Natural Resources
Kangaroo Island

Kangaroo Island Koala Management Project Annual Report 2016-17

Government of South Australia

PROJECT OFFICER CONTACT DETAILS
Robyn Molsher
Wildlife Program Manager
Natural Resources Kangaroo Island
37 Dauncey Street
Kingscote SA 5223

Phone: (08) 8553 4444
Email: robyn.molsher@sa.gov.au

NATURAL RESOURCES KANGAROO ISLAND CONTACT DETAILS
Regional Director
37 Dauncey Street
Kingscote SA 5223

Phone: (08) 8553 4444
Email: kinrc@sa.gov.au

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FRONT COVER IMAGES:
Catching koalas on Kangaroo Island, SA

EXECUTIVE SUMMARY

In 1997, the South Australian environment department initiated the Kangaroo Island Koala Management Program (KIKMP) to reduce the island's introduced koala population and prevent over-browsing of native vegetation.

The long-term objective of the KIKMP is:

To reduce over-browsing of the native vegetation by reducing koala densities to sustainable levels.

Project targets and achievements in 2016-17 were:

Aim	Performance target	Achievement
1. Koala population management	1.1 Sterilise 200 female koalas	285 female koalas sterilised
2. Monitoring	2.1 Assess koala density and tree condition at 40 sites	39 koala density and 46 tree condition sites assessed
3. Habitat management	3.1 No target	19 tree collars installed and existing guards maintained

Aim 1: Koala population management

Eleanor River and Timber Creek management unit (MU) was prioritised for management in 2016-17 based on measured koala density, tree condition, sterilisation rates and length of time since previous management.

A total of 294 koalas were captured from January to April 2017 (5.6 koalas/day). Of these, 285 female koalas were sterilised and nine were recaptured sterilised koalas.

Seventy-five percent of the unsterilised female koalas captured were reproductively active (pregnant, pouch young or back young). Sixteen back young were caught with their mothers and released unsterilised as they were male. Additionally, 266 koalas were observed but not caught because they were male (77%), or already sterilised (20%), or the tree in which they were seen was unable to be climbed (3%).

Only 16% of female koalas observed or caught were sterilised in the targeted MU, which is below the 55% sterilisation rate recommended by Delean et al. (2013) to stop the population from increasing.

Aim 2: Monitoring

Koala density

Mean koala densities have continued to increase each year since 2010. However, in the Cygnet River and Birchmore Lagoon MU (where management has previously been intensified) koala densities were significantly lower in 2016 (1.26 koalas/ha) than at the start of the program in 1996 (3.01 koalas/ha) ($P < 0.05$).

Mean koala densities overall ranged from 0.17 to 4.55 koalas/ha up from 0.05 to 1.30 koalas/ha in 2015. The maximum density recorded was 4.55 koalas/ha up from 1.76 koalas/ha in 2015. Similarly, koala densities were above the target level (0.75 koalas per ha) at 57% of sites in 2016 up from 29% in 2015.

Of the 100 female koalas recorded in the surveys, 23% were sterilised. Of the unsterilised females, 31% were carrying back young.

Tree condition

Tree condition was assessed by Louter (2017) and was relatively stable at most sites since 2007. However, the proportion of trees in poor condition in the Dudley Peninsula MU has increased since 2007, despite the absence of koalas, indicating that environmental factors are confounding the results. This data will be reviewed in 2017-18 to reduce the influence of confounding factors.

Aim 3: Habitat management

A total of 19 large trees impacted by over-browsing were fitted with corrugated iron collars to prevent koala access and thereby assist in their recovery.

The continuing increase in koala densities highlights the need to increase sterilisation targets. Spatial modelling is currently being reviewed to determine the optimal sterilisation target and management strategy.

CONTENTS

1. INTRODUCTION

The South Australian Government recognises the koala's (*Phascolarctos cinereus*) national status as an iconic Australian animal and that key sub-populations are declining in distribution and abundance. The koala is listed as vulnerable in Queensland, New South Wales and the Australian Capital Territory. However, in South Australia, koalas are for the most part an introduced species and, in some areas, are considered over-abundant because of their impact on eucalypt tree condition. Kangaroo Island is located 13 km off shore from the Fleurieu Peninsula, 100 km south of Adelaide. It is the third largest island in Australia with a total area of 438,000 ha (140 km long and 55 km wide). Much of the island's native vegetation (47%) remains intact, primarily at the western end.

Koalas were first introduced to Kangaroo Island in the 1920s from French Island in Victoria because of concerns that they were facing extinction on the mainland as a result of hunting and habitat destruction. Numbers expanded rapidly on Kangaroo Island and significant over-browsing impacts in native vegetation were detected in the 1940s. In particular, koala preference for rough-barked manna gum (*Eucalyptus viminalis* ssp. *cygnetensis*), which grows along the river systems, led to this tree species disappearing in some areas, and to visible signs of poor tree health across a broader area. By 1994, the estimated koala population of ~5000 was significantly impacting the health of manna gums at the landscape scale, with over 50% of the canopy of most trees defoliated (Masters et al. 2004).

In 1997, the South Australian Department of Environment and Heritage (now DEWNR-Department of Environment, Water and Natural Resources) initiated the Kangaroo Island Koala Management Program (KIKMP) to reduce the island's koala population to a sustainable level in order to restore native vegetation communities. The program comprises surgical sterilisation of koalas, relocation of koalas from critically damaged areas to the mainland, management of koala habitat and monitoring of koala density and tree condition to evaluate program effectiveness. An island wide koala population survey is conducted every five years to determine changes in population size.

Since the program began, >12,500 koalas have been sterilised, of which 3,801 have been relocated to the South East of the state where they once occurred naturally. In 2001, the survey showed that the koala population was larger and more widespread than previously thought, with an estimated 27,000 koalas occupying the native vegetation. Management was then intensified and subsequent population surveys in 2006 and 2010 showed that the population had been reduced to ~16,000 and ~14,000, respectively (Molsher et al. 2011). However, in 2015 the surveys showed that koala densities had significantly increased since the previous survey with an estimated 25,000 koalas in the native vegetation plus a further 24,000 koalas estimated for the newly created commercial hardwood plantations.

In light of the koala population increase, KIKMP in 2016-17 redirected resources from the sterilisation component of the project to addressing knowledge gaps. This included investigating the population dynamics, landscape distribution and density-related impacts of koalas on Kangaroo Island to assist in determining the most effective management strategy. This report primarily discusses the results of the koala sterilisation activities for 2016-17.

2. OBJECTIVE AND TARGETS

The long-term objective for the Kangaroo Island Koala Management Project is:

To conserve native vegetation by reducing koala densities to sustainable levels.

Table 1. Program targets for 2016-17

Field targets	
1. Koala population management	1.1 Sterilise 200 koalas
2. Monitoring	2.1 Assess koala density and tree condition at 40 sites
3. Habitat management	3.1 No target
Other targets	
4. Data management and redesign	4.1 Audit and review program datasets and extract and process historic data for population modelling
5. Communication and engagement	5.1 Communication strategy developed to communicate key messages 5.2 Community engagement facilitated
6. Addressing knowledge gaps	6.1 Determine relationship between tree condition and koala density for a range of koala food tree species 6.2 Investigate feasibility of using drones for monitoring koalas in hardwood plantations 6.3 Develop a spatial model to obtain a more confident estimate of population size and identify key population drivers 6.4 Collate information on koala movements in native vegetation to better understand immigration rates and habitat use. 6.5 Investigate koala movements in blue gum plantations. 6.6 Review available information on the use and efficacy of hormone implants for koala sterilisation in Victoria

Only the field targets are addressed in this report.

3. METHODS

3.1 Koala management

3.1.1. Study area and site selection

Koala density has been monitored at 26 fixed monitoring sites since the program began in 1996, primarily in the Cygnet River catchment. In 2000, 135 fixed monitoring sites were established across the island to allow a population survey to be carried out every five years. The sites, each of approximately five hectares (ha) in size, were selected randomly across the landscape and stratified by habitat quality and MU (Masters et al. 2004, Whisson 2007). Seven MUs were identified based on Kangaroo Island water catchments (Masters 2004, Whisson 2007) (Figure 1).

Suitable vegetation types for koalas on Kangaroo Island occurs over approximately 54,365 ha or 12% of the island area (Masters et al. 2004) (Figure 1). Suitable vegetation subgroups were grouped into three koala habitat classes according to their quality (high, medium, low) as a food source for koalas (Table 2) (Masters et al. 2004). The remaining habitat is considered unsuitable, although koalas are known to occur in these areas from time to time.

Table 2. Koala habitat classes

Habitat category	Area (ha)	Description
High quality	750 (2%)	Rough-barked manna gum (*Eucalyptus viminalis* ssp. *cygnetensis*), swamp gum (*E. ovata*), river red gum (*E. camaldulensis* var. *camaldulensis*) or South Australian blue gum (*E. leucoxylon* ssp. *leucoxylon*) present as dominant species.
Medium quality	12,909 (23%)	Rough-barked manna gum, swamp gum, river red gum or South Australian blue gum present as secondary species.
Low quality	40,706 (75%)	Brown stringybark (*E baxteri*) or messmate stringybark (*E. obliqua*) present.

Since 1996, koala density and food tree condition have been assessed annually at a subset of these sites in six of the MUs across Kangaroo Island. No monitoring or koala management occurs in the Gantheaume MU, where koala habitat is rare. Access to some monitoring sites is no longer possible, primarily due to landholders prohibiting access or the vegetation impenetrable after fire.

Tasmanian blue gum plantations (*E. globulus*) are also a known habitat for koalas that has relatively recently become available on the island. These commercial hardwood plantations comprise 13,198 ha and were first planted in the 1990s with the majority planted in 2005-06. The trees are estimated to have become suitable as koala habitat since 2008.

3.1.2. Koala sterilisation

Selection of specific MUs for koala sterilisation in 2016-17 was based on four factors: (1) % koala density increase since the previous census, (2) MU sterilisation rate (3) length of time since previous management and (4) tree condition. This prioritisation process led to the selection of Eleanor River and Timber Creek MU for koala management in 2016-17 (Figure 1).

Estimated area of Kangaroo Island in which koala management occurs is 134,179 ha (excludes blue gum plantations 13,198 ha and properties restricting access 18,801 ha).

Area of Kangaroo Island searched for koalas in 2016-17 was approximately 10,190 ha consisting of 11 private properties, 1 conservation estate, and a number of roadside verges.

In 2016-17, koalas were caught for sterilisation in *E. leucoxylon*, *E. baxteri* and *E. obliqua* trees. Halfway through the catch season, however, the stringybarks *E. baxteri* and *E. obliqua* flowered and koalas were no longer found in them, possibly related to changes in food composition or bee activity.

The koala 'catch season' began on 18 January 2017 and extended for 13 weeks until 10 April 2017. This period was selected as it provides optimal weather conditions in which to catch koalas; in addition, most back young are large enough to sterilise during this period. Koalas were not captured on hot days where temperatures exceeded 30º C to reduce handling stress to the animals or on catastrophic fire days when fieldwork is prohibited by DEWNR.

Two field teams, each with a team leader and three field assistants, searched suitable habitat in the selected MUs (primarily in high and medium quality habitats) for koalas. Only female koalas were targeted for capture as this maximises the effectiveness of population control, because males have multiple mates (Delean et al. 2013).

Koalas were caught by experienced tree climbers using the arborist method and a telescopic pole (up to seven metres extent) terminating in a hook that was used to place a lasso over the head of the koala. Koalas were coaxed to the ground with soft cloth flags, placed in hessian bags, transferred to a pet pack and transported to the veterinary surgery. Further information on catching and handling of koalas is provided in Whisson (2007).

Koala sterilisations (tubal ligation performed through key-hole surgery) were carried out twice a week. Information on animal condition, weight, age, reproductive status and parasite infestations was collected by veterinary staff prior to the procedure. Koalas were marked with an ear tag, and microchipped then released back at their capture sites within five hours of surgery.

3.2 Monitoring

The monitoring component of the Kangaroo Island Koala Management Project provides information on trends in koala density, distribution and impacts on food trees. It helps to prioritise areas for management and determine the effectiveness of the sterilisation program.

3.2.1. Koala density

Koalas were counted at 39 established monitoring sites from August - December 2016 (Table 3) using either single counts or double counts (i.e. two-count mark-recapture technique Caughley and Sinclair 1994, Masters et al. 2004). Double counts involved two observers independently searching a site for koalas. When a koala was seen by either observer, the tree was marked at the base. The other observer determined if a koala was a new sighting or a 'recapture'. In cases where double counts were not possible, koala density was assessed by a single observer who had completed at least 10 surveys using the two-count method. A correction factor based on the proportion of koalas seen by each observer during double counts was then applied to each of the single counts to estimate the number of koalas at the site (Duka and Masters 2005). For all sites, density estimates were derived by dividing the estimated number of koalas by the site area. The sex, presence of dependant young and presence of an ear tag (denoting a sterilised koala) were recorded for each koala. In 2016-17, all surveys were double counts.

3.2.2. Tree condition

Since 1996, tree condition has been assessed using the defoliation class method on a scale of 1 (excellent) to 5 (dead) where:

- Class 1 Crown normal
- Class 2 Thinning of crown (up to 50% defoliation)
- Class 3 Crown very sparse (50–80% defoliation)
- Class 4 Greater than 80% defoliation, often predominantly epicormic[1] growth
- Class 5 Crown absent, tree dead.

[1] An epicormic shoot is a shoot growing from an epicormic bud which lies underneath the bark of a trunk, stem, or branch of a plant. Sprouting usually occurs after disturbance or stress.

Tree species assessed included rough-barked manna gum, South Australian blue gum, swamp gum, messmate stringybark, and brown stringybark. From 1996 to 2000, the condition of every tree at a site was assessed. From 2001, the method was changed to allow a more sensitive comparison of condition change among individual trees. A sample of 50 trees of each species was marked for annual assessment.

In 2007, additional attributes were introduced to improve assessment sensitivity and better evaluate change in condition:

- Projected foliage cover (PFC%): percentage of ground occupied by a perpendicular projection of the foliage and branches, estimated by comparing leaf patterns of the canopy with a reference chart
- Dead branch index (DBI): ranging from 1 (no dead branches) to 5 (all branches dead)
- Epicormic growth index: presence of epicormic growth, which can indicate temporary stress, from 1 (no epicormic growth present), to 4 (growth present all over crown and stem) to 5 (no growth on crown).

In 2016-17, tree condition was assessed at 46 sites from August to December 2016, which were mostly the same sites as the koala density sites.

3.3 Data analysis

Koala density: Sites were grouped according to MU and habitat quality (high, medium and low). Descriptive statistics, including mean koala density and percentage of tagged (sterilised) koalas, were calculated for each combination of habitat quality and MU.

Tree condition: Data analysis is provided in Louter (2017).

3.4 Habitat management

Trees selected for management were those with a breast height diameter > 50 cm and a defoliation class ≥ 3 and were primarily manna gum and SA blue gum trees. A protective corrugated iron collar was placed around the base of the tree approximately 1 m from the ground to prevent koala access and thereby assist their recovery.

4. RESULTS

4.1 Koala management

A total of 294 koalas were captured in 52 days over a 13 week period representing an average catching rate of 5.6 koalas/day, down from 6.9 koalas per day in the previous year. Of those koalas captured, 285 (97%) (all female) were sterilised and nine (3%) were recaptures that had lost their ear tag and were assumed to be unsterilised or were found dead (usually on roadside) and the location entered into the database (Figure 2). No koalas were euthanized by the vet due to poor condition.

Of the 285 female koalas sterilised, 75% were reproductively active (i.e. pregnant or with pouch young or back young) compared to 66% in the previous year. Some koalas were both pregnant, and carrying back young, and pouch young.

A total of 16 back young were caught with their mothers (and not separated) but were released unsterilised because they were male and only females are targeted for sterilisation.

An additional 266 koalas were observed but not caught primarily because they were male (77%). In other cases, koalas were already sterilised (i.e. ear tag visible) (20%) or the tree could not be climbed (3%). This was similar to numbers observed in previous years.

Of the 350 female koalas found in 2016-17 (observed plus captures), 57 were already sterilised representing a 16% sterilisation rate for the area searched. In 2016, koalas were captured primarily in the Eleanor River and Timber Creek MU (Figure 3). Some captures were made outside this MU when adverse weather conditions restricted catching to roadside verges.

4.2 Monitoring

4.2.1. Koala density

Mean koala densities have continued to increase in the last few years in all habitat quality types (Figure 4). However, in the Cygnet River and Birchmore Lagoon MU (where management has previously been intensified) koala densities in high and medium quality sites combined are still significantly lower in 2016 (1.26 koalas/ha) than at the start of the program in 1996 (3.01 koalas/ha) ($P < 0.05$) (Figure 5).

As in previous years, koala densities were generally lower in low quality habitats and below the target density (<0.75 koalas /ha) compared with densities in medium and high quality habitats (Figure 4). Koalas were not observed in sites on the Dudley Peninsula (Table 3).

Mean koala densities overall ranged from 0.17 to 4.55 koalas/ha (Table 3) up from 0.05 to 1.30 koalas/ha in 2015 and were similar to densities recorded in 2000 (0.26–4.85 koalas/ha) (excludes Dudley Peninsula MU). The maximum density recorded was 4.55 koalas/ha (Rocky River MU) (Table 3) up from 1.76 koalas/ha in 2015. Koala densities were above the target level (0.75 koalas per ha) at 57% of sites in 2016 up from 29% in 2015 (excludes Dudley Peninsula MU) (Table 3).

Koala densities were generally lower in low quality habitats and below the target density (<0.75 koalas /ha) compared with densities in medium and high quality habitats (Figure 4).

Of the 181 koalas observed during the surveys 55% were female, 37% male and 8% unknown.

The highest percentage of tagged (and therefore sterilised) female koalas were observed in the Cygnet River and Birchmore Lagoon (28%) MU (Table 3). Overall, 23% of observed female koalas were sterilised.

Dependant young were observed with 31% of unsterilised females, which is similar to that reported in the previous year (i.e. 36%).

4.2.3. Tree condition

Tree condition in 2016-17 was assessed by Louter (2017) and the relationship to koala density investigated for a range of koala food tree species. Tree condition has been relatively stable since 2007, however, the proportion of trees in poor condition in the Dudley Peninsula MU has increased since 2007, despite the absence of koalas, indicating that environmental factors are confounding the results. This data will be reviewed in 2017-18 to investigate the influence of environmental factors and refine the monitoring techniques. For further information see Louter 2017.

4.3 Properties restricting access

Of the 18 landholders contacted (January to April 2017), two denied access to their properties for management purposes because: 1) they believed the program is cruel and koalas should be left alone and 2) nothing personal but likes privacy.

Of the 58 landholders contacted (August to November 2016) for access for monitoring, 11 landholders denied access. Reasons given were: 1) Anti-government sentiments (n=7); 2) a waste of time and money and it would be better to shoot them (n=2); 3) biosecurity concerns (n=1); and security after stock theft (n=1).

A further seven monitoring sites could not be accessed because of impenetrable regrowth after the 2007 fires.

4.4 Habitat management

Protective iron collars were placed on 19 manna gum trees in the Cygnet River and Birchmore lagoon MU to prevent koala overbrowsing.

5. DISCUSSION

The KIKMP exceeded its sterilisation target of 200 koalas by 42% as the catch program was extended for two weeks. On average, 5.6 koalas were caught each day, down from 6.9 koalas/day in the previous year, primarily due to the long-term experience of staff in the previous year.

The 2016 surveys showed that koala densities continue to increase steadily in all habitat categories as per the trends over the last few years. Only 16% of female koalas observed or caught in the Eleanor River Timber Creek MU in 2016-17 were sterilised, which is less than the 55% sterilisation rate recommended by Delean et al. (2013) to stop the population from increasing. The continuing increase in koala densities highlights the need to increase sterilisation targets. Sterilisation is currently the only permitted population reduction option for koalas in Australia as culling of koalas is not permitted under the terms of the *SA Koala Conservation and Management Strategy 2016.* Factors implicated in the population increase are discussed in Molsher (2017).

Spatial modelling is currently being reviewed to determine the optimal sterilisation target and strategy for future management on Kangaroo Island. It is paramount that the information gained in addressing knowledge gaps in 2016-17 is incorporated in to future planning of sterilisation targets and management strategies.

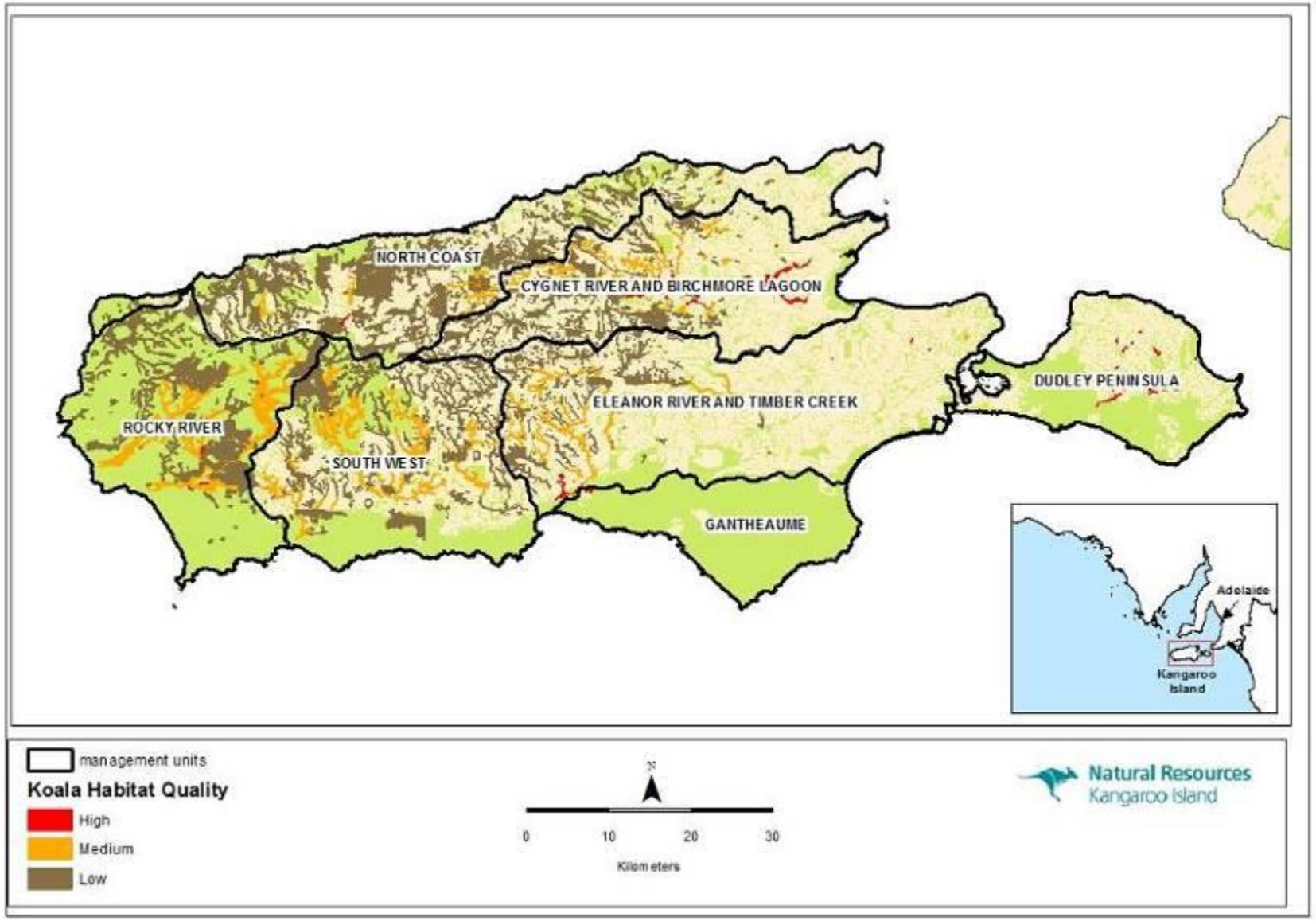

Figure 1. Koala habitat types

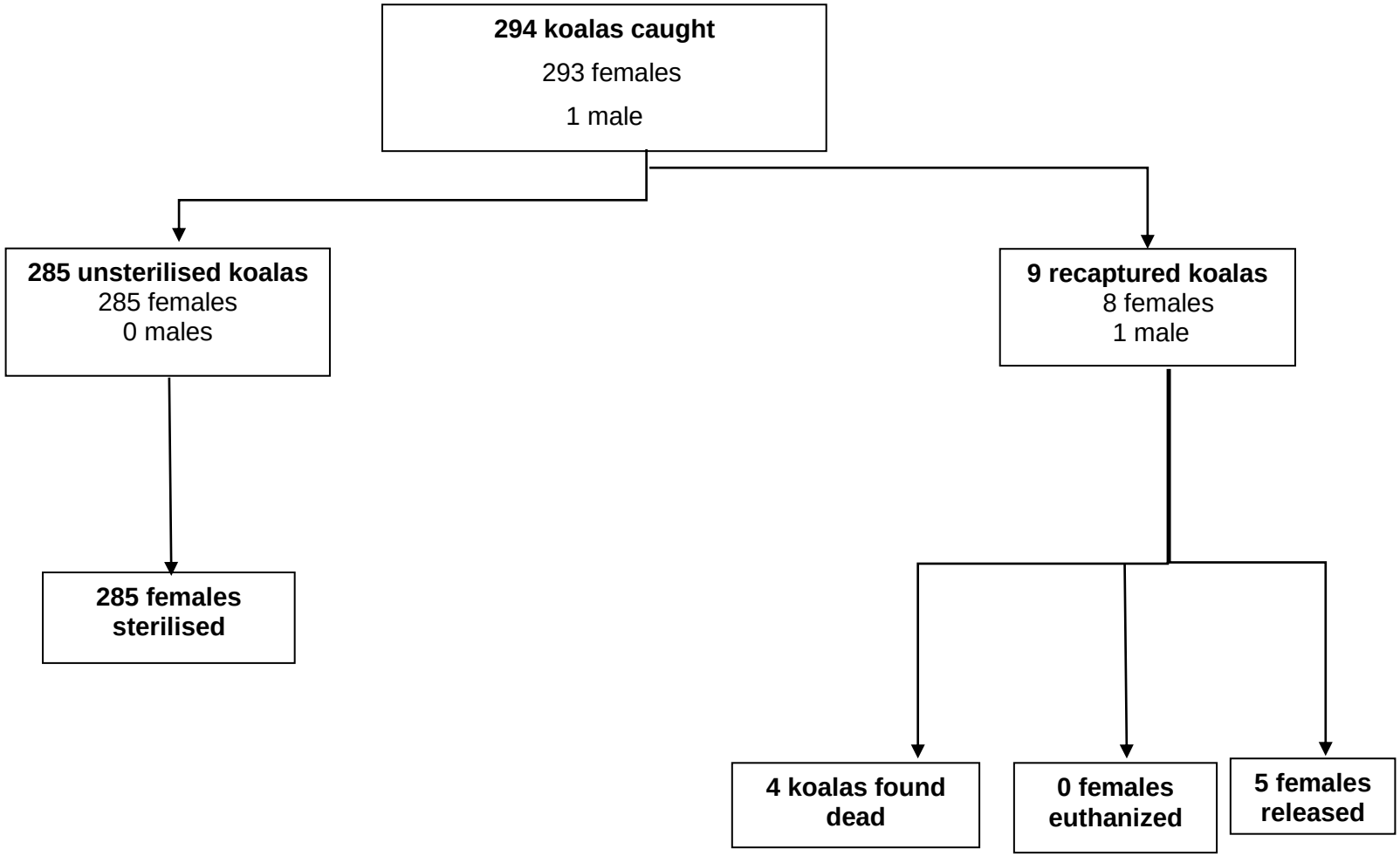

Figure 2. Numbers of koalas captured and sterilised in 2016-17

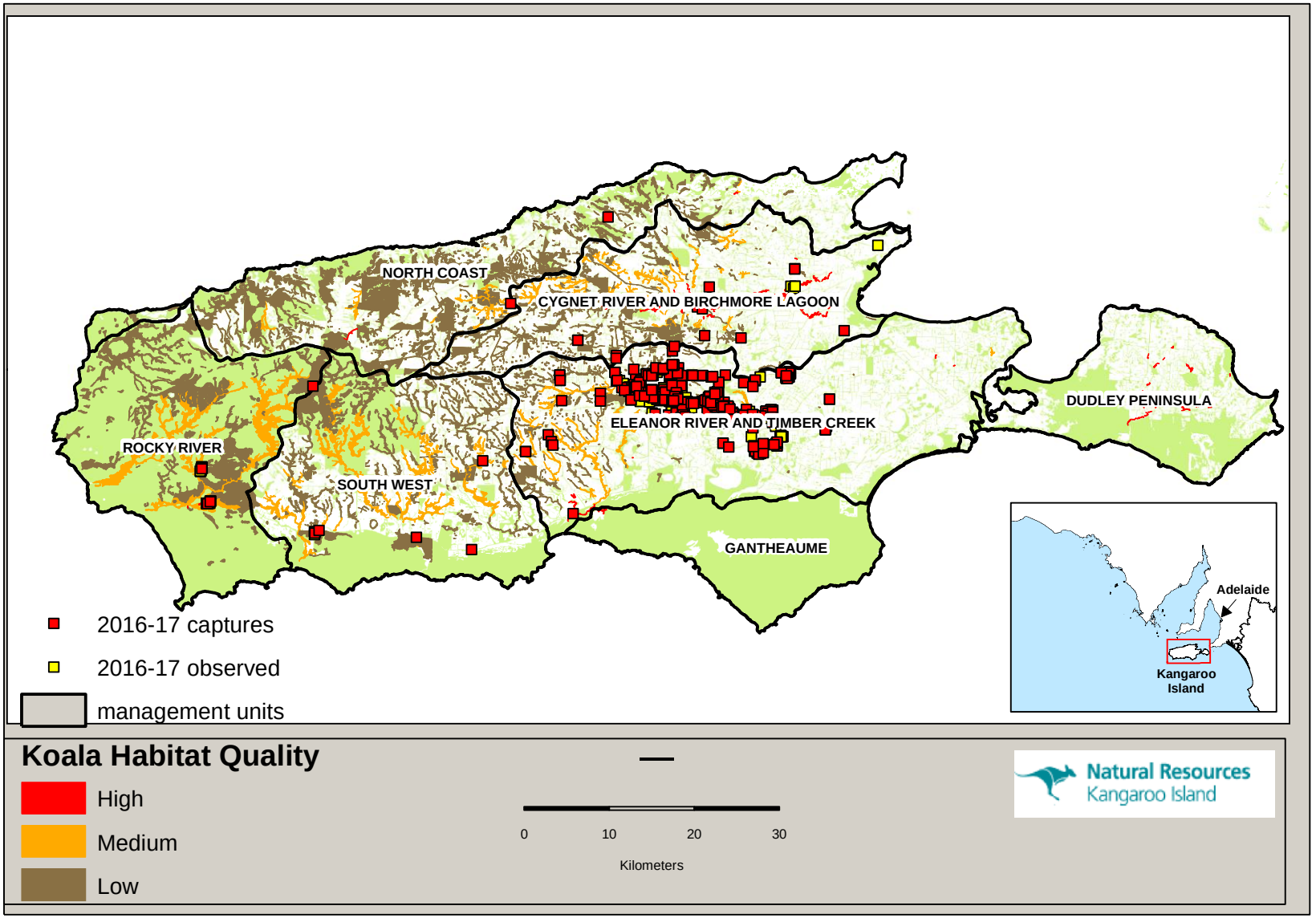

Figure 3. Koala capture locations 2016-17

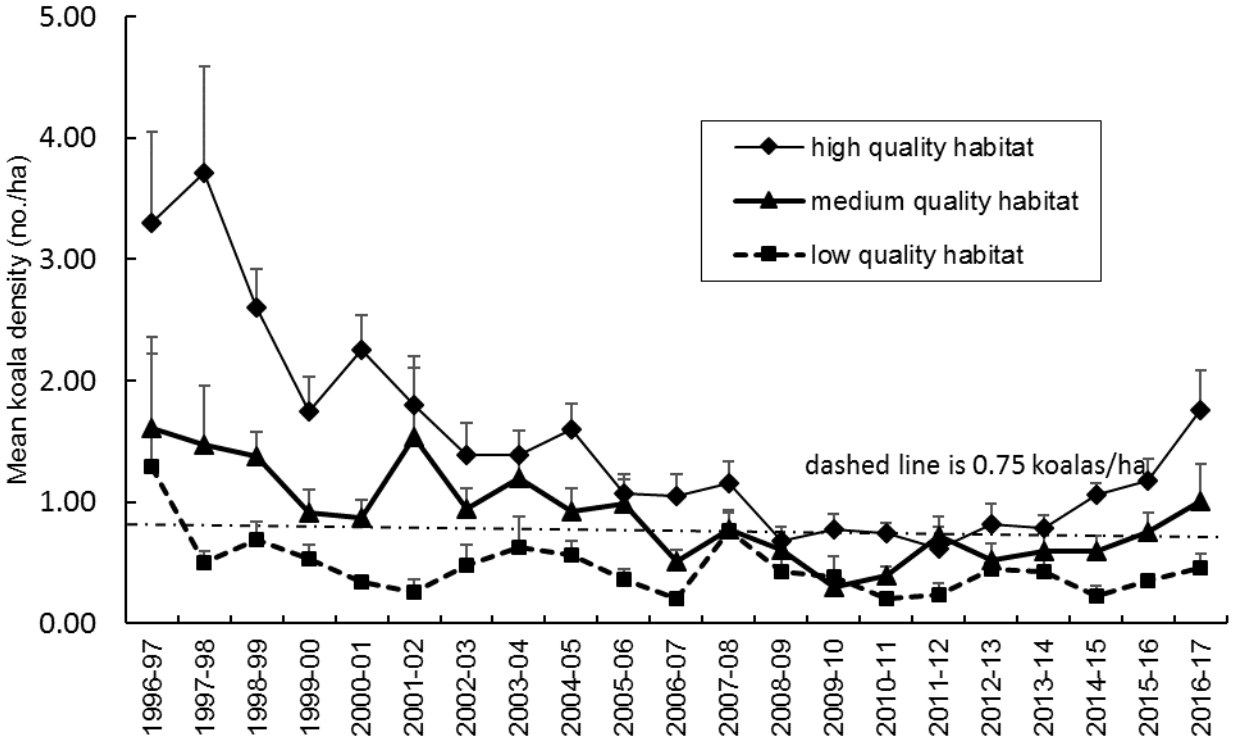

Figure 4. Mean koala density (± S.E.) per habitat type 1996–2016. Number of sites assessed varied among years (*n* = 2–56)

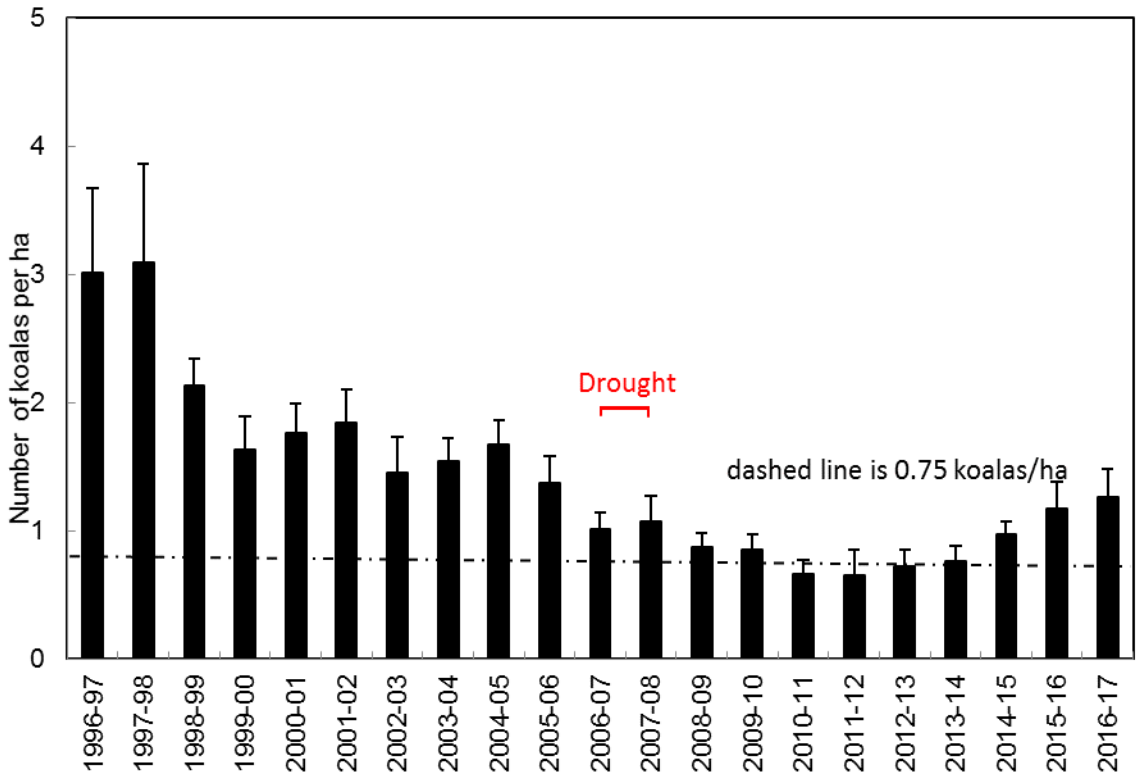

Figure 5. Mean koala density (± S.E.) in the Cygnet River and Birchmore Lagoon MU (high and medium quality sites combined, n = 15)

Table 3. Koala density (number/ha) in 2016-17 relative to habitat quality and management unit

Management Unit	Koala habitat quality	No. sites	Mean density (number/ha) ± SE	Maximum density (no./ha)	Total no. females observed	% females sterilised
Cygnet River and Birchmore Lagoon	High	10	1.53 ± 0.24	2.83	55	31
	Medium	5	0.72± 0.35	2.02	10	0
	Low	3	0.42 ± 0.02	0.46	4	50
	TOTAL for MU	**18**			**69**	**28%**
Eleanor River and Timber Creek	High	0	-	-	-	-
	Medium	1	0.94	0.94	2	0
	Low	1	1.05	1.05	3	0
	TOTAL for MU	**2**			**5**	**0%**
Southwest	High	0	-	-	-	-
	Medium	3	0.95± 0.38	1.47	13	15%
	Low	3	0.47± 0.29	0.99	4	50%
	TOTAL for MU	**6**			**17**	**24%**
North Coast	High	1	1.20	1.20	2	0%
	Medium	2	2.24± 1.58	3.81	6	0%
	Low	1	0.23	0.23	0	-
	TOTAL for MU	**4**			**8**	**0%**
Rocky River	High	1	4.55	4.55	1	0
	Medium	1	0.17	0.17	0	-
	Low	1	0.19	0.19	0	-
	TOTAL for MU	**3**			**1**	**0%**
Dudley Peninsula	High	6	0	-	-	-
	Medium	0	-	-	-	-
	Low	0	-	-	-	-
	TOTAL for MU	6			-	
	OVERALL	**39**			**100**	**23%**

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