CHAPTER THREE

In a land with few possums, even the common are rare: ecology, conservation and management of possums in the Northern Territory

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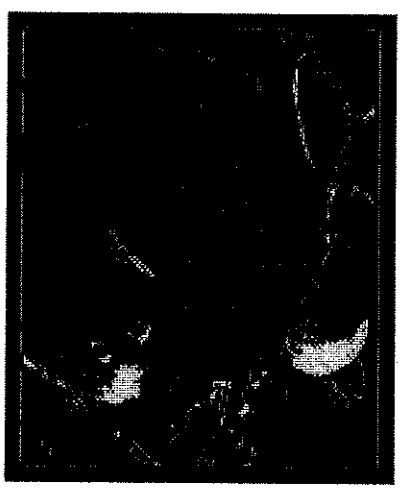
Despite its size and environmental range, the Northern Territory contains only four possum taxa: the sugar glider *Petaurus breviceps*, the rock ringtail possum *Petropseudes dahli*, and two subspecies of brushtail possum, the northern *Trichosurus vulpecula arnhemensis* and common *T. v. vulpecula*. This impoverishment is due partly to the small extent of rainforests (and associated possum species), and partly to the low possum diversity within the extensive eucalypt open forests. The latter is probably because the open forests have a relatively simple stature, low vegetative biomass, and the dominant eucalypts are taxonomically distinctive compared to those in eucalypt forests of temperate Australia. Of the four taxa, the sole representative in arid and semi-arid areas *T. v. vulpecula* has declined substantially over the last century and is now endangered. The three taxa occurring in higher rainfall areas of the Northern Territory are currently considered non-threatened, but landscape-wide changes in habitat quality (as a consequence of altered fire regimes, spread of weeds and feral animals) are likely to jeopardise that apparent security.



INTRODUCTION

A sparsity of possums

WITH just three species, the Northern Territory has the lowest diversity of possums (families Burramyidae, Petauridae, Pseudocheridae, Tarsipedidae, Acrobatidae and Phalangeridae) of any Australian jurisdiction, despite its vast size (1 364 000 km²) and substantial environmental range. Such low representation (12% of the Australian possum species) is not a feature typical of the Territory's mammal fauna, for the Northern Territory has (or had until recently) 27% of the Australian macropod species, 46% of the rodents, 47% of the dasyurids and of the bats, and 60% of the bandicoots.

The Territory possum impoverishment is due partly to lack of representation of the rich possum fauna associated with rainforests in northeastern Australia. The Northern Territory rainforest estate appears to be too small (total area 2 682 km²; Russell-Smith *et al.* 1992) and fragmented (around 15 000 individual patches, most of which are smaller than a few hectares) to support rainforest-dependent possum species; and indeed any rainforest-dependent mammal species other than some highly mobile bats (Menkhorst and Woinarski 1992; Bowman and Woinarski 1994). Further, periods of adverse climate, such as in parts of the Pleistocene, would have whittled the rainforest estate to a level well below even the meagre network now present. Such hostile periods would have produced far more marked diminution in the rainforest estate of the Northern Territory than in northeastern Australia where the far greater topographic complexity and altitudinal range could have provided some buffer and escape for rainforests and their biota (Winter 1988; Williams 1997; Williams and Pearson 1997). Having been depopulated, the Territory rainforest network would have been almost impossible to recolonise from the rainforests of northeastern Australia because of the Carpentarian Barrier, a spike of aridity extending to the southern coast of the Gulf of Carpentaria and segregating the mesic-adapted biota of northeastern Australia from the relatively high rainfall area of the "Top End" of the Northern Territory.

The other main component of the impoverishment is the low possum diversity within the extensive eucalypt forests of northern Australia. Eucalypt forests in southeastern Australia may

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typically support local assemblages from a diverse set of species including common brushtail possum *Trichosurus vulpecula*, eastern pygmy-possum *Cercartetus nanus*, feathertail glider *Acrobates pygmaeus*, sugar glider *Petaurus breviceps*, greater glider *Petauroides volans* and common ringtail possum *Pseudocheirus peregrinus*, with beta-diversity added on when moving to wetter forests containing mountain brushtail possum *T. caninus*, Leadbeater's possum *Gymnobelideus leadbeateri* and yellow-bellied glider *Petaurus australis* or drier woodlands containing squirrel glider *Petaurus norfolcensis* (e.g., Braithwaite *et al.* 1983; Lindenmayer 1997). In contrast, the eucalypt forests of the Northern Territory contain only a set of two species, the northern brushtail possum *T. vulpecula arnhemensis* and sugar glider, and there are no extra species added in when sampling forests across the rainfall gradient. In contrast to the rainforests, this low possum diversity in eucalypt forests cannot be due simply to contemporary or historic habitat shortage: forests dominated by *Eucalyptus miniata* and/or *E. tetrodonta* alone now extend over >180 000 km² in the Northern Territory (Fig. 3), and have probably been extensive for at least tens of thousands of years (Bowman 2000). Rather, it is probably intrinsic features of the quality of these forests, and the environments in which they occur, which makes them relatively possum-unfriendly. These may include:

- the extraordinarily seasonal climate, most notably an annually recurring 8–9 month drought period, to which many plants respond by deciduousness or semi-deciduousness (Williams *et al.* 1997);
- the relatively simple structure of many Top End forests, most notably the sparsity of the tall shrub layer, presumably a consequence of the frequent (typically annual or biennial) fire regime (Bowman 1988);
- the uniformity of tree species composition. Two tree species (*Eucalyptus miniata* and *E. tetrodonta*) are almost sole dominants across vast geographic areas, and this dominance extends over much of the (relatively limited) edaphic and topographic variation offered in this landscape (Wilson *et al.* 1990);
- the distinctly different taxonomic composition of Top End eucalypt forests compared to those of southern and eastern Australia. Top End eucalypt forests are generally dominated by eucalypts of the subgenus Eudesmia and the genus *Corymbia*; whereas those in temperate Australia are mostly in the subgenera Monocalyptus and Symphyomyrtus. These groups differ markedly in palatability, nutritional status and chemical defences of foliage (Ladiges 1997);
- the reduced stature of Top End eucalypt forests. For example, estimates of vegetation biomass in northern eucalypt forest (dominated by *E. tetrodonta* and *E. miniata*) range from 42 to 72 t/ha (O'Grady *et al.* 2000) compared with 325 to 492 t/ha in temperate eucalypt forests (Williams and Brooker 1997).

As (weak) compensation to the impoverishment of the eucalypt forests and the emptiness of the meagre rainforest network, one additional possum species is associated specifically with the single most distinctive feature of the otherwise generally subdued north Australian landscape — isolated outcrops of rock piles, escarpment and plateaus. The rock ringtail possum *Petropseudes dahli* shares this association with a relatively rich saxicoline fauna, including (in the Top End) three macropods, at least two dasyurids, two rodents and about five bat species. This relative diversity is a consequence of both historic and contemporary factors. The topographic complexity of the major rock massifs would have provided ameliorative refuge during times of adverse climate. That complexity also offers an unusually broad range of microclimates and some protection from fire, thereby supporting an unusually rich flora, including many plant species which produce the fleshy fruits favoured by possums (Freeland *et al.* 1988). The rock piles also provide shelter from predators, probably allowing the persistence of species which may otherwise have been eliminated from the landscape. But even the Territory rock possum fauna has been a little short-changed. Comparable environments in the Kimberley also have the scaly-tailed possum *Wyulda squamicaudata*, a bonus in the Kimberley's favour which contrasts with the biogeography of rock-dwelling plants, where the Territory's premier sandstone massif, the Arnhem Land Plateau, has far more species and far more endemics than for the Kimberley.

South of the Top End, the vast expanses of arid and semi-arid central Australia afford bleak prospects for possums. The only possum inhabitant, the common brushtail possum *T. v. vulpecula*, held a tenuous grasp on this country, sourced mainly in riparian areas, relatively restricted patches of maximum fertility and water availability in an otherwise barren landscape, and/or in rocky ranges. Over the last century, that beach-head has proven an inadequate base when faced with invasion by exotic predators and the rapid environmental deterioration due to pastoralism, feral stock and altered fire regimes (Kerle *et al.* 1992).

THE DISTRIBUTION, ECOLOGY, CONSERVATION AND MANAGEMENT OF NORTHERN TERRITORY TAXA

The Territory's possum fauna has been serviced relatively well by researchers. The common and northern brushtail and rock ringtail have been the focus of intensive specific ecological studies, by Kerle (1984, 1985, 1998; Kerle *et al.* 1992; Kerle and Howe 1992) and Runcie (2000, 2004) respectively.

Brushtail possums and (typically with far less information) sugar gliders have also been included in Northern Territory mammal community studies which have examined the effects of fire regimes (R. W. Braithwaite, in prep.), rainfall patterning (Braithwaite and Muller 1997), and vegetation clearance and habitat fragmentation (Rankmore and Price, in prep.), in studies examining habitat preferences of mammal assemblages (Kerle and Burgman 1984; Friend and Taylor 1985; Menkhorst and Woinarski 1992; Woinarski *et al.* 1992), and in studies examining population trends (Woinarski *et al.* 2001). Rock ringtail possums have been included in relatively fewer community studies (Kerle and Burgman 1984; Freeland *et al.* 1988; Woinarski *et al.* 1992).

Information about distribution, abundance and habitat associations has been gleaned on all possum taxa in the course of major regional fauna surveys, notably including the north of the Simpson Desert (Gibson and Cole 1988), the Tanami Desert (Gibson 1986), Uluru (Reid *et al.* 1993), Pellew Islands (Johnson and Kerle 1991), McArthur River area (CSIRO 1976), Wessel and English Company Islands (Woinarski *et al.* 1999), Tiwi Islands (Woinarski *et al.* 2000), Davenport-Murchison Ranges (Johnson *et al.* 1984), Cape Arnhem Peninsula (Gambold *et al.* 1995), Cobourg Peninsula (Calaby and Keith 1974), western Groote Eylandt (Webb 1992), Kakadu National Park (Braithwaite 1985; Woinarski and Braithwaite 1991), the catchment of the Mary River (Armstrong *et al.* 2001), and current regional studies in central Arnhem Land, the Barkly Tableland, Victoria River District, Sturt Plateau and the Finke bioregion. A consistent systematic sampling approach over the last decade has allowed the aggregation of data from these surveys into a data base of more than 5 000 quadrats, to be used for detailed distributional modelling.

The recent survey effort also provides a counterpoint to a patchy but rich historical record, from which some assessment of trends can be inferred (Parker 1973; Calaby 1974; Calaby and Keith 1974; Baynes and Johnson 1996; Calaby 1996; Gibson and Cole 1996; Kerle and Fleming 1996). The most notable of these baselines include Gillen and Spencer on the Horn Expedition in central Australia in 1894, Knut Dahl in the Mary, Daly and Alligator Rivers area from 1894 to 1896 (Dahl 1897, 1926; Collett 1897); W. Stalker on the Barkly Tableland in 1905 (Thomas 1906); J. F. Tunney in Arnhem Land in 1902–1903 (Thomas 1904), Donald Thomson in Arnhem Land in the 1930s and 1940s (Dixon and Huxley 1985), and H. H. Finlayson across much of central Australia between 1931 and 1956 (Finlayson 1961). This style of zoological inventory continued after the Second World War with the American-Australian Scientific Expedition to Arnhem Land in 1948 (Johnson 1964).

This historical record has been augmented and deepened by a small number of important studies of subfossil deposits (notably Baynes and Johnson 1996). Far more extensively, information held by Aboriginal people has provided a detailed account of the geographic and historical pattern of changing status (Burbidge *et al.* 1988) and some insights into ecology (Baker and Mutitjulu Community 1992; Baker and Nesbitt 1996), especially so for possums because of their significance for food, pelts and culture (Dixon and Huxley 1985; Kerle *et al.* 1992).

The conservation status of all Northern Territory vertebrate taxa has recently been assessed under the current criteria specified by the International Union for the Conservation of Nature (IUCN 2000), and listed as regulations under the *Territory Parks and Wildlife Conservation Amendment Act 2000*. This Act also provides for the declaration of "essential habitat" over any land tenure, as a process for the conservation management of lands which are significant for biodiversity and which may otherwise be threatened by unsympathetic land use. In the accounts that follow, I provide the listed status for each possum taxon, and also list the conservation reserves and Northern Territory islands from which each taxon has been recorded. Islands may be at least as vital as conservation reserves for the security of this fauna, as they provide some protection from landscape-wide processes affecting mainland populations. The occurrence of species on islands is drawn in part from Abbott and Burbidge (1995) and subsequent studies (Woinarski *et al.* 1999, 2000).

(NORTHERN) BRUSHTAIL POSSUM
Trichosurus vulpecula arnhemensis

Northern Territory status: NOT THREATENED

Conservation reserves: Kakadu (19 804 km²), Garig Gunak Barlu [= Gurig] (4 511 km²), Nitmiluk (2 949 km²), Litchfield (1 465 km²), Elsey (139 km²), Black Jungle (41 km²), Fogg Dam (19 km²), Berry Springs (8 km²), Leaning Tree Lagoon (1 km²).

(Woinarski et al. 2004)

Islands: Melville (5 788 km²), Bathurst (1 693 km²), Croker (310 km²), Elcho (269 km²), Field (45 km²), Indian (28 km²), Cotton (21 km²), North Peron (18 km²), South Peron (5 km²).

This distinctive subspecies is widespread in higher rainfall areas of the Northern Territory (Fig. 1), and is separated by a gap of about 300 km from the subspecies *T. v. vulpecula* in central Australia.

There is some evidence of historical decline, particularly at the lower rainfall fringes of its range. There are no recent records from the Barkly Tableland, where Stalker collected two specimens in 1905 (Thomas 1906). It is known to be extremely rare and/or localized in the Gulf of Carpentaria hinterland (Borroloola area) (CSIRO 1976; Johnson and Kerle 1991). There are no records from the Victoria River District nor from the adjacent south-east Kimberley (Western Australia) (Kitchener 1978). Within its more northern stronghold, there is evidence of at least localized decline over the last 10–20 years, even in large national parks such as Kakadu (Woinarski *et al.* 2001).

The northern brushtail possum occurs patchily in eucalypt tall open forests (typically in forests dominated by Darwin Stringybark *Eucalyptus tetrodonta* and Darwin Woollybutt *E. miniata*) and in mangrove forests. Within the eucalypt forests it forages preferentially on Cooktown Ironwood *Erythrophleum chlorostachys*, and on flowers and fruits from understorey shrubs and subcanopy trees, and is most abundant where these features occur (Kerle and Burgman 1984; Kerle 1985). Habitat suitability appears to be associated with fire frequency, in that: (a) ironwood is especially fire-sensitive, and its stature or abundance decreases with increasing frequency or intensity of fires (Bowman *et al.* 1988; Bowman and Panton 1995); (b) the tall shrubs (e.g., *Terminalia, Buchanania, Planchonia, Gardenia, Pouteria*) which produce fleshy fruits are diminished or eliminated by frequent fire, and produce less fruit following fire (Bowman *et al.* 1988; Williams *et al.* 1999a); (c) frequent fire reduces the number of fallen logs used at least occasionally as shelter; (d) older (hollow-bearing) trees are especially likely to be destroyed in intense fires (Williams *et al.* 1999b); and (e) frequent fire appears to favour a very dense tall grass understorey, which probably reduces foraging efficiency. Notwithstanding this apparent negative impact of fire, the northern brushtail possum has obviously persisted for tens of thousands of years in a very fire-prone environment subject to frequent burning by Aboriginal people. This apparent paradox can

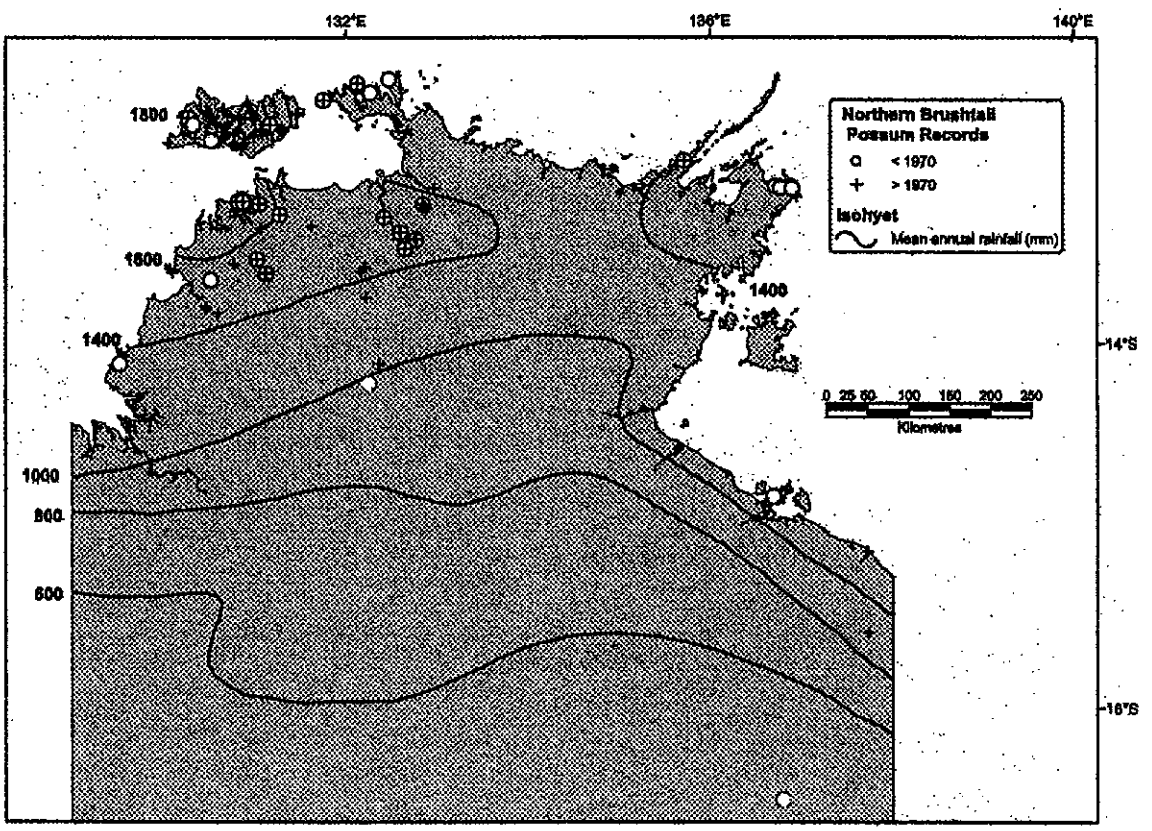

Fig. 1. Recorded distribution of northern brush-tailed possum *Trichosurus vulpecula arnhemensis* in the Northern Territory, with division of records into pre- and post-1970. Also shown are mean annual rainfall isohyets.

be resolved, if we recognise that some types of fire may increase habitat suitability. The ideal regime is probably close to that imposed traditionally by Aboriginal people — an intricate mosaic of burns, at the hectare or so scale of possum home-ranges, which clears some of the grass layer to permit easier ground foraging, and which serves to extend and flatten out the periods of fruit availability because those shrubs in burnt parts of a territory will have a delayed flower and fruit production (Bowman 1998; Williams *et al.* 1999a). At a landscape level, they probably require some long-unburnt areas within the open forests, and these may serve as a relatively stable source area. Over most of northern Australia, the traditional fire management is no longer practised, because most Aboriginal people no longer live so dependently on, and intimately with, their lands (Yibarbuk *et al.* 2001), and because much of the land is now used for other purposes (notably pastoralism) for which alternative burning regimes are preferred. The current regime across most of the eucalypt open forests of northern Australia is one of frequent (annual or biennial) more extensive fires occurring especially in the late dry season — when the fuel load is at its most flammable and hence fires are most destructive, and also when the fires have maximum deleterious impact upon fruit production.

This shift to a more damaging fire regime across vast areas has been exacerbated by the rapid spread of introduced pasture grasses (principally the African gamba grass *Andropogon gayanus* and mission grass *Pennisetum polystachion*), which dominate the understorey, replace native species, provide a fuel load which is up to five times greater than native species, and which cure later in the dry season, thereby ensuring that the late dry season fires are even more destructive (Dyer *et al.* 2001). Vegetation change, generally towards degradation, has also been driven by cattle on pastoral lands and increasing numbers of feral buffalo, cattle, horses, donkeys and pigs on almost all other lands. This broad-scale erosion of habitat quality is now effectively unstoppable, and is likely to operate across all land tenures, including conservation reserves.

In addition to the compounding and increasing impacts of altered fire regime and weed invasions, northern brushtail possums may suffer some impacts from predation by feral cats, although there is scant evidence for the level of predation or for trends in cat numbers in northern Australia. In contrast to the forces lined up against its arid relative (below), the northern brushtail possum does not have to contend with fox predation nor of the impacts of drought.

Although the pervasive and insidious impacts of fire and weeds present the most serious problem for northern brushtailed possums, these possums also face some more acute and localized impacts, in the form of increasing levels of vegetation clearance (Brock 2001; Woinarski and Dawson, ~~in press~~), for horticultural development or for pulpwood plantations of exotic timber species. Up to 12 000 km² of the best developed eucalypt open forests are currently proposed for clearance under a range of potential developments (Brock 2001). Some limited comfort for the possums from this threat can be taken from current studies in fragmented eucalypt forests near Darwin, which have reported high densities in remnant forest patches, particularly when the isolation of these offers protection from fire (B. Rankmore and O. Price, in ~~prep.~~), and some regulatory assurance that agricultural development will be accompanied by increased conservation security elsewhere in regions under development, and commitments to retention of some bushland within the agricultural framework.

(COMMON) BRUSHTAIL POSSUM
T. v. vulpecula

Northern Territory status:	ENDANGERED
Conservation reserves:	West MacDonnell (2 070 km²), Uluru-Kata Tjuta (formerly: 1 335 km²), Watarrka (formerly: 1 066 km²), Ruby Gap (93 km²), Arltunga (formerly: 55 km²).
Islands:	none.

The distribution, ecology and status of the common brushtail possum in the Northern Territory has been subject to a comprehensive review by Kerle *et al.* (1992). Kerle *et al.* (1992) noted that the common brushtail had been reasonably widespread and abundant in arid and semi-arid Australia, especially in riparian areas, rocky outcrops, and other sites with relatively high moisture retention, but that there had been a broad-scale decline after about the 1920s. This decline coincided with a number of factors, some interrelated: a long run of below-average rainfall between 1920 and 1970; the impact of cattle and rabbits (and other exotic herbivores) upon water availability, plant biomass and floristics; some more concentrated hunting of possums for food and commerce associated with permanent settlements; and spread of exotic predators (cats, foxes) and increases in abundance of dingoes. The impacts of these factors were compounded, especially in reducing the security offered by drought refugial patches, the small areas of relatively high nutrient and moisture status in an otherwise largely hostile environment.

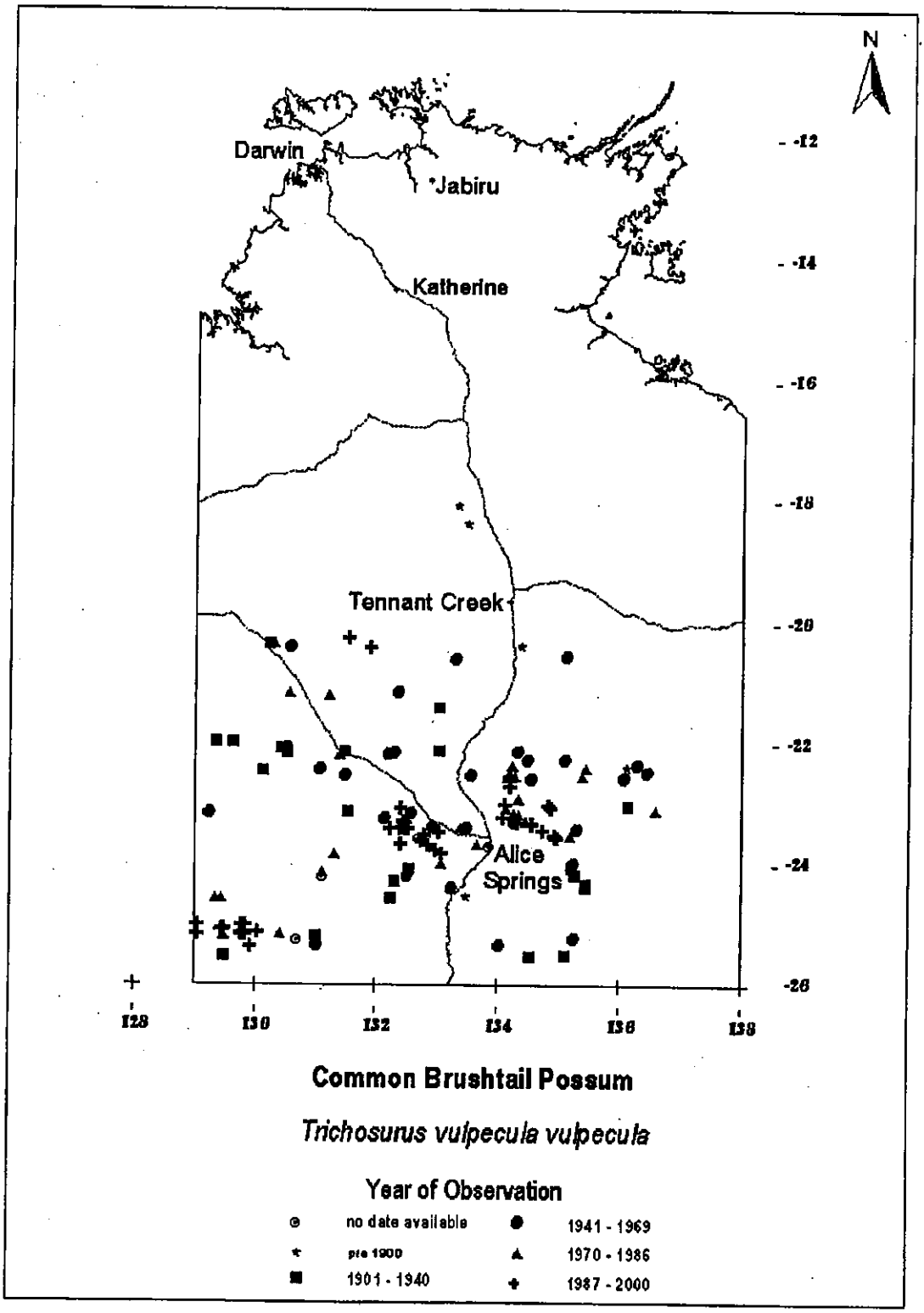

Fig. 2. Recorded distribution of common brushtail possum *T. v. vulpecula* in the Northern Territory, showing date of most recent record at any site.

To that review, I add some additional recent records (Fig. 2), confirming their continuing, but precarious, persistence in scattered ranges and riparian areas. Some of these populations, especially those occurring in the West MacDonnell National Park, are being supported by intensive control programmes for feral predators and more sympathetic fire management, and their outlook may even have improved since Kerle *et al.*'s review.

SUGAR GLIDER *Petaurus breviceps*

Northern Territory status: NOT THREATENED

Conservation reserves: Kakadu (19 804 km²), Gregory (12 791 km²), Limmen (12 357 km²), Garig Gunak Barlu [= Gurig] (4 511 km²), Nitmiluk (2 949 km²), Litchfield (1 465 km²), Alardju (719 km²), Keep River (578 km²), Elsey (139 km²), Flora River (78 km²), Umbrawara Gorge (9 km²), Berry Springs (8 km²).

Islands: Melville (5 788 km²), Groote Eylandt (2 258 km²), Bathurst (1 693 km²), Elcho (269 km²), Inglis (82 km²), Yabooma (27 km²), Wigram (23 km²).

Sugar gliders are patchily common in eucalypt open forests (especially those dominated by *Eucalyptus miniata* and *E. tetrodonta*) across northern Australia (Fig. 3). They are also locally common in patches of tall (to 10 m) shrublands of *Grevillea pteridifolia*, which produces prolific nectar-rich flowers over the course of the dry season. These shrublands typically occur on seasonally moist sandsheet lenses, often adjoining the more extensive eucalypt open forests.

There is no detailed information on abundance, trends in status, or impact of any threatening processes for the sugar glider in the Northern Territory. They are likely to be affected by altered fire regimes and spread of weeds in the same manner as for northern brushtail possums above, although those impacts are probably more pronounced for the semi-terrestrial northern brushtail possum. Notwithstanding their mostly arboreal habits, sugar gliders appear to be particularly susceptible to predation by cats (e.g., Dixon and Huxley 1985).

ROCK RINGTAIL POSSUM *Petropseudes dahli*

Northern Territory status: NOT THREATENED

Conservation reserves: Kakadu (19 804 km²), Limmen (12 357 km²), Nitmiluk (2 949 km²), Alardju (719 km²), Keep River (578 km²), Manton Dam (117 km²), Umbrawara Gorge (9km²).

Islands: Groote Eylandt (2 258 km²), ?Marchinbar (210 km²).

Along with very many other saxicoline species (notably the common rock-rat *Zyzomys argurus*), the rock ringtail possum has a highly fragmented distribution across northern Australia, in association with the discontinuous rock outcrop habitat. Within the Northern Territory, its centres of distribution are the sandstone massif of western Arnhem Land and adjacent granite tors in the upper Mary River catchment, and in the sandstone ranges of the Gulf of Carpentaria hinterland (extending down the rainfall gradient to Wollogorang, with about 700 mm annual rainfall) (Fig. 4). It also occurs in the north-west and east Kimberley, extending east of the Western Australian border to Keep River National Park.

The association with rock outcrops appears to be due at least in part to their relatively high diversity and abundance of plant species which produce fleshy fruits (Freeland *et al.* 1988; Trainor 1996) over a relatively extended phenological cycle (because of the different fruiting peaks of the diverse range of plant species, and because the topographic complexity provides a local range of different microclimates which breaks down the phenological synchronicity among individuals of the same plant species). The association with rock outcrops is also related to the longer-term security these provide in the face of rapid climatic cycles which would have periodically purged the lowlands of resources.

As with rock-dwelling animals elsewhere in Australia (Burbidge and McKenzie 1989), the rock ringtail appears to have been reasonably resilient, particularly as its distribution is north of that of the fox, probably the most pernicious of the threats generally affecting Australian rock-dwelling mammals.

However, as with the three other northern taxa considered here, the rock ringtail possum may be suffering from changed fire regimes. In many areas, the topographic protection from fire formerly offered by rock outcrops has been inadequate against the increased incidence of extensive hot fires in the late dry season. Frequent incursion of hot fires is causing rapid vegetation change across much of the stone country, leading to an uncontrollable spiral of increased extent of fire-promoting grasses at the expense of the woody vegetation required by rock ringtail possums (Russell-Smith *et al.* 1998, 2002).

CONCLUSION

Although there are so few species, the possums of the Northern Territory provide a good reflection of the fate and future of much of the Australian mammal fauna generally. The catastrophic decline in central Australia of the common brushtail possum, probably the most versatile and successful of all marsupials, is a telling and poignant statement of how much we must have distorted and perverted the ecology of this continent. We can take some solace instead in the apparently reasonable status of the three possum species of the north of the Northern Territory, but this comfort must be tempered by the realization that we are currently

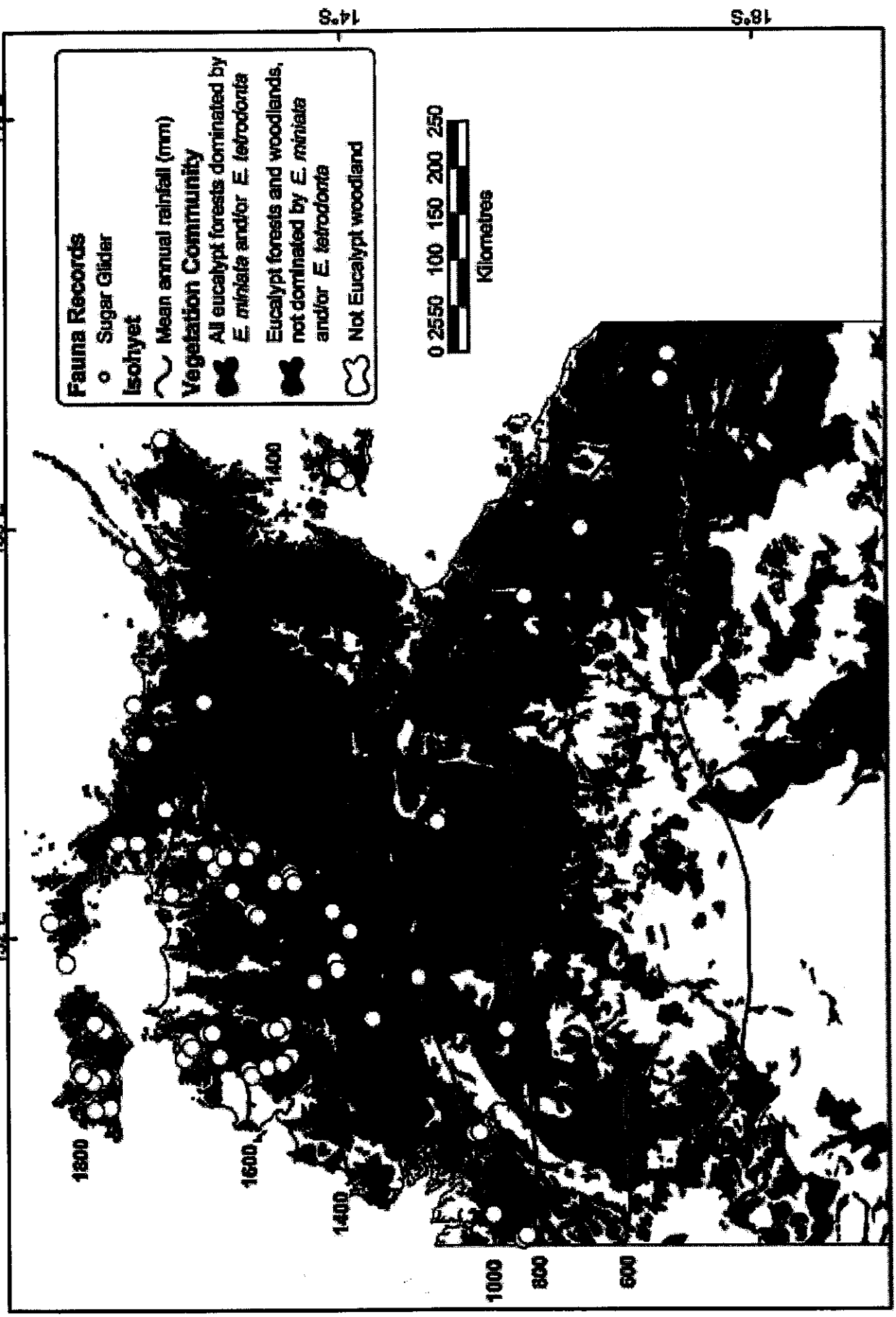

Fig. 3. Recorded distribution of sugar glider *Petaurus breviceps* in the Northern Territory. Also shown are mean annual rainfall isohyets, and distribution of eucalypt forests and woodlands.

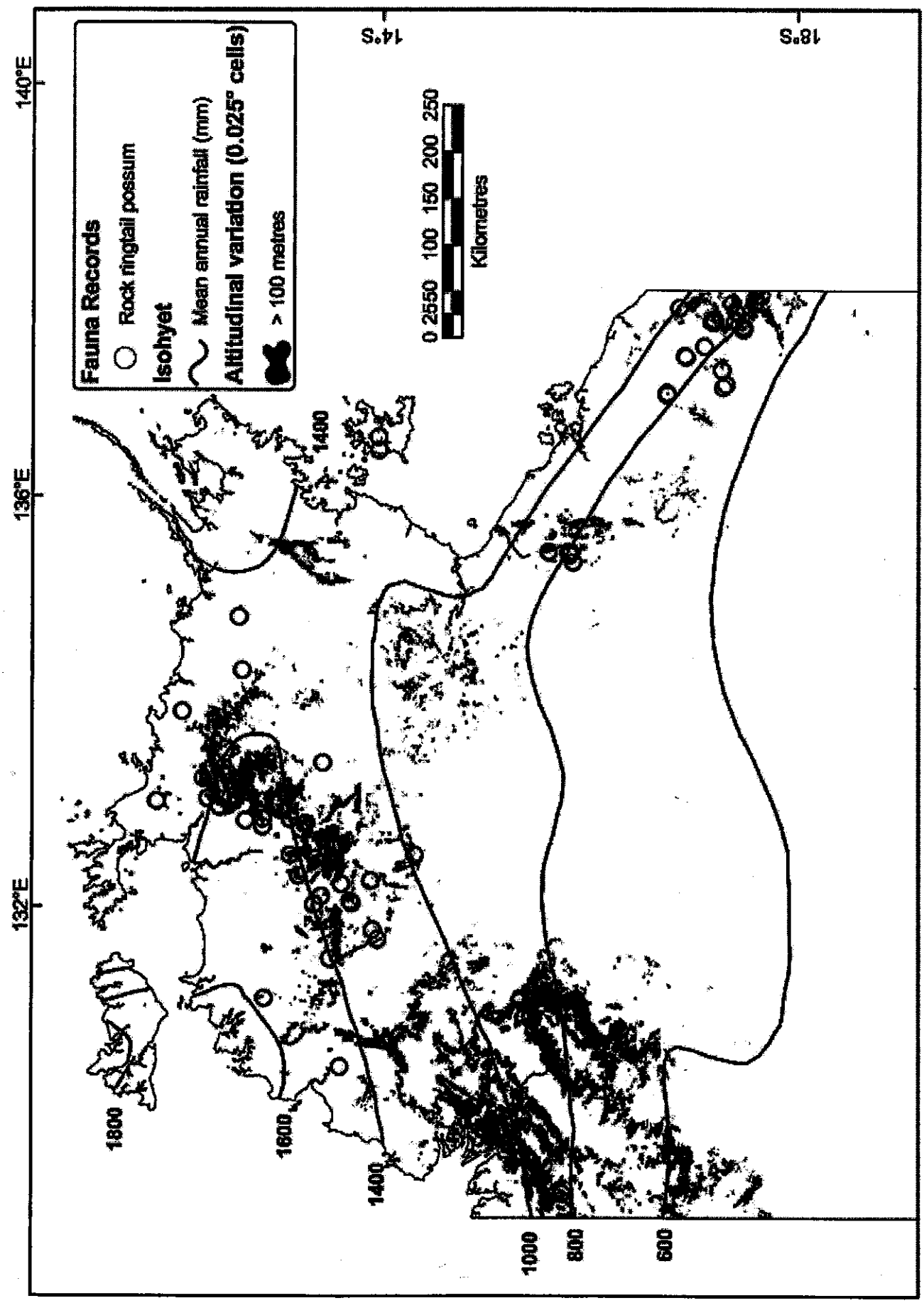

Fig. 4. Recorded distribution of rock ringtail possum *Petropseudes dahli* in the Northern Territory. Also shown are mean annual rainfall isohyets, and rock outcrops (areas with >100 m of elevation range within a cell of 0.025°).

witnessing the gradual, almost imperceptible, degradation of almost all lands there by processes we are now almost powerless to moderate or remedy.

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