these sites are both culturally and environmentally significant.

There are a number of threats affecting the health of waterways on Lama Lama country, including weeds and feral animal damage, especially impacts from pigs. Since 2011, the Lama Lama Rangers have used the I-Tracker Land Patrol Application to record data on the health of their waterways, such as native flora and fauna surveys, weed and pest impacts, and cultural use and values information, and are using that information to better map and manage these key areas on their country.

Sites where Lama Lama Rangers have undertaken observation-based water health checks since 2011

Locations where rangers have recorded water health data using the I-Tracker Land Patrol Application at Seven Mile Lagoon

Lama Lama Rangers attend a NAILSMA I-Tracker training program

Lama Lama Rangers attend the 2012 NAILSMA I-Tracker Forum

Lama Lama Rangers collect observational information at Seven Mile Lagoon using the I-Tracker Land Patrol Application

Land Patrol Application:

Native plants and animals

I-Tracker

Australia has been isolated from other continents for over 60 million years and its flora and fauna have evolved on their own unique trajectory. Unlike other continents, the flora are dominated by unique taxa such as Banksia and Eucalypts, as well as the largest diversity of Acacias on Earth. For its size, Australia is unusually diverse in bird and reptile taxa, and of course is unique in the diversity and abundance of marsupial mammals, which elsewhere were replaced by the evolution of placental mammals.

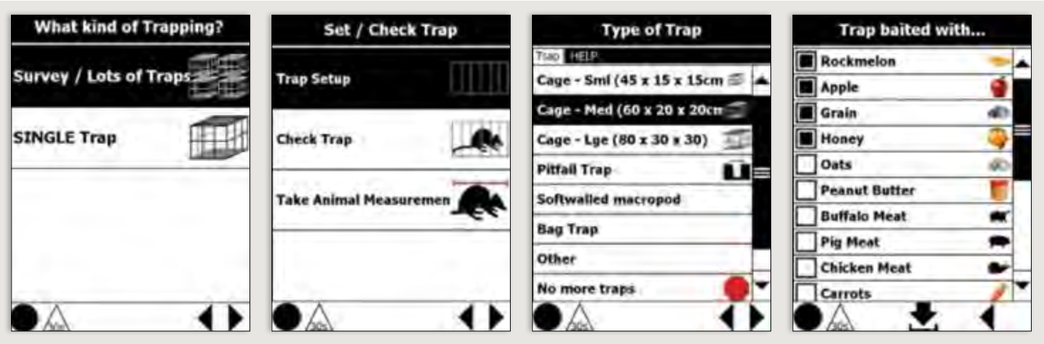
The management of this unique natural heritage has long been a central task for the Indigenous people of Australia's north. With sparse populations and vast areas to manage, the north of Australia presents significant challenges to the successful conservation and management of native plants and animals. Australia's Environment Protection and Biodiversity Conservation Act, the United Nations Declaration on the Rights of Indigenous People, and the Convention on Biodiversity all recognise and promote the role of Indigenous people in biodiversity conservation. A key challenge in fully realising this role is the development of a best practice model that combines the strengths of local action and knowledge with the expertise and standards of the environmental sciences.

With growing ownership of land by Indigenous people and over 36 million hectares of land in Indigenous Protected Areas, Indigenous conservation and land management efforts are essential to the success of native species conservation across much of Australia. Indigenous rangers are often the only locally-based managers present across much of the north, and their work in protecting native species is fundamental to the goals of broader conservation and land management efforts.

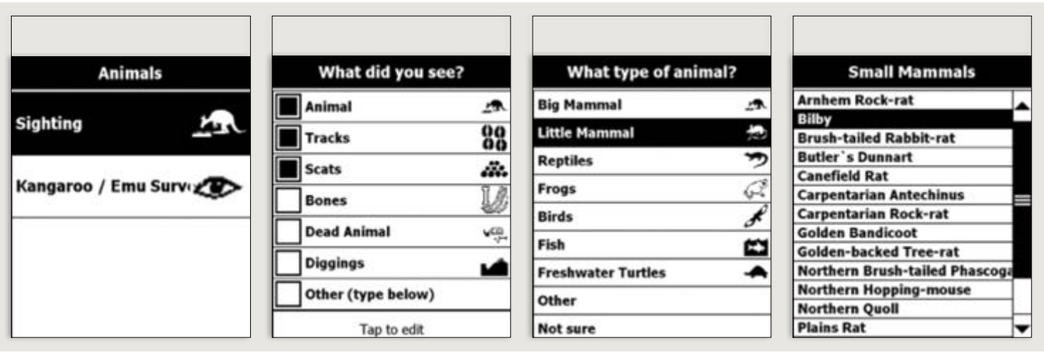
The Djelk Rangers work with a resident NT Government scientist to measure and record data about native animals using the I-Tracker Land Patrol Application

The native plants and animals section of the I-Tracker Land Patrol Application focuses on using best practice methodologies to record native plant and animal sightings, surveys and monitoring activities. The four main components of this section record information on trapping, camera surveys, plant and habitat assessments, and animal sightings.

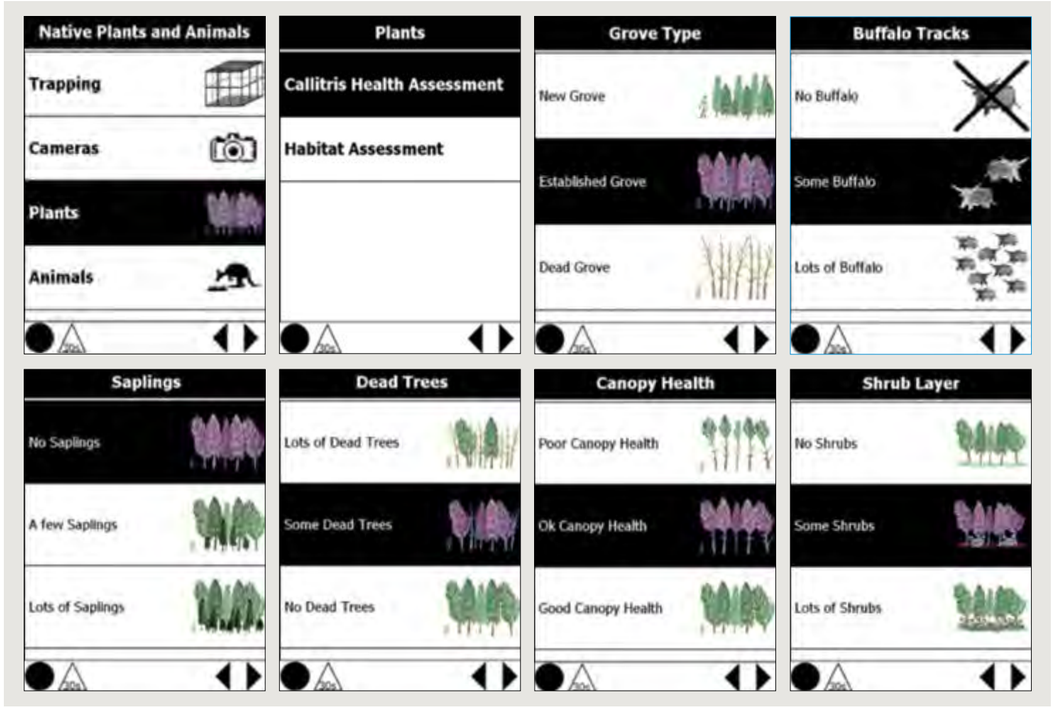
In addition to equipping rangers to better protect the native plants and animals on their own country, the I-Tracker Land Patrol Application also creates a network for long-term ecological monitoring and management, which can inform conservation science and planning at multiple levels.



Four of the data input screens used in the animal trapping section of the I-Tracker Land Patrol Application



Four of the data input screens used in the native animals section of the I-Tracker Land Patrol Application

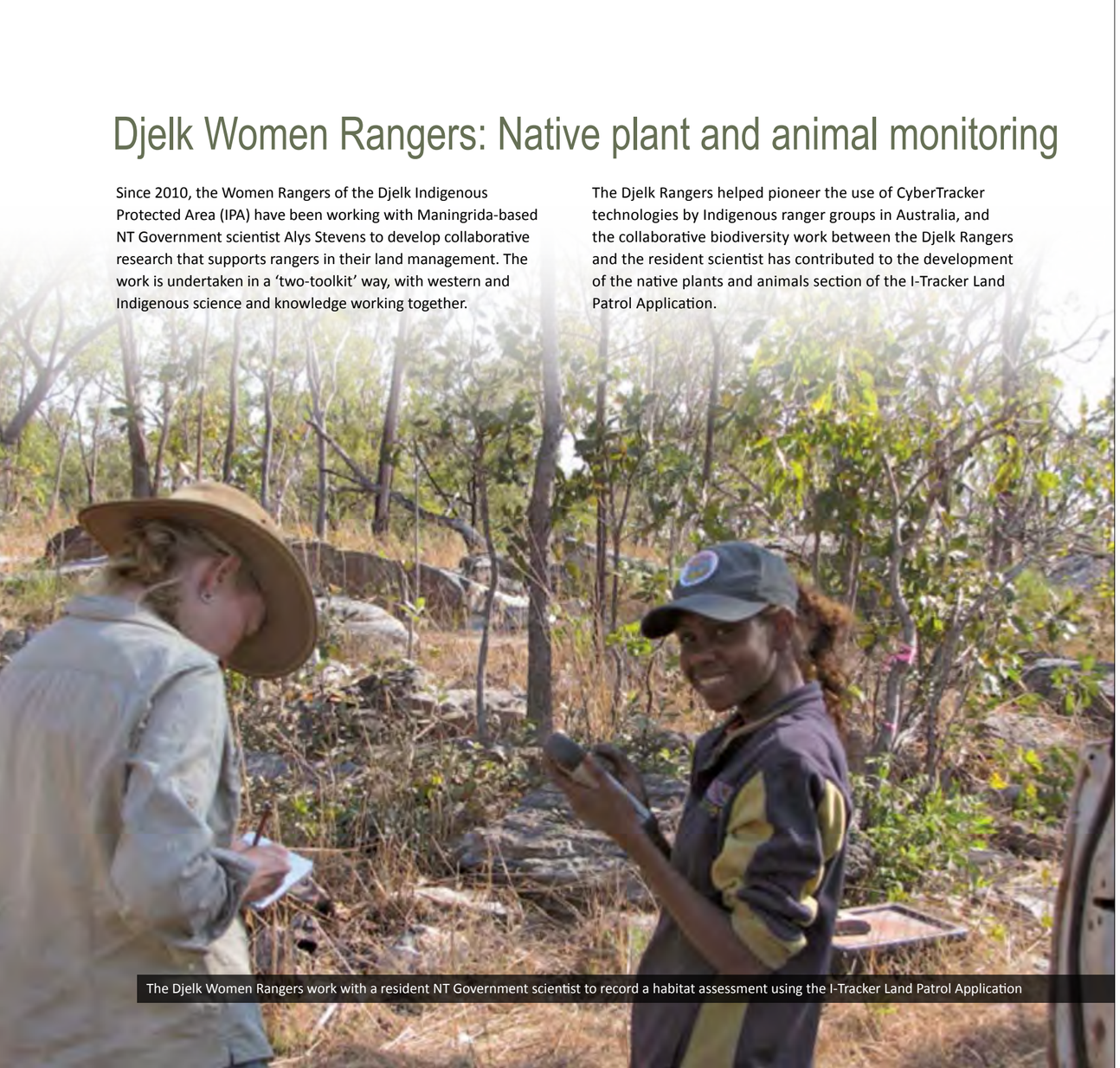


This part of the native plants and animals section of the I-Tracker Land Patrol Application calculates a health score for *Callitris*, using a Rapid Callitris Health Assessment developed by Clay Trauernicht with illustrations by Joshua Rostron from Kolorbidadah Outstation. The *Callitris* assessment can be used across most of north Australia and is a good indicator of general ecosystem health. There is also a habitat assessment in this section that incorporates the Woinarski methodology.

Djelk Women Rangers: Native plant and animal monitoring

Since 2010, the Women Rangers of the Djelk Indigenous Protected Area (IPA) have been working with Maningrida-based NT Government scientist Alys Stevens to develop collaborative research that supports rangers in their land management. The work is undertaken in a 'two-toolkit' way, with western and Indigenous science and knowledge working together.

The Djelk Rangers helped pioneer the use of CyberTracker technologies by Indigenous ranger groups in Australia, and the collaborative biodiversity work between the Djelk Rangers and the resident scientist has contributed to the development of the native plants and animals section of the I-Tracker Land Patrol Application.



The Djelk Women Rangers work with a resident NT Government scientist to record a habitat assessment using the I-Tracker Land Patrol Application

At the start of the collaboration, there was a period of getting to know each other on country which consisted of camping out with a good deal of small mammal and reptile trapping gear, and seeing what could be found. This work then developed into a federally funded project working to develop monitoring tools accessible to rangers on country, such as motion-sensing cameras, as well as identify a number of animal monitoring sites that can be related to particular land management activities, such as fire.

In August 2012, the Djelk Women Rangers together with collaborators set out to trial the first version of the trapping and habitat assessment sections of the I-Tracker Land Patrol Application. The women camped at Benembenemdi on the Imimbar Creek in the Djelk IPA in Arnhem Land for a week. They ran eight sites, with 24 small mammal traps at each one. The I-Tracker Land Patrol Application was used to record the trap composition of each site, each time the traps were checked, the details of any animals that were caught, and some basic habitat details of each trap site. There was much useful practical discussion of the layout of the trapping sequence during the trial, with suggested modifications recorded by the women and incorporated in the next version of the I-Tracker Land Patrol Application.

Use of the habitat assessment part of the application led to some unanticipated but very enlightening conversations. As they sat by the river and Alys Stevens attempted to communicate western scientific perceptions and classifications of country, the young Djelk women discussed these concepts in language between themselves, and with the senior female Traditional Owner for that area who accompanied them on all of their camping trips. What flowed from that was an exchange of higher-order country-specific language. The younger women learnt new terms in their own language for describing country, as well as some new English terminology.

The moral of this story is clear: getting people out bush and working on country has numerous positive outcomes, and Indigenous ranger groups are central to this effort. CyberTracker is quickly becoming a tool of the trade for Indigenous land management in the north, but through the melding of different knowledge systems it can have a host of other benefits beyond simple data collection, which is a win in itself for both Indigenous people and western scientists.

Native plant and animal (biodiversity) assessments and trapping locations undertaken by the Djelk Women Rangers in 2012

Bardi Jawi Rangers: Biodiversity monitoring

Damon Pyke and Frank Weisenberger (Kimberley Land Council)

The Bardi Jawi Rangers are made up of two distinct groups of people: Bardi and Jawi. Bardi people live on the mainland of the Dampier Peninsula and islands immediately offshore from Ardyaloon (One Arm Point). Jawi people call the islands further east, including Iwany (Sunday Island), their traditional country. Iwany formerly hosted a mission where many Bardi and Jawi people lived until it was closed in the 1960s, after which people moved either to the nearby mainland or further away to Derby.

A Bardi Jawi Traditional Owner and a ranger inspect a native mosaic-tailed rat *© Kimberley Land Council*

In 2012, the Bardi Jawi Rangers, supported through the Kimberley Land Council, returned to Iwany to undertake biodiversity surveys on the island. Across a five day period, they set up funnel line and cage traps in the southern part of Iwany near the old mission and an outstation site. There they recorded observations of birds, mammals and reptiles and also deployed camera traps across the islands. The survey was focused on the detection of rats, especially the introduced black rat (*Rattus rattus*), to better target eradication strategies.

The Bardi Jawi Rangers covered 644 km across 95 hours of survey effort. Observations included 15 species of reptiles, 40 species of birds, 10 species of bats, but only one species of rodent; the 30 cameras deployed across the islands provided abundant evidence of the native mosaic-tailed rat (*Melomys burtoni*), but no sightings of black rats.

The capacity of the rangers to successfully conduct the survey was greatly enhanced by the use of digital tools and applications. Live GPS positioning, tracking and mapping aided navigation across the seas between the islands, and the survey itself ran smoothly thanks to the capacity to manage remote deployment of camera traps with drop-off and pick-up sequences. The rangers were able to collect a wealth of data, including trapping data (species and biometrics such as length, weight, gender, and age) and incidental observations, and the collection of digital data expedited data entry after returning from the field.

The study has enhanced the understanding of the fauna present across the islands and their high conservation value. The native plants and animals section of the I-Tracker Land Patrol Application made key contributions to the success of these surveys, and will also allow the Bardi Jawi Rangers to easily access past observations and come informed when revisiting important natural and cultural sites on their country in the future.

Kimberley Land Council Rangers shade and hide funnel traps with spinifex *© Kimberley Land Council*

Kimberley Land Council Rangers set out cages near Sunday Island Mission *© Kimberley Land Council*

Rangers consult maps showing the locations of sacred sites, to plan where to place traps and cameras for biodiversity monitoring *© Kimberley Land Council*

Yirralka Miyalk Rangers: Bush product harvest

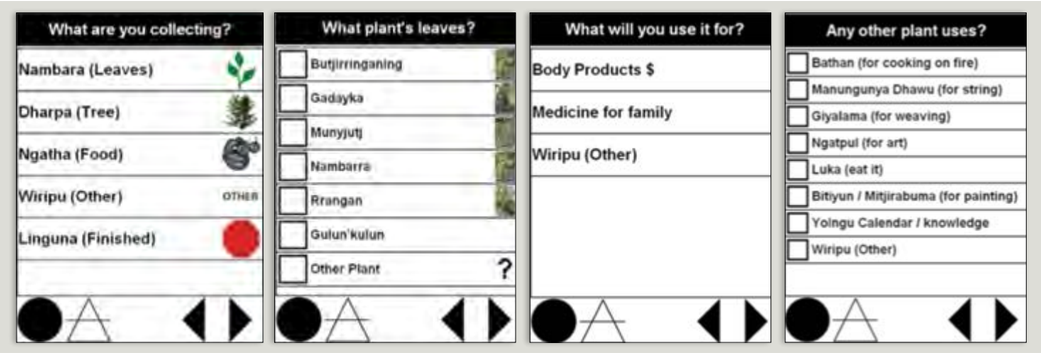
In 2011, the Yirralka Miyalk (Women) Rangers began developing a bush products enterprise consisting of the production of personal care products and essential oils. This was made possible through the local knowledge of the rangers and community members, and their involvement in various forms of training workshops with Indigenous community organisations such as Aboriginal Bush Traders. The workshops have built skills in all aspects of bush product development, from product making, product development and researching to business management and marketing. This has given the rangers an opportunity to learn valuable skills in business development and sustainable use of their natural resources.

The Yirralka Rangers use a number of I-Tracker applications to record information about their land and sea management work. A dedicated I-Tracker application was developed to monitor and record the Miyalk Rangers bush harvest activities. It records the specific plant species, fruit and seeds that are collected and used to make their bush products. It also records cultural

Yirralka Miyalk Rangers harvest plants to produce bush skincare products

knowledge and other information deemed important by the rangers. The application uses both English and Yolngu Matha throughout and contains pictures and icons of the different species that are being harvested. The application will continue to be modified to suit the Miyalk Rangers' requirements.

To date, the rangers have made and sold salt scrubs, soaps and lip balms at various festivals and markets across the NT including the Garma Festival, Nhulunbuy shops and the Darwin markets.



Four of the data input screens from the I-Tracker Yirralka Miyalk Rangers Bush Harvest Application

Yirralka Miyalk Rangers selling homemade bush products, Parap Markets 2012

The Yirralka Miyalk Rangers trial the Bush Harvest Application

Clockwise from above left: Yirralka Miyalk Rangers preparing plants to make their skincare bush products

Djäpa (*Carallia brachiata)*

Djiŋ'pu (*Ficus superba)*

Yirralka Miyalk Rangers sell their bush products at the Garma Festival 2013

Land Patrol Application:

Visitor management

I-Tracker

Tourism is a significant industry for Australia's economy, and north Australia is home to a number of destinations that attract large numbers of domestic and international tourists each year. Tourism ventures promise a wealth of opportunities for Indigenous communities, with success to date ranging from the Indigenous arts and craft sector to remote camping and fishing ventures.

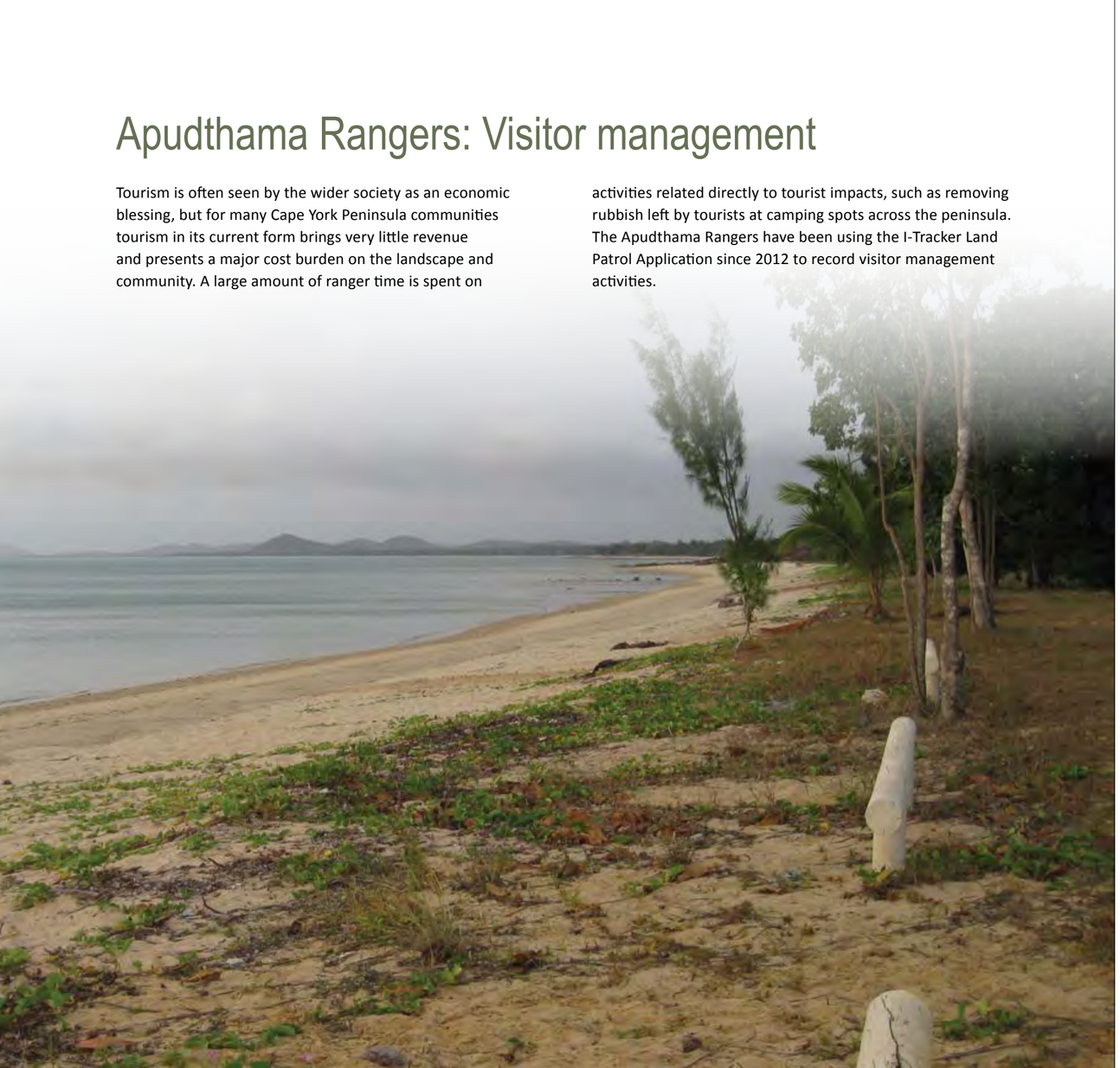
Creating and sustaining tourism-based enterprises on country involves significant work in visitor management. Considerable effort, time and financial support from government agencies and from Indigenous communities themselves is required to enable culturally appropriate enterprise development and economic benefits to be realised. In general, visitor management across north Australia has become an added workload for Indigenous ranger groups, requiring additional activities such as maintaining campsites, removing rubbish, managing visitor facilities, recovering stranded vehicles and boats, and rehabilitating tracks and sensitive areas that are damaged or degraded by visitor use.

The visitor management section of the I-Tracker Land Patrol Application enables data to be collected on visitor management activities. Many Indigenous ranger groups are responsible for managing tourist areas, and are interested in tracking their efforts as well as the numbers and activities of people that come onto their country every year. The visitor management section allows data to be collected on visitor numbers, travel activities, campsite maintenance tasks, and visitor impacts. The application also includes a section to record any assistance visitors require, as rangers are often involved in response activities such as recovering boats that have run aground or run out of fuel, recovery of vehicles, and attendance at accident scenes.

Nine of the data input screens from the visitor management section of the I-Tracker Land Patrol Application

Apudthama Rangers: Visitor management

Tourism is often seen by the wider society as an economic blessing, but for many Cape York Peninsula communities tourism in its current form brings very little revenue and presents a major cost burden on the landscape and community. A large amount of ranger time is spent on activities related directly to tourist impacts, such as removing rubbish left by tourists at camping spots across the peninsula. The Apudthama Rangers have been using the I-Tracker Land Patrol Application since 2012 to record visitor management activities.



Between July 2012 and January 2013, during 22 visitor management patrols totalling 149 hours, the rangers covered approximately 1863 km while undertaking visitor management activities including cleaning up rubbish and graffiti, and other general management activities. Using the I-Tracker Land Patrol Application to support their visitor management activities allows the rangers not only to manage their country more effectively, but also helps them document the amount of time and effort they spend in these activities, and better understand the extent of impacts from visitors to their country.

The Apudthama Rangers complete a range of campsite maintenance activities at several different camping sites during their patrols

At Somerset campground, souvenir rubbish is left by passing tourists

Apudthama Rangers use the I-Tracker Land Patrol Application to record information about their visitor management activities

Mapoon Land and Sea Rangers: Visitor management

Visitor management is an important part of the Mapoon Rangers' activities due to the large number of travellers that visit the Cape York Peninsula every year during the dry season. Visitors have impacts on various aspects of work undertaken by the rangers, and activities such as cleaning up campsites and general rubbish left by visitors, providing information, and rehabilitating fragile coastal camps take up a significant amount of ranger time each year. The rangers are also responsible for a number of other visitor management activities including fencing, cleaning toilets and showers, removing coconuts, and site improvements such as tree planting.

Mapoon has a permit system in place to monitor and record the number of visitors that come to Mapoon every year. All visitors are required to have a permit, which allows the rangers to monitor and record the number of people who visit the area, what activities they undertake, and why they are interested in Mapoon. This information helps the rangers to keep track of where visitors are going and provide relevant information on matters such as wildlife, areas of cultural significance and restricted areas.

Not all visitors to the area have a permit, and some neglect to pay for camping or entry fees, but there are no penalties for these lapses that are enforceable by the rangers. Collecting this information is still valuable though, as the rangers are then able to report back to the trustees on how many people are complying with the rules and permits.

Prior to using the I-Tracker Land Patrol Application to collect information on visitors, the rangers used paper data sheets, which are time-consuming to complete and require separate efforts for data entry. With the application, rangers can use their time more efficiently by collecting and digitally recording data while engaged in activities, and can also enhance their data recording with photos and voice recordings taken with their mobile devices.

Because visitor management takes up such a significant portion of the rangers' time, it is important to collect information on various aspects of visitor management, to see how much revenue is raised through the permit system in relation to how much time the rangers spend on this work. Using the I-Tracker Land Patrol Application improves ranger capacity to gather that information, and facilitates the sharing of that information with decision makers and the wider community.

Top: The Mapoon Rangers use the visitor management section of the I-Tracker Land Patrol Application to collect information on their visitor management activities at three remote camping areas and one serviced campground within the Mapoon Aboriginal Lands

Bottom: Cullen Point campground attracts large numbers of tourists every year. This is the only campground with facilities and a boat ramp.

Dhimurru Rangers: Visitor management

Dhimurru Aboriginal Corporation

Dhimurru is an incorporated Aboriginal organisation in north-east Arnhem Land that addresses the natural and cultural management priorities of Yolngu Traditional Owners. One of the principal tasks Traditional Owners have set for Dhimurru is to implement and manage a permit system that enables visitors to have access to Designated Recreation Areas. To fulfil this objective Dhimurru has been delegated authority to issue permits from the Northern Land Council, which is also formalised in an agreement between the Northern Land Council, the Commonwealth, the Northern Territory Government, and Dhimurru under section 73 of the Territory Parks and Wildlife Conservation Act.

Dhimurru Rangers maintain a walking track at Middle Beach *© Dhimurru Aboriginal Corporation*

Dhimurru Rangers conduct a permit compliance check *© Dhimurru Aboriginal Corporation*

All individual non-Yolngu persons, including children, visiting Designated Recreation Areas are required to have a Dhimurru Access Permit. Terms and conditions for the permits have been put in place to limit and control the impacts of visitors on Yolngu estates, and address issues including unintentional and intentional damage to infrastructure and country, uncontrolled hunting and fishing, fire damage, and the spread of weeds. Fees are charged for permits, and this income helps Dhimurru to manage country in their Indigenous Protected Areas.

To monitor Access Permit compliance, rangers conduct regular patrols of Designated Recreation Areas. Dhimurru have developed their own CyberTracker application that allows rangers to record and monitor the number of visitors accessing these areas. Rangers interview visitors, check permit stickers on vehicles, and record registration data using the Dhimurru Land Management Application.

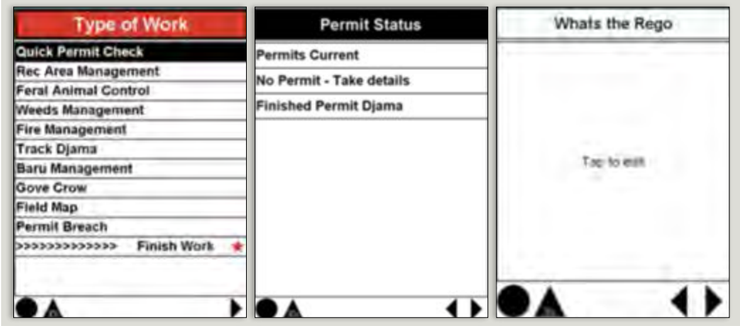
Back at the office, rangers download this information and provide it to the Dhimurru Customer Service Officer/Permit Officer, who then checks the information against the database of permit holders. Infringements and permit breaches are then followed up in line with policy set by Dhimurru's Board in consultation with the Northern Land Council and Traditional Owners.

Using CyberTracker software installed on handheld mobile devices has eliminated the need for paper data sheets and allows for simple exporting and sharing of data. Through appropriate training, the system also ensures the collection of good quality, accurate data by standardising the information gathered.

NAILSMA provides support to Dhimurru in the form of training and technical assistance in the use of Cybertracker software as part of the extensive I-Tracker network.

Permit compliance checks conducted between January and May 2013, with points indicating where permits were queried (map supplied by Dhimurru Aboriginal Corporation)

A permit compliance patrol of Nhulunbuy Township and beaches carried out 25 January 2013 (map supplied by Dhimurru Aboriginal Corporation)



Three of the screens from the Dhimurru Land Management Application that rangers use when conducting a permit check (Images supplied by Dhimurru Aboriginal Corporation)

Kalan Land Management: Culture Application

Building on the success of their experience with the I-Tracker Land Patrol Application created by NAILSMA, Kalan Land Management Officers identified the potential to develop a customised application to address cultural preservation needs. With the help of NAILSMA staff, Kalan created their own CyberTracker application to record sites and items of cultural significance in their own language.

The application is an important aspect of achieving a key objective of Kalan Enterprises: to record and document culture, and preserve cultural heritage. The Kalan Culture Application records a range of native plants and animals, their cultural significance, and their uses. The application encourages the transfer of intergenerational knowledge and provides an easy-to-use tool to help record, preserve and teach language to their young people.

A Kalan Land Management Officer demonstrates how data recorded using the I-Tracker Land Patrol Application can be viewed within CyberTracker

Working together

NAILSMA has a central organisational commitment to forging partnerships that foster and support Indigenous innovation and excellence. NAILSMA works with a range of government, non-government, research, and industry partners to deliver programs that build resilience and prosperity by supporting Indigenous land and sea managers.

From design to implementation, the I-Tracker program is at its heart a collaborative undertaking, bringing together people and the best of scientific and Indigenous knowledge and methods. A range of partners and stakeholders have come together to make I-Tracker applications successful tools for improved land and sea management in north Australia, and NAILSMA staff continue to work closely with scientists and researchers to bring their expertise into the design and development of applications.

For our ranger group partners, the I-Tracker program brings the strengths of a tailored design and a regional coordination network to enhance and inform local practice. The use of standardised protocols across north Australia gives I-Tracker participants the potential to share data regionally and therefore monitor environmental issues such as catchment health and migratory species, which require information at larger spatial scales. The I-Tracker program's commitment to ongoing training and support also brings together members of the I-Tracker network to share and learn from one another at forums and workshops.

The I-Tracker program is showing its vibrancy and broader potential to deal with new and emerging threats and impacts, spurring creative thinking by Indigenous rangers who regularly suggest new data collection sequences and applications. As the I-Tracker program becomes more widely adopted and incorporated into daily practice, rangers are able to benefit not only from the strategies already developed by other groups within the network, but also from the exchange of ideas with others facing similar challenges.

The I-Tracker program also enables ranger groups to build their own partnerships with collaborating organisations. The value of locally undertaken and supported conservation activities has long been recognised, and using I-Tracker applications facilitates data-sharing and fee-for-service partnerships between ranger groups, and government and industry partners.

In addition to setting a standard for participatory research models, the standardised data collection and analysis tools developed by the I-Tracker program are now being adopted and adapted overseas (for example, the Coast Tracker program used by coastal First Nations Guardian Watchmen in British Columbia, Canada).

The collective experience of Indigenous Australians and the numerous wider partnerships formed through involvement in the I-Tracker network are central to the ongoing success of the I-Tracker program as a tool for Indigenous natural and cultural resource management.

Research partnerships

Uunguu Rangers and researchers work together to collect data on marine turtles and dugongs

The expanding area of land and sea country under active Indigenous management presents an unprecedented opportunity to better manage and monitor biodiversity across north Australia. Indigenous people have extensive traditional ecological knowledge and maintain strong cultural links to their country, and they are often the only locally-based land and sea managers over vast areas of the north.

The growing Indigenous environmental workforce is becoming increasingly skilled in the use of quantitative field methods, and it is vital for them to have access to scientifically robust methods and technological advances that are directly relevant to the work they are doing on the ground.

Establishing best practice models of research partnerships that facilitate cross-cultural understandings of biodiversity management is also critical for the successful management of north Australia's land and seas. Research partnerships provide opportunities for Indigenous rangers to access specialist knowledge, training and equipment, and to develop innovative approaches to monitoring environmental values and indicators identified through community-based environmental planning processes.

The I-Tracker program works to develop tools that support scientifically robust, community-based biodiversity monitoring programs for Indigenous land and sea managers, and fosters partnerships that contribute to sustainable Indigenous livelihoods based on looking after country. The on-ground work of Indigenous rangers in locally-based research projects builds ranger capacity and skills, documents local environmental circumstances, and assists Indigenous communities to implement their own management plans. The data collected through joint research projects also increases baseline scientific knowledge of the north Australian environment, and lays the foundation for rangers to engage in long-term monitoring for biodiversity conservation.

Nyul Nyul Rangers work with researchers to sort aquatic macroinvertebrate samples

Marine Turtle and Dugong Monitoring Project

Dugongs and marine turtles are species of great cultural and conservation value in north Australia. The region contains robust populations of these species, some of which are globally threatened, but obtaining reliable population estimates and monitoring local populations of these migratory animals can be difficult, especially in remote locations.

Established scientific monitoring methods for dugongs and marine turtles have presented significant challenges to their use in the north Australian context. Nesting beach surveys, which are used to estimate marine turtle numbers, can be prohibitively expensive given the number of nights per year and the decades-long data sets that are needed to detect population trends.

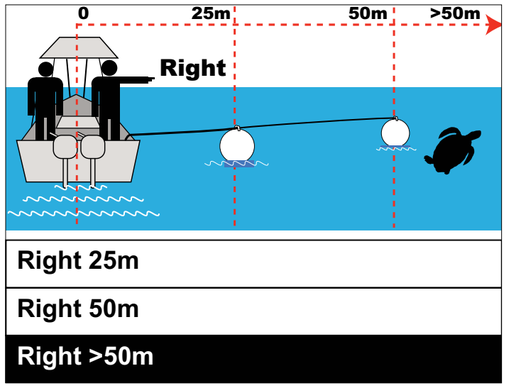
© Micha Jackson

Conducting marine turtle surveys on land also puts researchers at risk of crocodile encounters. In addition, only adult females are surveyed, thus limiting the scope of data collected. Aerial surveys, which are usually used to estimate dugong numbers, also have drawbacks, both in terms of limited community participation and high costs.

To address these limitations and complement established methods, NAILSMA's I-Tracker program has worked with Indigenous land and sea managers and scientists to develop tools that utilise and build on local Indigenous ranger capacity to monitor marine turtles and dugongs. The I-Tracker Saltwater Country Patrol Application equips rangers to record in-water observations of turtles and dugongs, nesting turtles, turtle nests, nest predation, and instances of stranded or entangled animals.

As part of the ongoing evaluation, expansion, and enhancement of the I-Tracker program's dugong and marine turtle monitoring tools, NAILSMA established a collaborative research project with the Wunambal Gaambera Aboriginal Corporation's (WGAC) Uunguu Rangers and the Commonwealth Scientific and Industrial Research Organisation (CSIRO). Together, the project partners have developed a new boat-based survey method for monitoring the density and abundance of local marine turtle and dugong populations. Funded through the Northern Australia Hub of the Australian Government's National Environmental Research Program (NERP), the project is one of several relating to biodiversity monitoring by Indigenous communities. The boat-based survey method has also been trialled with the Dambimangari Rangers and the Gumurr Marthakal Rangers.

The survey method involves one observer stationed on each side of the boat, and a recorder who uses a handheld field computer (PDA) loaded with an I-Tracker application to record all sightings of turtles and dugongs as called out by the observers. The boat travels slowly at about five knots along transects approximately 1.0 to 2.5 km long. Environmental conditions are recorded at the beginning and end of each transect. Help screens that can be accessed on the PDA at the time of the sighting are located throughout the application.

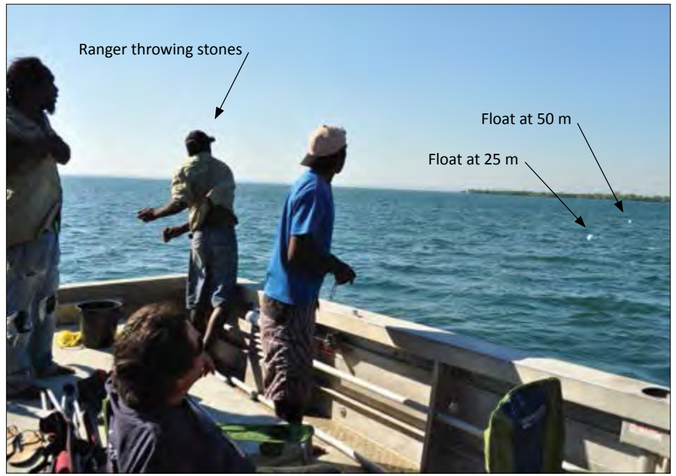


An example of a help screen explaining how a turtle sighting more than 50 m away from the right side of the boat should be recorded using the I-Tracker Application (i.e. the choice 'Right >50m' is correct)

Whenever possible, turtles are recorded individually and a GPS point is taken after each sighting. The following additional information is recorded for each turtle sighting:

- distance from the boat (see diagram above)
- species
- size
- behaviour.

The data collected by this method are then analysed using line transect models to generate density and abundance estimates of local turtle populations.



A key variable influencing sightability of turtles and dugongs is the distance of an animal from the boat. To ensure that observers are estimating distance accurately, a training program is used whereby a rope with two large, white floats is trailed off the back of the boat. One float is set 25 m away from the boat, and a second float is set 50 m from the boat.

Rangers throw stones to different distances to simulate animal sightings. All participants call out the relevant 'band' where the stone lands, e.g. 'right 50 plus' to express that the stone landed to the right side of an imaginary line drawn through the middle of the boat, and at a distance of greater than 50 m.

Participants then practice calling out the whole sequence of variables that are recorded for each turtle observation, e.g. 'right 25, green, adult, underwater' which corresponds to a sighting of an adult green turtle seen below the surface of the water, at a distance of 25 m or less from the boat.

Left: Uunguu Rangers practice distance estimates

Uunguu Rangers

Indigenous communities have increasingly been expressing their aspirations for the management of their marine and coastal environments through planning. The Wunambal Gaambera Aboriginal Corporation (WGAC), representing the Traditional Owner (TO) community associated with the Uunguu Native Title Determination, has chosen to create a 'Healthy Country Plan'.

Many Indigenous groups across Australia have been using 'Healthy Country Planning', applying an internationally-accredited Conservation Action Planning methodology to develop plans for looking after country and communicating with government and stakeholders. WGAC, representing the TO community, developed the first Healthy Country Plan in Australia with local TO participation and support from Bush Heritage Australia.

The plan identifies performance criteria for maintaining healthy sea country and identifies 'targets' for management, such as important species or critical habitat. *Mangguru* (turtles) and *balguja* (dugongs) were identified as a key marine target for management, because, as stated in the plan:

'We need to know more about where they [turtles and dugong] *travel, their habitats in our country and how to look after them. Working together...using our traditional knowledge, doing surveys...will help us keep these animals healthy in our country as well as keeping our saltwater traditions strong.'*

The Marine Turtle and Dugong Monitoring Project directly supports a number of specific objectives relating to the implementation of this target of the Healthy Country Plan. Results of the project are reported to the community to inform assessments of the success of the plan's objectives, and to support future revisions of the plan.

The initial fieldwork for the project took place from 21-25 May 2012, and focused on Mary Island, West Bay and Wobinbeyi (in Napier Broome Bay). The field trip brought together the Uunguu Rangers, NAILSMA staff, a CSIRO scientist, community members, other WGAC staff and Bush Heritage staff.

The field trip involved:

- a project planning workshop
- fieldwork at various sites to scope the best areas to set up turtle and dugong transect areas
- training in the use of the I-Tracker Turtle and Dugong Survey Application
- training in techniques relevant to completing boat-based transect surveys
- nightly feedback workshops to revise the I-Tracker Application and review field work
- a knowledge mapping workshop
- a future directions workshop.

Initial data analysis estimated relative densities ranging between 1.1 individuals per km in the lower density zone, to 3.4 individuals per km in the higher density zone. The data analysis indicated that standard distance sampling methods can be applied to small-boat surveys of marine animals to obtain reliable estimates of their distribution and abundance. It also supported the conclusion that boat-based surveys by community-based ranger programs are an effective means of gathering data on turtle and dugong distributions in remote localities in north Australia.

Subsequent to the initial field trip, rangers completed additional surveys around Mary Island in June, August, and September 2012, and March 2013. Each survey utilised the I-Tracker Turtle and Dugong Survey Application to record turtles and dugongs along the transects around Mary Island (see data in chart). Based on the results from these early surveys, the transects around Mary Island were revised and refined to suit on-ground realities and tidal conditions.

The result of this trialling and revision process is that the Uunguu Rangers can conduct periodic standard surveys along the final transects, which can then be analysed with support from NAILSMA and CSIRO. Alongside the data collected in the 2012 surveys, this growing body of data will identify and explore the seasonal and environmental factors that most influence turtle and dugong distribution and abundance.

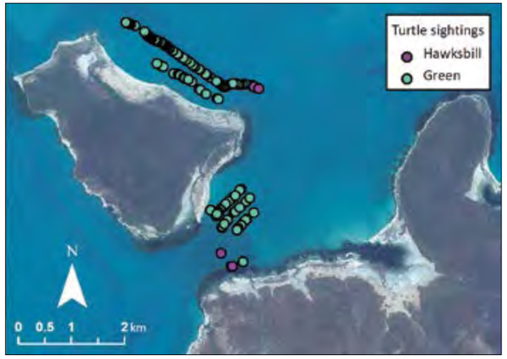
Date	Location/s	Total	Details
May 2012	Mary Island West Bay Wobinbeyi	94 turtles	64 green turtles 9 hawksbill turtles 21 species unsure
May 2012	Mary Island West Bay Wobinbeyi	42 dugong	One male bull no calves
Jun 2012	Mary Island	9 turtles	8 green turtles 1 hawksbill turtle
Aug 2012	Mary Island	175 turtles	169 green turtles 6 hawksbill turtles
Sep 2012	Mary Island	56 turtles	53 green turtles 3 hawksbill turtles
Mar 2013	Mary Island	43 turtles	36 green turtles 5 hawksbill turtles 2 species unsure

Results from boat-based surveys by the Uunguu Rangers

Transects for Uunguu Rangers' boat-based marine turtle and dugong surveys around Mary Island

Uunguu Rangers record environmental conditions and animal sightings using the I-Tracker Turtle and Dugong Survey Application

The above map shows the Uunguu Rangers' transect survey records and tracks from 23 May 2012. Two boats were used that day, with each boat's track and sightings shown here in a different colour.



Turtles recorded by the Uunguu Rangers around Mary Island, August 2012

Uunguu Rangers with CSIRO and NAILSMA staff

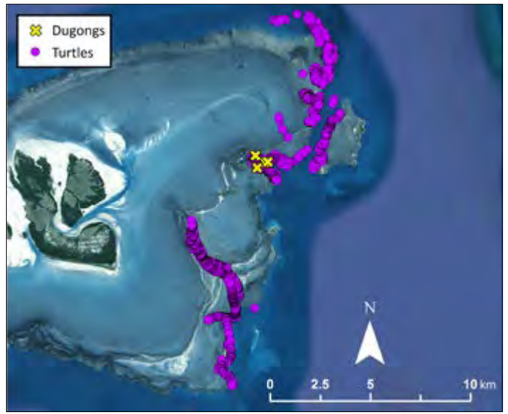
Dambimangari Rangers

Since the initial trials of the boat-based survey method in 2012 with the Uunguu Rangers, the project learnings have been shared with additional groups. One of these groups, the Dambimangari Rangers, have collaborated with the Kimberley Land Council (KLC) and NAILSMA to trial the boat-based survey method at Montgomery Reef in the Kimberley. This location is known as an extremely high-density area for green turtles.

From 20-26 August 2012, thirteen people participated in a survey trip, including members of the Dambimangari Rangers, other Traditional Owners, and KLC and NAILSMA staff. The camp was based at Freshwater Cove near Montgomery Reef, where the surveys were conducted. The field trip was very successful and participants recorded large quantities of turtles, providing the Dambimangari community with information for use in the development of a monitoring program.

Date	Location	Total	Details
Aug 2012	Montgomery Reef	2363 turtles	For 1461 turtles recorded as individuals (1461 of 2363 sightings): 1387 green turtles 18 hawksbill turtles 56 species unsure
		5 dugongs	1 calf

Results from boat-based surveys, Dambimangari Rangers, 2012



The above map shows all of the Dambimangari Rangers' turtle and dugong sightings recorded between 22-25 August 2013 around Montgomery Reef. A total of 2363 turtles were recorded in the four days of the survey.

Dambimangari Rangers and other participants travelled by boat from Derby to the survey area of Montgomery Reef

Gumurr Marthakal Rangers

Another group that has participated in additional trials of the boat-based marine turtle and dugong survey method is the Gumurr Marthakal Rangers. Five Gumurr Marthakal Rangers and two NAILSMA staff conducted a trial of the survey method in the Wessel Islands, NT, from 11-15 December 2012. The field trip gathered important baseline data, which informs the community in the development of a customised monitoring program.

Date	Location	Total	Details
Dec 2012	Wessel Islands	95 turtles	75 green turtle 12 hawksbill turtles 8 species unsure

Results from boat-based surveys, Gumurr Marthakal Rangers, 2012

Approximate field work area of Gumurr Marthakal Rangers' marine turtle and dugong surveys, with the camp at Yirringa marked with a yellow triangle

The Gumurr Marthakal Ranger team and NAILSMA staff trialled the boat-based survey method in the Wessel Islands in December 2012

The Nature Conservancy collaborates with Indigenous peoples and local communities throughout the world to foster our shared commitment to environmental stewardship. A key activity in north Australia for The Nature Conservancy is Healthy Country Planning workshops. These workshops are based on Open Standards for the Practice of Conservation, which is a successful framework for conservation action used around the world. The workshops assist groups to move forward in making a Healthy Country Plan: a shared vision for their community and country.

The Nature Conservancy
Protecting nature. Preserving life.

Green turtles feeding in shallow reef areas were recorded in vast numbers at Montgomery Reef

Freshwater Research and Monitoring Project

Freshwater springs and billabongs are central to the life of the Nyul Nyul people of the Dampier Peninsula in Western Australia. For generations, these areas have been important sources of food and clean drinking water. Many freshwater sites are also places of deep cultural significance.

There are a variety of different freshwater habitats on Nyul Nyul country including lakes, billabongs and springs. Nyul Nyul wetlands are safe havens for many bird species such as black-winged stilts and brolgas.

Nyul Nyul Rangers record freshwater monitoring data using an I-Tracker application at Yarp Lakes WA

Since European colonisation, new threats to the health of freshwater habitats have emerged including altered fire regimes, grazing by cattle and feral donkeys, and impacts from introduced pest species such as cats and invasive fish. The impact of donkeys on freshwater health, for example, can easily be seen on Nyul Nyul country. As the dry season progresses, donkey tracks wear a criss-cross pattern between the springs and waterholes they frequently visit. Within the springs, the donkeys stir up the bottom and turn clear water muddy, and consume numerous water plants. The impact of cats is not always apparent but they are well-known for being very efficient predators of small mammals, birds and reptiles, many of which rely on or congregate around freshwater habitats. And during a scoping trip to identify sampling sites, high densities of introduced mosquito fish (*Gambusia holbrooki*) were discovered in a number of wetlands. There had been a single record from 1987 of this species occurring near Beagle Bay, and another at Cape Leveque, but it had been hoped that these were isolated occurrences.

To address these and other threats, the Nyul Nyul Rangers are engaging in a collaborative research project on freshwater health and monitoring on Nyul Nyul country, funded through the Northern Australia Hub of the Australian Government's National Environmental Research Program (NERP). The project brings researchers from the University of Western Australia and Griffith University together with staff from NAILSMA and the Kimberley Land Council-facilitated Nyul Nyul Rangers to explore and understand freshwater habitats. The rangers gain the expertise of the collaborating research partners to improve the planning

Nyul Nyul Rangers work in collaboration with a UWA scientist and a NAILSMA staff member

and outcomes of their freshwater management program, while the project partners gain the opportunity to learn about freshwater places from the local people.

Prior to this project, there had been virtually no scientific research on freshwater systems of the Dampier Peninsula. Very little was known about the freshwater fish and macroinvertebrate populations of the region, and there was a real need for structured sampling of water quality. This project is providing the opportunity for the Nyul Nyul Rangers to work with experts to collect a wide array of baseline scientific data about these freshwater habitats. The project is mapping the distribution of highly invasive species like the mosquito fish, as well as native species such as the empire gudgeon and oxeye herring, and this information assists the rangers and the wider community to explore management options for these species. Using I-Tracker applications allows the rangers to document their traditional knowledge alongside scientific information, a vital step in combining both bodies of knowledge to inform the design and development of management plans.

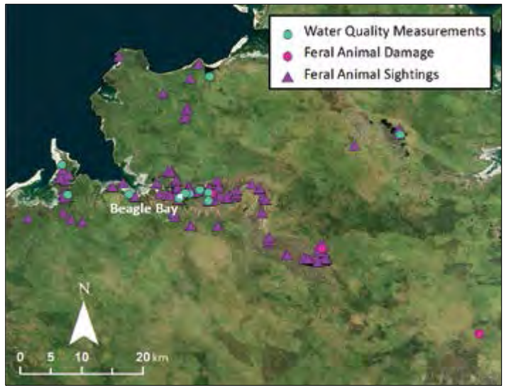
The project is also enhancing the capacity of rangers to undertake ongoing monitoring in the future. Many established freshwater sampling techniques are time-consuming or require the use of expensive equipment that is difficult to maintain and calibrate to sufficient accuracy. The research team is assessing and adapting existing techniques so that they are more practical for use by rangers who have limited facilities and resources to maintain sensitive devices, and require less precise data for water health monitoring than may be needed in other sectors.

NAILSMA staff are involved in the development of a dedicated I-Tracker application for freshwater monitoring to assist the rangers in collecting and managing their data. Plans for this customised application include a number of special features such as an area-specific species list (based on the baseline data collected by researchers during the field sampling trips), use of local language for plant and animal names, and detailed help screens explaining the customised sampling techniques.

Nyul Nyul Rangers work alongside scientists to analyse data about small fish and aquatic macroinvertebrates

Feral donkeys threaten the health of freshwater habitats by stirring up the bottom of springs and consuming native water plants

Rangers and scientists work together to sample small fish and aquatic macroinvertebrates using a seine net



Data collected using I-Tracker applications include water quality measurements and sightings of feral animals

Oxeye herring (*Megalops cyprinoides*) are a common native species and have been found in a number of Nyul Nyul freshwater sites

Uncontrolled late dry season fires burn right to the water's edge, damaging sensitive riparian vegetation

Shorebird Monitoring Project

Migratory shorebirds are one of nature's great wonders, and their dependence on marine and freshwater habitats makes them sensitive indicators of the quality and environmental health of wetlands.

The Gulf of Carpentaria region is home to the third-largest migratory shorebird congregation site in Australia. North Australia is also rich in resident shorebird species and beach-nesting birds, and provides important breeding areas for these birds on its islands, beaches and dune systems.

Despite national and international protection, shorebird populations have been declining dramatically since the 1990s. Their effective conservation both nationally and internationally (along the migration route of the migratory birds) relies on reliable data on shorebird populations. However, accessible data on numbers of shorebirds in the Gulf region and the exact location of their roosting and feeding sites is incredibly sparse. This represents a serious knowledge gap in the research of shorebird populations, migration routes and stopover areas, as well as the status of resident shorebirds on Cape York Peninsula, where they are assumed to be faring better than in more heavily populated areas in southern Australia.

In 2012, the Mapoon Land and Sea Rangers, the Nanum Wungthim Land and Sea Rangers (based in Napranum), li-Anthawirriyarra Sea Rangers (based in Borroloola), the Pormpuraaw Rangers, NAILSMA and BirdLife Australia began a collaborative project to develop shorebird monitoring in the Gulf of Carpentaria.

Indigenous land and sea ranger programs in the Gulf are uniquely placed through their skills, traditional knowledge, and access to country to make a major contribution to the collective research knowledge about shorebirds, their status and migration routes in Australia.

At the same time, data gathered locally can contribute to on-ground environmental management by helping to measure the success of conservation actions. For example, the positive effect of tighter controls on vehicle access to a roost site may become evident in greater numbers of shorebirds at the site. These data also contribute to community efforts to develop long-term databases for monitoring climate change impacts.

The Shorebird Monitoring Project aims to develop the skills of rangers to accurately identify and count shorebirds at local congregation sites. This information supports local and cultural

understandings of the importance of monitoring the health of beaches. In addition, the project facilitates the transfer of this local information to national databases, and raises awareness in the community about shorebirds and the issues they face (including local threats to resident shorebirds). The project involves on-ground workshops and training by NAILSMA and BirdLife Australia staff, and joint outreach activities with local schools.

Through the project, shorebird areas and count areas have been officially established and registered with BirdLife Australia. A long-term aim is for ongoing counts to be completed in these areas at least twice a year during important migration times and in line with other Australian national counts.

A key part of the Shorebird Monitoring Project has been the development of two I-Tracker applications: one to record shorebird counts, and the other to assist with shorebird identification. These applications were developed to assist land and sea rangers to collect and manage data about

shorebird counts using CyberTracker software. As with other I-Tracker applications, data are collected on mobile devices and uploaded to the rangers' computers. One goal of collecting data using standardised I-Tracker applications is the coordinated and consistent collection of information that streamlines regional data collation and analysis.

The I-Tracker Birdlife Australia Shorebird Count Application was developed to make recording shorebird data as straightforward as possible. Birds are put into intuitive groupings, and species for the relevant geographic area are highlighted. It was trialled and modified based on feedback from participating ranger groups. The application includes maps showing established local shorebird areas and count areas, and includes additional information on resident nesting shorebirds so that exact locations of nests and sightings of chicks can be recorded.

In addition to shorebirds, the application allows rangers to record any waterbirds, gulls and terns present at the count. It also includes the ability to enter information on sightings of shorebirds with leg flags. This provides information on which birds are using the Gulf of Carpentaria during their migration.

The application also mirrors BirdLife Australia's Shorebird Count Form so that data collected using the I-Tracker application can be easily exported to a spreadsheet which is compatible with the Shorebirds 2020 National Database. This removes the need for any manual data entry, which improves data quality and saves time for both the rangers and BirdLife staff. Once data has been uploaded to the BirdLife Australia national databases, rangers can gain access by using a secure log-on.

The second application, the I-Tracker Birdlife Australia Shorebird Identification Application, was developed to assist with shorebird identification in the field. It incorporates icons developed by BirdLife Australia in collaboration with Jeff Davies and World Wildlife Fund. It allows for easy searching of shorebird species showing key identification features, and breeding and non-breeding plumage colours.

The Shorebird Monitoring Project has included on-ground activities involving NAILSMA and BirdLife Australia staff with all four participating ranger groups. Completed activities include:

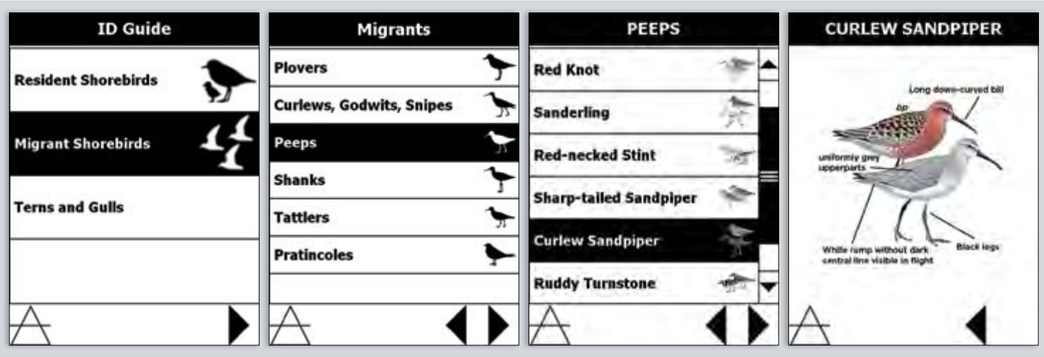
- training on shorebird identification and counting
- training in the use of the two I-Tracker Birdlife Australia Shorebird applications
- establishment of local shorebird and count areas
- completion of shorebird counts
- submission of local count data collected using the I-Tracker application to the Shorebirds 2020 National Database
- community outreach activities including open community barbecues and information sessions, classroom presentations and field trips with students.

Selected results are shown in the table opposite. With the scope and extent of data being collected, Indigenous rangers using the I-Tracker Birdlife Australia Shorebird applications are now playing an integral role in the conservation of shorebirds in Australia.

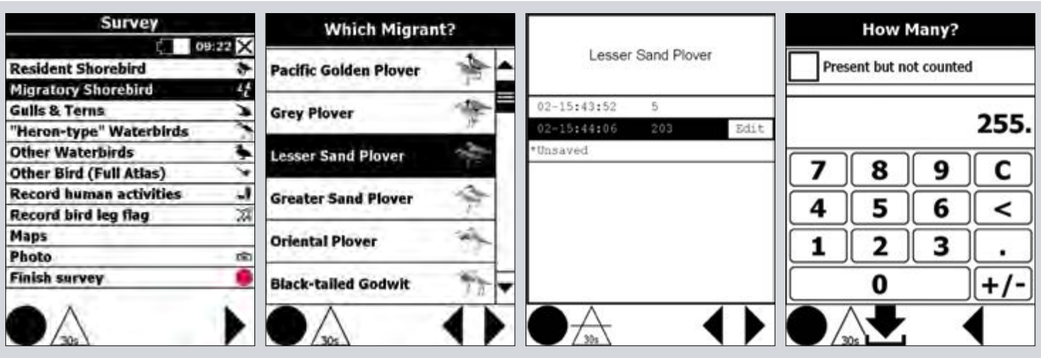
Red-capped plover © *Micha Jackson*

Shorebird Area	Count Area	Count Date	Total Birds Counted	Total Species	Migratory Shorebird Species	Migratory Shorebirds	Resident Shorebird Species	Resident Shorebirds	Most Common Shorebird	Number
Mapoon	Vrathi	18 Oct 2012	303	7	3	200	3	50	Red-Necked Stint	148
		09 Nov 2012	332	25	8	93	5	69	Sharp-Tailed Sandpiper	53
		18 Mar 2013	351	13	3	53	3	6	Great Knot	40
		08 Apr 2013	239	22	5	53	4	17	Greater Sand-Plover	26
		09 Apr 2013	296	23	5	28	4	39	Red-Capped Plover	24
Mapoon	Namaletta	11 Oct 2012	4376	28	13	3467	5	240	Sharp-Tailed Sandpiper	1625
		24 Oct 2012	1811	27	15	1395	3	58	Red-Necked Stint	348
		02 Nov 2012	3213	31	14	2623	4	103	Sharp-Tailed Sandpiper	600
		16 Nov 2012	740	27	13	609	5	23	Lesser Sand-Plover	263
Mapoon	Leginjar	18 Oct 2012	88	4	0	0	1	80	Masked Lapwing	80
Pennefather River	Spit	18 Oct 2013	108	12	2	3	1	3	Pied Oystercatcher	3
		04 Apr 2013	451	6	0	0	1	3	Pied Oystercatcher	3
Pennefather River	Island	18 Oct 2013	1617	14	5	3	3	46	Unidentified	1317
		10 Apr 2013	222	13	5	165	1	2	Great Knot	75
Pine River	Duyfken Point	Not yet surveyed								
Mission River	Albatross Hotel & Rocky Point	18 Oct 2012	16	7	3	4	0	0	Red-Necked Stint	2
		11 Apr 2013	63	10	4	43	1	2	Black-Tailed Godwit	31
Mission River	Gong Bung & Pelican Island	11 Apr 2013	35	9	2	2	1	4	Pied Oystercatcher	4
Mission River	Wallaby Island	11 Apr 2013	69	12	5	62	4	7	Greater Sand-Plover	27
Borroloola	Island Near Gundieq	14 Nov 2012	131	12	5	32	2	5	Curlew Sandpiper	8
Borroloola	Mule Creek	15 Nov 2012	347	21	12	291	3	49	Red-Necked Stint	97
Borroloola	Mirnngarra	13 Nov 2012	710	20	0	0	4	10	Comb-Crested Jacana	6
Borroloola	Crooked Mouth	14 Nov 2012	789	17	9	708	0	0	Red-Necked Stint	420
Pormpuraaw	Airport Wetlands	22 Mar 2013	270	17	0	0	1	16	Black-Winged Stilt	16
Pormpuraaw	Pormpuraaw Beach	22 Mar 2013	13	3	0	0	1	7	Black-Winged Stilt	7
Pormpuraaw	South Chapman Beach	21 Mar 2013	1093	28	7	417	3	22	Great Knot	260
Pormpuraaw	Pormpuraaw Causeway	22 Mar 2013	1349	21	5	690	2	143	Red-Necked Stint	622
Pormpuraaw	Mungkan Mouth	Not yet surveyed								
TOTALS		**26 counts**	**19,032**			**10,941**		**1004**		

Summary of counts from 2012 and early 2013 in newly established count areas across the operational regions of the four participating ranger groups

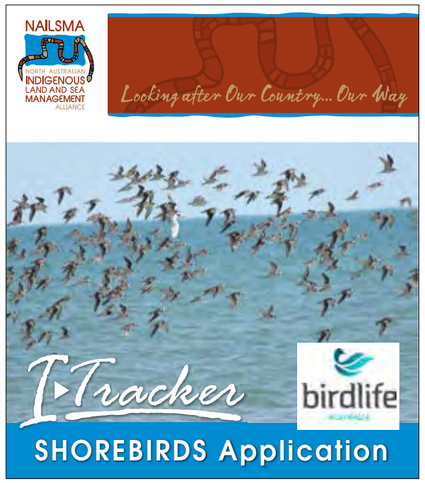


Four of the help screens from the I-Tracker BirdLife Australia Shorebird Identification Application



Four of the data input screens from the I-Tracker BirdLife Australia Shorebird Count Application

Pormpuraaw Rangers survey shorebirds and wetland birds on the Causeway near Pormpuraaw, Qld



birdlife AUSTRALIA

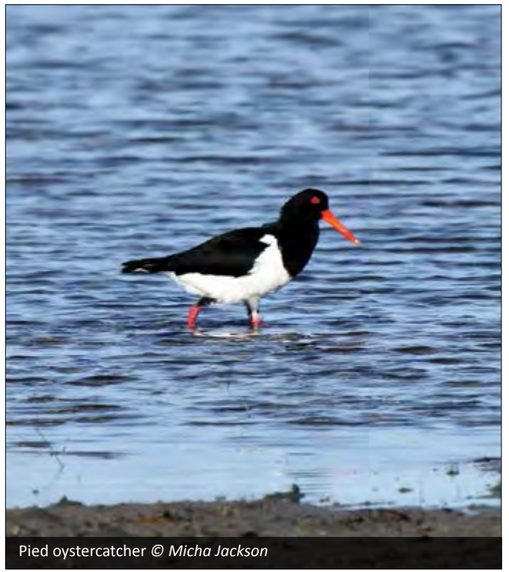
BirdLife Australia is the country's oldest national conservation and research organisation, with over 10,000 members and supporters and more than 50 branches across the country. The Shorebirds 2020 project is BirdLife Australia's nationwide shorebird monitoring, education and conservation program. The program relies on over 1400 skilled volunteers who conduct standardised shorebird surveys in the nation's shorebird hotspots, and supports them in using the data to inform on-ground conservation actions, environmental advocacy and nature awareness activities. Shorebirds 2020 provides volunteers with accurate mapping of the shorebird roosting and feeding areas identified, a secure online database, identification and education materials, on-ground workshops and on-line training modules, and support for and expertise in shorebird conservation. BirdLife Australia's shorebird monitoring has now run for over 30 years and one of its great strengths throughout this time has been the sharing of knowledge and expertise by its dedicated volunteers.

For more information, visit www.birdlife.org.au

Pormpuraaw Rangers survey shorebirds from a boat

Mapoon Rangers get ready to survey shorebirds at Namaletta Count Area

Beach stone-curlew *© Micha Jackson*



Pied oystercatcher *© Micha Jackson*

li-Anthawirriyarra Sea Rangers survey shorebirds at Bing Bong near Borroloola

Black-fronted dotteral *© Micha Jackson*

Nanum Wungthim Land and Sea Rangers receive participation certificates

Nanum Wungthim Land and Sea Rangers survey shorebirds at Pennefather Beach

Iconic Marine Species Project

Tanya Vernes (WWF) and Frank Weisenberger (Kimberley Land Council)

In 2005, a new species of dolphin was named in Australian waters: the Australian snubfin dolphin (*Orcaella heinsohni*). Previously it was thought that this dolphin was the Irrawaddy dolphin which is found in coastal areas and major rivers of south-east Asia, and is in serious decline. The discovery that this is a new mammal makes this an extremely rare and exciting finding.

The Australian snubfin dolphin is Australia's only endemic dolphin, meaning it is unique to northern Australia, and occurs from the Kimberley region across north Australia as far east as Yeppoon in Queensland. The dolphins are strongly linked to the mouths of tidal rivers and are usually found close to the coast, within 10 km of land and river mouths, in small and isolated populations.

Kimberley coastal ranger groups set out on a joint survey trip *©Kimberley Land Council*

Coastal and river dolphins are among the most threatened species of mammal in the world, as their coastal habitat often intersects with threatening human activities. One of the major obstacles to their effective on-ground management in north Australian waters has been the lack of knowledge about the basic ecology of these dolphins (as well as Indo-Pacific humpback dolphins), and the threats these animals face.

To overcome some of these data gaps, World Wildlife Fund-Australia (WWF) teamed up with cetacean researcher Dr Deb Thiele and Kimberley Indigenous Ranger Groups facilitated through the Kimberley Land Council's Land and Sea Management Unit. A rapid assessment research project aimed to develop the critical science and community capacity needed to increase the knowledge of iconic marine species across the Kimberley.

Over a three-year period, six coastal Kimberley Ranger groups participated in surveys and workshops. While the main objective of the project was to gather critical data on Australian snubfin dolphins and other iconic marine species, the secondary objective was to build the capacity of community members in survey techniques. Using the I-Tracker Saltwater Country Patrol Application as the major tool for data collection in the field, the Nyul Nyul, Bardi Jawi, Mayala, Dambimangari, Uunguu and Balanggarra Rangers were able to log information on the location, behaviour and species of marine mammals.

Australian snubfin dolphin *© Deb Thiele WWF-Australia*

From mid-2009 until June 2012, the six coastal ranger groups participated in multiple surveys covering two broad regions: north and south of Kalumburu (Napier Broome Bay including the Drysdale River), and the region from Talbot Bay through to King Sound. Most surveys were supported by a large vessel while utilising small boats for survey transects during the day. Travelling more than 4200 km in boats, a total of 392 hours of survey effort were spent looking for Australian snubfin and Indo-Pacific humpback dolphins as the focus species, and recording a wide range of other species that were encountered.

Marine wildlife observer training was conducted during surveys to enable the local ranger groups to undertake ongoing monitoring of the health of their conservation targets. Maps, satellite images and charts were used to collaboratively determine the best locations to search for dolphins. Discussions often focused on threats to the dolphins as evidence of these were encountered during surveys. While the Kimberley coast is remote and sparsely populated, the surveys showed that significant amounts of international and domestic marine debris regularly wash up in the habitat of these threatened and culturally important animals.

The survey work and knowledge sharing with the rangers has greatly increased our understanding of the distribution and relative abundance of near-shore dolphins, particularly the Australian snubfin and Indo-Pacific humpback dolphins in the Kimberley. Identifying resident dolphin groups is critical to the development of effective monitoring programs, due to the need for repeat sampling of individuals for many aspects of their life history, and for conservation of these animals. The ranger surveys and knowledge sharing have resulted in new high priority study areas for these species in the Kimberley which have a high likelihood of success as monitoring sites.

Date	Area	Ranger Group
Aug 2009	Buccaneer Archipelago, King Sound	Mayala, Bardi Jawi, Dambimangari, Uunguu, Balanggarra
Apr 2010	Napier Broome Bay	Balanggarra
May 2010	Talbot Bay, Buccaneer Archipelago, King Sound	Dambimangari
Jul/Aug 2010	Napier Broome Bay, Admiralty Gulf	Uunguu
Aug 2011	Prince Regent, Admiralty Gulf	Dambimangari, Uunguu, Bardi Jawi, Nyul Nyul
Jun 2012	Cambridge Gulf	Balanggarra

Overview of survey areas and participating ranger groups

Spotting Australian snubfin dolphins on Uunguu sea country *© Tanya Vernes WWF-Australia*

The success of this project was built on equity, mutual respect and a degree of flexibility by all parties enabling science to line up with Traditional Owner priorities for improved outcomes. The approach taken to include local groups from the outset and assist them to increase their skills to care for and manage their natural assets is one that aims for enduring outcomes and incorporates inclusiveness, acknowledgement and responsibility.

Acknowledgements

This project received funding support from the Australian Government through the Caring for our Country Coastcare and IPA Program.

CARING FOR OUR COUNTRY

Clockwise from top left: Survey areas for the Iconic Marine Species Project, Kimberley (map supplied by Kimberley Land Council)

Dambimangari Rangers look for surface splash *© Kimberley Land Council*

Prince Regent survey area showing Australian snubfin dolphin sightings (map supplied by Kimberley Land Council)

Organisational partnerships

© Michael Lawrence-Taylor

The I-Tracker program was developed with a vision to create networks, tools, knowledge and skills that support and promote coordinated and collaborative Indigenous land management. A key aspect of the program has been the establishment of the I-Tracker network of land and sea managers, who meet and communicate regularly to share ideas and knowledge, review current data collection and mapping tools, develop new ideas and tools together, and provide feedback on the program.

The I-Tracker program also plays a key role in partnerships between ranger groups and external organisations. A significant aspect of developing sustainable Indigenous livelihoods is the capacity to enter into fee-for-service and other agreements with a range of government, non-government, and industry partners. Rangers across the I-Tracker network use I-Tracker applications to engage in work in partnership with other organisations on a wide range of issues including control of weeds and feral animals, biosecurity surveillance, protection of cultural sites, patrolling of fisheries closures, and monitoring and removal of marine debris.

I-Tracker applications are designed to collect standardised data while allowing for customisation to reflect local and regional priorities. Partnerships with researchers and scientists inform best practice methodologies that meet the requirements of Indigenous rangers and data end users such as government or enforcement agencies. Incorporating community-based planning goals with external contractual requirements has been a major aim throughout the development of the applications.

Using I-Tracker applications, ranger groups can electronically document the process, effort and results of their patrols, making it easier to fulfil contractual obligations for organisations such as federal and state fisheries agencies. The applications also improve the transfer of data into mapmaking software and other data visualisation and analysis tools, and create standardised reporting templates that rangers can use for numerous reporting and planning purposes.

By standardising data collection across north Australia, I-Tracker applications also enable data sharing for issues that occur across larger spatial scales (such as marine debris and national biosecurity issues). Data sharing can be a sensitive area, and NAILSMA staff have worked closely with Indigenous land and sea managers to develop agreements that protect their intellectual property rights, while enabling the sharing of data to improve management outcomes, inform regional decision-making and promote the work being done in north Australia.

The numerous partnerships formed through the I-Tracker network are central to the success of not only Indigenous natural and cultural resource management in north Australia, but of wider conservation efforts in Australia as a whole.

Department of Agriculture, Fisheries and Forestry

The Department of Agriculture, Fisheries and Forestry (DAFF), through the Northern Australia Quarantine Strategy (NAQS) Indigenous Engagement program, has been a key NAILSMA I-Tracker partner since 2010. Participation by Indigenous communities in NAQS surveillance activities has provided an important element in the program's success since its inception in 1989, and the ongoing collaboration with the I-Tracker program has brought together a number of key government and non-government stakeholders to develop and promote effective working relationships on country and build biosecurity surveillance capacity amongst Indigenous ranger groups.

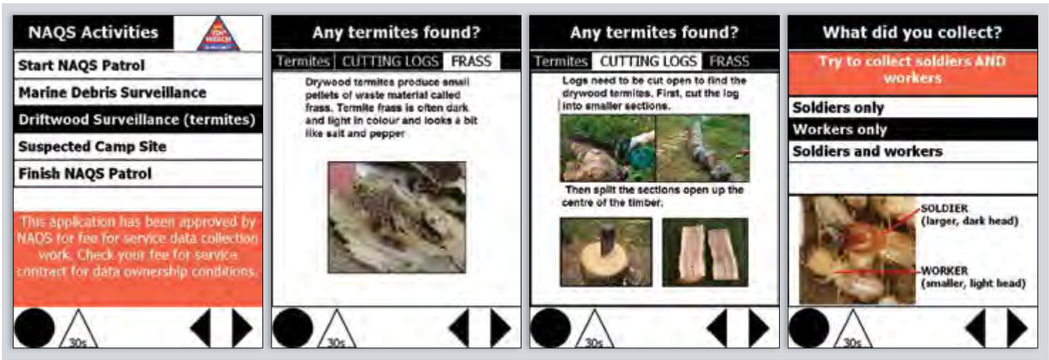
The NAQS Indigenous Engagement program engages some 38 Indigenous ranger groups across north Australia in fee-for-service biosecurity surveillance activities, ranging from marine debris patrols to plant host mapping and targeted surveillance activities.

Prior to the implementation of the I-Tracker program, the process of reporting these activities was limited to paper data sheets being completed and sent to DAFF Community Liaison Officers for consolidation and entry into relevant surveillance databases. Survey locations, patrol tracks, waypoints and routes for these activities were limited to GPS points being manually entered onto data collection sheets.

The inclusion of NAQS Indigenous Engagement activities into the I-Tracker Saltwater Country Patrol and Land Patrol Applications has provided an efficient and consistent tool for ranger groups to record scientific data and patrol data utilising standardised applications and rugged mobile devices. Using these applications, rangers are now able to provide enhanced data collection, collation and analysis of field surveillance and monitoring data in remote areas of north Australia. The project has also facilitated effective collection and transfer of biosecurity surveillance data on a range of activities undertaken by Indigenous rangers on behalf of DAFF.

The use of I-Tracker applications across Indigenous ranger groups has seen a significant improvement in the data collection process. Ongoing development of the project enables a more detailed, concise and professional representation of the key work being undertaken by NAQS staff and scientists in partnership with Indigenous rangers across north Australia.

With many Indigenous ranger groups now trained in the use of the NAILSMA I-Tracker applications, biosecurity data is supporting Indigenous land and sea managers to inform their own on-country work as well as providing key information to DAFF biosecurity surveillance.



Four of the data input and help screens from the driftwood surveillance section of the I-Tracker Saltwater Country Patrol Application

Australian Government
Department of Agriculture, Fisheries and Forestry

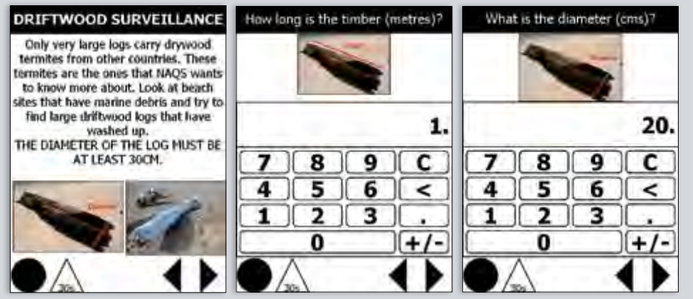
Apudthama Rangers: Driftwood surveillance

One of the numerous activities for which rangers have partnered with DAFF is driftwood surveillance. Data collection for this activity is included in the I-Tracker Saltwater Country Patrol Application. The objective of this activity is to check for the presence of invasive termites in marine driftwood, including driftwood that has come from foreign fishing vessels (FFVs) or rafts. Rangers patrol for driftwood, then split it open with axes or chainsaws and collect samples of any termites present. These samples are then analysed by DAFF to ensure that they are not invasive species.

The Apudthama Rangers patrol a vast coastal area on both the east and west sides of the tip of Cape York Peninsula that covers the furthest northern reaches of the Australian mainland. They have undertaken a number of large-scale driftwood surveillance activities alongside DAFF staff, and regularly discover FFV driftwood during beach patrols. Any driftwood thought to be a potential risk is burned on the beach to prevent the spread of invasive termites.

Apudthama Rangers check for invasive termites

Apudthama Rangers burn a foreign raft that drifted on to their coast



Above: Data from a driftwood surveillance exercise conducted by the Apudthama Rangers, DAFF and NAILSMA staff on the west coast of the Northern Peninsula Area in 2011

Left: Rangers use these data input and help screens from the I-Tracker Saltwater Country Patrol Application to record information about foreign driftwood to report to DAFF. Foreign wood materials pose a security risk to Australia from their potential to transport invasive species like termites.

Aboriginal Areas Protection Authority

The Aboriginal Areas Protection Authority (AAPA) is an independent statutory organisation established under the Northern Territory Aboriginal Sacred Sites Act. Under the Act, all sacred sites in the Northern Territory are protected, regardless of whether they are located on or off of Aboriginal land.

AAPA is responsible for overseeing the protection of Aboriginal sacred sites on both land and sea across the NT, and a core function under the Act is consulting with custodians to issue Authority Certificates that both protect sites and indemnify those who conduct works in accordance with the conditions of the Certificate. AAPA also has the authority to take legal action against anyone who damages or otherwise breaches the laws protecting sacred sites in the NT.

Djelk Rangers install marker buoys to alert people that there is a registered sacred site in the area

NAILSMA and AAPA have collaborated in several ways, most notably by creating, at the request of ranger groups, an I-Tracker application for recording and monitoring sacred sites. This application, which is available to groups by request, incorporates general AAPA monitoring requirements, as well as any specific requirements for each individual group. The application allows groups to record detailed information about their cultural sites, as well as maintenance activities and other monitoring.

Rangers also use the I-Tracker application to monitor marine buoys that mark registered sacred sites. Several ranger groups participate in the proactive protection of marine sacred sites, including the Djelk Rangers who have worked with AAPA and NT Fisheries to install marker buoys at sacred sites around Maningrida. Using the I-Tracker application as part of their recording and regular monitoring of marine buoys, rangers are able to better protect their marine sacred sites, and the quality of the data collected has contributed to several successful prosecutions of people acting illegally in these areas.

Aboriginal Areas Protection Authority
protecting sacred sites across the territory

Djelk Rangers check a sacred site marine buoy while on a sea country patrol

Gooniyandi Rangers

Frank Weisenberger (Kimberley Land Council)

The Gooniyandi Rangers are based out of Fitzroy Crossing in the Kimberley region of north-west Australia. Under the guidance of their senior Traditional Owners, the Kimberley Land Council-facilitated ranger group is looking after their traditional lands in the Fitzroy Valley.

Managing a landscape changed by a century of pastoral activities requires flexibility and adaptability in the land management practices of the Gooniyandi Rangers. With many Indigenous and non-Indigenous pastoral leases within their Native Title Claim boundaries, the rangers are always looking for ways to work with their neighbours and diversify the environmental services they offer.

Gooniyandi Rangers fix fences as part of the environmental services they provide to neighbouring pastoral leases *© Kimberley Land Council*

Checking the fences around pastures is both a way to manage feral animals in the landscape and a welcome opportunity to undertake fee-for-service work, growing the ranger program. Since the development of the I-Tracker Land Patrol Application, the Gooniyandi Rangers have covered more than 560 km on patrols across 38 hours.

The rangers inspect the fences and record missing wires, fallen posts and broken gates, so that they can better plan for their work fixing the fences up. While on patrol, the rangers also collect information about invasive species and native vegetation, and over time a solid database is being built up in the Gooniyandi Rangers' office to inform future land management activities.

Using the I-Tracker Land Patrol Application allows the Gooniyandi Rangers to report back to their Traditional Owner community on the daily jobs of the ranger team—and nothing tells a story better than a map.

Recording fencing work at Mt. Pierre *© Kimberley Land Council*

Fence patrols follow the boundaries of the pastoral leases on Gooniyandi country and are recorded on the I-Tracker Land Patrol Application (map supplied by Kimberley Land Council)

Gooniyandi Rangers at Pillara *© Kimberley Land Council*

Great Barrier Reef Marine Park Authority

The Great Barrier Reef Marine Park Authority (GBRMPA) is the Australian Government agency responsible for managing the Great Barrier Reef Marine Park. GBRMPA has been working with Traditional Owners (TOs) for many years and recognises that establishing effective and meaningful partnerships with TOs is essential in order to protect heritage and cultural values, conserve biodiversity, and contribute to the resilience of the Great Barrier Reef.

Traditional Use of Marine Resources Agreements (TUMRAs) have been designed by GBRMPA to boost conservation and management work by TOs on their land and sea country. These voluntary agreements with GBRMPA and the Queensland Government are partnerships that support TOs and their cultural traditions and heritage values for managing their country.

GBRMPA project management staff guide TOs through the development phase of each TUMRA. TOs coordinate a range of meetings and on-country activities to develop their management strategy. Once agreements are accredited by the Queensland Department of National Parks, Recreation, Sport and Racing, and GBRMPA, TOs are provided with ongoing support to enact their aspirations for sea country management, often including a range of research, compliance and education-based programs. TUMRAs are developed and implemented with support from the Australian Government's Reef Rescue Land and Sea Country Indigenous Partnership Program, administered by GBRMPA with funding from Caring for our Country.

As of September 2013, there were seven TUMRAs accredited in the region, covering about 43,000 km^2 or 18% of the Great Barrier Reef Marine Park. One of the most recent of these TUMRAs was developed by the Lama Lama TOs of eastern Cape York. Under their agreement, they have committed to the sustainable management of their traditional use activities, including the hunting of culturally iconic animals such as turtles and dugongs.

The Lama Lama Traditional Owners are emerging leaders in sea country management within the Great Barrier Reef Marine Park, having already commenced a number of scientific, compliance, cultural mapping, education, and research activities with the support of GBRMPA. The Lama Lama Rangers use the I-Tracker Saltwater Country Patrol Application in support of their sea country management activities, which equips them to record and report on environmental management, monitoring and other patrol activities.

Australian Government
Great Barrier Reef
Marine Park Authority

A Lama Lama Ranger records information about marine debris

Lama Lama Rangers, community representatives and GBRMPA staff at a TUMRA meeting in 2013

Lama Lama Junior Rangers watch a demonstration on how to safely use a flare during a training session organised by GBRMPA

Tangaroa Blue Foundation

Tangaroa Blue Foundation is an Australian registered charity focused on improving the health of marine environments. In 2004, Tangaroa Blue launched the Australian Marine Debris Initiative (AMDI), a network of volunteers, communities, Indigenous rangers, schools, industry and government working to reduce marine debris in Australia's oceans.

The AMDI program starts with beach and river clean-ups where on-ground teams remove marine debris from coastal sites and waterways. The marine debris collected on a clean-up day is sorted into categories based on the types of material (e.g. glass, plastic, metal, or rubber), and grouped based on likely classes of sources (from litter left by visitors to fishing debris or marine debris from international sources). Data about the on-ground activities and the gathered debris is then recorded, and the data is used to find out what types of debris are impacting each coastal site.

Since 2009, NAILSMA's I-Tracker program has provided support for Indigenous land and sea managers to collect basic information on marine debris and ghost nets through the I-Tracker Saltwater Country Patrol Application. Tangaroa Blue uses some of the same field data collection technologies, namely CyberTracker software paired with mobile devices, that NAILSMA provides support for through its I-Tracker program.

Tangaroa Blue, Lama Lama Rangers and junior rangers, the community, NAILSMA staff, GBRMPA and visiting scientists all participated in the beach clean-up at One Mile Beach, Port Stewart, Queensland in 2013. NAILSMA staff helped with the data collection on mobile devices using Tangaroa Blue's CyberTracker application for recording marine debris.

Tangaroa Blue's CyberTracker application allows users to record detailed data during marine debris clean-ups. By using a CyberTracker application installed on mobile devices instead of paper data sheets, the data is less prone to human error during data entry, and can be easily downloaded to a computer database, making the data available for immediate analysis. The devices also have a built-in GPS, so users can extract a track of where the clean-up activity occurred, and quantify effort.

Once the data has been added to the database, Tangaroa Blue Foundation provides a bi-annual summary report back to the project volunteers and partners that shows trends and helps identify potential rubbish sources. Tangaroa Blue then works to engage stakeholders to work on practical solutions to reduce the rubbish, and create source-reduction plans to stop marine debris from occurring in our oceans.

The collection of detailed data is essential to addressing the complex issue of marine debris. The database now houses more than 2.4 million data entries for marine debris from 1040 coastal sites around Australia, gathered with the assistance of over 26,000 volunteers and partners. Using digital collection methods and tools is a significant asset to Tangaroa Blue's efforts, and NAILSMA looks forward to continuing to contribute to Tangaroa Blue's work to reduce these major threats to marine environments.

Indigenous land and sea rangers and other Indigenous communities, from locations across north Australia, contributed data to the Australian Marine Debris Initiative during the 2012-2013 reporting period

International connections

© Douglas Neasloss

The importance of Indigenous ranger programs and the environmental work they do is gaining national and international recognition, as are the benefits of bringing together Indigenous peoples from different countries to exchange and share knowledge.

NAILSMA has always recognised the value of such international connections and often plays a formal role in the promotion and facilitation of Indigenous exchanges. In 2008, for instance, NAILSMA partnered with Ocean Revolution to develop the Native Oceans Community Exchange Program, which featured an on-country visit to Mexico by Indigenous land and sea managers from Australia, and a return visit to northern Australia by the Comcaac of Sonora, Mexico.

The I-Tracker program has continued on these foundations, fostering international collaboration between Indigenous land and sea managers. International participants have been hosted at various I-Tracker forums, including representatives of the Canadian Coastal Guardians Watchmen Network, and the founders of CyberTracker software, Louis Liebenberg (South Africa) and Justin Steventon (USA). NAILSMA also maintains membership in the Arafura Timor Sea Experts Forum and the related Arafura Timor Sea Ecosystem Action project, and the I-Tracker program is a key focus of exchange visits through that forum.

Through its use of CyberTracker, the I-Tracker program links Indigenous Australian rangers into an international network of practitioners and supporters. The extensive experience that the I-Tracker program team has in developing and evaluating land and sea management applications has also informed several international groups and organisations in the development of their own CyberTracker applications.

NAILSMA's CEO welcomes participants to the 2012 I-Tracker Forum. Australian and international Indigenous rangers gather at these annual forums to exchange knowledge and share their experiences in land and sea management.

British Columbia Coastal First Nations

Coastal First Nations – Great Bear Initiative

In May 2010, while travelling in Canada, NAILSMA Project Manager Rod Kennett connected with the Coastal First Nations – Great Bear Initiative (CFN), an Indigenous organisation that coordinates a network much like NAILSMA along the central and north coasts of British Columbia. The timing was ideal, as CFN was holding its annual gathering of Guardian Watchmen—resource technicians similar to north Australia's Indigenous rangers. CFN invited Rod to attend the gathering, where they were launching their Regional Monitoring System.

Rod introduced CFN to the I-Tracker program and so began a relationship between NAILSMA and CFN that has continued and grown over the years. Each year since then, delegations of Guardian Watchmen have attended I-Tracker forums and visited ranger groups in north Australia. They have been invited to share stories about the CFN Regional Monitoring System and the CoastTracker, their version of an I-Tracker application.

Through CFN, First Nations are working together to improve ecological and human wellbeing and re-establish their authority to manage and protect their territories. The territories of coastal First Nations have been impacted by past resource use and continue to be threatened by ongoing activities and planned development. Federal and provincial government agencies have not committed sufficient staff or funding to effectively monitor and patrol these remote regions. Agencies need to address this shortfall, but coastal First Nations are also carrying out their inherent responsibilities to address these issues. Guardian Watchmen play a critical role in monitoring and protecting cultural sites and important ecosystems, and are the eyes and ears in each coastal First Nation territory.

Coastal First Nations members on the coast of British Columbia, Canada

The Regional Monitoring System was developed because coastal First Nation communities have a strong desire to know more about what is going on in their territories and regions and work toward common goals. The goals of the Regional Monitoring System are to:

- develop a standardised approach to monitoring priority issues at the regional scale
- provide tools for communities to collect, store, and retrieve data
- compile and compare coast-wide data for use by communities
- empower communities to use data in planning and decision-making.

The issues being monitored reflect priority concerns expressed by communities regarding damage to cultural sites, over-use and over-fishing, declining populations of fish and wildlife, and the inadequate presence and response of enforcement agencies. Over the long term, coordinated monitoring efforts will mean that First Nations will have stronger relationships with resource users; an enforcement presence in the region; a solid baseline of data for planning, management, and decision-making; and a clear case for conservation.

Guardian Watchmen collect data on a range of indicators through the Regional Monitoring System:

- **Wildlife sightings**: Sightings of specific marine and terrestrial wildlife species, including species at risk, are recorded to improve knowledge of habitat use and range.
- **Boat sightings**: The number and location of sport fishing, tourist, and other types of boats are monitored to get an idea of how territories are being used.
- **Activities of tourists**: Tourists on land or anchored boats are surveyed to find out about their activities, develop relationships with them, and engage in education and outreach.
- **Impacts to cultural and ecological sites**: Assessments are conducted before, during, and after the field season at cultural, ecological, high tourism, and community-use sites to ensure these areas are being used appropriately.
- **Suspicious activities**: Suspicious activities are recorded and reported to enforcement agencies. The outcomes of reports are tracked to try to improve enforcement, ensure accountability of enforcement agencies, and work toward establishing First Nations' authority to engage in compliance and enforcement.
- **Bear hunting:** Bear hunting activities are monitored and recorded to determine if there is hunting in contravention of the First Nations-declared trophy hunting ban and to develop a strategic and coordinated response.
- **Crab and prawn trap sightings**: Sightings of commercial, recreational, and food-fish crab and prawn traps are recorded to determine the location and proportion of fishing effort.
- **Stream surveys**: Guardian Watchmen collect water quality data, conduct habitat assessments, and survey returning salmon at priority streams within their territories to improve knowledge of habitat and fish stocks.
- **Tsunami debris**: Sightings of tsunami debris from the Japanese earthquake are recorded to assess the extent and impacts of the debris on the coast and build a case for resources to address impacts and debris removal.

The Regional Monitoring System provides Guardian Watchmen with standardised methods for collecting and recording data. First Nations use a set of field cards and a mobile device called a CoastTracker to collect data, and a secure online data management system to store and access information. Each First Nation controls access to its information and authorised users can download raw data or generate reports and maps. Data collected through the Regional Monitoring System are used to inform First Nations' land and marine use plan implementation, fisheries and wildlife management, and tourism and economic development at the First Nation and regional level.

Two specific ways that First Nations have used the Regional Monitoring System are in managing protected areas and undertaking fisheries research. The following two sections tell the stories of the Kitasoo/Xai'xais Nation using the Regional Monitoring System to manage the Mussel River estuary, and the Nuxalk Nation using it to undertake Dungeness crab research in their territory.

Kitasoo/Xai'xais Nation's management of Mussel Inlet

The Mussel River estuary at the head of Mussel Inlet is an important site in the Kitasoo/Xai'xais Nation's territory. It was protected in a conservancy, a special class of protected area, as part of a First Nation-Government of British Columbia land use planning process. The Kitasoo/Xai'xais Nation has worked with the Government of British Columbia to develop a conservancy management plan for the area and is actively managing the conservancy.

Using CoastTracker to collect data on impacts to cultural and ecological sites

Despite being situated on a remote and isolated part of the coast, the Mussel River estuary becomes a busy place in mid-August. People come from all over the world to view and take pictures of grizzly bears when the salmon return.

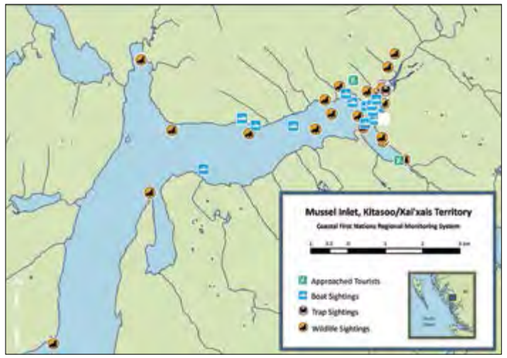
The Kitasoo/Xai'xais Nation has developed a world-class ecotourism business focused on viewing these bears as well as the 'Spirit bears' dispersed throughout their territory. Spirit bears, also known as Kermode bears, are a subspecies of black bear (*Ursus americanus kermodei*) that live only on the central and north coasts of British Columbia. They carry a recessive gene that gives approximately one-tenth of the population a cream-coloured coat.

The Mussel River estuary is also a popular spot for other tourism operators and public recreational boaters. The Kitasoo/Xai'xais Nation has signed protocol agreements with most of the tourism companies operating in its territory. These innovative agreements define operating permissions, regulations, and restrictions for the operators. The protocol agreements generate a 'per user' fee for the Nation, and revenue is allocated toward Kitasoo/Xai'xais Guardian Watchmen monitoring activities in the conservancies and elsewhere in the territory. Kitasoo/Xai'xais

Kitasoo/Xai'xais Guardian Watchmen monitor bear activity in the Mussel River estuary *© Phil Charles*

Watchmen are stationed in the Mussel Inlet throughout the tourist season to monitor the area and ensure that everyone is abiding by the rules laid out in the management plan.

Kitasoo/Xai'xais Watchmen, along with other staff who patrol the territory, use the Regional Monitoring System and their CoastTrackers to collect data on tourist activities and sightings of boats, wildlife, and crab and prawn trap floats in the estuary and inlet. The map below illustrates some of the data that are used to inform the ongoing management of this important area.



Management information collected at the Mussel Inlet Conservancy

Nuxalk Nation Dungeness Crab Research

Dungeness crab (*Metacarcinus magister*) is a highly prized food species on the coast, and there are Indigenous, commercial, and recreational fisheries. Little research has been conducted on crab populations along the central coast, and the commercial and recreational fisheries are not sufficiently monitored by the Canadian government. First Nations have concerns about the impacts of commercial and recreational fisheries on crab populations. As part of the Regional Monitoring System, sightings of crab trap floats are recorded in order to monitor the location of fishing pressure.

Boat and trap sightings where Dungeness crab research is conducted

In 2011, the Nuxalk Nation began research into the population dynamics of Dungeness crabs. They used both Indigenous knowledge and information collected through the Regional Monitoring System to select research locations. By combining crab population research with data collected through the Regional Monitoring System, the Nuxalk are better able to understand the impacts of the fisheries on crab populations. These data will be useful if they want to close recreational or commercial fisheries in specific areas of their territory.

Looking ahead

Indigenous land and sea management across north Australia has a strong future. While there is still much work to be done, 40 years of land rights, Native Title, and a decade of community-based land and sea management have laid a foundation that enables Indigenous people to lead and manage their own efforts to look after country. This was always the hope of the original architects of NAILSMA.

Indigenous land and sea management programs have grown enormously since the late 1990s, and the multi-award winning I-Tracker program has had a significant influence in this sector over just a few years. Through the program, NAILSMA is setting new standards for the development and delivery of data collection tools, while also providing the training, support, and networks required to sustain their use across the north.

The I-Tracker program equips Indigenous land and sea managers to collect robust data that captures the full picture of their work on country. Valuable digital data such as ranger effort (for example distances travelled on a patrol, number of people involved, or hours spent on work or surveys), sightings or lack of sightings, and exact tracks travelled are all easily recorded through I-Tracker applications, rather than sitting in scattered notebooks or partially completed data sheets. These data are critical as both a record of activities undertaken and the basis of future environmental and logistical planning.

The program has significantly improved the capacity for consistent, professional data collection and management across the northern Indigenous estate. This has been achieved through robust collaborations, extensive training and remote technical support, a diverse suite of scientifically-robust and culturally-appropriate tools, and a facilitated network that links Indigenous people, researchers, and government and non-government representatives.

These links, and the standardisation in data collection, mean that data can be aggregated to examine issues across larger scales. Standardised digital data collection also enables rangers to evaluate the effectiveness of their activities over time and enhances accountability back to Traditional Owners, with accurate mapping, detailed recording of management interventions, and repeat surveys all contributing to more effective on-ground management.

Indigenous land and sea management has significant potential to define and create sustainable livelihoods in rural and remote parts of north Australia. Further, with most of the north under some form of Indigenous interest or title, the north's future will rely heavily on Indigenous rangers taking up the challenges of the 21st century and actively managing their land and sea country on behalf of their clans and importantly, the nation as a whole. The I-Tracker program is a natural fit to support these efforts to sustain people, culture and country.

Acronyms

AAPA	Aboriginal Areas Protection Authority
AFL	Australian Football League
AMDI	Australian Marine Debris Initiative
AQIS	Australian Quarantine Service
CFN	Coastal First Nations
CGNP	Carpentaria Ghost Nets Programme
CIR	Crocodile Island Rangers
CLCAC	Carpentaria Land Council Aboriginal Corporation
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAFF	Department Of Agriculture, Fisheries and Forestry
DMTP	Dugong and Marine Turtle Project
DOGIT	Deed of Grant of Land in Trust
EPBC	Environment Protection and Biodiversity Conservation Act
FFV	Foreign Fishing Vessel
GBRMPA	Great Barrier Reef Marine Park Authority
GNA	GhostNets Australia
GPS	Global Positioning System
HCP	Healthy Country Planning
IPA	Indigenous Protected Area
I-Tracker	Indigenous Tracker
KLC	Kimberley Land Council
NAFI	North Australian Fire Information
NAILSMA	North Australian Indigenous Land and Sea Management Alliance Ltd
NAQS	Northern Australia Quarantine Strategy
NASA	National Aeronautics and Space Administration
NERP	National Environmental Research Program
NLC	Northern Land Council
NOAA	National Oceanic and Atmospheric Administration
NRL	National Rugby League
NT	Northern Territory
NTG	Northern Territory Government
PDA	Personal Digital Assistant (handheld field computer)
SPN	Saltwater People Network
TNC	The Nature Conservancy
TO	Traditional Owner
TRaCK	Tropical Rivers and Coastal Knowledge
TUMRAs	Traditional Use of Marine Resources Agreements
USA	United States of America
UWA	The University of Western Australia
WA	Western Australia
WALFA	Western Arnhem Land Fire Abatement Project
WGAC	Wunambal Gaambera Aboriginal Corporation
WWF	World Wide Fund for Nature

Looking After Country **chronicles a revolutionary approach to land and sea management by Indigenous rangers. For the first time, the experiences of nearly twenty different ranger groups, as well as almost a dozen partner organisations, are collected together to demonstrate how Indigenous rangers are making some of the biggest contributions to on-ground land and sea monitoring and management in north Australia.**

NAILSMA's I-Tracker program (short for Indigenous Tracker) was created to develop networks, tools, knowledge, and skills that support and promote coordinated and collaborative Indigenous land and sea management. The core of the I-Tracker program is a commitment to ensuring that knowledge and data remain in Indigenous hands and are used to address Indigenous priorities.

The I-Tracker program plays a key role in NAILSMA's efforts to foster equitable partnerships that support Indigenous innovation and excellence, and create opportunities to access new technologies, resources and relationships that inform Indigenous land and sea management. The program is underpinned by NAILSMA's commitment to promote and facilitate evidence-based research, and to spearhead the concept of an Indigenous culture-based economy that builds on Indigenous culture, knowledge and connection to country.

With a growing workforce of over 700 Indigenous rangers across some of the most remote and biodiverse environments in the world, the work of Indigenous rangers is essential to sustainable futures and livelihoods in the north. *Looking After Country* highlights this work, situates the I-Tracker program within larger regional and national contexts, and demonstrates how the program can make even greater contributions to livelihood and fee-for-service opportunities while continuing to deliver essential support to help Indigenous people achieve healthy country outcomes.

North Australian Indigenous Land and Sea Management Alliance Ltd

www.nailsma.org.au

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Looking after Our Country... Our Way