# final report

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# Mitigation of methane emissions from the northern beef herd - extension to field laser research

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# Abstract

Methane ($CH_4$) emissions associated with beef production systems in northern Australia are yet to be quantified for commercial sized herds. Methodologies are available to measure individual emissions, but application in extensive grazing environments is challenging.

A micrometeorological methodology for estimating herd scale emissions using an indirect open-path spectroscopic technique and an atmospheric dispersion model is described. Livestock emissions have been measured for properties in Queensland and Northern Territory. As part of the extension to the original project B.CCH.1004, “Mitigation of methane emissions from the northern Australian beef herd”, methane measurements using open path lasers (OPL) have also been obtained from two sites in the Northern Territory; Douglas Daly Research Farm, and AACo Brunette Downs. These additional campaigns have measured methane flux from Brahman cross and composite heifers grazing predominantly unimproved pastures typical of northern Australia. At both sites methane emissions were measured using OPL for up to 5 h per day for at least 12 days and estimated with a bLS dispersion model. Calculated daily methane emissions (g $CH_4$/d) for 12 valid measurement periods (11 to 22 August 2011) obtained at Kidman Springs for Brahman and Brahman x Senepol cross heifers (mean ± sem liveweight 316 ± 4.5 kg) ranged from 65 ± 18.4 g/d to 257 ± 25.8 g/d. Data obtained at Brunette Downs (27/04/2012 to 14/05/2012) on the Barkly Tablelands for composite heifers (mean ± sem liveweight 287 ± 6.2 kg) grazing an *Astrebla* sp. dominated sward has yet to be processed. An additional campaign is proposed for August 2012 on Hamersley Station, WA and will add further emission data for benchmarking heterogeneous grazing systems across northern Australia.

This report documents two campaigns conducted as part of the project extension (B.CCH. 1063).

# Executive Summary

Methane ($CH_4$) emissions from cattle grazing pastures characteristic of northern Australia are yet to be reliably quantified. Poor quality pastures, marked seasonal rainfall and low animal productivity are characteristic of northern Australia, but are also associated with high methane ($CH_4$) emissions intensity/unit animal product.

Northern subtropical and tropical regions account for 54.5% of the national beef cattle herd. The smallest unit of measure to characterise livestock greenhouse gas (GHG) emissions across land and pasture types, bio-agronomic regions and or seasons may be at the herd scale. An on farm methodology is required to generate reliable baseline emission data and to assess the effect of mitigation activities at the herd scale. There are no suitable methods for measuring emissions for the northern beef herd, yet measurement is a critical component for benchmarking emissions form existing beef production systems.

This report provides detail on two additional campaigns conducted in 2011 and 2012 as part of the extension to the original project BCCH-1004 “Mitigation of methane emissions from the northern beef herd’.

Calculated daily methane emissions (g $CH_4$/d) for 12 valid measurement periods (11 to 22 August 2011) obtained at Kidman Springs for Brahman and Brahman x Senepol cross heifers (mean ± sem liveweight 316 ± 4.5 kg) ranged from 65 ± 18.4 g/d to 257 ± 25.8 g/d. Data obtained at Brunette Downs (27/04/2012 to 14/05/2012) on the Barkly Tablelands for commercial composite heifers (mean ± sem liveweight 287 ± 6.2 kg) grazing an *Astrebla* sp. dominated sward has yet to be processed. An additional campaign is proposed for August 20122 on Hamersley Station, WA and will add further emission data for benchmarking heterogeneous grazing systems across northern Australia.

Measurement opportunities that complement normal animal behaviour will be crucial in ensuring a low input methodology for extensive grazing environments. Further development of equipment rather than the methodology is required to have this technology more widely adopted by the industry. Developing a system that interfaces with current technology such as electronic identification systems (EIDs) to identify individual animals and source intensity (number of animals measured and liveweight data) will be beneficial and support long term measurements.

# Contents

# 1. Background

Australia's northern rangelands are dominated by beef production and extensive grazing systems. Across these regions pastures are large, often > 120 $km^2$ (Hunt *et al*., 2007), and are dominated by C4 grasses, which generally have lower nutritional value than temperate grasses (Wilson, 1994). Poor soils, marked seasonal rainfall and a wide range of native and introduced grasses, legumes and forbs contributes to marked heterogeneity in between grazing systems.

Methane from farmed livestock accounts for ~10.7 % ($CO_2$-e) of Australia's total Greenhouse Gas (GHG) emissions (AGEIS, 2008) of which almost 95% originate from enteric sources. Factors affecting $CH_4$ production are poorly understood for Australia's northern beef production systems (Charmley *et al*., 2008). Current estimates are derived from Intergovernmental Panel of Climate Change (IPCC, 2006) methodologies or predictive algorithms, based on animal and dietary factors, using large data sets from dairy and beef cattle (Ellis *et al*., 2007, Yan *et al*., 2009).

Emissions from beef production systems characteristic of northern Australia are considered to be higher than cattle grazing improved pastures in temperate regions and there is a positive relationship between enteric methane production and DM intake (Kurihara *et al*., 1999, Hunter 2007). Beef cattle grazing rangelands of widely varying quality can be assumed to produce up to 60 kg $CH_4$/hd/year, or approximately 164 g/d (Tier I; IPCC 2006), but this value is applied to cows, bulls and young animals regardless of seasonal variability and is used in national GHG inventories. Emission rates between classes of livestock are apparent and similarly diet has a significant effect; Hunter (2007) reports methane production by Brahman crossbred steers to range from 94.5 to 215 g/d for Angleton or Rhodes grass diets, respectively. Consequently, $CH_4$ measurements from the northern herd and for specific production systems are yet to be reliably quantified. National inventories require accurate $CH_4$ emission measurements from whole farm systems (McGinn *et al*., 2008) based on geography, management (including mitigation strategies) and seasonal influences. An indirect micrometeorological methodology based on inverse dispersion (Flesch *et al.,* 2005) has been used across a number of grazing systems to determine emission signatures for different pastures and livestock typical of northern beef production systems.

# 2. Project Objectives

This report details the results from two campaigns conducted in the Northern Territory to obtain emission data from Brahman cross and composite cattle.

# 3. Methodology

## 3.1 Application of laser technique to large paddocks; study sites

*3.1.1 Kidman Springs Research Station, Northern Territory*

One field study was conducted at the Northern Territory Government Department of Resources Kidman Springs Research Station (lat -16.116° S; lon 130.956° E) in August 2011. The average annual minimum and maximum temperatures are 20.2 °C, and 34.9 °C, respectively. This region has a hot, seasonally dry monsoonal climate. Average annual rainfall is 680 mm, with most rain falling between December and March. Methane emissions from animals grazing an open woodland pasture of *Bauhinia* sp. dominated by Native couch (*Brachyachne* sp.), Golden Beardgrass (*Chrysopogon fallax*) and Mitchell grass (*Astrebla* sp.) were measured using an indirect open-path spectroscopic technique/ bLS dispersion model methodology only.

*3.1.2 Australian Agricultural Company Ltd. Brunette Downs, Northern Territory*

One field study was conducted at AACo Brunette Downs (lat -18.638° S; lon 135.946° E), as representative of the land systems associated with the Barkly Tablelands. The average annual minimum and maximum temperatures at the site are 18.7 °C and 33.4 °C, respectively. Average annual rainfall (1957-2012) is 420.6 mm with 858 mm recorded for 2011. Methane emissions from animals grazing a sward dominated by Hoop and Barley Mitchell (*Astrebla elymoides* and *A. pectinata*, respectively) with some Flinders grass (*Iseilema* spp.) were measured using an indirect open-path spectroscopic technique/ bLs dispersion model methodology only.

## 3.2 Animals and grazing management

The experimental protocol complied with the Australian Code of Practice for the care and use of Animals for Scientific Purposes (NHMRC, 2004) and was approved by the organisational Animal Experimentation and Ethics Committee (RH259/09 and A4/2010). Table 1 summarises descriptors for animals and pastures at each study site.

3.2.1 *Kidman Springs Research Station, Northern Territory*

Seventy six Brahman x Senepol cross heifers, mean ± sem LW of 317 ± 4.5 kg, continuously grazed a 5.0 $km^2$ native pasture consisting of open woodland of *Bauhinia* sp. with an understorey of Native couch (*Brachyachne* convergens), Golden Beardgrass (*Chrysopogon fallax*) and occasional Mitchell grass (*Astrebla* sp.) patch. Estimated available biomass was 3005 kg DM/ha.

*3.2.3 AACo Brunette Downs, Northern Territory*

Seventy AACo Composite heifers (Senepol x Charolais x Santa Gertrudis) mean ± sem LW of 287 ± 6.2 kg, continuously grazed an unimproved pasture (14.0 $km^2$) dominated by Hoop and Barley Mitchell grass (*Astrebla elymoides* and *A. pectinata*, respectively) with some Flinders grass (*Iseilema* spp.) from 02 April 2012. Samples of available pasture, were collected along three transects radiating from the water point. Available biomass (kg DM/ha), for the duration of the measurement period has yet to be determined.

Table 1. Study site descriptors for pasture and animals for $CH_4$ measurement campaigns in Queensland and Northern Territory.

| Site | Pasture | | | Animals | | |
|---|---|---|---|---|---|---|
| | Size (ha) | Dominant species | Available biomass (kg DM/ha) | *n* | Liveweight (kg)[§] | Stocking rate (AE/ha)[ll] |
| Kidman Springs Research Station | 500 | *B. convergens, C. fallax* | 3005 | *76* | 317 ± 4.5 | 0.11 |
| AACo Brunette Downs | 1400 | *A. elymoides, A pectinata, Iseilema* spp. | TBD | *70* | 287 ± 6.2 | 0.03 |

[§]mean ± sem, [ll] AE Adult equivalent ~ 450kg steer, TBD to be determined

## 3.3 Methane measurements and data processing

*3.3.1. Methane measurements using open-path lasers; field scale studies*

Methane emissions from each group of cattle for each site was measured for approximately 5 h per day for up to 28 d using open-path lasers (Fig 1a, 1b). Recording interval for line-averaged $CH_4$ mixing ratio (ppmv) for all paths was every second for 55 s. Animals were confined, immediately after morning grazing to a known area, associated with the only water point in the study paddock.


Fig. 1 Animals involved in methane flux measurements at Kidman Springs NT were confined at a water point after morning grazing for up to five hours.

This confinement assumes uniform distribution within the area and surface-source assumptions are used in a bLS dispersion model to derive methane flux. The surrounding area at each site was flat and considered to present no major obstacles to wind.

Two OPL were used to measure line averaged methane mixing ratio for each path; one set upwind to measure the background methane mixing ratio and another mounted on a scanner measured line averaged methane mixing ratios from the source area along two perpendicular paths.

Before and after each campaign, with the absence of animals, the $CH_4$ mixing ratio was recorded for each OPL unit operating along independent, but parallel laser paths. This allowed for evaluation of systematic errors between the two units during each measurement periods.

Methane mixing ratios from each laser for each campaign was averaged over 10 min periods. Laser return light levels were also checked throughout each campaign to ensure values between 3000 and 11,000 (no units). This range is recommended by the laser manufacturer and associated $CH_4$ concentration readings can be considered reliable.

At each site a micrometeorological mast was located upwind and adjacent to each source area. The mast was fitted with a three-dimensional sonic anemometer (CSAT3, Campbell Scientific Inc, Logan, UT, USA) mounted at a height of 2.4 m which sampled wind components at 10 Hz. A barometric pressure sensor (CS106, PTB 110, Campbell Scientific Inc.) and temperature humidity sensors (HMP45C, Campbell Scientific Inc.), a cup anemometer and wind sentry were also mounted on the mast (Fig 6). Micrometeorological data including wind speed, direction and wind component variance were recorded at 10 Hz, averaged over 10 min intervals using a data logger (CR1000, Campbell Scientific Inc.) and extracted daily onto a laptop computer.


Fig. 2 Animals involved in methane flux measurements at AACo Brunette Downs NT were confined in a circular compound centred on a water point for up to five hours immediately after morning grazing.

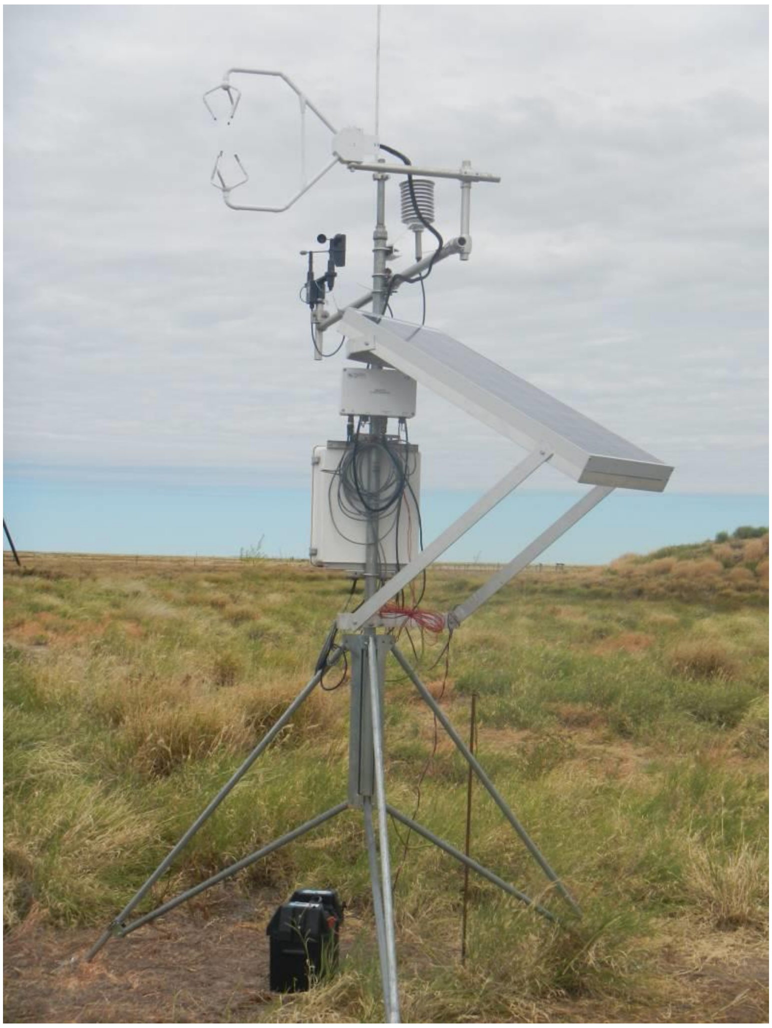


Fig. 3 A micrometeorological mast equipped with a three-dimensional sonic anemometer, cup anemometer, wind sentry and temperature/humidity sensors was located upwind and adjacent to the source area defined for the AACo Brunette Downs campaign.

*3.3.2. Data processing*

Laser, sonic anemometer and micrometeorological data were merged and managed with SAS (1999) statistical software as described by Tomkins *et al.,* (2011) before using bLS modelling in WindTrax (WindTrax dispersion model V.2.0.8.3,Thunder Beach Scientific, Halifax, NS, Canada). The placement of source boundaries and sensors are also required in this model and were determined using a handheld dGPS unit.

The filtering criteria used throughout the studies for pre- and post-simulation (using WindTrax) were similar to that described by Flesch *et al.,* (2007) and McGinn *et al*., (2009) and included; 3000 < light level <11000, surface roughness (Z; m) 0.0000001 < $Z_0$< 0.9, atmospheric stability (L; m), absolute <2, friction velocity (u*; m/s) >0.15 m/s, where < 0.15 indicates calm conditions and unsteady wind directions, and fraction covered by touchdown (FRAC) > 10 % with $\Delta$ $CH_4$ > 10 ppb. In addition, if the wind direction relative to either open path varied by more than 15° then this data was considered unreliable and excluded from modelling using WindTrax. The $CH_4$ mixing ratio for each path was converted to an absolute concentration based on air pressure and temperature. Mean animal methane emission values were then calculated (g hd/d) for each study site based on the total number of 10 min average data that satisfied the filtering criterion as described.

# 4. Results

## 4.1 Field (commercial) scale evaluation of laser and sensor methodology measurement technology for northern production systems

Methane emission estimates for 139 heifers, grazing northern pastures at two sites in the Northern Territory have been conducted over a total of 33 days using an indirect micrometeorological/ bLS dispersion model. At the time of writing, only the data from Kidman Springs Research Station has been analysed and these are shown in Table 2.

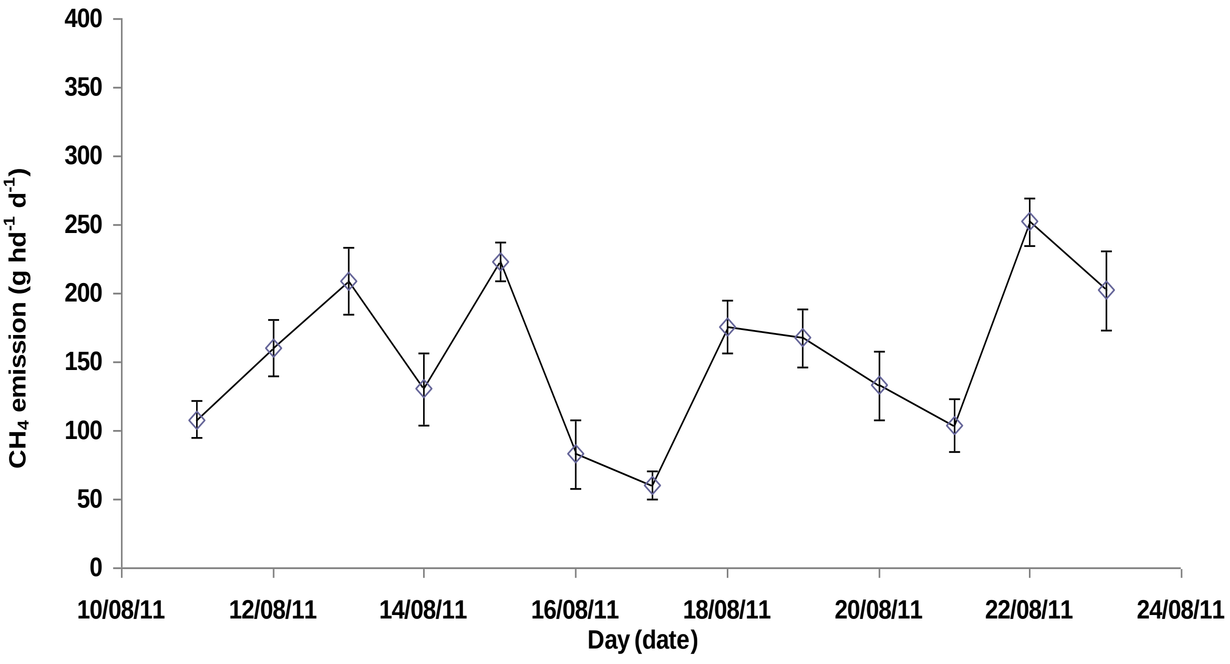



Fig. 4 Mean (± sem) methane emissions calculated on a daily basis for heifers grazing a *Brachyachne* sp. and *Chrysopogon sp.* dominated pasture at Kidman Springs Research Station.

Table 2. Study dates, days of data collection, livestock class and methane emissions (mean ± sem) for two field campaigns in NT using an OPL and bLS modelling methodology

| | | | | Methane emissions | |
|---|---|---|---|---|---|
| | Start-finish (dates) | Data Collected (d)* | Livestock measured | g/hd/d† | g/kg LW‡ |
| Kidman Springs Research Station | 10 Aug -23 Aug | 13 (12) | Heifers | 162 ± 4.3 | 0.5 |
| AACo Brunette Downs | 27 April – 15 May | 18 (-) | Heifers | - | - |

*Number of days used in bLS dispersion model to derive mean methane emissions. Values in parenthesis are actual days used to report emission data, †extrapolation based on 4-5h measurements, ‡$CH_4$ emission/mean live weight (LW; kg).

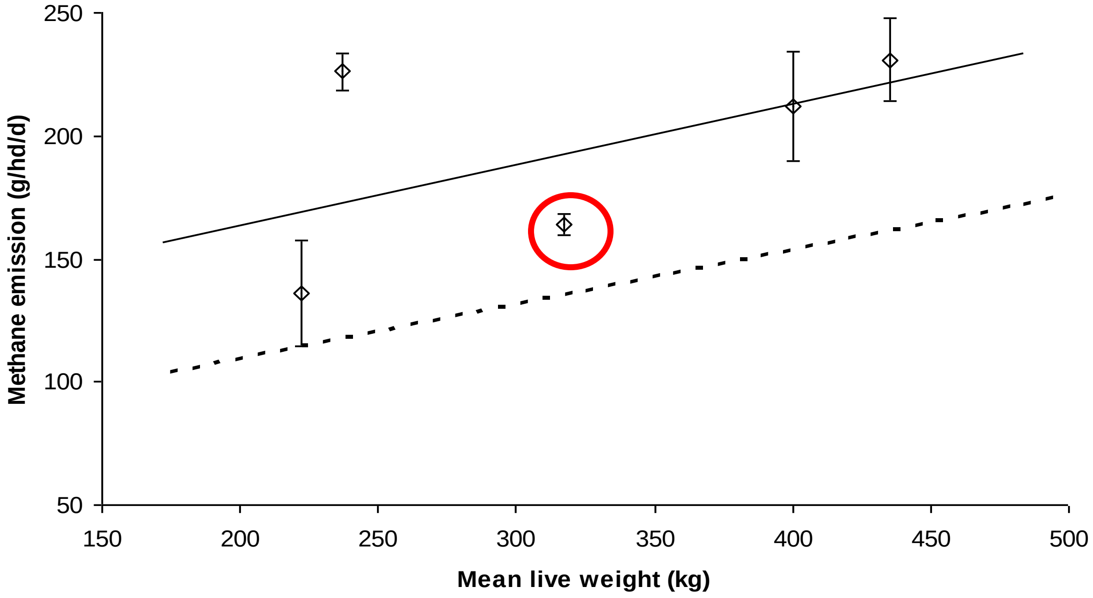


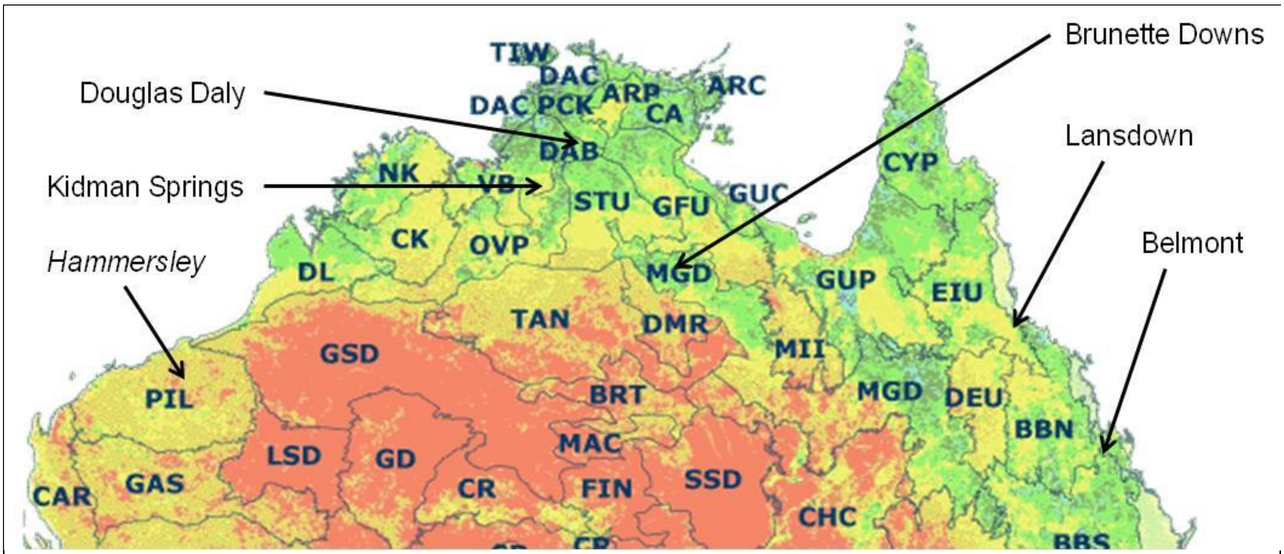

Fig. 5 Relationship between live weight (LW) and total mean (± sem) methane emission (◊) for all sites (BCCH1004/1063) using OPL methodology ($CH_4$ (g/hd/d) = 0.24(LW)+115.1, $R^2$=0.31). Additional line (---) indicates relationship described by Yan *et al.*, (2009). Kidman Springs data circled.

# 5. Discussion & conclusion

## 5.1 Summary of the campaigns

This study complements other campaigns conducted across Queensland and Northern Territory to date using an indirect micrometeorological/bLS dispersion method to estimate methane emissions from beef cattle grazing native and improved pastures. Approximate location of these sites is shown in Figure 6, together with associated bioregions. Climatic, soils and vegetation data are taken directly from http://www.anra.gov.au/topics/rangelands/overview/index.html.

The five sites represent an incomplete cross section of the grazed rangelands of northern Australia. The bioregions they represent account for approximately 20% of cattle numbers in northern Australia. A proposed deployment at Hamersley Station in the Pilbara WA will be conducted after the scheduled termination of the extension (BCCH1063) in an effort to capture emission data from cattle at sites representative of additional bioregions.




Selected bioregions:

| | | | |
|---|---|---|---|
| BBN | Brigalow Belt North | MGD | Mitchell Grass Downs |
| DAB | Daly Basin | PIL | Pilbara |
| EIU | Einasleigh Uplands | VB | Victoria Bonaparte |

Figure 6. Approximate location of study areas and associated bioregion.

Brigalow Belt North (Belmont Research Station)

The bioregion experiences a semi-arid to tropical climate with dry winters. Rainfall decreases from north to south and with the distance from the coast. The annual average rainfall ranges from 400mm in the south-west to 1200mm on the coast. Rainfall is more intense in the summer and can occur in association with the tropical cyclones. Temperatures in the Clermont area range from 22° C to 38° C in the summer and from 8° C to 22° C in winter.

The vegetation of the Brigalow Belt North bioregion consists of woodlands of ironbarks (*Eucalyptus melanophloia, Eucalyptus crebra*), poplar box (*Eucalyptus populnea*) and Brown's box (*Eucalyptus brownii*) with forests of brigalow (*Acacia harpophylla*), blackwood (*Acacia argyrodendron*) and gidgee (*Acacia cambagei*).

Daly Basin (Douglas Daly Research Farm)

The Daly Basin has a tropical monsoonal climate with distinct wet and dry seasons and high temperatures throughout the year. Almost all rain falls in the wet season from November to March. Rainfall decreases from 1400mm in the north of the region to 950mm in the south. Katherine, in the south of the bioregion has a mean annual rainfall of 972mm. Temperature ranges increase towards the south of the bioregion. Katherine has a summer range between 24? C - 38? C and a winter range from 13? C-29? C.

The bioregion is dominated by Eucalypt woodlands with tussock grass understorey. There are also small areas of monsoon forest and billabong fringing vegetation (Kerle, 1996).

Einasleigh Uplands (Lansdown Research Station)

Lansdown Research Station lies just to the east of this Bioregion and strictly speaking lies outside the rangelands. The bioregion has a tropical climate with high rainfall summers and drier winters. The mean summer temperatures range from 20.1° C - 36.5° C. The mean winter temperature for the bioregion ranges from 11° C - 25.4° C. Extensive rainfall in the summer is associated with the passage of tropical cyclones across the coast. The bioregion receives an average annual rainfall between 400mm and 1000mm. The average annual rainfall decreases from north to south and with distance from the coast.

The soils of the bioregion are predominantly shallow soils and loamy lithosols. Areas of alluvial sands and clays occur in the west of the bioregion. Red-black soils developed on the basalt occur in the south. The undulating hills and ranges of the bioregion are dominated by woodlands of georgetown box (*Eucalyptus microneura*) with areas of narrow-leaved ironbark (*Eucalyptus crebra*) and broad-leaved ironbark (*Eucalyptus shirleyi*). Small woodland areas of Reid River box (*Eucalyptus brownii*), Molloy red box (*Eucalyptus leptophleba*) and Cullen's ironbark (*Eucalyptus cullenii*) occur on the surrounding slopes and lower areas. The basalt soil in the central and southern areas of the bioregion support ironbark (*Eucalyptus* spp.) woodlands and mountain coolibah (*E. orgadophila*) open woodlands. The wetter climate in the east supports open forests including ironbark (*Eucalyptus drepanophylla*) and lemon-scented gum (*Corymbia citriodora*). River red gums (*Eucalyptus camaldulensis*) occur along large water courses.

Victoria-Bonaparte (Kidman Springs Research Station)

The climate is semi arid with a dry, warm monsoonal climate. There is a four to five month rainy season from November to March, in which up to 90% of the rain falls. Rainfall varies from Kunanurra in the west where the mean annual rainfall is 789mm to Daly River in the northeast with a mean annual rainfall of 1386mm. Skeletal sandy soils occur on the rugged plateau but some of the major watercourses have broad, flat-bottomed alluvial valleys. On the coastal lowlands there are alluvial red earth and black soil plains.  The region includes dissected plateaux and alluvial plains, and a number of river basins including the lower reaches of the Ord River. Eucalypt woodlands are the dominant vegetation community. Other communities include paperbarks along watercourses, and coastal vegetation such as samphire on tidal flats, mangroves and pockets of monsoon vine thickets.

Pilbara (Hamersley Station)

The Pilbara lies south of the area normally penetrated by the north-west monsoon in the summer months, and is only occasionally influenced by weather systems of the westerly circulation in the winter months. Rainfall is low and variable. Average rainfall over the area ranges from about 200mm to 350mm, although rainfall may vary widely from the average from year to year. Most of this rain falls between December and March, with a pronounced dry period between August and November. The average yearly evaporation (about 2,500mm) exceeds average yearly rainfall. This is consistent throughout the year

The drainage lines on the northern flanks of the Hamersley are parallel, short, and have steep gradients, which terminate in large outwash fans. Further south on the plateau, the patterns are dendritic with frequently interrupted drainage lines. The plains on the plateau act as internal drainage basins, holding large volumes of water after cyclonic rains. Cyclones cause major flows in a number of rivers almost every year between December and April. The rivers are generally dry between August and November, with only occasional short-lived flows. Localised river flows may be sustained by small spring discharges from aquifers intersected by river channels.

Eucalypts are one of the most conspicuous plant groups across the Pilbara region. Arid grasses and shrubs are also characteristic of the region. Due to the variable rainfall, grasses are adapted to long periods of drought. The coastal strip consists of grasslands and low open woodlands. High shrub lands and low woodlands occur along major river valleys and southern flanks of the Hamersley Range.

Mitchell Grass Downs (Brunette Downs)

The Mitchell Grass Downs bioregion forms a band of 335,100 $km^2$ spanning across the central west of Queensland and Northern Territory. The climate is controlled largely by high pressure cells travelling east, except during the summer months when the north-west monsoons impact on the northern parts of the region. Rainfall across the region decreases from north to south and from east to west. The north receives 85% of rain from December to February. The south receives less than 70% of annual rain in summer.

The entire area is gently undulating and dominated by largely treeless plains of Mitchell grasses with some occasional ridges and rivers. The bioregion is dominated by Mitchell grass (*Astrebla* spp.) tussock grasslands on rolling plains with some low tree over storey of gidgee and other species although the area is generally characterised by a lack of tree and shrub cover.

During the warmer part of the year, there is a hot low-pressure system over the region resulting in clear skies and very high temperatures from November to February, with average maximum temperatures often over 40° C. During the winter months the average maximum temperature falls to about 25° C. Temperature ranges are generally greater in inland areas away from the moderating effects on onshore winds common in coastal areas.

## 5.2. Overall conclusions from the results.

These campaigns, conducted over a period of 3 years (and still ongoing) represent the most comprehensive measurement of methane emissions from cattle under northern Australian grazing conditions. With each campaign lasting up to a month in extreme conditions, they represent a significant investment in labour, capital and operating expenses. Nevertheless, they represent only a fraction of the diversity in climate and land type across the north. Further there has not been any attempt to evaluate temporal changes in emissions within any one study site. Nevertheless, the data do offer a critical insight into the magnitude and variability of methane emissions from grazing cattle in northern Australia.

The studies also represent a significant improvement and refinement in methodology. This technique had never been used under these conditions previously and completely new protocols had to be developed, often in extreme and challenging situations.

Several key conclusions can be made from the study:

1. The method provides data that is credible. Validation with other methodologies (e.g. open circuit calorimeters and model estimates) demonstrates that the results are within the expected range. The standard errors have consistently declined as the technique was developed over successive deployments.
2. Methane emissions in the paddock appear to be higher (approximatey 10 to 20% higher) that would be expected based on intensive chamber studies (Kennedy and Charmley 2012). This is most probably attributed to higher voluntary intakes under commercial grazing conditions. The need for reliable method of estimating intake of grazing cattle in the north is the single most serious knowledge gap that currently exists.
3. Variation between sites exists and while some of this can be attributed to the size and class of animal it is impossible to determine other contributing factors.

# 6. Appendices

## 6.1 Financial report

End of month financial reporting is currently not available. Whole of project financial report will now include April 2012, but will not be available until end of May 2012.

## 6.2 Summary report, Web Abstract, draft and published scientific papers

Summary Report

Methane ($CH_4$) emissions from cattle grazing pastures characteristic of northern Australia are yet to be reliably quantified. Poor quality pastures, marked seasonal rainfall and low animal productivity are characteristic of northern Australia, but are also associated with high $CH_4$ emissions intensity/unit animal product. The smallest unit of measure to characterise livestock greenhouse gas emissions may be at the herd scale. There are no suitable methods for measuring emissions for the northern beef herd, yet measurement is a critical component in mitigation and a carbon farming framework. This project was conducted to address this deficiency. Calculated daily methane emissions (g $CH_4$/d) for 12 valid measurement periods (11 to 22 August 2011) obtained at Kidman Springs for Brahman and Brahman x Senepol cross heifers (mean ± sem liveweight 316 ± 4.5 kg) ranged from 65 ± 18.4 g/d to 257 ± 25.8 g/d. Data obtained at Brunette Downs (27/04/2012 to 14/05/2012) on the Barkly Tablelands for commercial composite heifers (mean ± sem liveweight 287 ± 6.2 kg) grazing an *Astrebla* sp. dominated sward has yet to be processed. An additional campaign is proposed for August 20122 on Hamersley Station, WA and will add further emission data for benchmarking heterogeneous grazing systems across northern Australia.

Web abstract

Methane ($CH_4$) emissions associated with beef production systems in northern Australia are yet to be quantified. Methodologies are available to measure individual emissions, but application in extensive grazing environments is difficult.

A methodology for estimating herd scale emissions using open-path lasers and a dispersion model is described. Data sets have been generated from two properties in the Northern Territory. Calculated daily methane emissions (g $CH_4$/d) for Brahman and Brahman x Senepol cross heifers (mean ± sem liveweight 316 ± 4.5 kg) grazing native pastures characteristic of the Victoria Bonaparte bioregion ranged from 65 ± 18.4 g/d to 257 ± 25.8 g/d. Data obtained on the Barkly Tablelands for commercial composite heifers (mean ± sem liveweight 287 ± 6.2 kg) grazing an *Astrebla* sp. dominated sward has yet to be processed. An additional campaign is proposed for August 20122 in the Pilbara WA and will add further emission data for benchmarking heterogeneous grazing systems across northern Australia.

Draft and published scientific papers

Material from the final reports submitted for BCCH-1004 and 1063 will be used for a manuscript to be included in published papers for Greenhouse Gases and Animal Agriculture 2013.

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