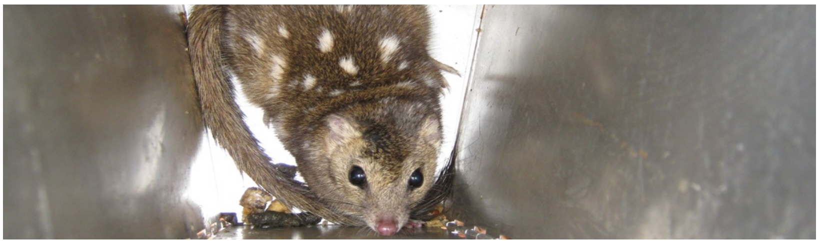
Biota Environmental Sciences

Yandicoogina Expansion Northern Quoll Position Paper



Prepared for Rio Tinto Iron Ore

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Yandicoogina Northern Quoll Position Paper

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1.0 Introduction

1.1 Project Background

The Yandicoogina iron ore mine is located approximately 75 km north-west of Newman, in the Pilbara region of Western Australia (Figure 1.1). This mine site is owned and operated by Rio Tinto Iron Ore (RTIO).

RTIO is seeking to expand their current mining operations located at Yandicoogina. This involves three expansion areas:

- Yandicoogina Junction South West (JSW); and
- Oxbow;

The study area for the JSW development lies immediately west of the existing Yandicoogina operations while the Oxbow study area abuts the western extremity of JSW. The third development site, Billiard South, is located to the south-east of the existing Yandicoogina operation.

The Yandicoogina expansion project was referred to the Western Australian Environmental Protection Authority (EPA) under Section 38 of the *Environmental Protection Act 1986*. The EPA subsequently determined that the project would be formally assessed at the level of Public Environmental Review (PER).

The proposed action of constructing the Yandicoogina expansion project has not yet been referred to the Federal Department of the Environment, Water, Heritage and the Arts (DEWHA) under ther terms of the Federal *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*. The most likely factor requiring this referral would be the potential for the action to affect the Northern Quoll *Dasyurus hallucatus* under the 'Threatened Species and Communities' matter of National Environmental Significance (NES).

1.2 Scope and Role of this Report

In order to support the likely Federal referral, RTIO commissioned Biota Environmental Sciences (Biota) to prepare a position paper on the Northern Quoll, focusing on the Pilbara bioregion and the Yandicoogina area in particular. This report built on a similar exercise previously completed for the Hope Downs IV proposal (Biota 2009a). The scope of this exercise was to:

- provide a summary background on the general distribution, ecology and conservation status of the Northern Quoll, with particular reference to the Pilbara region;
- complete an updated consolidation of all readily available records of the species in the Pilbara region, including whether there is any relationship with Land Systems, sub-bioregional boundaries or other geographical divides;
- carry out a comparison of this with database results for the species from the DEWHA *EPBC Act 1999* Protected Matters search tool;
- revisit the background and basis to the Commonwealth listing of the species, including identified threatening processes and their relevance to Pilbara populations; and
- provide an updated assessment on the status of the Northern Quoll in the Pilbara region.

Specific comments on the likelihood of the Northern Quoll occurring in the Yandicoogina expansion project area are also provided.

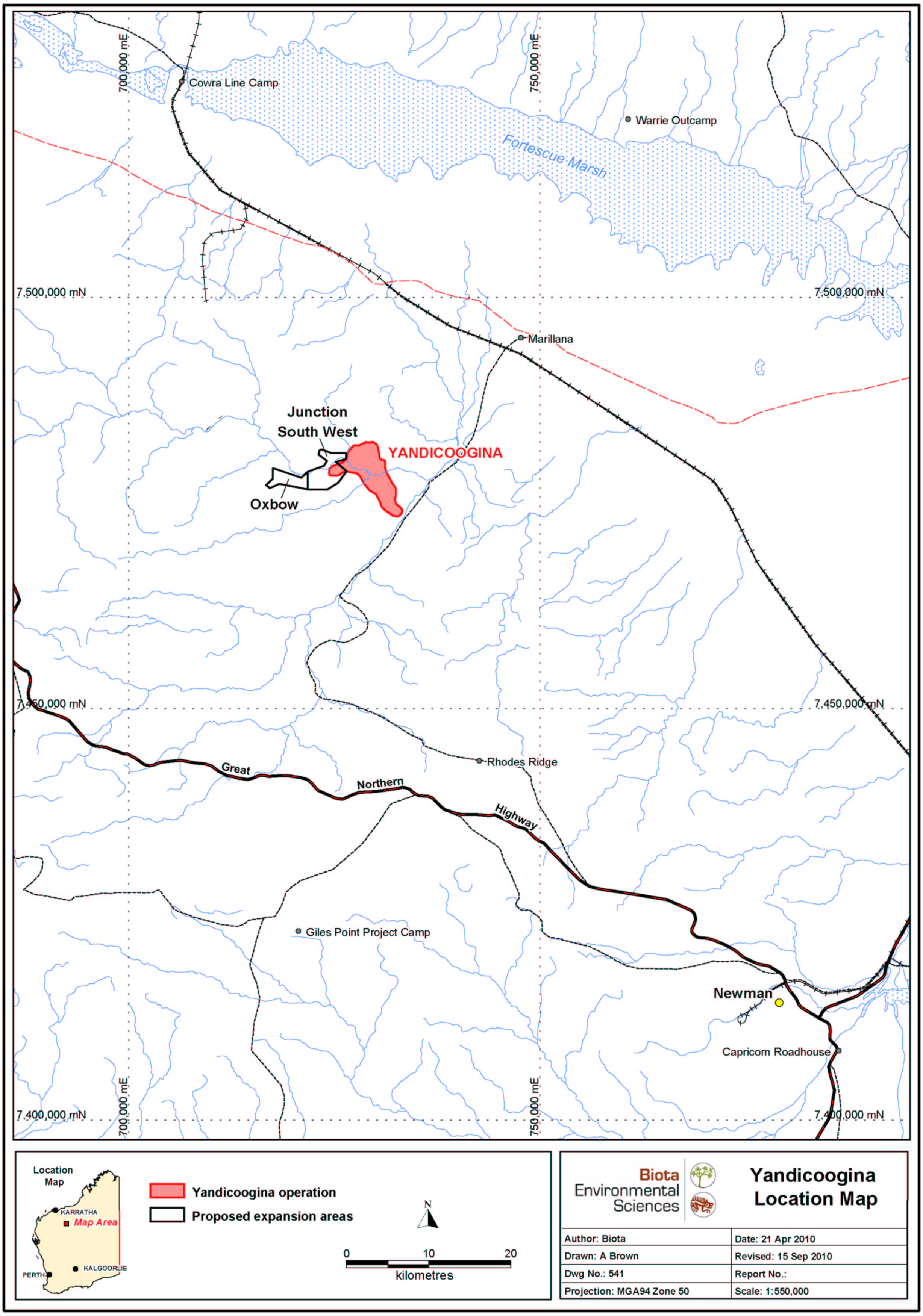


Figure 1.1: Locality map for the Yandicoogina expansion project area.

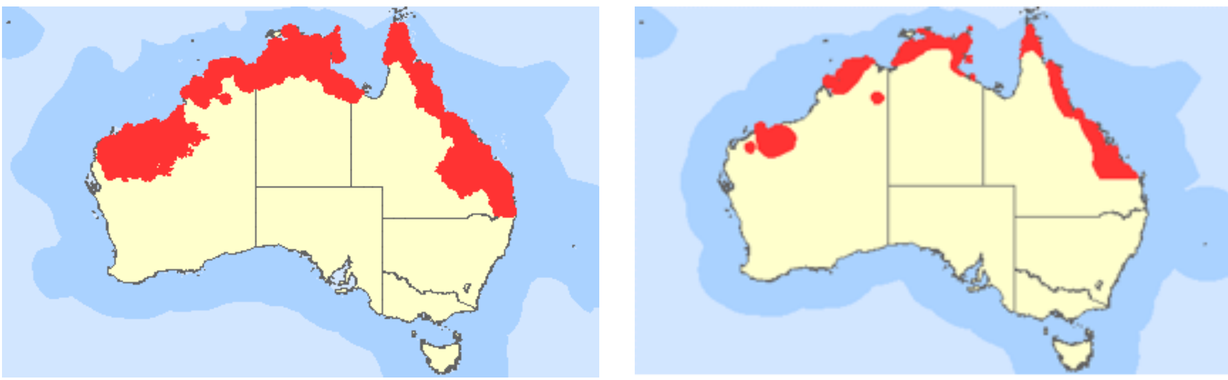
2.0 Background on the Northern Quoll

2.1 Australian Distribution

The Northern Quoll *Dasyurus hallucatus* had a pre-European distribution that extended across northern Australia from North-west Cape, Western Australia to south-east Queensland, but its range has contracted in recent years (Braithwaite and Griffiths 1994). The species' distribution is now restricted to six main areas:

- the north and western top end of the Northern Territory;
- north of Cape York;
- the Atherton-Cairns area,
- the Carnarvon Range-Bowen area of Queensland (Menkhorst and Knight 2001),
- the northwest Kimberley and
- the Pilbara region of Western Australia (Braithwaite and Griffiths 1994).

The Northern Quoll also occurs on numerous islands off the Australian coast (Abbott and Burbidge 1995, Burbidge and McKenzie 1978; How et al. 2006). The current distribution of the species as shown by DEWHA (2010) is shown in Figure 2.1.



2010 2009

Figure 2.1: Australian distribution of the Northern Quoll *Dasyurus hallucatus* as shown on DEWHA in 2010 (left) compared to 2009 (right).

The distribution maps shown on DEWHA (2010) have been substantially extended from those of DEWHA (2009) (as reproduced in Biota (2009a)). The distribution of the species in the Pilbara region in particular has greatly increased to the south and south-east of the bioregion (Figure 2.1: 2010). It should be noted that this extension to the southeast in this particular distribution map appears to have been influenced by a single dubious record. This desiccated specimen was recovered from cave and cannot positively be identified as *Dasyurus hallucatus* (Ric How, WA Museum pers. comm. 2010). While genetic data indicate it belongs to the *D. hallucatus* phylogenetic clade, a specialist working on skull morphology identified the specimen with some confidence as the Western Quoll *Dasyurus geoffroii*. This distributional record should currently be treated with considerable caution and DEWHA are in the process of re-revising these maps (T. McGrath, DEWAH, pers. comm. 2010).

In the interim, an updated and more detailed review of the distribution of the Northern Quoll specific to the Pilbara bioregion has been completed for this document, building on the work completed by Biota (2009a) (Section 4.0).

2.2 Biology

The Northern Quoll is a medium-sized dasyurid marsupial, with adult weight ranging from 300 to 1,200 g. It is considered a partially arboreal and aggressive carnivore, preying on a varied diet of small invertebrates and vertebrates, including lizards, birds, snakes, small mammals and frogs (Oakwood 1997). It is also known to feed on fleshy fruit and carrion. The Northern Quoll is mostly nocturnal, although crepuscular (dusk and dawn) activity also occurs. The species makes a den in spaces amongst rocks or in log and tree hollows. Many records from the Pilbara bioregion have come from mesa and breakaway features abutting large creeks (Garth Humphreys, Biota, pers. obs.) and from boulder tors of the Abydos-Woodstock Plain (How et al. 1991).

The Northern Quoll is a short-lived mammal, with both sexes maturing at 11 months. Females reproduce only once each year and almost all males die shortly after reproducing (Dickman and Braithwaite 1992, Oakwood 2000). The discrete male cohorts that arise within populations can make quolls more susceptible to local population extinctions. If no juvenile male quolls survive to adulthood, there will be no males available for mating the following year and the local population will rapidly go extinct (Braithwaite and Griffiths 1994, Oakwood 2000).

Therefore, any factor that results in significant increases in mortality rates of female and juvenile quolls could result in the loss of local populations.

2.3 Conservation Status

Dasyurus hallucatus is specially protected under both State and Federal legislation. The species is listed as Schedule 1 ('Endangered') under the Western Australian *Wildlife Conservation Act 1950-1979* and is also listed as 'Endangered' under the Federal *EPBC Act 1999*.

The listing of the Northern Quoll as a threatened taxon by the Australian Government in 2004 was largely predicated on the dramatic decline of populations of the species across northern Australia associated with the spread of the Cane Toad *Bufo marinus*. To date, the species remains widely distributed and relatively common in the west Kimberley, although this is likely to change with the arrival of the Cane Toad in the next several years (see Section 5.1). Pilbara populations are currently unaffected by this introduced species, though this may change in the future (Section 5.1).

3.0 Methods

3.1 Database Searches

Updated searches were conducted of the Department of Environment and Conservation (DEC) Threatened Fauna and Fauna Survey Returns databases, the NatureMap database and the Biota Environmental Sciences Internal Database for Northern Quoll *Dasyurus hallucatus* records within the Pilbara bioregion.

The Biota Internal Database was additionally searched to identify all records of Elliott trapping that not have not yielded Northern Quoll records. As most records from the bioregion have come from Elliott trapping, these null data are indicative of areas where *D. hallucatus* was not detected by systematic surveys (see Section 4.4.2 for a fuller discussion).

Updated, 2010 point searches with a 50 km radius were conducted of the *EPBC Act 1999* Protected Matters database for four locations representative of the spatial extent of the Pilbara bioregion:

- Pannawonica 21°38'S and 116°19'E;
- Port Hedland 20°18'S and 118°36'E;
- Nullagine 21°53'S and 120°06'E; and
- Newman 23°21'S and 119°43'E.

A search of the Protected Matters database was also conducted specifically for the Yandicoogina expansion project area.

3.2 Literature Review

An updated literature review of both scientific and 'grey' literature was also undertaken concurrently with the database searches (Section 6.0 and Appendix 1). This review included collating any records of Northern Quoll observations, and also any records of Elliott trapping within the Pilbara that did not result in Northern Quoll captures. The literature review included the recently undertaken targeted Northern Quoll survey at Yandicoogina (Biota 2009b) and other systematic terrestrial fauna survey work completed for the Yandicoogina expansion (Biota 2010a and 2010b).

3.3 Spatial Analysis

The locations of all collated Northern Quoll records were captured in MapInfo Professional v8 Geographical Information System (GIS). These point data were then used to compile updated distribution maps for the Pilbara region that are validated on specimen database and survey records. MapInfo was then used to intersect the records with bioregion and Land System spatial data to examine any broad distributional patterns for the species occurrence in the region.

3.4 Study Limitations

This report, while collating large amounts of data, should not be considered as an exhaustive account of all Northern Quoll records for the Pilbara bioregion. Database searches and literature reviews were undertaken where records were accessible and in the time permissible. It is therefore probable that not all observations of the Northern Quoll in the Pilbara bioregion have been documented. However, as the State-owned databases of the WA Museum and the DEC were searched, it is expected that most published and validated records have been captured here.

The coverage of this study is also restricted to areas of the Pilbara bioregion where systematic biological surveys have been conducted. Not all of the data collated had coordinates provided, so data analysis could only be conducted on known records.

4.0 Results

4.1 Northern Quoll Records from the Pilbara

The compiled Northern Quoll records show a wide distribution across the Pilbara, with 245 records from locations across the extent of the bioregion (accumulated over several decades by the WA Museum, DEC, Biota and others). Confirmed locations where the species has been recorded in the Pilbara are shown in Figure 4.1.

Searches conducted of the *EPBC Act 1999* Protected Matters database yielded the Northern Quoll as "Species or species habitat may occur within area" for Port Hedland, Pannawonica, Nullagine, Newman and the Yandicoogina expansion project area. As these sites span the extent of much of the bioregion, it appears likely that the *EPBC Act 1999* search tool now reflects the updated distribution maps shown in Figure 2.1. A corollary of this is that this same result will probably be yielded for searches done for any location within the bioregion: effectively meaning that any future actions may require Federal referral on this basis.

4.2 Northern Quoll Occurrence within IBRA Subregions

The Interim Biogeographic Regionalisation for Australia (IBRA) recognises 85 bioregions (May and McKenzie 2003). The Pilbara bioregion is divided into four subregions: Hamersley, Fortescue Plains, Chichester and Roebourne Plains, and are described by May and McKenzie (2003) as the four major components of the Pilbara Craton:

- Chichester (PIL1): undulating Archaean granite and basalt plains include significant areas of basaltic ranges. Plains support a shrub steppe characterised by *Acacia inaequilatera* over *Triodia wiseana* (formerly *Triodia pungens*) hummock grasslands, while *Eucalyptus leucophloia* tree steppes occur on ranges;
- Fortescue Plains (PIL2): alluvial plains and river frontage. Extensive salt marsh, mulga-bunch grass, and short grass communities on alluvial plains in the east. Deeply incised gorge systems in the wester (lower) part of the drainage. River gum woodlands fringe the drainage lines. Northern limit of Mulga (*Acacia aneura*). An extensive calcrete aquifer feeds numerous permanent springs in the central Fortescue, supporting large permanent wetlands with extensive stands of river gum and cadjeput *Melaleuca* woodlands;
- Hamersley (PIL3): mountainous area of Proterozoic sedimentary ranges and plateaux, dissected by gorges (basalt, shale and dolerite). Mulga low woodland over bunch grasses on fine textured soils in valley floors, and *Eucalyptus leucophloia* over *Triodia brizoides* on skeletal soils of the ranges; and
- Roebourne Plains (PIL4): quaternary alluvial and older colluvial coastal and sub-coastal plains with a grass savannah of mixed bunch and hummock grasses, and dwarf shrub steppe of *Acacia stellaticeps* or *A. pyrifolia* and *A. inaequilatera*. Uplands are dominated by *Triodia* hummock grasslands. Ephemeral drainage lines support *Eucalyptus victrix* or *Corymbia hamersleyana* woodlands. Samphire, *Sporobolus* and mangal occur on marine alluvial flats and river deltas.

These subregions are largely equivalent to the physiographic regions of Beard (1975), although the coastal portion of Beard's Abydos Plain unit comprises the Roebourne Plains subregion, while the inland portion is included within the Chichester subregion.

A total of 220 individual Northern Quoll records were able to be sourced for this study, distributed across all four of the Pilbara subregions (Table 4.1; Figure 4.1). The majority have come from the Chichester and Hamersley subregions, with records from only 10 locations within the Roebourne subregion and only two in the Fortescue subregion (Figure 4.1).

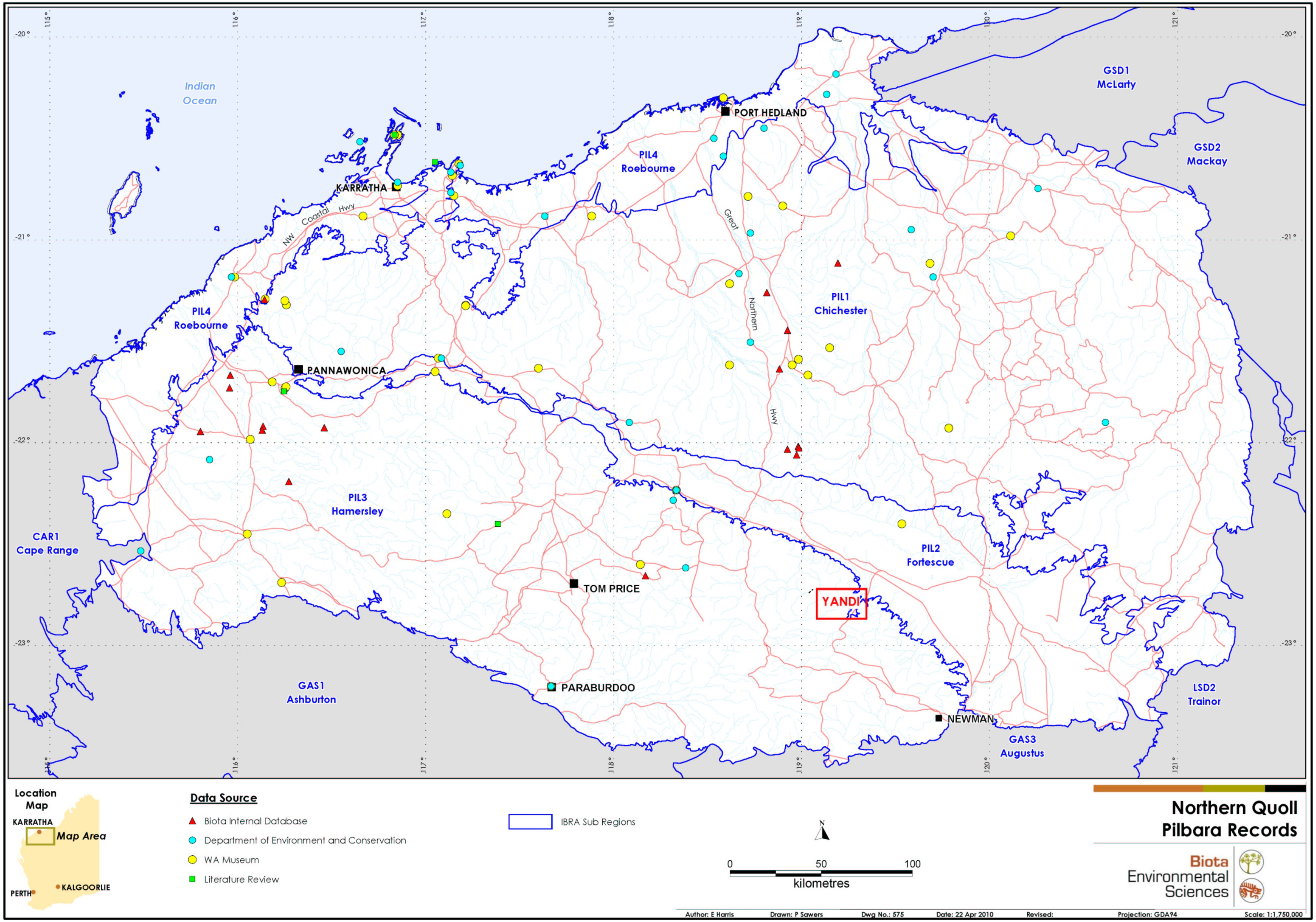


Figure 4.1: Distribution of Northern Quoll *Dasyurus hallucatus* records in the Pilbara.

4.3 Northern Quoll Occurrence within Land Systems

Land Systems (Rangelands) mapping covering the study area has been prepared by the Western Australian Department of Agriculture (van Vreeswyk et al. 2004). Land Systems are comprised of repeating patterns of topography, soils, and vegetation (Christian and Stewart 1953) (i.e. a series of "land units" that occur on characteristic physiographic types within the Land System). A total of 107 Land Systems occur in the Pilbara bioregion. [This information was obtained by combining the Land System mapping for the Pilbara (van Vreeswyk et al. 2004) and Ashburton (Payne et al. 1988), and intersecting this with the Pilbara bioregion (Environment Australia 2000) in ArcView 3.2a.].

Of the 220 Northern Quoll records compiled for the Pilbara region, 49 occurred within the Rocklea Land System, 42 within the Macroy Land System and 36 within the Robe Land System (Table 4.1). These three Land Systems contain rocky hills, mesas, plateaux, drainages and granite tor fields, representing the Northern Quoll's preferred habitat in the Pilbara (see Section 2.2). More than half of all records (58%) have come from sites within these three Land Systems. *D. hallucatus* has also been recorded relatively frequently from the Capricorn, Wona and River Land Systems, which also include hills, ridges and major drainage habitats (Table 4.1). Together, these six Land Systems account for 74% of the Northern Quoll records from the region.

Both the Robe and River Land Systems occur within the Yandicoogina expansion project area (Biota 2010a and 2010b). However both are present within the project area at less than 0.3% of their total areas within the Pilbara bioregion.

While this regional analysis indicates these Land Systems contain the preferred habitats for the species, Northern Quolls also occur across a wide range of other units throughout the Pilbara bioregion. This is illustrated by the large number (27) of different land systems where the Northern Quoll has been recorded (Table 4.1). Many of the records outside of the Northern Quolls preferred habitat are likely to be foraging or dispersing individuals.

Table 4.1: Relationship between Northern Quoll records and Land Systems in the Pilbara bioregion (Land Systems in grey contain core habitats for the Northern Quoll).

Land System	No. of Records	Description
Rocklea	49	Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex (and occasionally soft spinifex) grasslands.
Macroy	42	Stony plains and occasional tor fields based on granite supporting hard and soft spinifex grasslands.
Robe	36	Low plateaux, mesas and buttes of limonites supporting soft spinifex (and occasionally hard spinifex) grasslands.
Capricorn	17	Hills and ridges of sandstone and dolomite supporting low shrublands or shrubby spinifex grasslands.
Wona	10	Basalt upland gilgai plains supporting tussock grasslands and minor hard spinifex grasslands.
River	8	Active flood plains, major rivers and banks supporting grassy eucalypt woodlands, tussock grasslands and soft spinifex grasslands.
Newman	7	Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.
Horseflat	7	Gilgaied clay plains supporting tussock grasslands and minor grassy snakewood shrublands.
McKay	5	Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands.
Boolgeeda	5	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands.
Calcrete	5	Low calcrete platforms and plains supporting shrubby hard spinifex grasslands.
Uaroo	5	Broad sandy plains supporting shrubby hard and soft spinifex grasslands.

Land System	No. of Records	Description
Boolaloo	3	Granite hills, domes and tor fields and sandy plains with shrubby spinifex grasslands.
Taylor	3	Stony plains and isolated low hills of sedimentary rocks supporting hard and soft spinifex grasslands.
Urandy	3	Stony plains, alluvial plains and drainage lines supporting shrubby soft spinifex grasslands.
Littoral	2	Bare coastal mudflats with mangroves on seaward fringes, samphire flats, sandy islands, coastal dunes and beaches.
Mosquito	2	Stony plains and prominent ridges of schist and other metamorphic rocks supporting hard spinifex grasslands.
White Springs	2	Stony gilgai plains supporting tussock grasslands and hard spinifex grasslands.
Houndstooth	1	Rough shale hills, stony plains and broad drainage floors supporting hard spinifex grasslands and sparse shrubs.
Ruth	1	Hills and ridges of volcanic and other rocks supporting hard spinifex (occasionally soft spinifex) grasslands.
Carpentaria	1	Coastal flats, associated sandy margins and dunes; saline sands and muds; paperbark thickets, samphire meadows, extensive bare mud flats with fringing mangrove forests.
Marandoo	1	Basalt hills and restricted stony plains supporting grassy mulga shrublands.
Pago	1	Gently undulating sandstone country with open forest vegetation and deep sandy soils, found throughout the area except in the extreme west.
Paraburdoo	1	Basalt derived stony gilgai plains and stony plains supporting snakewood and mulga shrublands with spinifex, chenopods and tussock grasses.
Stuart	1	Gently undulating stony plains supporting hard and soft spinifex grasslands and snakewood shrublands.
Talga	1	Hills and ridges of greenstone and chert and stony plains supporting hard and soft spinifex grasslands.
Turee	1	Stony alluvial plains with gilgaied and non-gilgaied surfaces supporting tussock grasslands and grassy shrublands of mulga and snakewood.

4.4 Likelihood of a Northern Quoll Population at Yandicoogina

4.4.1 Habitat Types

The Yandicoogina expansion area includes two of the Land Systems that represent core habitat for Northern Quolls in the Pilbara region based on the analysis presented in Section 4.3. Both the River and the Robe Land Systems occur in the expansion area (Biota 2010a and b), meaning that apparently suitable habitat for *Dasyurus hallucatus* is present in the study area. A total of 515.8 ha of River Land System and 137.2 ha of Robe Land System occurs in the expansion area (Biota 2010a and b).

4.4.2 Null Elliott Trapping

Numerous fauna surveys have been conducted throughout the Pilbara region (see Section 6.0 and Appendix 1), with many utilising Elliott traps as part of their methodology. Elliott traps are one of the suitable methods for trapping Northern Quolls, with many of the records collated by this study having been yielded via this method. Previous sampling experience along the Robe River valley (Ecologia 1991), on the Mitchell Plateau, on offshore islands of the Kimberley and on the Abydos-Woodstock plain (How et al. 1991), have indicated that the use of appropriately baited Elliott traps is suitable to demonstrate the presence of Northern Quolls if they occur in an area.

A large number of systematic fauna surveys have been undertaken in the area surrounding the Yandicoogina expansion project. Elliott trapping has been completed at nearby Hope Downs I, II and IV, Weeli Wolli Creek, West Angelas, Mt Whaleback, Orebody 18 and Ophthalmia Dam, none of which have yielded any Northern Quoll records (Figure 4.2). The closest Northern Quoll specimen record is from 1980 (WAM Database) ~50 km to the north of the Yandicoogina expansion project area, north of the Fortescue Marshes. The next closest record is at Marandoo, ~100 km west of the Yandicoogina expansion project area (Figure 4.1). In addition, Ecologia (1995, 1998), Ninox (1994) and Biota (2009b, 2010a, 2010b) undertook targeted Elliott trapping in several areas of the Yandicoogina locality, with a total of 5,731 Elliott trap nights over several survey phases. No Northern Quolls were recorded from this survey effort, which spanned 15 years.

This null result from Elliott trap effort in the south-eastern Pilbara includes targeting areas such as Weeli Wolli Springs, approximately 15 km away (within the Yandicoogina locality), which is good prospective habitat for *Dasyurus hallucatus*. Habitats present in this area comprise a spring-driven creekline with large mature eucalypt and *Melaleuca* trees full of hollows, adjacent to rocky cliffs with numerous *Zyzomys argurus* (a primary prey item for the species in the Pilbara). No Northern Quolls have been recorded from this area, despite extensive Elliott trapping associated with the Weeli Wolli Creek Surveys (1,840 Elliott trap nights; Ecologia 1998), the Hope Down mine biological survey (2,710 Elliott trap nights; Ecologia 1997) and Hope Downs Rail options fauna survey (800 Elliott trap nights; Halpern Glick Maunsell 2000). The species was also not recorded during several years of Pebble Mound Mouse *Pseudomys chapmani* monitoring conducted using Elliott traps in similar habitats in the immediate locality at Marillana Creek (a total of over 7,000 Elliott trap nights over several years; Halpern Glick Maunsell 1998).

4.4.3 Other Observations

At present, the only indication the species occurs at Yandi comes from anecdotal observations from inside the warehouse at the existing Yandicoogina operations (730335 mE; 7482373 mN). A single individual was sighted on a number of occasions by mine workers during a two month period in 2008, and appeared to have become habituated to the warehouse area as is common with the species, as they are often found in roofs of houses (Van Dyck and Strahan, 2008). Much of the suitable habitat adjoining the operations was burnt during 2009 however (as noted in Biota (2009b)) and the individual has not been sighted since. No Northern Quolls were recorded during trapping carried out by Biota (2009b) which targeted the most prospective habitats close to this location.

In overview then, only a single animal has been observed from sightings in the past 15 years. With a total trap effort of over 10,000 Elliott trap nights spread over a number of years and seasons, it is probable that at least one individual would have been trapped at some point in time if a significant population of this species occurred in the Yandicoogina locality.

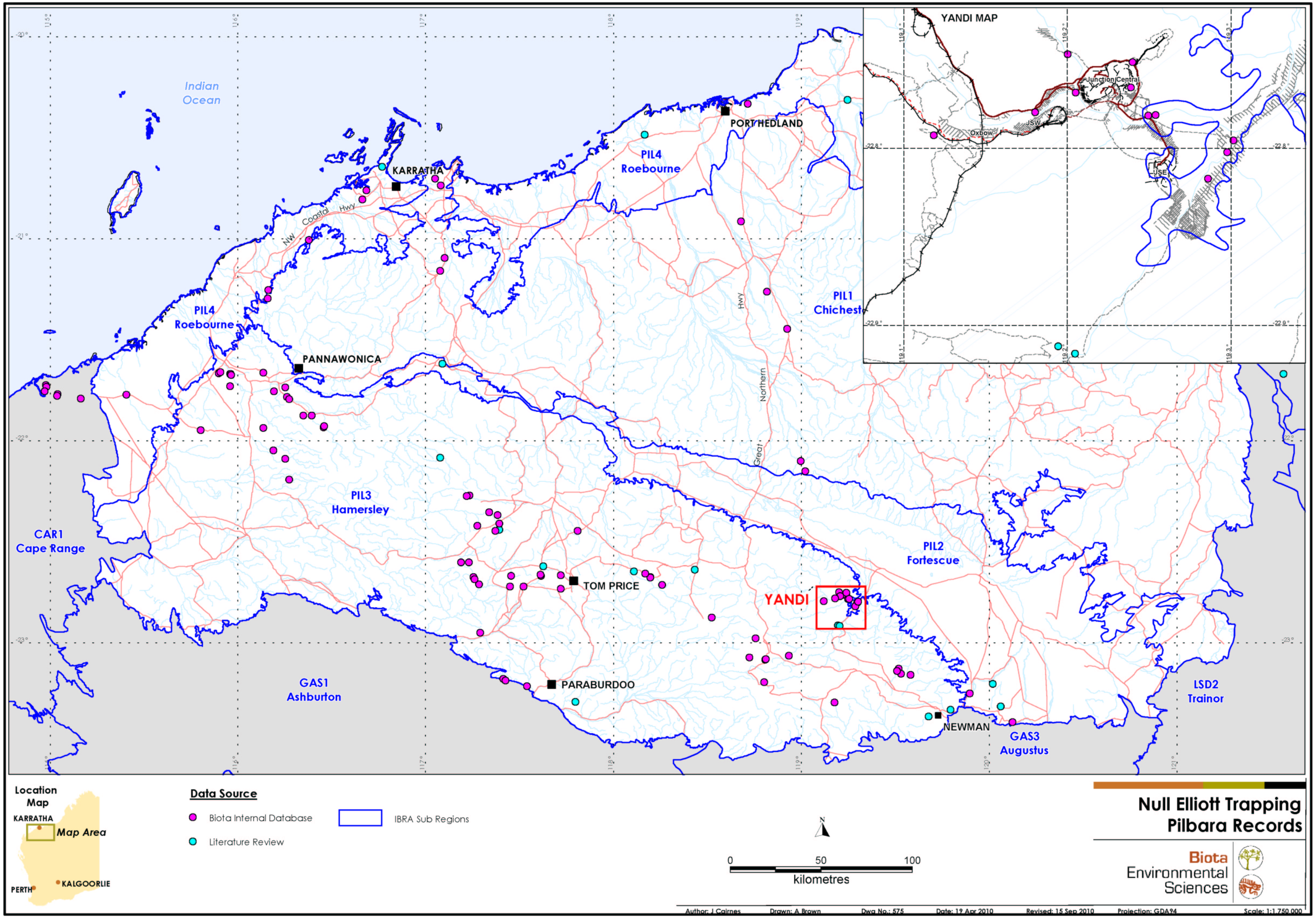


Figure 4.2: **Sites in the Pilbara where Elliott trapping has been completed and no Northern Quolls were recorded.**

5.0 Discussion

5.1 Identified Threatening Processes

DEWHA (2009) identifies three threatening processes for the Northern Quoll in its conservation advice arising from the species' Federal listing:

1. inappropriate fire regimes;
2. predation following fire; and
3. lethal toxic ingestion of Cane Toad toxin.

Habitat loss through too inappropriate fire regimes and related land management have been suggested as contributing factors to the decline in Northern Quoll populations in Queensland and the Northern Territory by several studies (summarised in DEWHA 2010). Change in vegetation structure and increased predation rates post-fire were identified as the key processes affecting these *Dasyurus hallucatus* populations (Oakwood 2000). Fire may also be locally detrimental to foraging habitat for the species in the Pilbara, but mesa, gorges and boulder pile habitats, may act as local population refugia for the species in the bioregion during these events. Fire is also a natural landscape process in the Pilbara region, and many events in the Pilbara are part of the normal cycle rather than reflecting any recent anthropogenic increase or broad scale land management practices.

Predation of Northern Quolls can occur via domestic dogs, feral cats, dingos, foxes, owls, kites and snakes (Woinarski et al. 2008). Death due to motor vehicle collision is also a cause of individual mortality of Northern Quolls in the Pilbara bioregion. While fire and predation undoubtedly place pressure on Northern Quoll populations, it seems likely that the species has persisted in the bioregion with these processes occurring over the long term.

It should be noted that clearing due to development (such as mining-related activities) is not identified as a threatening process by DEWHA (2009).

The most significant factor contributing to the decline of the species in Queensland and the Northern Territory is the invasion of the Cane Toad *Bufo marinus*. Cane Toads are potential prey for Northern Quolls and can release a powerful toxin from their parotoid glands during predation events, which can result in the death of the Quoll. The Cane Toad does not currently occur in the Pilbara, but has recently been confirmed entering the Kimberley (DEC 2009a).

Urban et al. (2007) predict the movement of the Cane Toad into Western Australia based on climate and habitat requirements. Figure 5.1 illustrates Urban et al.'s (2007) projected range for the Cane Toad. They state: "*(a) Cane toads now inhabit approximately 1.2 million km^2 of Australia (dark grey). (b) The predicted distribution of cane toads (black) based on annual maximum and minimum temperature, their squared terms, annual precipitation, precipitation, topographical variation, elevation, annual evaporation, minimum moisture index per cent built-up area and paved road density as estimated by model-averaged logistic regression at a data-derived threshold of 0.505. The future range area of cane toads predicted by this model (2.0 million km^2) is almost triple the projections from the most recent model (0.7 million km^2) based on its native limits (Sutherst et al. 1995).*" (Urban et al. 2007).

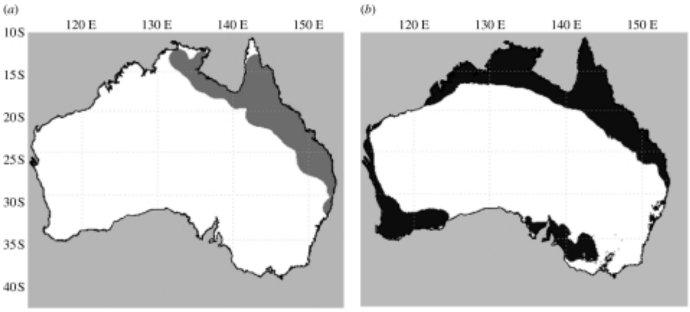


Figure 5.1: Current and projected range of invasive cane toads in Australia (source: Urban et al. 2007).

It is noteworthy that Urban et al. (2007) do not predict the expansion of the Cane Toad's range into the inland Pilbara (Figure 5.1 (b)). DEWHA (2005) states that mainland populations of the Northern Quoll are likely to disappear in the 'Top End' over the next 10 years, it is also expected that this will occur for many of the Kimberley mainland populations. However, it is expected that this will not happen in the Kimberley during the next 10 years and will not happen in the Pilbara (D. Pearson DEC, pers. comm. In: DEC 2009b)

It is also of interest that recent work in northern Queensland has documented the persistence of Northern Quoll populations in areas inhabited by the Cane Toad *Bufo marinus* (Woinarski et al. 2008). It is not yet understood how these populations have persisted, but the current theories include:

- population-specific genetic or behavioural characteristics;
- the occurrence of Northern Quolls in habitat where Cane Toad numbers are low; or
- the invasion of Cane Toads into habitat that is highly suitable for Northern Quolls,

with either of the latter two possibilities potentially enabling the Northern Quoll population to sustain a small amount of Cane Toad-related mortalities. This uncertainty means it is not possible to determine whether there are habitats suitable for Quoll survival post-Cane Toad invasion in the parts of the Quoll's range where the introduced species has not yet reached (HLA – Envirosciences 2004).

5.2 Status of the Northern Quoll in the Pilbara Bioregion

The Northern Quoll records for the Pilbara bioregion demonstrate that the species is widespread throughout the majority of the region, having been recorded from 220 locations, across a wide range of Land Systems (Table 4.1). Available data suggest however, that the species is absent or at very low density in the south-eastern most portion of the Pilbara bioregion. The Land Systems where the species has most commonly been recorded comprise habitats such as rocky hills, mesas, plateaux, major drainages and granite tor fields (Section 4.3).

Northern Quoll populations experience natural fluctuations due to the species life history and other stochastic factors (Section 2.2). There are no long-term data sets that adequately document this for individual populations in the Pilbara. However, variation in abundance at habitat, seasonal and decadal levels recorded in the northern Kimberley suggests that Northern Quoll populations are highly variable in both temporal and spatial scales. Long-term studies conducted at the Mitchell Plateau, recorded large fluctuations in this species, with a substantial population disappearing after 20 years without any apparent threatening process (Ric How, WA Museum, pers. comm.; Schmitt et al. 1989). This suggests that natural population peaks and troughs occur in Northern Quoll populations that are unrelated to any anthropogenic source.

While more limited information is available from the Pilbara, the data suggest that the same situation exists in that bioregion. A population of *Dasyurus hallucatus* was documented by Ecologia (1991) on the Robe River adjacent to mesa landforms at the Mesa J mine (with 29 individuals recorded). Subsequent targeted trapping in 2005 (Biota and How 2005) failed to record any individuals at the same location, and only a single individual from the Robe River locality (some 50 km to the west of Mesa J). Three Northern Quolls were however subsequently recorded from 15 km to the west of Mesa J the following year (Biota 2006). Biota and How (2005) suggest that these types of fluctuations may be a function of seasonal conditions in years preceding surveys and related prey item availability. It follows that limited conclusions on the impacts of environmental disturbance on Quolls can be drawn from short-term studies.

Searches of the Federal *EPBC Act 1999* Protected Matters database for areas across the Pilbara bioregion revealed that this database shows the Northern Quoll or its habitat possibly occurring throughout the entire Pilbara (see Section 4.1). This implies that the Northern Quoll will be identified by the Protected Matters Search Tool as a potential matter of National Environmental Significance for almost any location in the Pilbara, whether or not the species or its core habitat occurs in the area in question.

There is a clear disjunct between the Pilbara Northern Quoll populations and those of the Kimberley. Recent genetic work indicates differentiation of the Kimberley and Pilbara Northern Quoll populations (How et al. 2009). It is therefore relevant to review the basis for the species' listing and conservation concern specific to the Pilbara setting. *Dasyurus hallucatus* is widely distributed through the Pilbara of Western Australia (Figure 4.1) but the status of resident populations has not been studied in any detail. This observation is in contrast with The Action Plan for Australian Marsupials and Monotremes, which suggests that there has been a "….substantial decline in the Pilbara….", citing Braithwaite and Griffiths (1994) as the source for this conclusion. This statement is paraphrased by DEWHA (2009) in its Northern Quoll conservation assessment and advice.

However, Braithwaite and Griffiths (1994) make no statement about a decline in Pilbara populations specifically, other than: "Owl deposits reveal that it was formerly common throughout the Pilbara well into the arid zone", and then in turn cite Morton and Baynes (1985). There is no comment in the Braithwaite and Griffiths (1994) paper to suggest a "substantial decline".

Significantly, Morton and Baynes (1985) make no mention of historical abundance of Northern Quoll based on evidence from owl deposits. Rather, the theme of their paper addresses changes in overall species richness of rodents and polyprotodont marsupials since European settlement. Morton and Baynes (1985) do state that "….analysis, of skeletal remains from the surfaces of cave deposits at 15 sites in the western arid zone shows that species richness of rodents and polyprotodont marsupials has declined to 44% and 41% of the pre-European numbers." It is also highly improbable that any measure of abundance for any mammal species could be derived from reviewing the contents of owl deposits. In summary, there appears to be little if any support for the statement regarding the decline of the Northern Quoll in the Pilbara contained in the Action Plan and thence paraphrased on the DEWHA website (DEWHA 2009). It appears that this have been derived from, and perpetuated, by a series of mis-citations rather than any empirical evidence or population data from the Pilbara region.

The State Schedule 1 listing for the Northern Quoll is based on the species Kimberley populations, which are at risk due to the predicted invasion of the Cane Toad (Section 5.1). Given the lack of long-term studies in the Pilbara region, and that current predictions do not show Cane Toads invading the inland Pilbara, a more appropriate listing for the *Dasyurus hallucatus* specific to the Pilbara region would be "data deficient".

Ecological refugia is a concept outlined by Morton et al. (1995), which recognises areas in which a suite of species persists over short periods when surrounding habitat becomes unsuitable due to adverse climatic or ecological conditions. There is the potential for the Northern Quoll's core habitat of rocky hills and gorges to act as refugia in the event that the Cane Toad *Bufo marinus* does encroach into the inland Pilbara.

5.3 Yandicoogina Project

In the case of the Yandicoogina expansion project, there appears to be very little to suggest a significant population of the Northern Quoll occurs in the area (see Section 4.4). Field fauna surveys completed specifically for the expansion proposal did not record any *D. hallucatus*. Biota (2009) completed a total of 1,294 Elliott trap nights in the project area without recording any evidence of the species (Section 4.4.2). The anecdotal record of an individual occurring at the warehouse on site remains the only evidence of the species, and no individuals have been recorded during extensive systematic surveying over a 15-year period (Section 4.4).

Substantial sections of the Yandicoogina expansion project area were recently burnt or heavily degraded (P. Runham, Biota pers. obs.) by introduced species such as cattle from previous pastoral activities, potentially limiting their value for *D. hallucatus*. It is also relevant that there were no records of the Common Rock Rat (*Zyzomys argurus*) during the targeted fauna survey (Biota 2009) and also no records for this species in the locality on NatureMap. This species is a known prey item for the Northern Quoll, and its apparent absence could contribute to the lack of Quoll records in the Yandicoogina expansion project area.

Significant national-scale threats to the Northern Quoll are related to landscape level effects such as the spread of the Cane Toad and inappropriate burning regimes. Localised, generally small-scale impacts (such as clearing and occasional collisions with vehicles) associated with mining operations are not the major contributing factors to the species declining status at the Australian scale. Clearly, mining operations can contribute to some of these landscape factors at local scale, for example by increasing feral animal abundance around camps or increasing fire risk, but these are likely to be short-tem, localised and are able to be effectively managed as part of project EMP's and environmental commitments.

Under the *EPBC Act 1999*, an action requires referral to the Federal Environment Minister if it is deemed likely to have a significant impact (as defined) on a matter of National Environmental Significance (in this case a listed threatened species: the Northern Quoll *Dasyurus hallucatus*). However, there is little if any evidence to indicate the presence of a significant population of the Northern Quoll occurring within the Yandicoogina expansion project area based on the review carried out in this document, as:

- historical Elliott trapping of over 10,000 trap nights in the Yandicoogina locality over 15 years has not recorded any individuals;
- systematic and targeted Elliott trap effort over several phases failed to record the species;
- systematic Elliott trap effort over several phases failed to record the known prey species *Zyzomys argurus*; and
- the nearest confirmed *D. hallucatus* specimen record is over 50 km from the project area.

Given the above findings, it appears unlikely that a significant population of this species is present in the Yandicoogina expansion area. Considering that mining is not a major threatening process for this species, it is therefore very unlikely that the action would result in a significant impact to the Northern Quoll at national scale.

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Appendix 1

Scientific and Grey Literature References for Northern Quoll *Dasyurus hallucatus* Records and Null Elliott Trapping Records

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