CYPLUS
CAPE YORK PENINSULA
LAND USE STRATEGY

NATURAL RESOURCES ANALYSIS PROGRAM (NRAP)

INSECT FAUNA SURVEY OF CAPE YORK PENINSULA

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Queensland Department of Primary Industries
and
I.D. Naumann and T.A. Harwood
CSIRO Division of Entomology
1995

CYPLUS is a joint initiative of the Queensland and Commonwealth Governments

DPI
QUEENSLAND
DEPARTMENT OF
PRIMARY INDUSTRIES
NORTH REGION

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Note:

Due to the timing of publication, reports on other CYPLUS projects may not be fully cited in the REFERENCES section. However, they should be able to be located by author, agency or subject.

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CAPE YORK PENINSULA LAND USE STRATEGY
STAGE I

PREFACE TO PROJECT REPORTS

Cape York Peninsula Land Use Strategy (CYPLUS) is an initiative to provide a basis for public participation in planning for the ecologically sustainable development of Cape York Peninsula. It is jointly funded by the Queensland and Commonwealth Governments and is being carried out in three stages:

- Stage I - information gathering;
- Stage II - development of principles, policies and processes; and
- Stage III - implementation and review.

The project dealt with in this report is a part of Stage I of CYPLUS. The main components of Stage I of CYPLUS consist of two data collection programs, the development of a Geographic Information System (GIS) and the establishment of processes for public participation.

The data collection and collation work was conducted within two broad programs, the Natural Resources Analysis Program (NRAP) and the Land Use Program (LUP). The project reported on here forms part of one of these programs.

The objectives of NRAP were to collect and interpret base data on the natural resources of Cape York Peninsula to provide input to:

- evaluation of the potential of those resources for a range of activities related to the use and management of land in line with economic, environmental and social values; and
- formulation of the land use policies, principles and processes of CYPLUS.

Projects examining both physical and biological resources were included in NRAP together with Geographic Information System (GIS) projects. NRAP projects are listed in the following Table.

Physical Resource/GIS Projects	Biological Resource Projects
Bedrock geological data - digitising and integration (NR05)	Vegetation mapping (NR01)
Airborne geophysical survey (NR15)	Marine plant (seagrass/mangrove) distribution (NR06)
Coastal environment geoscience survey (NR14)	Insect fauna survey (NR17)
Mineral resource inventory (NR04)	Fish fauna survey (NR10)
Water resource investigation (groundwater) (NR16)	Terrestrial vertebrate fauna survey (NR03)
Regolith terrain mapping (NR12)	Wetland fauna survey (NR09)

Physical Resource/GIS Projects	Biological Resource Projects
Land resource inventory (NR02)	Flora data and modelling (NR18)
Environmental region analysis (NR11)	Fauna distribution modelling (NR19)
CYPLUS data into NRIC database FINDAR (NR20)	Golden-shouldered parrot conservation management (NR21)
Queensland GIS development and maintenance (NR08)*	
GIS creation/maintenance (NR07)*	

* These projects are accumulating and storing all Stage I data that is submitted in GIS compatible formats.

Research priorities for the LUP were set through the public participation process with the objectives of:

- collecting information on a wide range of social, cultural, economic and environmental issues relevant to Cape York Peninsula; and
- highlighting interactions between people, land (resource use) and nature sectors.

Projects were undertaken within these sector areas and are listed in the following Table.

People Projects	Land Projects	Nature Projects
Population	Current land use	Surface water resources
Transport services and infrastructure	Land tenure	Fire
Values, needs and aspirations	Indigenous management of land and sea	Feral and pest animals
Services and infrastructure	Pastoral industry	Weeds
Economic assessment	Primary industries (non-pastoral, non-forestry)	Land degradation and soil erosion
Secondary and tertiary industries	Forest resources	Conservation and natural heritage assessment
Traditional activities	Commercial and non commercial fisheries	Conservation and National Park management
Current administrative structures	Mineral resource potential and mining industry	
	Tourism industry	

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SUMMARY

Probably two out of every three species of living things on Cape York Peninsula are insects. This report, which surveys a cross-section of the Peninsula's insects, thus provides information on the largest portion of the region's biodiversity

A total of 22 505 identified insect specimens, collected on Cape York Peninsula and representing 695 species, have been recorded in a relational database. These species represent selected target groups and include members of nine insect orders: Odonata (dragonflies, damselflies), Plecoptera (stoneflies), Isoptera (termites), Orthoptera (grasshoppers, locusts, crickets), Hemiptera (bugs, cicadas, etc.), Neuroptera (lacewings), Coleoptera (beetles), Lepidoptera (moths, butterflies) and Hymenoptera (wasps, bees, ants). These target groups include species from all major Cape York Peninsula ecosystems and all trophic levels. A copy of all computer-based records has been provided to ERIN (Environmental Resources Information Network; within the Commonwealth Department of Environment, Sport and Territories). This document summarises these records to family level in a series of tables. Two tables summarising species level records are presented as examples. A series of maps depicts all collecting records, distribution records for a small sample of species, and predicted distributions of species as projected by computer-based BIOCLIM analysis. This report also includes brief explanatory notes on the target groups of insects.

Records derive from (1) pre-existing museum collections, principally in the Australian National Insect Collection (ANIC, CSIRO Division of Entomology, Canberra), the Queensland Department of Primary Industries collections (Mareeba), and the Queensland Museum (Brisbane), and (2) a CYPLUS-funded, two-year survey of Cape York Peninsula. As part of the latter, 11 survey sites were established in various vegetation types and at various localities throughout the Peninsula. This report describes and maps these sites. Flight intercept and Malaise traps collected insects continuously at these sites for one or two years. At approximately monthly intervals, seasonal conditions permitting, each site was visited and additional insects were collected using standard insect collecting techniques (e.g. light trapping, hand netting, hand searching). Numerous additional localities between the survey sites were also surveyed.

The report recommends

(1) further fieldwork in the 'Gulf triangle' (that part of the Peninsula south of Weipa and bounded by the Gulf of Carpentaria and the Peninsula Development Road);

(2) a more intensive survey of the conservation significance of the Shelburne Bay area and

(3) formal taxonomic work on the Peninsula's many unnamed insects so that their conservation and scientific significance can be better assessed.

The project has been jointly undertaken by Queensland Department of Primary Industries, CSIRO Division of Entomology and the Queensland Museum.

1. INTRODUCTION

The insects comprise the most biologically diverse and species-rich group of living organisms inhabiting Cape York Peninsula. Insects are present in all terrestrial habitats and are of immense ecological importance. Some species are damaging to human activities and others have the potential to become pests as agriculture and human settlement extend into new areas of the Peninsula. Many insect species have potential value in the monitoring of environmental quality.

The aim of the insect survey (Project NR17) has been to provide a large set of point records for the insects of the Peninsula. Because of the immense numbers of insect species, clearly an all-inclusive survey was beyond available resources. Therefore a range of target groups, representing the Peninsula's insect diversity, was selected, identified to species level and databased. The survey drew upon pre-existing museum collections and the results of a two-year field survey. Pre-existing collections tended to be from a limited number of localities and vegetation types. The NR17 field work sought to correct this imbalance and paid particular attention to the seasonally dry woodlands and heaths of the Peninsula.

The outcomes of NR17 are twofold. Firstly, a large set of point records of target groups has been provided to ERIN and is now available in electronic form for immediate GIS-based analyses. Secondly, an even larger reserve of insect data has been laid down in several Australian institutions in the form of curated, partially identified specimens. The latter reserve can be drawn upon in the future as required by land use, environmental or pest investigations.

NR17 has been a joint project by CSIRO Division of Entomology (involving staff of ANIC, the Australian National Insect Collection), the Queensland Department of Primary Industries (QDPI) and the Queensland Museum (QM). The project was planned and managed by a committee comprising Dr E.S. Nielsen (CSIRO Entomology), Dr G.B. Monteith (QM) and Dr I. Cunningham (QDPI). Dr Cunningham was responsible for day to day supervision.

This report makes no attempt to review published information on the insects of Cape York Peninsula nor does it focus on pest species in particular. However, the computer-based files resulting from NR17 include many records which have appeared in various printed publications and also records of pest or potential-pest species. Analysis of Cape York Peninsula insect distribution records is beyond the scope of NR17. For an introductory discussion of the Peninsula's insect fauna the reader is referred to Kikkawa *et al.* (1981) and various articles in Berg and Long (1994).

2. METHODS

2.1 Fieldwork: diary of events

The two-year study period was divided into monthly collecting trips through the Peninsula, followed by periods of insect sorting, identifying, and databasing. Each trip was organised and carried out by the CYPLUS entomologist Paul Zborowski, from the Department of Primary Industries (DPI) base at Mareeba. Where practical, a specialist taxonomist from CSIRO Division of Entomology flew to Cairns and joined one of the monthly trips. Each trip consisted of servicing the permanent insect traps (see survey sites, p. 6), and general collecting at trap sites and in other parts of the Cape. The presence of visiting specialists enabled intensive collecting of different target groups (see below) of insects on most trips. These specialists were also largely responsible for identifying the insects to species, prior to entry into the computer database. These most important tasks, of taxonomy and data entry, were largely performed outside the funding of this study.

April and May 1992 were spent preparing traps and all other field and laboratory equipment and chemical supplies needed for the study. Some of this took place at CSIRO Division of Entomology in Canberra and some at DPI, Mareeba where the vehicle was outfitted.

The following is a month-by-month diary of the trips undertaken by vehicle in the dry seasons and on the mail 'plane in the wet seasons during the two years from June 1992 to May 1994. All driving trips consisted of a central route via all trap sites, enabling servicing the traps, and general collecting of all target groups and associated insects. Most trips included extra effort on a particular target group, and detours to collect over as much of the Peninsula as was practical.

Year 1 (June 1992 to May 1993)

Central Route was: Laura to Batavia Downs to Heathlands

June 1992 — *In field 15–26 June.* Tom Weir, a beetle and aquatic bug specialist from CSIRO, accompanied on this trip which was the exploratory trip during which potential trap sites were investigated and traps erected and set on 6 chosen sites. These sites were on Batavia Downs, on Heathlands, and at Split Rock (see p. 6 for description of survey sites). Some general collecting and specialist beetle collecting was possible between these tasks.

July 1992 — *In field 20–31 July.* Ebbe Nielsen, a moth specialist from CSIRO, accompanied on this trip. Major effort was directed towards night collections with the 250 watt UV lights and portable, battery-operated light traps used mainly at the trap sites.

August 1992 — *In field 15–26 August.* Jo Cardale, a wasp and bee specialist from CSIRO, accompanied on this trip. Major effort was directed towards wasp collecting via various daytime traps and netting of flowers and other potential habitats. Trip detours included the coastal forests of the Bloomfield area.

September 1992 — *In field 15–22 September.* Leigh Miller, a termite specialist from CSIRO, accompanied on this trip. Major effort was directed towards collecting of termites and study of their nesting habits. Trip detours included rivers east of Coen and the hill forests in the Bloomfield area.

October 1992 — *In field 13–30 October.* Tom Weir from CSIRO, accompanied on this trip. Major effort was directed towards water insects, especially the surface-dwelling, gerromorph bug families. Trip detours included the tip of the Cape and all routes north of the Jardine; the creeks and rivers between the Wenlock and Jardine River; the Iron Range area; Temple Bay and Bolt Head area; the rivers and lagoons of Rokeby National Park and Lakefield National Park, and many forays along minor creeks of the Cape.

November 1992 — *In field 17–26 November.* Andrew Calder, a beetle specialist from CSIRO, accompanied on this trip. Major effort was directed towards several beetle families including water-dwelling beetles. Trip detours included the Jardine River and tributaries area, and the creeks east of Laura to the coast.

December 1992 — *In field 6–13 December.* Walter Dressler, a beetle specialist from CSIRO and Keith Halfpapp, an economic insect specialist from the DPI, Mareeba accompanied on this trip. Major effort was directed towards determining the distribution of economic insects in the early wet season, and beetles in general. Trip detours included the western creeks south of the Jardine River, and the sandstone country east of Laura.

January 1993 — *In field 13–20 January.* This was a flying trip to Batavia Downs with only Paul Zborowski undertaking general collecting of all target groups on land and in water in the early wet season of the central Peninsula.

Febr–March 1993 — *In field 18–19 February* servicing the Split Rock trap and collecting in the Laura to Bloomfield area.
In field 24 February–3 March. This was a flying trip to Heathlands with only Paul Zborowski undertaking general collecting of all target groups on land and in water during the peak of the wet season.

March–April 1993 — *In field 31 March–7 April.* This was a flying trip to Heathlands with only Paul Zborowski undertaking general collecting of all target groups on land and in water during the late wet season. Trip detours included the coastal forests and grasslands around Captain Billy Landing.

April 1993 — *Also in field 27–28 April.* This was a trap-servicing trip to Split Rock and included collecting in the Laura and eastern escarpments area.

May 1993 — *In field 18–28 May.* Alison Roach, an orthopteroid specialist from CSIRO, accompanied on this trip. Major effort was directed towards crickets, grasshoppers, mantids and phasmids in daytime and nocturnal collecting. Trip detours included the Shelburne Bay, Weipa, and Rokeby River areas. Many of the detours were arranged in order to inspect possible new trap sites and meet the relevant landholders whose permission and good will was necessary to make this second year of the project possible.

June 1993 — *In field 16–28 June.* Ian Naumann, a wasp specialist from CSIRO, accompanied on this trip. Major effort was directed towards wasp collecting, though the primary effort of this trip was the setting up of new trap sites for the second year of the study. Previous insect collecting on the Peninsula had left major gaps in the west and several new trapping sites were selected in an effort to cover such gaps. On this trip the traps at Batavia Downs and Heathlands were removed and taken to new sites at Captain Billy Landing turn off, east of Weipa, Rokeby National Park and south of Coen (see p. 6 for details of sites).

Year 2 (June 1993 to May 1994)

The central route was:

Laura to Hann River to Coen to Heathlands to Weipa to Rokeby

July 1993 — *In field 11–17 July.* Paul Zborowski was unavailable for this trip. Two entomologists from DPI at Mareeba, Keith Halfpapp and Stef De Faveri, drove the central route to service all traps and collect generally with emphasis on economic insects.

August 1993 — *In field 10–20 August.* John Balderson, an orthopteroid specialist from CSIRO, accompanied on this trip. Major effort was directed towards collecting mantids, crickets, grasshoppers and phasmids. Trip detours included the Bertiehaugh Creek, Ducie River, western Wenlock River, Edward River, Normanby River and Bloomfield River areas. During this trip another trap site was set up at Hann River.

September 1993 — *In field 7–16 September.* Steve Shattuck, an ant specialist from CSIRO, accompanied on this trip. Major effort was directed towards collecting ants and information about their habitats. Trip detours included the Bertiehaugh, Ducie River, Holroyd River and the Edward River areas.

October 1993 — *In field 19–29 October.* David Rentz, an orthopteroid specialist from CSIRO, accompanied on this trip. Major effort was directed towards crickets, grasshoppers, mantids and phasmids. Trip detours included the tip of the Cape, the Lake Wicheura area, the Jardine River area, the western Archer River and 'The Desert' plateau near Kimba.

November 1993 — *In field 10–19 November*. Marianne Horak, a moth specialist from CSIRO, accompanied on this trip. Major effort was directed towards moth and nocturnal insect collecting in general. Trip detours included the Moonlight and Myall Creek areas, 'The Desert' plateau near Kimba, and the Gap Creek-Bloomfield River area.

December 1993 — *In field 12–19 December*. No accompanying entomologist on this trip. General collecting, with extra effort at new waterholes appearing at the very start of the wet season; such collecting provided data on the insect succession through the seasons. Trip detours included the Normanby River and Gap Creek areas.

January 1994 — *In field 12–21 January*. Ted Edwards, a moth specialist from CSIRO, accompanied on this trip. Major effort was directed towards running powerful light with a view to recording nocturnal insects, especially moths, from the population pulses characteristic of the early wet season in the tropics. The central route was not run due to the Archer and Wenlock Rivers already being difficult to pass. The trip concentrated on the Coen, Hann River, Jowalbinna sandstone escarpment and Cooktown-Battle Camp areas.

February 1994 — *In field 14–21 February*. This was a flying trip with only Paul Zborowski undertaking all general collecting on land and in the wet season waterbodies of the Weipa area. Comalco arranged transport, accommodation and all logistic support for this very useful and rare look at wet season insects of the west coast of the Peninsula.

March 1994 — *In field 16–23 March*. This was a flying trip with only Paul Zborowski undertaking all general collecting on land and in the wet season water bodies of the Heathlands area. Queensland National Parks and Wildlife Service provided accommodation and transport support was provided by the James Cook University.

April 1994 — *In field 22–27 March*. A general collecting trip with only Paul Zborowski present. The central route was not run due to the Wenlock and Archer Rivers still being difficult to cross. Collecting concentrated on the Coen and Hann River areas, and escarpments west and south of Cooktown.

May 1994 — *In field 19–30 May*. This was a visit to all sites in order to dismantle traps at the end of the study. Paul Zborowski also undertook general collecting and visited as many as possible of the people who have assisted the field work.

June 1994 — Because of the need to compile data and prepare the study report there was no field work in June.

2.2 Description of survey sites and collecting techniques

During the two years of the project two separate sets of survey sites were chosen to run for one year each (Fig. 8). Every site was equipped with two types of automatic, insect-catching traps. The MALAISE TRAPS (Fig. 1) are tent-like structures which trap flying insects day and night, and are especially effective for wasps and flies. FLIGHT INTERCEPT TRAPS (Fig. 2) consist of a trough at ground level and an intercept panel above this. These traps catch insects which walk or hop along the ground as well as a variety of insects which fly into the vertical panel and fall into the trough. Beetles, crickets and many flying insects are especially sampled this way. Traps were emptied once a month throughout the year. Year round sampling is necessary because of fluctuations in insect abundance and diversity over the changing seasons. During the monthly visits, insects were collected at the sites by other methods. These included using a light sheet (Fig. 3) and light traps for night-flying insects, vegetation sweeping, and hand-net collecting (Fig. 4). Nearby water bodies were sampled by net, especially for the surface-dwelling gerromorph bugs. This combination of methods enables the sampling of most insect orders. Trapping alone or hand collecting alone would not have given a comprehensive sampling of the insects present at any particular survey site.

Decisions on site location had to take into account the logistics of road and/or flying access through the seasons. In some locations the presence of a local person interested in helping to service the traps in the wet season months was a very important consideration. Rangers of the Queensland National Parks Service have been especially important in this role.

Year 1

Information obtained from Neldner and Clarkson (personal communication) and their study of the flora of Batavia Downs (Neldner and Clarkson 1991) was used to determine the major vegetation communities that should ideally be sampled. In the first year emphasis was placed on the most typical vegetation communities, the *Eucalyptus tetrodonta*-dominated woodlands. Therefore four of the six sites were placed on Batavia Downs in central Cape York where a variety of these woodlands could be accessed in both the wet and dry season. Sites for year 1 were as follows:

Site 1

(12°41'S 142°41'E) 5 km S Batavia Downs Homestead
(Operated 18/6/92–17/6/93)
Placed within a remnant vine thicket surviving along a minor tributary of Lydia Creek. Deciduous microphyll species in a low, closed forest. Typical habitat along many Cape York waterways forming refugia for species not found in the open forests around them.

Site 2

(12°40'S 142°39'E) 3km W Batavia Downs Homestead
(Operated 18/6/92–17/6/93)
In woodland typical of large areas of the Peninsula from the bauxite areas of the west coast to the centre and parts of the east. Dominated by *Eucalyptus tetrodonta*, *E. nesophila* and *E. hylandii.*

Site 3

(12°43'S 142°42'S) 7km S Batavia Downs Homestead
(Operated 19/6/92–18/6/93)
In an open woodland association typical of parts of the central and northern Peninsula. Dominated by *Eucalyptus leptophleba*, *E. papuana* and *E. clarksoniana.* This soil/vegetation association has good potential for intensive grazing.

Site 4

(12°39'S 142°42'E) 4km NE Batavia Downs Homestead
(Operated 19/6/92–18/6/93)
In low open woodland typical of grey, low-lying soils over much of the Peninsula. These areas often flood during the wet season. Dominated by *Melaleuca viridiflora* with some *Eucalyptus clarksoniana.*

Site 5

(15°39'S 144°31'E) Split Rock area, 13km south of Laura
(Operated 24/6/92–5/94)
In a woodland area on the slope of a sandstone plateau typical of the southern Peninsula from Cooktown in the east to smaller escarpments in the west. Dominated by *Eucalyptus hylandi*, *E. tetrodonta* and *E. crebra*. This site was chosen to operate for the full two years.

Site 6

(11°45'S 142° 35'E) 'Heathlands' Station
(Operated 20/6/92–19/6/93)
Placed in heath on loose, sandy soil over sandstone. Dominated by *Asteromyrtus lysicephala*, *Jacksonia thesioides*, *Choriceras tricorne* and emergent *Neofabricia myrtifolia*. This is typical of many patches of east coast and escarpment country from Cape Flattery in the south to the tip of the Peninsula.

Year 2

Sites in Year 2 were chosen to represent various dominant vegetation types and geographic regions of the Peninsula not well covered by Year 1 sites, or by previous insect studies on the Peninsula.

Site 1

(11°41'S 142°42'E) 14km ENE of 'Heathlands' Station
(Operated 19/6/93–5/94)
In notophyll vine forest on a sandsone plateau. This site is typical of the wetter, remnant 'scrub' patches over the northern Peninsula. Though widespread, the patches tend to be larger and floristically more complex in the Heathlands area.

Site 2 (12°40'S 142°00'E) 13km E by S of Weipa
(Operated 22/6/93–5/94)
Placed in tall woodland typical of the rich bauxite plateau of the western Peninsula. Dominated by *Eucalyptus tetrodonta*, *E. nesophila* and the Cooktown Ironwood *Erithrophleum chlorostachys*. The site is on COMALCO land not yet affected by mining operations, and therefore the data from this area could be used to compile a picture of the local habitat before mining.

Site 3 (13°40'S 142°40'E) 2km N of Rokeby Homestead
(Operated 24/6/93–5/94)
In red earth woodland. While still dominated by *Eucalyptus tetrodonta*, and *E. nesophila,* this is a woodland with a lower canopy and a less complex understorey than the richer bauxite areas of the west.

Site 4 (13°57'S 143°12'E) 1km SE of Coen
(Operated 25/6/93–5/94)
In a deciduous vine thicket typical of the wetter parts of the central and eastern ranges. As these areas are now relatively small remnants, the traps here are effectively sampling a border with the surrounding and more wide ranging *Eucalyptus leptophleba* open woodland.

Site 5 (15°11'S 143°52'E) Hann River
(Operated 17/8/93–5/94)
In riverine open woodland typical of the major streams of the Peninsula. Dominated by *Melaleuca leucadendra, M. argentea* and *Leptospermum parviflorum* Hann River is a spring-fed river which normally flows even in the dry season and is a tributary of the massive Normanby River system.

Site 6 The Split Rock site was chosen to run for another year as it proved particularly productive and represented an area very rarely sampled in previous insect work on the Peninsula (see Year 1 description).

Some additional trap data has been obtained by using two old sites set up by CSIRO during the Royal Geographical Society of Queensland wet season expedition to Heathlands in early 1992. These were at Cockatoo Creek west of Heathlands — in open riverine woodland — and at a vine thicket remnant site south of Heathlands.

2.3 Processing of specimens

Fig. 7 depicts the sequence of steps undertaken, culminating in the identification, databasing and deposition of specimens. It was also possible to database significant batches of specimens collected and identified outside CYPLUS funding. Most important among these batches are holdings of the ANIC, QM Brisbane and QDPI Mareeba. Cicada records were provided by Mr M. Moulds, Sydney.

2.4 ANIC Database

All insect records were entered in the ANIC Database, a centralised, networked database on Informix–SQL software. Informix–SQL is a relational database management system. All data entry was undertaken according to the *ANIC Database Field Specifications and Data Dictionary* (unpublished document available from CSIRO Division of Entomology, Canberra). The following data are associated with each record: species, classification (family, order, etc.), sex, type status of specimens, geographical location, latitude, longitude, habitat where recorded (esp. vegetation type), date of collection, collector. Distribution maps were produced using the local Divisional program, BNMAP.

2.5 Insect target groups

Taken together the various trapping and hand-collecting techniques employed during this study capture and preserve a diverse range of insects. Very large numbers of specimens have been collected, labelled and divided between the ANIC and QDPI collections. However, all insects collected during the study could not possibly be processed to the point of entry into a computer database. Databasing requires identification to species level and this can be done only for groups for which specialists are available to perform identifications. Even when specialists are available the choice of groups for databasing is further restricted by the poor state of taxonomic knowledge of tropical insects. The study draws heavily on work-in-progress and the database includes records of unnamed species currently under study by specialists, principally within CSIRO.

Because of these taxonomic limitations and the anticipated sheer volume of material, a series of **target groups** was chosen at the start of the study. Specimens of these groups were collected and processed preferentially. The target groups were mostly families or sub-portions thereof. They include both 'abundant' and naturally 'rare' species and species of known or potential economic importance. Target groups were chosen also to include insects which could be used as indicators of environmental quality and which represented a broad range of feeding habits in a variety of habitats. Thus predators, herbivores, parasites, dung and other nutrient recyclers, and tree-, grassland-, soil- and water-frequenting species are included in the following list of target groups.

The list of target groups was revised several times during the life of the project. Some families chosen initially proved taxonomically intractable or were poorly represented in early NR17 collections. These families were rejected in favour of families which were more readily identifiable or which proved unexpectedly rich in early collections.

Aquatic insects (phytophagous, predatory and scavenging) are represented by the immature Odonata, Plecoptera and gerromorph Hemiptera, and by several families of Coleoptera. Tridactylid crickets

frequent the margins of aquatic habitats. Terrestrial, phytophagous insects are represented by the Isoptera, Cicadidae (Hemiptera) and the families of Lepidoptera, which include some pest species and some species of potential economic importance. Terrestrial predators are represented by adult Odonata, some Orthoptera, sphecid Hymenoptera and some Formicidae. Mantispid Neuroptera and diapriid, scelionid, chalcidid and rhopalosomatid wasps are parasitic on other insects in terrestrial habitats. The Isoptera, dung beetles (Scarabaeidae) and some ants could be regarded as representative of the scavenger and nutrient-recycler guilds.

Table 1. Target groups

Order Odonata (dragonflies, damselflies)
Order Plecoptera (stoneflies)
Order Isoptera (termites)
Order Orthoptera
- Acrididae (grasshoppers, locusts)
- Gryllacrididae (crickets)
- Tettigoniidae (katydids)
- Tridactylidae (crickets)

Order Hemiptera (bugs, etc.)
- Cicadidae (cicadas)
- Gerromorpha (six families of water bugs)

Order Neuroptera (lacewings)
- Mantispidae

Order Coleoptera (beetles)
- Dytiscidae
- Gyrinidae
- Hydrophilidae
- Hygrobiidae
- Noteridae
- Scarabaeidae – Scarabaeinae dung beetles
- Chrysomelidae

Order Lepidoptera (moths, butterflies)
- Cossidae (wood moths, goat moths)
- Noctuidae
- Sphingidae (hawk moths)
- Tortricidae

Order Hymenoptera (wasps, bees, ants)
- Diapriidae
- Scelionidae
- Chalcididae
- Rhopalosomatidae
- Sphecidae
- Formicidae (ants)

More detailed remarks on the target groups can be found in the Results section below.

3. RESULTS

Fig. 9 shows all of the localities from which insect records were obtained during the course of this study. Table 2 summarises the total records of Cape York insects entered into the ANIC Database as at 1 May 1994. These records were supplied to ERIN on 2 May 1994. They are accessible in electronic form to non-CSIRO partners in NR17 on request to CSIRO, Division of Entomology, Canberra.

Table 2 gives the total number of specimens identified and databased (right-hand column) and the total number of records. Each collection of a species at a particular locality constitutes a record, irrespective of how many specimens of the species from that collection were preserved and databased. A re-collection of the species from the same locality but on a different date constitutes a different record.

3.1 Order Odonata (dragonflies and damselflies)

Table 3 gives a break-down by family for the records of the first target group, the Odonata. Table 4 gives a break-down by species for one dragonfly family, the Gomphidae.

Odonates are predators of other insects, both in their aquatic immature phase and as flying adults. Coenagrionids and lestids, which frequent sluggish or still waters, provide over half of the NR17 records.

3.2 Order Plecoptera (stoneflies)

Adult stoneflies (Table 5) feed on algae, lichens, bark and decaying plant material. Their immature stages are aquatic, generally requiring cool, well-aerated water, where they are detritivores, herbivores or carnivorous.

3.3 Order Isoptera (termites)

Three families of termites (Table 6) are represented on Cape York Peninsula with grass-feeding, mound-building species being a conspicuous feature of more open ecosystems. A particular search for some of the lesser known, non mound-building species was undertaken in the first year. During the entire study more wood-feeding than grass-harvesting termite species were recorded. The free-standing mounds are constructed by only a handful of species — most Peninsular species of termites inhabit less prominent nests.

3.4 Order Orthoptera (crickets, katydids, locusts and grasshoppers)

Over half of the NR17 records for this order are of gryllid crickets (see Table 7) which are especially diverse in north-eastern Australia. Most are omnivorous and species tend to occur at characteristic levels relative to the ground (e.g. in burrows, in low grass, in treetops) rather than in

association with particular plant species or vegetation types. Tridactylid crickets, which occur along the margins of fresh water, and katydids (Tettigoniidae), which are predominantly phytophagous and active on trees, shrubs and grasses at night, comprise most of the remaining records. Notable among the Tettigoniidae was a previously undescribed genus and species related to the genus *Hexacentrus*. The new genus was discovered in the Shelburne Bay area in a sandy, east coastal habitat type in which very little entomological collecting has been possible. It had been planned that as part of NR17 permanent trap sites would be established in this habitat type, at both Shelburne Bay and near Cape Flattery in the south. However, difficulties of access prevented this.

3.5 Order Hemiptera (bugs, aphids, scale insects, cicadas)

The only family databased so far is that comprising the plant-feeding cicadas (Table 8). However, a large set of records of six gerromorph families is being collated with the assistance of a grant from the Australian Biological Resources Study. The gerromorph families are mainly surface-dwelling, aquatic bugs such as the pond skaters that live on most still and slow waters, fresh and salt. The species diversity over time of these bugs can be used to determine changes in the water quality.

A most exciting discovery is that of a previously undescribed genus and species of Gerridae: Halobatinae living in freshwater habitats. Members of the genus *Halobates* are almost exclusively marine but *Austrobates rivularis* has only been collected in flowing freshwater creeks at two localities on Cape York Peninsula (Lydia Creek, 12°40'S 142°40'E and Andoom Creek, 12°20'S 141°53'E) and then only during the wet season. Andersen and Weir (1994) have postulated that *Austrobates* is the 'missing link' between water striders living in freshwater and seawater and that *Halobates* originated from *Austrobates*-like ancestors and became adapted to the marine environment. Fig. 11 shows the known distribution in Cape York Peninsula of *Austrobates rivularis* and its closest relative *Halobates mjobergi*.

NR17 has also allowed mapping of the distribution of the genera and species of Gerridae: Gerrinae. One such species is *Limnogonus windi* which is widely distributed across northern Australia and in Cape York Peninsula has not been collected further south than 16°00'S. It occurs in both still and flowing freshwater and Fig. 10 shows its extensive distribution in the Cape.

3.6 Order Neuroptera (lacewings)

Only the family Mantispidae, the immature stages of which parasitise the egg sacs of spiders, have been databased (Table 9).

3.7 Order Coleoptera (beetles)

Five families of aquatic beetles were selected for databasing (Table 10). Most records are of Dytiscidae. Adult and larval dytiscids are predacious and especially abundant near the margins of still and sluggish waters; adults fly widely at night, dispersing to locate new water bodies and are commonly attracted to light. Adult Gyrinidae (whirligig beetles) scavenge on water surfaces while their larvae are bottom-dwelling predators. Noteridae feed on detritus along the margins of shallow ponds, especially among the roots of floating or emergent plants. Hygrobiidae are bottom-feeding predators in stagnant water; they are among the most rarely collected of aquatic beetles. Hydrophilidae are phytophagous or saprophagous as adults and predacious as larvae. Thus the range of families represents aquatic predators, scavengers and bottom nutrient recyclers.

The majority of records of Scarabaeidae are made up by the dung beetles (Scarabaeinae) (Table 11). Introduced dung beetle species are of particular importance in the maintenance of pasture quality and the control of fly pests in the cattle country of Cape York Peninsula. Native dung beetles, e.g. those associated with marsupial dung and fungi, are also important in nutrient recycling. Species of Scarabaeinae provided more data records than any other group during the CYPLUS study. These were a combination of existing records held in the ANIC, QM and the QDPI, Mareeba, and new records generated during the study period. Figs 12,13,15,17 depict distribution records for a sample of these species.

Onthophagus signaticollis (Fig. 12) is a species rare in collections and previously known from only a few specimens from Endeavour River, Iron Range and Mareeba. The CYPLUS study produced examples from Heathlands and Rokeby and gave an insight into its hitherto unknown biology. At Heathlands it was observed to be a diurnal fungus feeder, flying to fungi between 11.00 am and 12.30 pm and rapidly burying these. It has been taken in flight intercept traps at both Heathlands and Rokeby and is known to be active between January and April. The map shows its restricted distribution in the Cape.

In contrast, *Coptodactyla glabricollis* (Fig. 13) is a common, widespread species ranging across northern Australia and extending into Papua New Guinea. It is predominantly an open forest dweller whose adult population numbers peak during the wet season, part of an activity period spanning December to June. Dung of various sorts is utilised and here it has been taken in human, cattle and dingo dung as well as in pitfall and flight intercept traps.

Figs 15 &17 depict actual distribution records for two additional species of Scarabaeinae. Figs 14 &16 are predicted distribution maps. The latter were generated at an early stage of the project from a small number of

actual records using the computer program BIOCLIM. The BIOCLIM maps demonstrate one possible use for the database records produced during NR17. Both BIOCLIM maps underestimate the true distribution of the species concerned. This emphasises the need for a reasonably large number of actual records (at least more than 10) before BIOCLIM predictions can be made reliably.

Leaf- and nectar-feeding scarabs and chrysomelids make up the balance of records for this family.

3.8 Order Lepidoptera (moths and butterflies)

Four families of Lepidoptera have been databased (Table 12). Wood moths (Cossidae), are large to very large in size. All the species from the open forests of Cape York Peninsula are endemic to Australia. The moth larvae bore in wood, particularly in *Acacia* and *Eucalyptus* and cause some damage to timber. In recent years increasing interest has focused on them as luxury food items; the well-known witjuti grub is a cossid.

Of the large family Noctuidae only the brightly coloured, day-flying Agaristinae have so far been sorted and named. Species occur in the open forest habitats of Cape York Peninsula. Caterpillars of many species use the plant families Vitaceae and Dilleniaceae as foodplants. A few Australian species are known from New Guinea but most are endemic.

Hawk moths (Sphingidae) are large, very mobile and some travel long distances. All have a long proboscis for feeding at flowers and some have been implicated as important pollinators of native and crop plants. Most species are nocturnal. The majority of Australian species also occur in New Guinea and some westwards to Asia but there are a small number of endemic Australian species and a few of these occur on Cape York Peninsula. Rubiaceae and Vitaceae are favoured as foodplants.

Tortricidae records comprise (1) the Olethreutinae which are leafrollers or fruitborers with often very specific and narrow range of food plants, and (2) the Tortricinae which are nearly all leafrollers with a broad range of foodplants. The fruitboring Olethreutinae are of great economic importance for horticulture.

A very substantial set of records for the butterflies of Cape York Peninsula is in hand and at present is being entered into the ANIC Database.

3.9 Order Hymenoptera (wasps, bees and ants)

Six families of Hymenoptera were selected for databasing (Table 13). Two hundred and thirty records of the family Formicidae (ants) were stored on dBASE IV on a PC and included with the data delivered to

ERIN. Ants are widely used as environmental indicators. The species composition of an area's ant fauna reflects the degree of environmental disturbance. The Diapriidae, Scelionidae, and Chalcididae are all wasps and important parasites of other insects, playing a central role in regulating the abundance of these insects over the seasons. The chalcidid records comprise exclusively records of the genus *Smicromorpha*, a parasite of the ubiquitous green tree ant, *Oecophylla smaragdina*. Diapriidae parasitise the immature stages of Diptera, including blowflies and fruitflies. Scelionidae parasitise the eggs of other insects; genera databased especially attack eggs of grasshoppers, crickets, bugs and moths. Rhopalosomatidae are also parasitic on other insects but exceedingly rarely collected. Sphecidae are predatory on other insects and build or excavate nests.

4. PRIORITIES FOR FUTURE RESEARCH

4.1 Western Cape York Peninsula, especially a roughly triangular area with Weipa at its apex, remains poorly known entomologically. Fig. 8 reveals that no permanent traps were located in this area as part of NR17, and Fig. 9 depicts the paucity of entomological records generally. Access to this "Gulf triangle" is difficult, especially in the wetter months. However, a broad documentation of this area is desirable before generalisations can be made on the biogeography of peninsular insects.

During NR17 limited fieldwork was carried out in the sandy heaths of the east coast. Preliminary study of collections from the environs of Shelburne Bay suggest that this area may support an exceptionally diverse insect fauna. The area, which is outside but near the Jardine River National Park, may be of higher conservation value than at present recognised.

4.2 Many apparently undescribed species have been collected or recognised during the course of NR17. There is an urgent need for formal taxonomic study to provide these species with names.

4.3 During the life of NR17 we have also become acutely aware of the need for more comprehensive taxonomic studies and databasing of non-Cape York Peninsula records of target groups. For some groups of insects our knowledge of the Queensland and Australian fauna generally now lags behind our knowledge of the Cape York Peninsula fauna. A clearer view of the non-Peninsula fauna is essential for a rational evaluation of the conservation significance of many of the Peninsula's insects.

5. ACKNOWLEDGMENTS

This project was primarily a joint initiative of the Queensland Department of Primary Industries, the CSIRO Division of Entomology, and the Queensland Museum. However, such a largely field-oriented operation would not have been posssible without the kind assistance of many people who live in the study area of Cape York Peninsula.

The field entomologist, Paul Zborowski, spent over one-third of the two year project in the field on Cape York. During this time many people have been of help with travel logistics, accommodation, access to locations, and with servicing insect traps in the wet season. As some individuals helped in a variety of ways, the following list does not differentiate the type of support, but lists all to whom we are deeply indebted.

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6. REFERENCES

Andersen, N.M., and Weir, T.A. (1994). *Austrobates rivularis*, gen. et sp. nov., a freshwater relative of *Halobates* Eschscholtz (Hemiptera: Gerridae), with a new perspective on the evolution of sea skaters. *Invertebrate Taxonomy* **8**: 1–15.

Berg, K., and Long, S. (1994). *Cape York Peninsula Scientific Expedition Report* 2 vols. Royal Geographical Society of Queensland: Fortitude Valley.

Kikkawa, J., Monteith, G.B., and Ingram, G. (1981). Cape York Peninsula: Major region of faunal interchange. Pp. 1695–1742. In Keast, A. (ed.). *Ecological Biogeography of Australia*. Junk: The Hague.

Neldner, V.J., and Clarkson, J.R. (1991). *Vegetation Survey of Batavia Downs, Cape York*. Queensland Department of Primary Industries, Queensland. Research Establishments Publication QR 901003.

TABLES 2 – 13

Table 2. Records from the ANIC Database of insects found in the CYPLUS region

Order Name	No. of Species	No. of Records	No. of Specimens
Odonata	47	268	393
Plecoptera	6	22	89
Isoptera	61	938	938
Orthoptera	71	302	302
Hemiptera	39	527	527
Neuroptera	20	209	476
Coleoptera	228	4 928	16 936
Lepidoptera	77	363	545
Hymenoptera	146	1 219	2 297
TOTAL	695	8 778	22 505

Table 3. Records from the ANIC Database of Odonata found in the CYPLUS region

Family Name	No. of Species	No. of Records	No. of Specimens
Aeshnidae	1	2	7
Amphipterygidae	1	6	7
Chlorocyphidae	1	2	2
Coenagrionidae	15	125	149
Gomphidae	13	42	66
Isostictidae	5	13	33
Lestidae	4	38	57
Lestoideidae	1	5	9
Megapodagrionidae	2	7	10
Petaluridae	1	1	1
Protoneuridae	2	26	45
Synlestidae	1	1	7
TOTAL	47	268	393

Table 4. Records from the ANIC Database of Gomphidae (Odonata) found in the CYPLUS region

	No. of Records	No. of Specimens
Antipodogomphus		
edentulus	3	3
neophytus	1	1
proselythus	10	14
Austrogomphus		
arbustorum	4	5
bifurcatus	4	5
cornutus	1	2
divaricatus	4	6
doddi	1	4
melaleucae	1	
prasinus	39	46
Hemigomphus		
comitatus	8	10
Ictinogomphus		
australis	6	6
paulini	4	4
TOTAL	86	107

Table 5. Records from the ANIC Database of Plecoptera found in the CYPLUS region

Family Name	No. of Species	No. of Records	No. of Specimens
Eustheniidae	1	4	25
Gripopterygidae	5	18	64
TOTAL	6	22	89

Table 6. Records from the ANIC Database of Isoptera found in the CYPLUS region

Family Name	No. of Species	No. of Records	No. of Series
Kalotermitidae	4	7	7
Rhinotermitidae	8	60	60
Termitidae	57	871	871
TOTAL	69	938	938

Table 7. Records from the ANIC Database of Orthoptera found in the CYPLUS region

Family Name	No. of Species	No. of Records	No. of Specimens
Acridoidea	1	3	3
Gryllacrididae	1	2	2
Gryllidae	51	177	177
Tettigoniidae	14	93	93
Tridactylidae	4	27	27
TOTAL	71	302	302

Table 8. Records from the ANIC Database of Hemiptera found in the CYPLUS region

Family Name	No. of Species	No. of Records	No. of Specimens
Cicadidae	39	527	527
TOTAL	39	527	527

Table 9. Records from the ANIC Database of Neuroptera found in the CYPLUS region

Family Name	No. of Species	No. of Records	No. of Specimens
Mantispidae	20	209	476
TOTAL	20	209	476

Table 10. Records from the ANIC Database of Coleoptera found in the CYPLUS region

Family Name	No. of Species	No. of Records	No. of Specimens
Chrysomelidae	14	55	99
Dytiscidae	83	1 547	2 987
Gyrinidae	2	40	104
Hydrophilidae	7	36	90
Hygrobiidae	1	1	3
Noteridae	4	68	205
Scarabaeidae	117	3 181	13 738
TOTAL	228	4 928	16 936

Table 11. Records from the ANIC Database of Scarabaeidae (Coleoptera) found in the CYPLUS region

	No. of Records	No. of Specimens
Amphistomus		
complanatus	14	86
palpebratus	19	57
squalidus	26	98
tuberculatus	35	89
Anoplognathus		
aeneus	1	1
rothschildti	13	13
smaragdinus	85	85
Aptenocanthon		
sp.nov.	1	1
Boletoscapter		
cornutus	1	1
Coptodactyla		
depressa	15	106
ducalis	2	4
glabricollis	187	945
monstrosa	44	293
subaenea	224	1 580
torresica	38	177
Demarziella		
eungella	4	13
geminata	1	1
imitatrix	1	2
storeyi	1	1
tropicalis	7	29
yorkensis	5	14
Lepanus		
globulus	5	16
latheticus	1	1
monteithi	57	168
nitidus	16	166
parapisoniae	4	4
pisoniae	19	58
pygmaeus	23	121
sp.1	4	9
sp.2	5	7
sp.3	3	3
sp.nov.1	14	22
Monoplistes		
ccidentalis	62	180
hanophilus	8	12
sp.	2	6
sp.nov.	3	6
Onthophagus		
atrox	18	23
bicarinaticeps	23	94
bicavicollis	10	58
bicornis	2	2
binyana	6	7
bornemisszanus	5	5

Onthophagus (cont'd)		
bunamin	22	42
bundara	6	34
capellinus	1	1
capitosus	97	355
clypealis	1	8
comperei	3	3
consentaneus	67	270
conspicuus	14	34
cruciger	6	14
darlingtoni	2	2
desectus	3	4
dicranocerus	19	55
discolor	78	360
dummal	9	14
furcaticeps	17	31
gandju	14	65
gazella	60	107
gidju	5	6
glabratus	13	62
gulmarri	1	1
gurburra	116	255
incornutus	1	1
jangga	53	156
koebelei	3	3
ora	2	2
lamgalio	18	41
laminatus	60	184
latro	37	115
mije	1	1
millamilla	8	15
minusculus	12	24
monteithi	113	373
mulgravei	135	412
mundill	3	5
muticus	35	72
nodulifer	5	8
ocelliger	24	142
paluma	11	32
parallelicornis	12	18
parrumbal	14	22
parvus	32	80
pillara	2	3
planicollis	11	14
prehensilis	8	21
propinquus	47	415
purpureicollis	2	2
quadripustulatus	95	383
rubescens	33	89
rubrimaculatus	77	525
rufosignatus	22	43
sagittarius	1	1
semimetallicus	403	2 288
signaticollis	6	22
sp.	21	56
symbioticus	17	41
tabellicornis	11	13
trawalla	4	4
tricavicollis	36	111
vilis	8	20
walteri	26	115

Onthophagus (cont'd)		
waminda	5	28
wanappe	19	43
wigmungan	30	54
wombalano	77	281
yaran	17	52
yeyeko	7	19
yiryoront	1	1
yunkara	1	1
Temnoplectron		
bornemisszai	11	114
disruptum	36	83
diversicolle	14	46
laeve	1	1
politulum	18	399
rotundum	42	158
subvolitans	24	113
Tesserodon		
feehani	3	3
gestroi	36	62
novaehollandiae	48	120
simplicipunctatum	1	1
TOTAL	3 368	13 738

Table 12. Records from the ANIC Database of Lepidoptera found in the CYPLUS region

Family Name	No. of Species	No. of Records	No. of Specimens
Cossidae	13	22	40
Noctuidae	10	40	79
Sphingidae	36	149	216
Tortricidae	18	152	210
TOTAL	77	363	545

Table 13. Records from the ANIC Database of Hymenoptera found in the CYPLUS region

Family Name	No. of Species	No. of Records	No. of Specimens
Chalcididae	5	89	308
Diapriidae	26	262	542
Rhopalosomatidae	1	13	34
Scelionidae	22	175	378
Sphecidae	92	680	1 035
TOTAL	146	1 219	2 297

Fig. 1 A Malaise Trap set at a riverine woodland site on Cockatoo Creek near Heathlands. Insects which fly into the tent-like structure move up towards the light and are trapped in the chemical-filled jar at the top right of the trap.
[Photo by P. Zborowski]

Fig. 2 A Flight Intercept Trap set at a *Eucalyptus tetrodonta* open woodland site on Batavia Downs. CSIRO entomologist Tom Weir is servicing the trap. Flying insects which intercept the panel fall into the chemical-filled trough at ground level, while ground insects walk or hop in. [Photo by P. Zborowski]

Fig. 3 A powerful 250 watt Ultra Violet lightsheet being used to sample night-flying insects near Coen during the wet season. CSIRO moth specialist Ted Edwards is in attendance.
[Photo by P. Zborowski]

Fig. 4 A *Melaleuca* woodland near Heathlands being sampled for pollinating insects by CSIRO wasp specialist Jo Cardale during the brief flowering season. [Photo by P. Zborowski]

Fig. 5 Following a night of light-trapping insects, CSIRO moth specialist Ebbe Nielsen sorts and pins the diverse catch at a temporary field base on the Archer River.
[Photo by P. Zborowski]

Fig. 6 Field entomologist Paul Zborowski sorting and pinning the day's catch at the Heathlands Ranger Base which served as a base for several trap sites. [Photo by E.S. Nielsen]

1	2
3	4
5	6

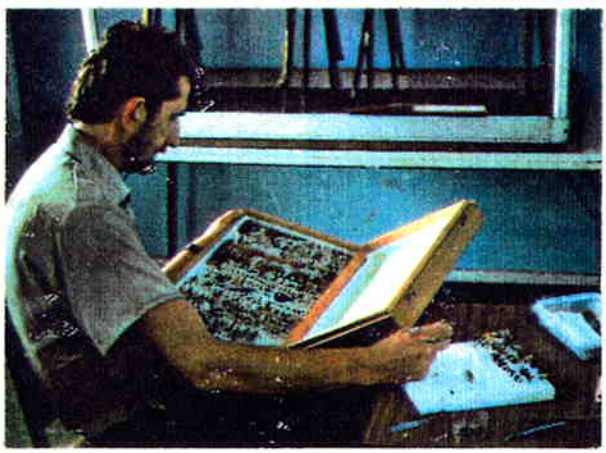


Fig. 7 Project Design

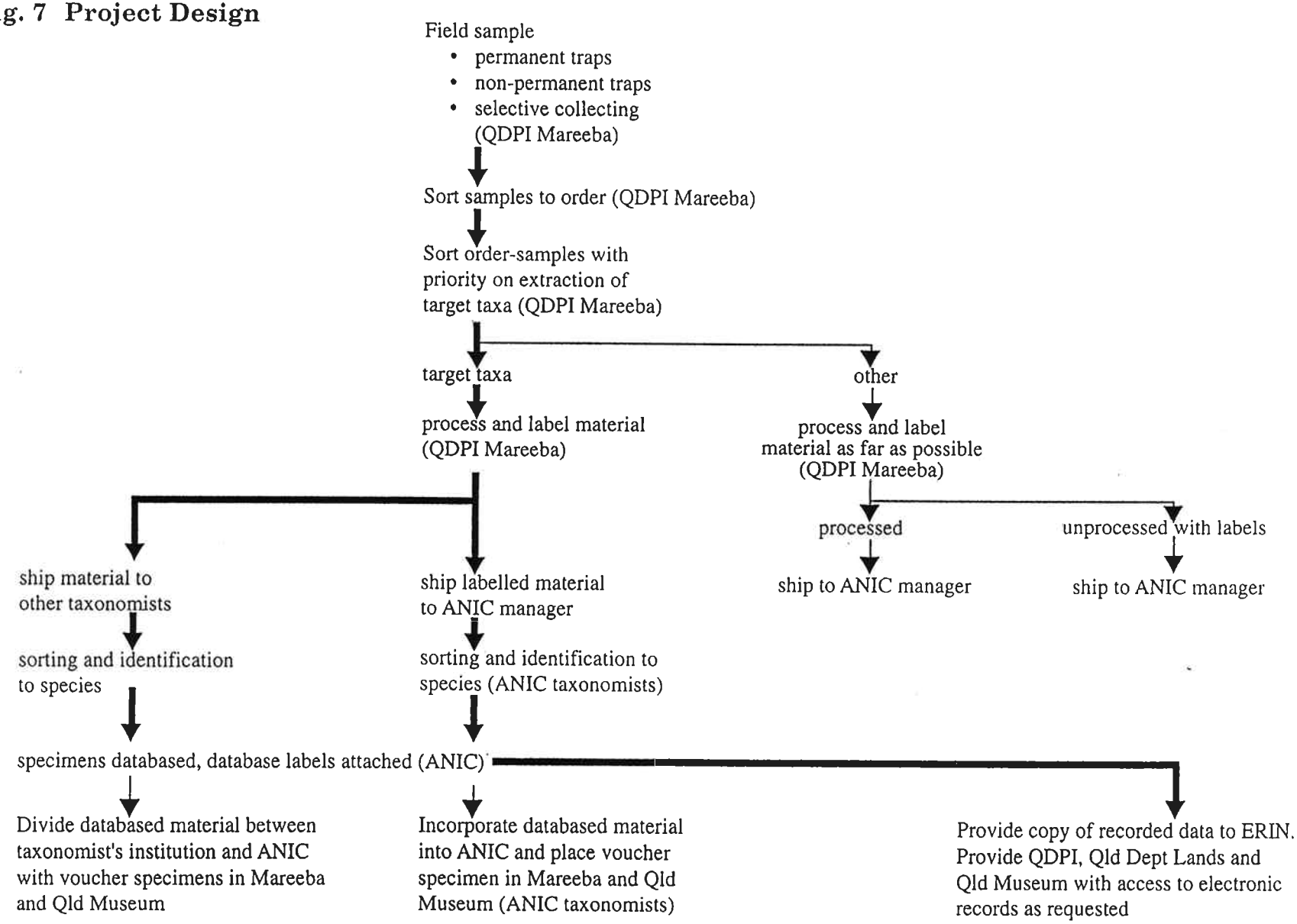


Fig. 8 Map showing all permanent trap sites.

Key — Permanent Trap Sites

1.	12°41'S	142°41'E	5km S Batavia Downs Homestead	(year 1, site 1)
2.	12°40'S	142°39'E	3km W Batavia Downs Homestead	(year 1, site 2)
3.	12°43'S	142°42'E	7 km S Batavia Downs Homestead	(year 1, site 3)
4.	12°39'S	142°42'E	4 km NE Batavia Downs Homestead	(year 1, site 4)
5.	15°39'S	144°31'E	Split Rock 13km S of Laura	(year 1, site 4)
6.	11°45'S	142°35'E	'Heathlands' Station	(year 1, site 6)
7.	11°41'S	142°42'E	14km ENE of Heathlands	(year 2, site 1)
8.	12°40'S	142°00'E	13km E by S of Weipa	(year 2, site 2)
9.	13°40'S	142°40'E	2km N of Rokeby Homestead	(year 2, site 3)
10.	13°57'S	143°12'E	1km SE of Coen	(year 2, site 4)
11.	15°11'S	143°52'E	Hann River	(year 2, site 5)

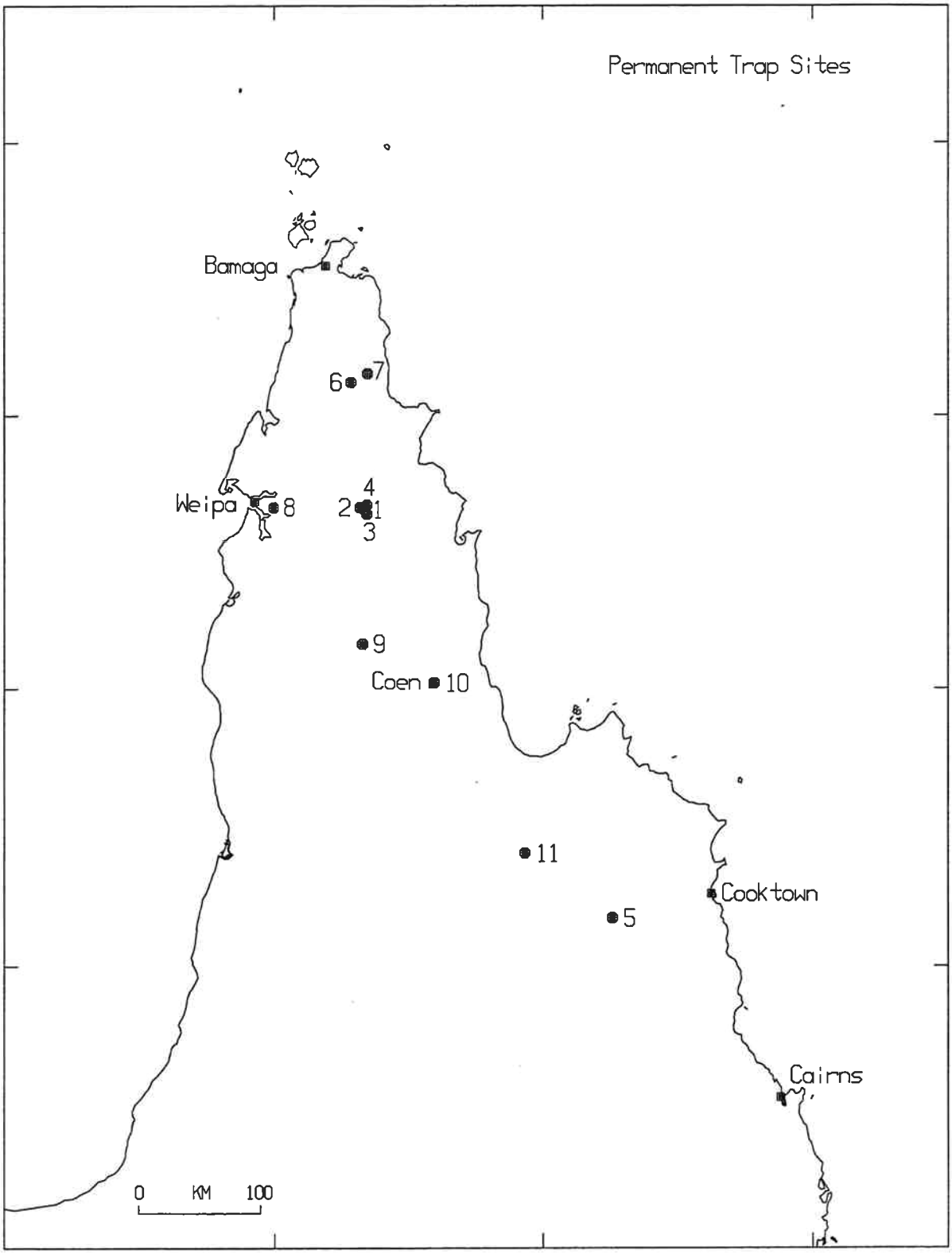

Permanent Trap Sites
Bamaga
6
7
Weipa
8
2
4
1
3
9
Coen
10
11
Cooktown
5
Cairns
0
KM
100

Fig. 9 Map showing all localities from which insect records were obtained on or adjacent to Cape York Peninsula.

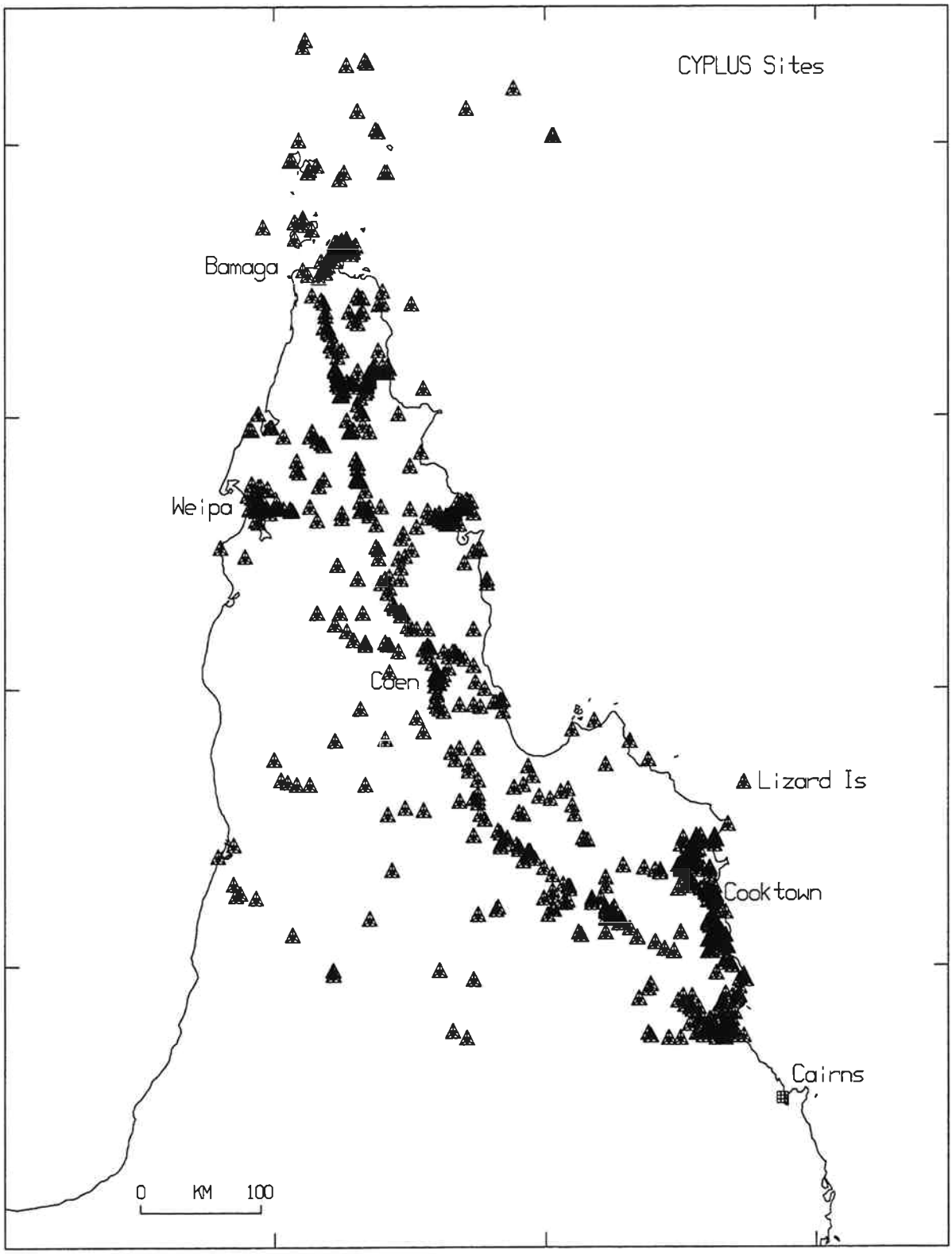

CYPLUS Sites
Bamaga
Weipa
Coen
Lizard Is
Cooktown
Cairns
0 KM 100

Fig. 10 Localities where water strider *Limnogonus windi* was found on Cape York Peninsula. Printed directly from latitude/longitude records in ANIC.

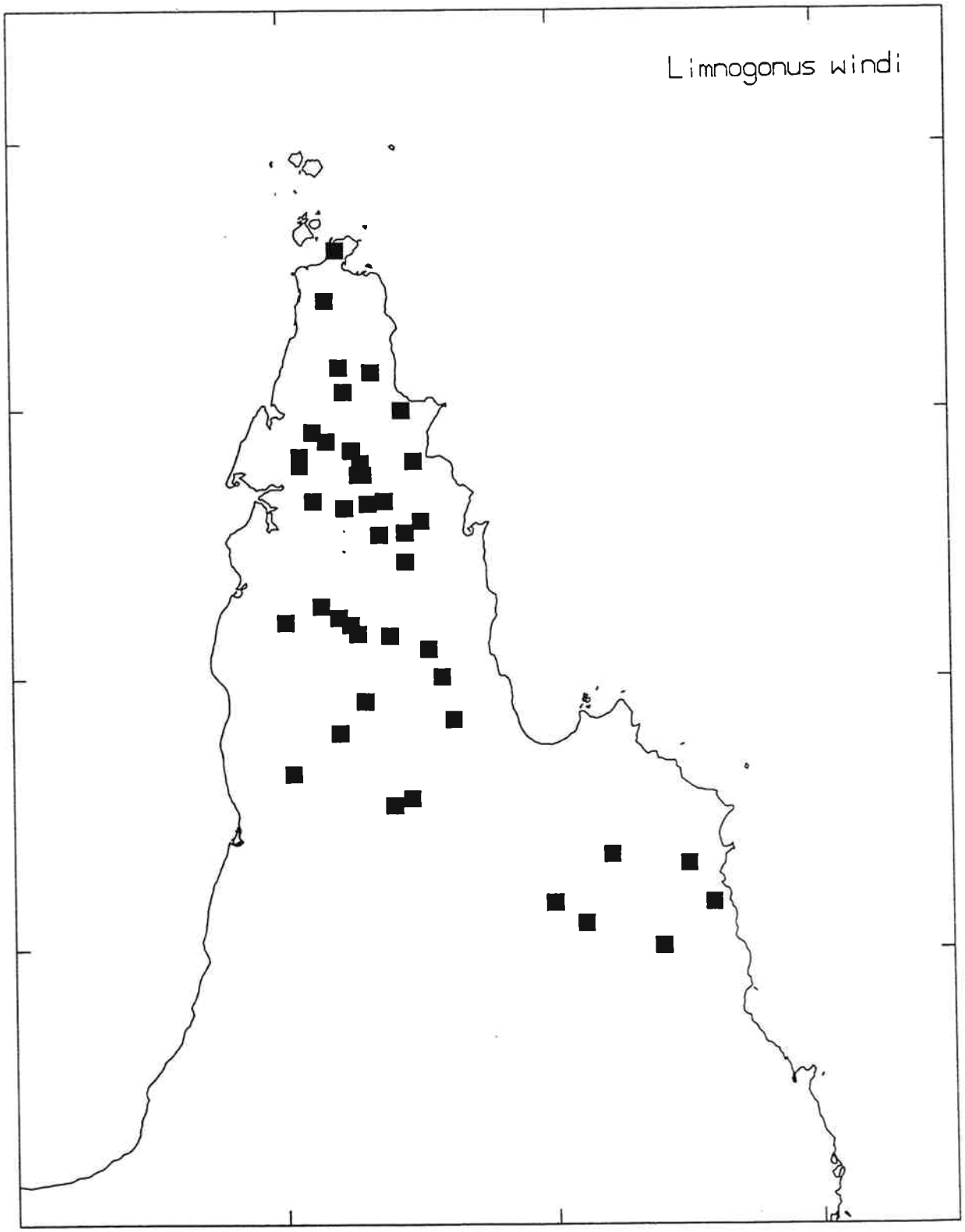

Limnogonus windi

Fig. 11 Localities where water striders *Austrobates rivularis* ■ and *Halobates mjobergi* ▲ were found on Cape York Peninsula. Printed directly from latitude/longitude records in ANIC.

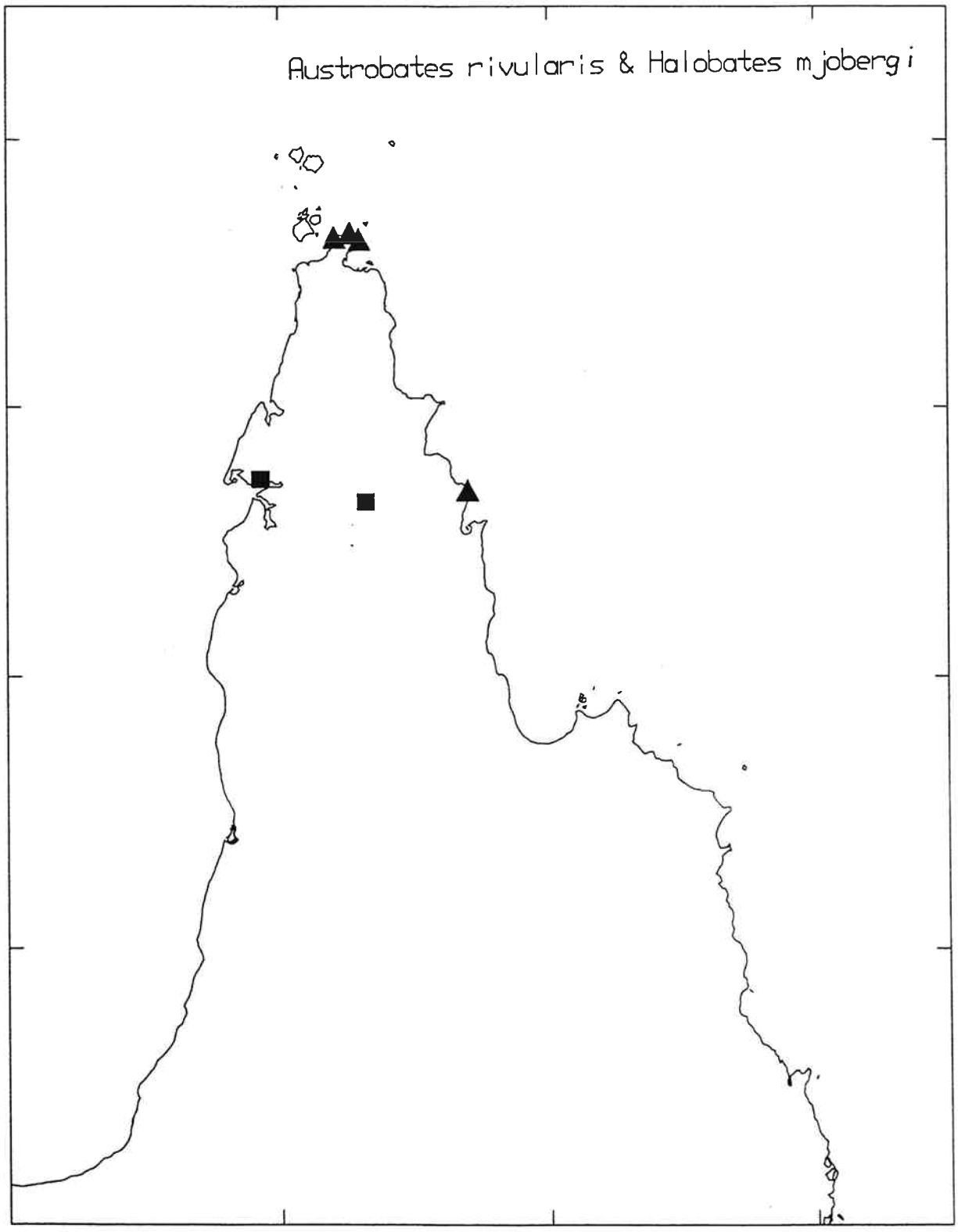

Austrobates rivularis & Halobates mjobergi

Fig. 12 Localities where dung beetle *Onthophagus signaticollis* was found on or adjacent to Cape York Peninsula. Printed directly from latitude/longitude records in ANIC.

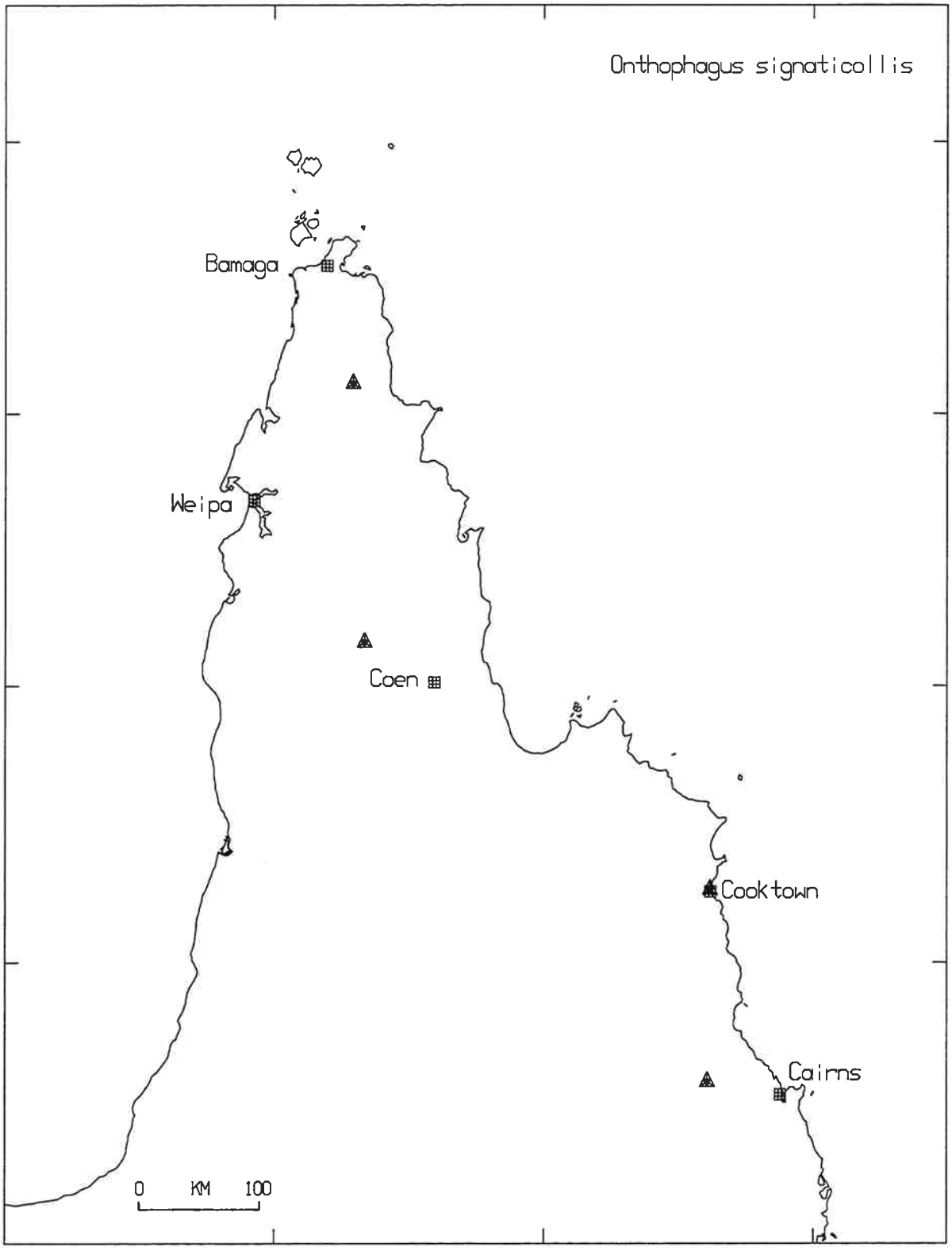

Onthophagus signaticollis
Bamaga
Weipa
Coen
Cooktown
Cairns
0 KM 100

Fig. 13 Locations where dung beetle *Coptodactyla glabricollis* was found on Cape York Peninsula. Printed directly from latitude/ longitude records in the ANIC Database in June 1994.

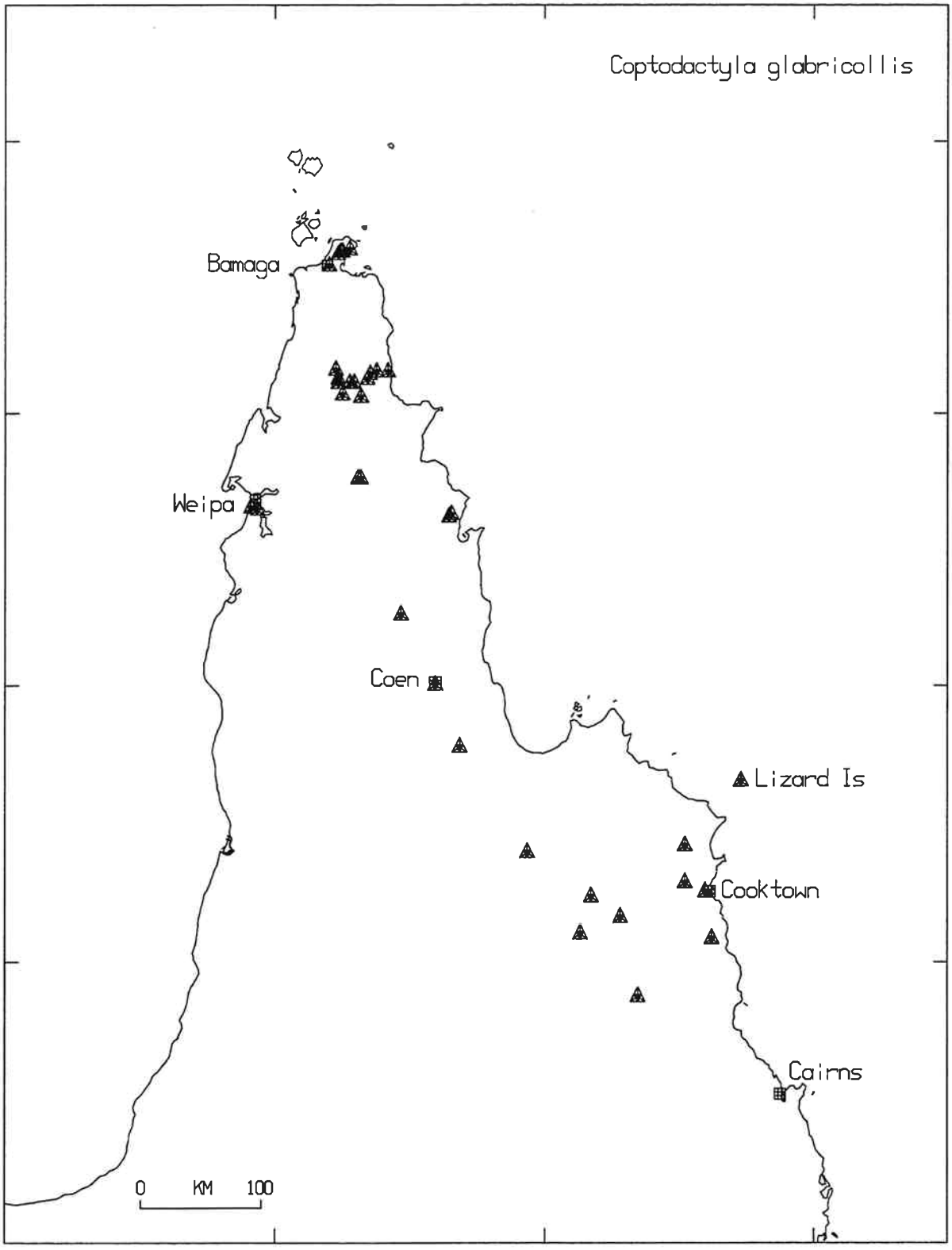
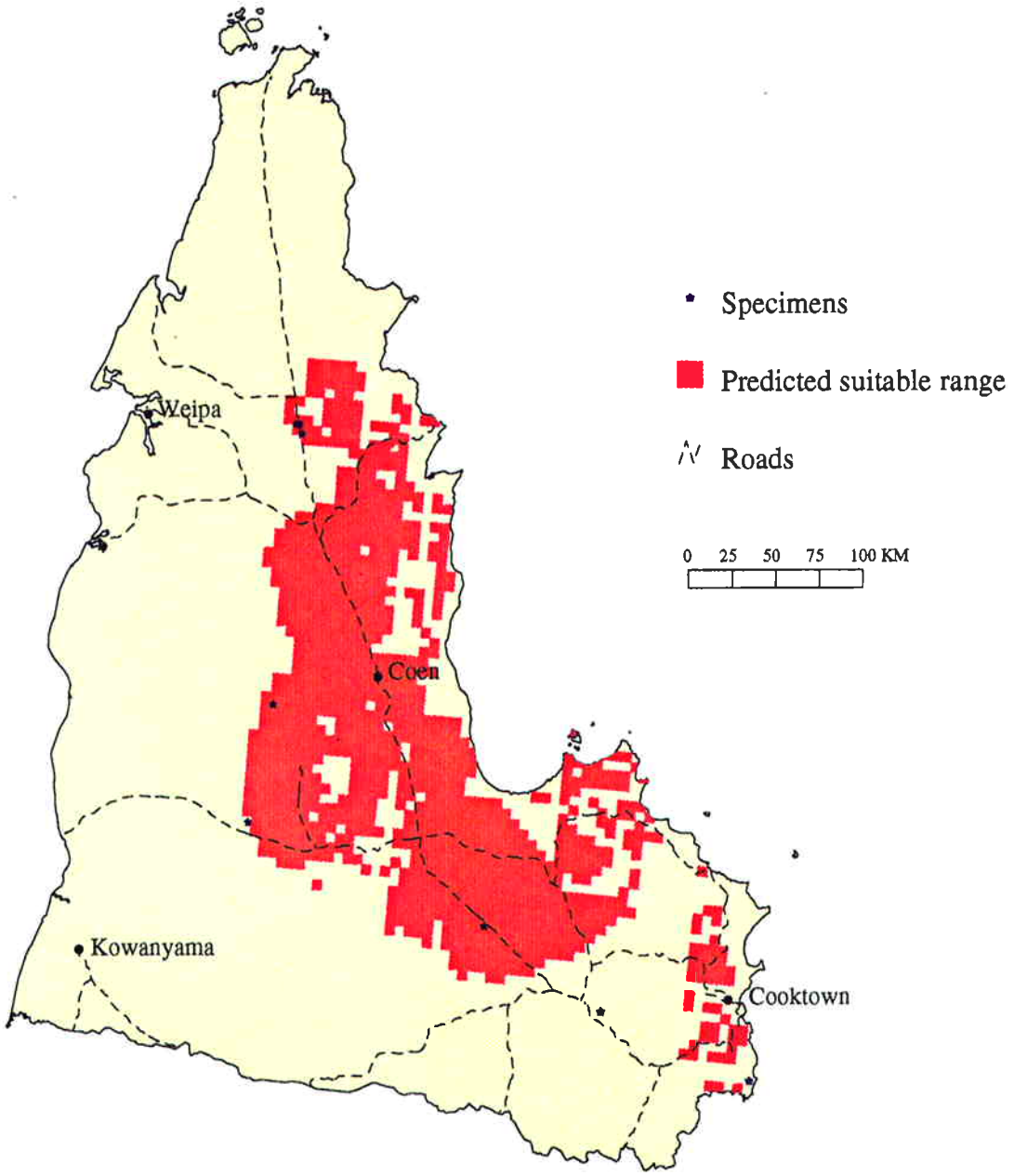

Coptodactyla glabricollis
Bamaga
Weipa
Coen
Lizard Is
Cooktown
Cairns
0 KM 100

Fig. 14 Distribution of dung beetle *Onthophagus gazella* on Cape York Peninsula predicted by the computer program BIOCLIM based on a small number of records available in 1993.

Onthophagus gazella (dung beetle)
Predicted Range
in Cape York Peninsula



Projection Albers equal area

Reduction Ratio....1:4000000

Produced at ERIN : March 24, 1994

Sources....

BIOCLIM prediction based on climate surfaces generated from BoM data (1901– 1975).
Coastline data provided by AUSLIG.
Specimen locations provided by Paul Zborowski, QDPI.

Caveats....

Plotted specimen locations do not represent entire species distribution.
BIOCLIM species distribution predictions based upon 16 climatic variables and elevation.

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Fig. 15 Known occurrences of dung beetle *Onthophagus gazella* on or adjacent to Cape York Peninsula. Printed directly from latitude/longitude records in the ANIC Database in June 1994.

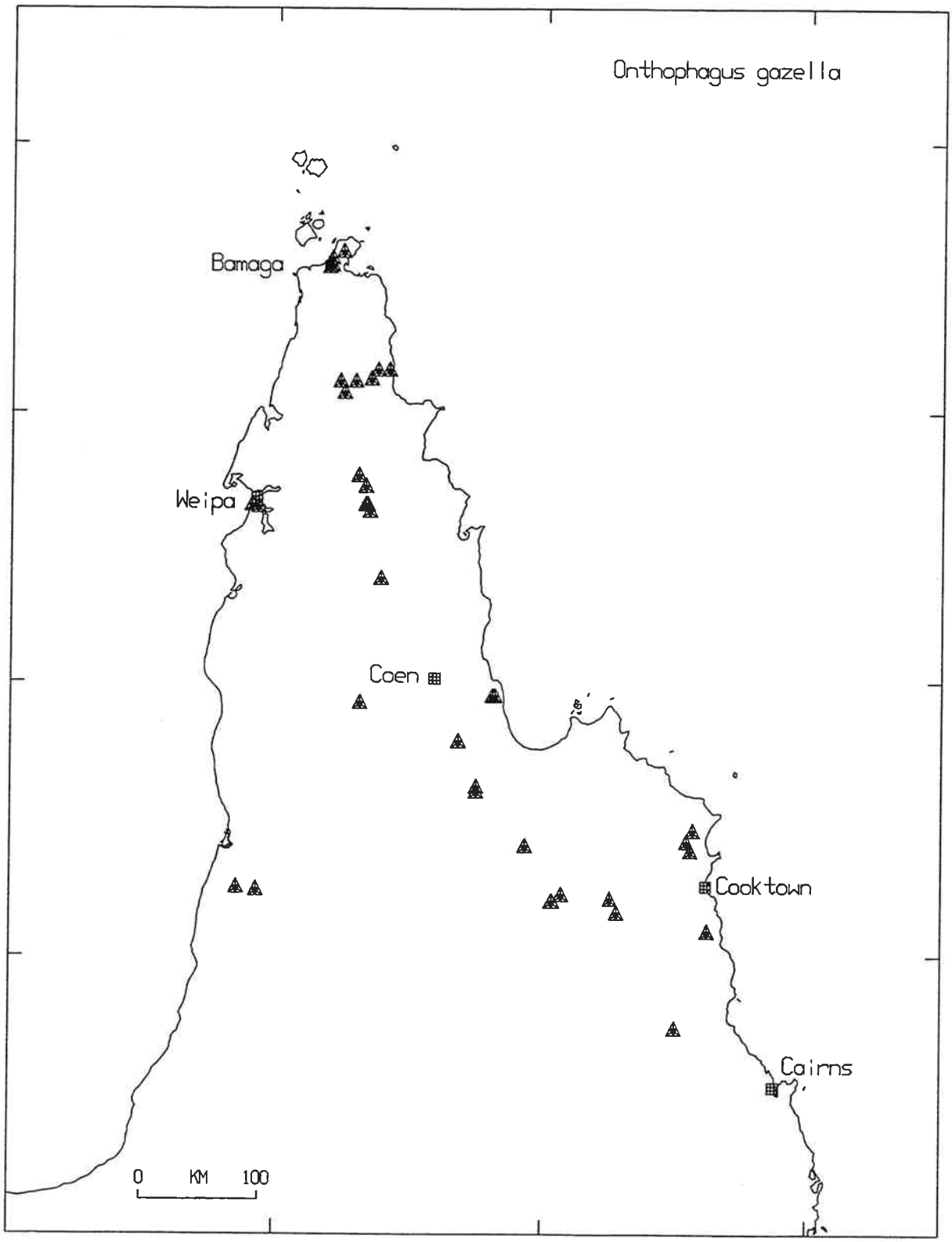
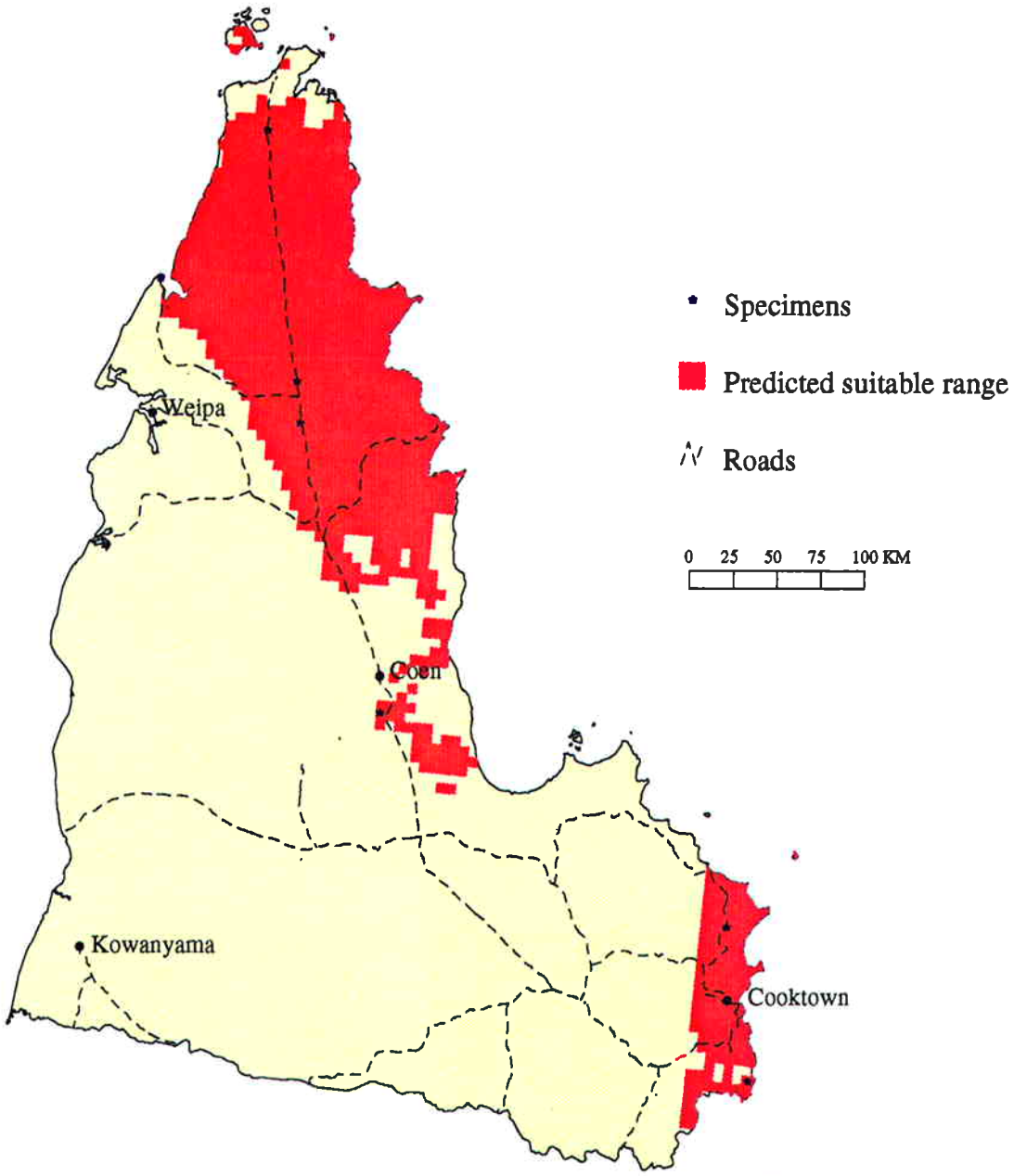

Onthophagus gazella
Bamaga
Weipa
Coen
Cooktown
Cairns
0 KM 100

Fig. 16 Distribution of dung beetle *Onthophagus consentaneus* on Cape York Peninsula predicted by the computer program BIOCLIM based on a small number of records available in 1993.

Onthophagus consentaneus (dung beetle)

Predicted Range

in Cape York Peninsula



Projection Albers equal area

Reduction Ratio....1:4000000

Produced at ERIN : March 24, 1994

Sources....

BIOCLIM prediction based on climate surfaces generated from Bureau of Meteorology data (1901–1975).
Coastline data provided by AUSLIG.
Specimen locations from ANIC insect database (1993).

Caveats....

Plotted specimen locations do not represent entire species distribution.
BIOCLIM species distribution predictions based upon 16 climatic variables and elevation.

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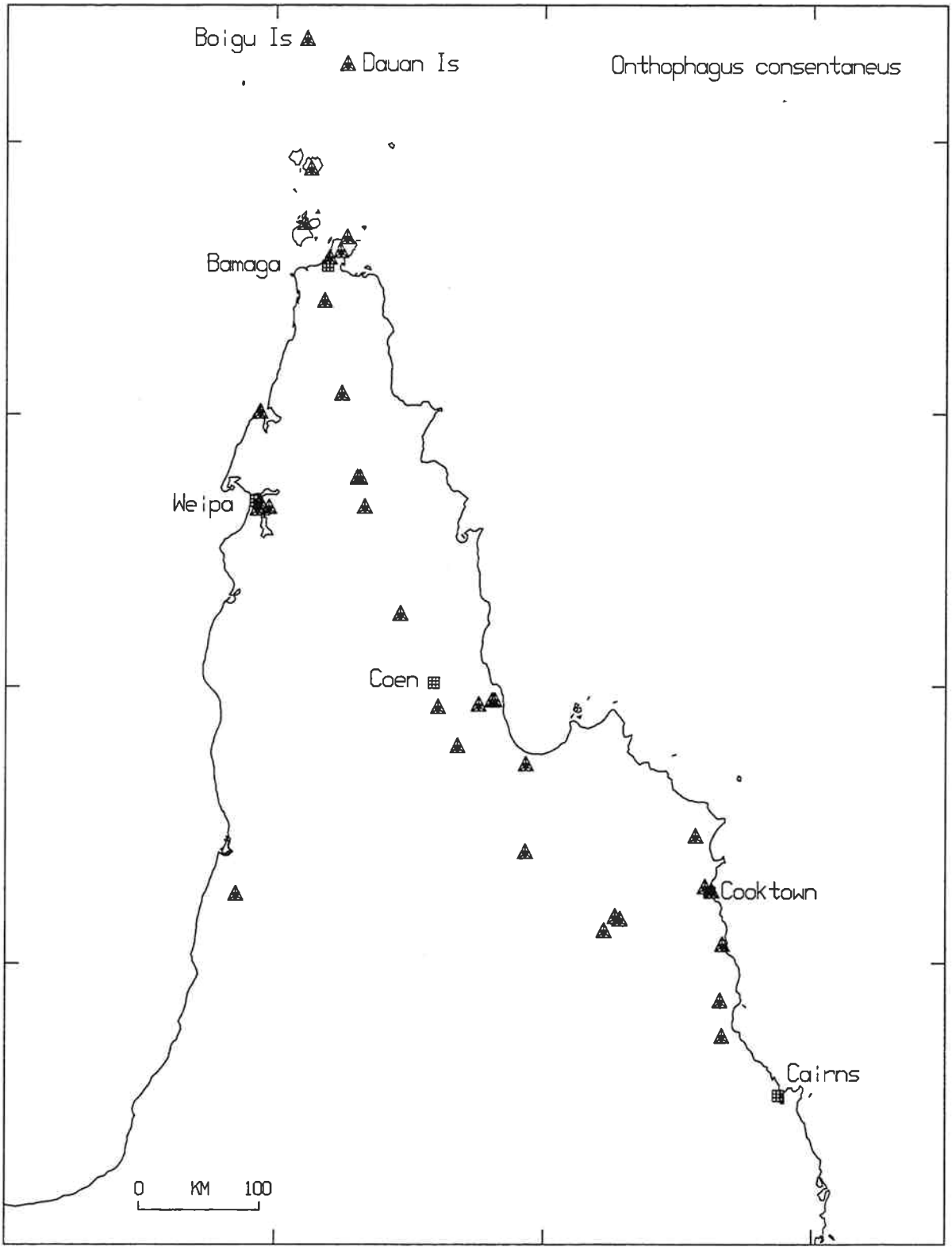
Fig. 17 Locations where dung beetle *Onthophagus consentaneus* was found on or adjacent to Cape York Peninsula. Printed directly from latitude/ longitude records in the ANIC Database in June 1994.


Boigu Is
Dauan Is
Onthophagus consentaneus
Bamaga
Weipa
Coen
Cooktown
Cairns
0 KM 100