

*Full length paper*

**EVALUATION OF A CAPTURE-NEUTER-VACCINATE-RELEASE (CNVR) PROGRAM:  
INTERVENTION TO CONTROL THE DOG POPULATION AND RABIES IN BHUTAN**

**KARMA RINZIN<sup>\*1</sup>, ID ROBERTSON<sup>2</sup>, YESHEY TSHERING<sup>1</sup>, N DAHAL<sup>1</sup> and RK PANDEY<sup>2</sup>**

<sup>1</sup>Department of Livestock, Ministry of Agriculture and Forests, P.O. Box 155, Thimphu, Bhutan

<sup>\*</sup>College of Veterinary Medicine, School of Veterinary and Life Sciences, Murdoch University, 90 South Street Murdoch, Perth, WA, Australia 6150

\* Author for correspondence: rinzink@gmail.com

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**ABSTRACT:** Dog population survey was undertaken in the months of January and February 2012 in the main towns of six selected districts to monitor and evaluate the effectiveness and progress of the CNVR programme in Bhutan. The field survey included counting male and female dogs with and without ear notches, lactating females and puppies. The study also assessed the body and skin condition of the neutered and un-neutered free-roaming dogs. The population survey in the field indicated an overall CNVR coverage of 52% ranging from 32% in Bumthang to 72% in Samdrup Jongkhar. Approximately 8% of the adult females were seen lactating and 11% of the dogs were puppies in the survey areas. The body condition of neutered dogs was found significantly better than entire dogs with 36% of un-notched dogs being categorised as thin to very thin, compared with 26% of notched dogs. There was no significant difference in the proportion of dogs with skin problems in the notched (19%) and un-notched dogs (23%). Based on the findings of this study, it is recommended to carry out further rounds of CNVR campaigns, and institute continuous follow-up programmes in all districts targeting females, and extending the CNVR campaign to adjoining Indian towns to improve animal welfare and to effectively control rabies. The indicator count should be repeated along the fixed routes at least twice a year after the six weeks period of the peak whelping seasons i.e., July and January to continuously monitor the CNVR programme.

**Keywords:** Animal welfare; capture-neuter-vaccinate-release; dogs; free-roaming; rabies.

## 1. INTRODUCTION

Dogs were the first species to be domesticated sometimes 14000 to 15000 years ago (Clutton-Brock 1995; Savolainen 2007). Since then people have been intimately involved in domesticating wild dogs for use as pets and companions, for hunting, as guard dogs, draught animals, or for commercial purposes (Coppinger and Schneider 1995; Stafford 2006). Currently, dogs are used for specialized works including the detection of illegal goods, tracking criminals, search and rescue work and in sporting activities (Murray and Penridge 1992; Stafford 2006). Dogs play an important role in society, enhancing the psychological and physiological well-being of many people (Blackshaw 1996; DiSalvo et al. 2005). Paul & Serpell (1996) suggested association of keeping pets with a higher level of self-esteem in children.

Although many dogs are confined and have owners within communities, there are others that roam freely in the neighborhood, which are designated as free-roaming dogs. A free-roaming dog population can

rapidly increase in size due to a high reproductive potential resulting in a hazard to animals, humans and the environment. A diverse range of zoonotic infections, including parasitic, bacterial, viral, protozoal and fungal diseases, can be transmitted from dogs to humans (Robertson and Thompson 2002; Schlundt et al. 2004). The majority of cases of rabies in humans are acquired from street dogs (Childs et al. 1997; Cleaveland et al. 2003; Hemachudha 2005; Kayali et al. 2003; Kitala et al. 2001a; Matter et al. 2000b; Zinsstag et al. 2011) resulting in more than 55,000 deaths per year, mainly in Asia and Africa (WHO 1987; 1988, 1996, 2004; WHO/WSPA 1990). The impact of free-roaming dogs on the spread of rabies and infectious diseases to wildlife is also of significant concern (Butler et al. 2003; Cleaveland Sarah et al. 2007; Manor and Saltz 2003). In addition, free-roaming dogs cause many other problems through dog bites, by fouling public places with excreta, noise pollution, causing road traffic accidents and putting pressure on the road users (Feldman et al. 2004; Keuster et al. 2005;

Marsh et al. 2004; Overall and Love 2001; Robinson 1974; Tenzin et al. 2011c).

Rabies is endemic in the southern districts of Bhutan sharing borders with India. Dogs are the main reservoir of rabies and are responsible for spill-over infection to other domestic species, especially cattle (Rinzin et al. 2006; Tenzin et al. 2011a; Tenzin et al. 2011b; Tenzin et al. 2010). A survey conducted in three hospital catchment areas reported an annual dog bite incidence in humans of 869.8, 293.8 and 284.8 per 100,000 population in Gelephu, Phuentsholing and Thimphu, respectively (Tenzin et al. 2011c). The presence of large numbers of free-roaming dogs and the associated barking at night also has an adverse effect on tourism (TCB 2010 2011), which is an important industry in Bhutan.

Several initiatives to control the free-roaming dog population have been made by international organizations (OIE, FAO, WHO), animal welfare organizations (WSPA, HSI) and national authorities (ICAMC 2007; OIE 2010; WHO/WSPA 1990). Mass culling of dogs has historically been used in many developing countries to control the dog population. However, there is no direct evidence that removal of dogs alone has a significant impact on the dog population density or the spread of rabies (OIE 2010). Animal birth control (ABC) through capture-neuter-vaccinate-release (CNVR) programme is an alternative means of population control pursued in many developing countries, including Bhutan. The World Health Organization (WHO) Expert Committee on Rabies in 2004 recommended that at least 70% vaccination coverage was required to break the rabies cycle and at least 70% of dogs sterilized to maintain a stable dog population (WHO 2004).

The coverage of past CNVR campaigns was inadequate to break the rabies cycle and stabilize the dog population (NCAH 2006) in Bhutan. Thus, the Department of Livestock, Royal Government of Bhutan (RGOB) in collaboration with the Humane Society International (HSI), USA commenced a CNVR programme from February 2009 in Bhutan. As of January 2012, a total of 32,276 dogs was neutered, vaccinated and released back to their place of origin in 18 of the 20 districts in Bhutan.

Following a CNVR programme a field survey was recommended to assess its success (Childs et al. 1997; Hiby 2005; Hiby et al. 2011; Kayali et al. 2003; Kitala et al. 2001a; Matter et al. 2000a; Reece and Chawla 2006). Therefore, the study was undertaken to monitor and evaluate the effectiveness and progress of the ongoing RGOB-HSI project on dog population management and rabies control.

## 2. MATERIALS AND METHODS

### 2.1 CNVR programme

The CNVR programme focused on sterilization and vaccination of captured stray and owned dogs. Sexually intact dogs older than 4 months of age were humanely

captured by trained dog catchers using nets. The owned dogs were either brought to the clinics by their owners or collected from a designated place. The dogs brought to the CNVR clinics were administered xylazine (1mg/kg) and atropine sulphate (0.05 to 1mg/kg) as pre-anesthetic medications and anesthetized using intramuscular ketamine at 15mg/kg body weight. All dogs were given ivermectin (1% w/v) injectable for parasite control. Benzathine penicillin (11000 to 22000 IU/kg) and meloxicam (0.2 mg/kg), were administered to prevent secondary bacterial infection and to relieve pain, respectively. Male dogs were castrated through a single prescrotal incision, and female dogs were sterilized by complete ovariohysterectomy through a mid-ventral abdominal incision. The neutered dogs were ear notched while anesthetized using a cautery device for identification. After surgery the dogs were observed in an enclosure and once fully recovered from anesthesia were either returned to their owners or the place where they were captured. All procedures performed on the dogs were approved by the Murdoch University Animal Ethics Committee. All the animal handling and surgical procedures were performed by Veterinarians and Para-veterinarians trained on the standard HSI protocol for the CNVR programme.

### 2.2 Population surveys

A survey to monitor and evaluate the CNVR programme was undertaken in January and February 2012 in the main towns of six districts (Bumthang, Samtse, Samdrup Jongkha (SJ), Tashigang, Thimphu and Tsirang). These districts were distributed in different agro-ecological zones representing the different regions of Bhutan. Before the surveys were conducted the enumerators were trained on dog population counting techniques and scoring of body and skin conditions. The process included counting male and female dogs with and without ear notches, lactating females and puppies. A similar count was undertaken in the border Indian towns within a 3 km radius of SJ town, as CNVR had also been performed in these places.

The health condition of both neutered and entire dogs was scored in Thimphu through visual assessment on a scale of 1 to 5 (1 = very thin, 2 = thin, 3 = ideal, 4 = stout and 5 = overweight). The skin condition (mange score) was assessed for each dog using a four point scale (0 = normal, 1 = mild, 2 = moderate, 3 = severe). Dogs were assessed in the street without physical contact to maximize the examiners safety and to minimize stress to the dogs.

### 2.3 Statistical analysis

Descriptive analyses of the proportion of neutered and vaccinated dogs, lactating female among adult female dogs and puppies were undertaken and expressed as a percentage with 95% confidence intervals for each district town. The Chi-square test of independence was used to compare the difference in proportions of neutered dogs (notched dogs) between gender and

districts. The proportion of puppies of all dogs sighted and lactating females of adult females were also compared using chi-square tests. To determine if there was an association between the CNVR programme and various health indices, the proportion of dogs in the different assessment groups were also compared using chi-square tests. A Pearson's product-moment correlation coefficient was computed to assess the relationship between the proportion of dogs covered under CNVR and the proportion of lactating bitches and puppies. Statistical significance was assessed at the 5% level. All analyses were carried out using the statistical software package PASW Statistics v18 (SPSS Inc., Chicago, IL, USA).

### 3. RESULTS

#### 3.1 CNVR programme

A total of 32,276 dogs, of which 15,217 (47.2; 95% CI 46.60, 47.69%) were females had been processed through the CNVR programme by January 2012. More than half (52.4%; 95% CI 51.89, 52.98) of the dogs presented to the CNVR clinic were ownerless. The team came across 526 (1.6%) cases of transmissible venereal tumour (TVT), 1,112 (7.3%) cases of pyometra and 1,607 (5.0%) cases of mange during the CNVR programme. A total of 1,263 bitches (8.1%; 95% CI 7.65, 8.51%) brought to the CNVR clinic were pregnant.

#### 3.2 Population surveys

A total of 2,886 dogs (2,581 adults and 305 puppies) were sighted during the survey period in the main towns of six districts. All dogs found in public places were classified as free-roaming dogs. For this study adult dogs were classified as those older than approximately four months which were eligible for sterilization. Of the 2,581 adults the neuter status of 70 dogs was not known and 71 dogs had been sterilized in previous anti-rabies campaigns but had not been ear notched. Consequently, the final analyses were undertaken on 2,440 adult dogs. Just over half (52%; 95% CI 50.3, 54.2%) of the adult dogs sighted had been processed through the CNVR program. Of these 56.1% were males and 43.9% females. There were no significant differences in the sterilization and vaccination coverage between male (53%) and female dogs (52%) ( $\chi^2 = 1.486$ ,  $df = 1$ ;  $p = 0.22$ ).

The proportions of the CNVR coverage in the different districts are presented in Table 1. The coverage was lowest in Bumthang (44/137, 32%) and highest in SJ (182/252, 72%). Overall, the coverage was significantly different between the districts ( $\chi^2 = 70.45$ ,  $df = 5$ ;  $p < 0.001$ ). There was no significant difference in the coverage in SJ town (107/139, 77%) compared with the adjacent border town in India (49/65, 75%) ( $\chi^2 = 0.06$ ,  $df = 1$ ;  $p = 0.803$ ).

In Table 2 data on sightings of lactating females and puppies are presented. A total of 91 (8.3%) lactating females and 305 (11.1%) puppies were

counted in the visited areas. The proportion of lactating females of all adult female dogs was significantly different between districts ( $\chi^2 = 11.95$ ,  $df = 5$ ;  $p = 0.035$ ) with the highest percentage in Bumthang (9/54, 16.7%) followed by Samtse (12/91, 13.2%) and Tsirang (10/108, 9.3%). Similarly, the proportion of puppies was significantly different between districts ( $\chi^2 = 38.73$ ,  $df = 5$ ;  $p < 0.001$ ) with the highest proportion in Tsirang (38/187, 20.3%) followed by Samtse (43/234, 18.4) and Bumthang (23/160, 14.4%). There was a negative correlation between the proportion of dogs covered under CNVR and the proportion of lactating bitches ( $r = -0.739$ ,  $n = 6$ ,  $p = 0.093$ ) and puppies ( $r = -0.606$ ,  $n = 6$ ;  $p = 0.202$ ).

In total 1,835 adult dogs (857 notched and 978 un-notched) from Thimphu were assessed for body and skin condition. Approximately two-thirds (61%; 95% CI 59.2 - 63.6) of the dogs had a body condition score of 3 which is considered an ideal body condition, 32% (95% CI 29.6 to 39.9) were thin to very thin (2 to 1) and only 7% (95% CI 5.8 to 8.1) were categorized as stout to overweight (4 to 5). Only 21% (95% CI 19.3 to 23.0) of the sighted dogs had skin problems (skin condition score 1 to 3).

The proportion of dogs in the five body condition scores for notched and un-notched dogs in Thimphu was assessed. Neutered dogs were found to be in significantly better body condition than entire dogs ( $\chi^2 = 27.39$ ,  $df = 4$ ,  $p < 0.001$ ) with 36% of un-notched dogs being categorised as thin to very thin compared with 26% of notched dogs. There was no significant difference in the proportion of dogs with skin problems in the notched (19%) and un-notched dogs (23%) ( $\chi^2 = 6.63$ ,  $df = 3$ ,  $p = 0.085$ ).

### 4. DISCUSSION

The counting of dogs with and without ear notches, lactating bitches and puppies in the selected towns of six districts was useful for determining the progress of the CNVR programme in Bhutan. The CNVR coverage varied from 32% in Bumthang to 73% in SJ (Table 1). This finding is consistent with studies conducted in other countries where the coverage differed widely between locations (Hiby et al. 2011; Kayali et al. 2003; Kitale et al. 2001a; Matter HC et al. 2000a). The coverage in the districts was highly dependent on when the CNVR was carried out, the number of CNVR programmes conducted in that particular area and the number of days spent in the area. Bumthang district had the lowest coverage as the first round of CNVR was completed in January 2010 and there had been no subsequent follow-up campaigns. In contrast, SJ had the highest coverage as the second round of CNVR program was already completed. The coverage in five out of six districts surveyed were lower than the WHO/WSPA recommended minimum vaccination and sterilization coverage of 70% to eliminate rabies in dogs and to stabilize the dog population, respectively

**Table 1:** Percentage of free-roaming dogs neutered and vaccinated in selected districts with 95% confidence intervals.

District	Notched dogs	Un-notched dogs	CNVR Coverage (95% CI)	Remarks
Bumthang	44	93	32.12 (24.9 - 40.3)	First round in October 2009 to Jan 2010
Samtse	100	91	52.36 (45.3 - 59.3)	First round in Feb to May 2011.
Samdrup Jongkhar	182	70	72.22 (66.4 - 77.4)	Second round completed in January 2012
Tashigang	55	38	59.14 (49.0 - 68.6)	First round in May to Aug 2011
Thimphu	825	793	50.99 (48.6 - 53.4)	Second round completed in November 2011
Tsirang	64	85	42.95 (35.3 - 51.0)	First round ongoing
Total	1270	1170	52.05 (50.1 - 54.0)	
CNVR programme in SJ town and adjoining Indian border towns within 3 km of the international border				
Bhutan side	107	32	77.0 (69.3 - 83.2)	Second round completed in January 2012
Indian side	49	16	75.4 (63.7 - 84.2)	Second round completed in January 2012

(Cleaveland et al. 2003; Coleman and Dye 1996; WHO 1987, 2004; WHO/WSPA 1990).

A large reduction in the street dog population was reported in two Indian cities following the implementation of Animal Birth Control (ABC) programme. Reece and Chawla (2006) reported a 28% reduction in the street dog population in Jaipur city following the ABC programme implemented between 1994 to 2002, as well as reduction of human rabies cases to zero in the campaign area when compared with a non-campaign area. Similarly a reduction in the street dog population in three of the five areas surveyed was reported in Jodhpur following the implementation of

ABC program between 2005 to 2007 (Totton et al. 2010). There may not be a sudden reduction of the street dog population seen after implementation of a CNVR programme in Bhutan owing to the longer lifespan of dogs in Bhutan. Moreover, the CNVR programme in Jaipur and Jodhpur were concentrated in one city over a long period of time unlike the Bhutan programme where the CNVR team was required to move from district to district. Therefore, the CNVR programme should be carried out in all districts until the population stabilization threshold is achieved.

With the existing composition of the CNVR team only three districts can be covered simultaneously at a

**Table 2:** Number and percentage of lactating bitches and puppies counted in the main towns of the six selected districts.

District	Total dogs	Matured Female	No. of Puppies	No. of Lactating	Puppies (%)	Lactating (%)
Bumthang	160	45	23	9	14.4	20.0
Tashigang	100	43	7	2	7.0	4.7
Tsirang	187	98	38	10	20.3	10.2
Samtse	234	79	43	12	18.4	15.2
SJ	274	101	22	7	8.0	6.9
Thimphu	1790	704	172	51	9.6	7.2
Overall	2745	1070	305	91	11.1	8.5
CNVR programme along Indo-Bhutan border (SJ, Bhutan and Daranga, Assam, India)						
Bhutan (SJ Town to Char kilo)	135	4	11	150	3.0	7.3
India (from Bhutan gate to Mela Bazaar)	65	1	6	72	1.5	8.3

given time. In order to have sustainable dog population control it is recommended to build a technical and staffing capacity in every district to carry out ABC programmes regularly, in addition to the existing CNVR team. Since rabies is endemic only in a few districts, annual dog rabies vaccination should be carried out in these high-risk areas, in addition to the ongoing CNVR programme.

In the current survey a higher number of male than female free-roaming dogs was found in all study areas. Similarly higher proportions of males have been observed in studies conducted in other developing countries (Acosta-Jamett et al. 2010; Brooks 1990; Butler and Bingham 2000; Kitala et al. 2001b). The CNVR coverage in male dogs was slightly higher than female dogs, although ideally a higher proportion of females should be neutered to have a greater impact on the dog population. The ABC programme for the street dog population in Jaipur in India covered only female dogs to maximize the impact of that programme (Reece and Chawla 2006; Reece et al. 2008).

In this study it was assumed that there was an equal probability of detecting a notched and un-notched dog during the field survey. However, dogs not caught by the CNVR team are likely to be more sensitive and the probability of missing those dogs by the enumerators during the field surveys was high, leading to overestimation of the number of dogs neutered in the CNVR programme.

Approximately 75% of observed dogs on the Indian side had been neutered and vaccinated (Table 1). The programme had been successful due to the active involvement of members of the Bhutan Indian Friendship Association (BIFA) and local leaders on both sides of the border (Dechen, K – Personal Communication).

It is recommended that CNVR be extended to other border towns of India in consultation with the local Indian authorities. This effort will create a buffer zone and significantly contribute towards the control of rabies in humans and other animals in both India and Bhutan. The number of lactating females and puppies seen following the CNVR programme was a good indicator of the success of the programme.

Similarly, it is anticipated that a successful campaign will result in a change in the age structure of the population with a greater proportion of adult dogs in areas where a CNVR programme had been conducted compared to those where the programme had not been implemented. The proportion of lactating females and puppies seen during the survey depended on when the first round of CNVR had been carried out, whether the team visited the area for the second time and the stage of the first and the second round of CNVR programme (Table 2). Bumthang had the highest proportion of lactating bitches as the last CNVR programme had been carried out from October 2009 to January 2010. The proportion of puppies was highest in Tsirang due to the fact that the first round of the CNVR was ongoing during the survey period. A similar study

conducted by Totton et al. (2010) in the Indian city of Jodhpur reported a higher proportion of adults in the population (80 to 96%) when compared with sub-adults (0-18%) and puppies (0-4%). Although there was a negative correlation between the proportion of dogs covered under CNVR and the proportion of lactating females and puppies, the correlation was not significant. This indicates that the current CNVR coverage is not sufficient to stabilize the free-roaming dog population and more dogs, especially females, should be neutered and vaccinated.

Most of the free-roaming dogs in Bhutan were found to be in good health condition as they are fed by members of the local Buddhist communities. The health condition of the neutered dogs was observed generally better than that of entire dogs. A similar finding was reported in a study conducted in Rajasthan in India (Totton et al. 2011; Yoak et al. 2014). This is due to a number of behavioral and health benefits arising from the neutering of dogs (Reichler 2009). The repeated pregnancies in female dogs can physically stress the animals while the absence of pregnancy can improve the health of dogs (Jackman and Rowan 2007). There is a reduced risk of acquiring cancer or other diseases of the reproductive organs, including TVT and pyometra, after sterilization (Jackman and Rowan 2007, Michell 1998). Neutering has been identified as an important risk factor for obesity in dogs due to increased food consumption, decreased metabolic rate and reduced physical activity (German 2005; Robertson 2003). However, in this study only few obese dogs (1%) were sighted. This could be due to the type of diet that free-roaming dogs can access and their continuous physical activity searching for food when compared to owned and confined dogs or dogs in other nations.

Approximately 20% of the dogs had skin problems with 17% having mild, 2% moderate and 1% severe problems. There was no significant difference in the skin condition scores between neutered and entire dogs. Although neutered dogs would be expected to have fewer skin problems as they were treated with ivermectin in this study, the time of examination after the single treatment was more than 3 months when the antiparasitic effect of ivermectin would have gone or been reduced (Campbell and Benz 1984, Scheidt et al. 1984). In contrast others have found a higher prevalence of skin problems in sterilized dogs. This was believed to be due to infections acquired during the CNVR programmes and transfer of ticks to dogs awaiting surgery (Totton et al. 2011; Yoak et al. 2014). These contrasting findings may also be due to the influence of external factors such as climate, breed, and type of food available. It is likely that in the current study the prevalence of skin problems was underestimated as it is difficult to assess animals from a distance, in contrast to caught or anesthetized dogs.

Through the ongoing CNVR programme 32,276 dogs were neutered and vaccinated, representing 65% of the 2005 dog population (DOL 2006). In contrast, based on more recent population surveys in six districts,

the coverage is estimated at 52%. The calculation of coverage (neutered and vaccinated) based on the earlier record may be an overestimate due to under estimation of the population as the 2005 census did not include stray dogs. It is important to estimate the population of both owned and un-owned dogs using suitable scientific methods. Cross-sectional household surveys have been performed to estimate the owned dog population (Butler and Bingham 2000; De Balogh et al. 1993; Kitala et al. 2001b; Matter et al. 2000a) while for free-roaming dog populations, capture-mark-recapture surveys have been used (Childs et al. 1998; De Balogh et al. 1993; Hiby et al. 2011). In order to plan long term dog population control, it is important to confirm the proportion of owned dogs that are free-roaming. Enumeration of dogs should be undertaken before the start of any CNVR programme, and during and after its implementation to allow effective planning of the programme and monitoring of its success. In order to continuously monitor and evaluate the success of the CNVR programme, indicator counts should be undertaken by selecting one or two routes across the cities. Repeated indicator counts should be conducted along the fixed routes at least twice a year approximately six weeks after the peak whelping season i.e. July and January in Bhutan.

## 5. CONCLUSION

The high tolerance of the Bhutanese society to free-roaming dogs may lead to the dog population becoming unmanageable, resulting in a threat to the welfare of dogs and public health if appropriate interventions are not taken. The CNVR programme undertaken by the Royal Government of Bhutan and Humane Society International provides a solution to address the increasing dog population problem. This study highlighted the status of the CNVR programme in Bhutan, as well as various benefits to the welfare of the dogs and the control of rabies. Dogs that were neutered and vaccinated were found to be in better body condition compared with un-neutered and un-vaccinated dogs. The proportion of the lactating females and puppies sighted were higher in those places where the CNVR programme was carried out less frequently. The overall CNVR coverage of 52% is much lower than the WHO Expert Committee recommended 70% vaccination and sterilization coverage to break the rabies cycle and to maintain a stable dog population. This indicates that there should be continuous follow-up CNVR programmes in all districts by specifically targeting females. The CNVR programme should be continued and combined with education on responsible dog ownership and habit control (food, water and shelter) through a one health approach. At the same time routine monitoring work should be repeated at six monthly intervals to evaluate the dog population control programme, as well as its benefit to the welfare of the dogs.

## ACKNOWLEDGEMENT

The authors would like to thank Department of Livestock, Royal Government of Bhutan and Humane Society International for supporting this research. We would also like to thank the concerned officials from NCAH, Dzongkhag Livestock Office and National Dog Population Management and Rabies Control Project team in Bhutan for their support during the field surveys. We wish to thank Australian Postgraduate Endeavour Award Team for funding the principal author's scholarship to undertake PhD programme at Murdoch University.

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