Canid Biology & Conservation

 ISSN 1478-2677

Field report

Home range size of the dhole estimated from camera-trap surveys

Arjun Srivathsa[1,2 *], N. Samba Kumar[1,2] and K. Ullas Karanth[2,3]

[1] Wildlife Conservation Society, India Program, 1669, 31st Cross, 16th Main, Banashankari 2nd Stage, Bengaluru 560 070, India. Email: arjuns.cws@gmail.com

[2] Centre for Wildlife Studies, 1669, 31st Cross, 16th Main, Banashankari 2nd Stage, Bengaluru 560 070, India.

[3] Wildlife Conservation Society, Global Conservation Program, 2300 Southern Boulevard, Bronx, New York 10460, USA.

* Correspondence author

Keywords: camera traps, dhole, home range, India, Western Ghats.

Abstract

The dhole *Cuon alpinus* is one of the least studied large carnivores in the world. Unlike many other social canids, dholes occur at low densities in tropical forests. Furthermore, they are wary, and difficult to capture and radio-tag, thereby posing challenges in the field for tracking their movements or making behavioural observations. We conducted intensive camera-trap surveys in Nagarahole and Wayanad wildlife reserves in the Western Ghats of southern India, as part of a long-term study of tiger population dynamics. The survey duration was kept short, from 28 November 2014 to 12 January 2015 (45 days), to ensure demographic closure. Besides generating data on tigers, the surveys also yielded incidental photographic captures of dholes. In general, individual dholes cannot be uniquely identified from camera-trap photographs. But we were able to identify two individuals in a pack based on distinct markings on their pelage, enabling us to map locations of the pack during the survey period. We present here, an estimate of home-range size (~85km^2) for this dhole pack from non-invasive camera-trap surveys.

Article

The Asiatic wild dog or dhole *Cuon alpinus* is one of the top predators in tropical forests of Asia (Karanth and Sunquist 2000, Grassman et al. 2005, Kamler et al. 2012). It is also the only pack-living wild canid in Asia that primarily occurs in forested habitats. Historically, dholes were widespread across Asia and hunted as vermin. Global dhole numbers have declined drastically in recent decades, with remnant populations now largely being restricted to few fragmented forests (Kamler et al. 2015). Recent assessments suggest that 900-2,100 mature dholes may survive globally. Despite being listed as 'Endangered' on the IUCN Red List (Kamler et al. 2015), dholes remain one of the least studied species among large, social carnivores.

In India, dholes have been extirpated from 60% of their former range in the last 100 years, due to human persecution and habitat loss (Karanth et al. 2010). The Western Ghats landscape of India is among the few regions that still supports high densities of the species (Karanth et al. 2009, Srivathsa et al. 2014). The landscape supports a diverse assemblage of wild ungulates such as the chital *Axis axis*, four-horned antelope *Tetracerus quadricornis*, gaur *Bos gaurus*, Indian muntjac *Muntiacus muntjak*, sambar *Rusa unicolor* and wild pig *Sus scrofa*, at high densities (Karanth et al. 2004). The region also hosts source populations of tigers *Panthera tigris* and leopards *P. pardus* (Karanth and Sunquist 2000). We conducted intensive camera trap surveys in adjacent reserves of Nagarahole (in Karnataka State; 644km^2) and Wayanad (in Kerala State; 78km^2) in the Western Ghats of India (Figure 1). The survey, conducted over a period of 45 days from 28 November 2014 to 12 January 2015 (post-monsoon winter), was part of a long-term study of tiger population dynamics in the region. Camera-traps were set at 162 locations for photo-capturing large carnivores, ensuring uniform geographic coverage of the area (Figure 1). To increase the probability of photo-capturing carnivores (dholes, leopards, and tigers), we set up camera-traps along forest roads, and the stations were spaced at 1-3km apart. Each trap consisted of two automated digital *Panthera v4* camera-trap units (Panthera, USA), set at a height of 45cm from the ground. Every

The following is the established format for referencing this article:

Srivathsa, A., Kumar, S.N. and Karanth, K.U. 2017. Home range size of the dhole from camera-trap surveys. *Canid Biology & Conservation* 20(1):1-4. URL: http://www.canids.org/CBC/20/dhole_home_range.pdf.

photo-capture event of a large carnivore had associated data on the location, date and time. These data together constituted a photo-encounter event. We treated any two capture events ('event' being a series of dhole photo-captures) that were >60 minutes apart as separate encounters, in order to avoid double counts. The traps were regularly checked to maintain corrected date/time information.

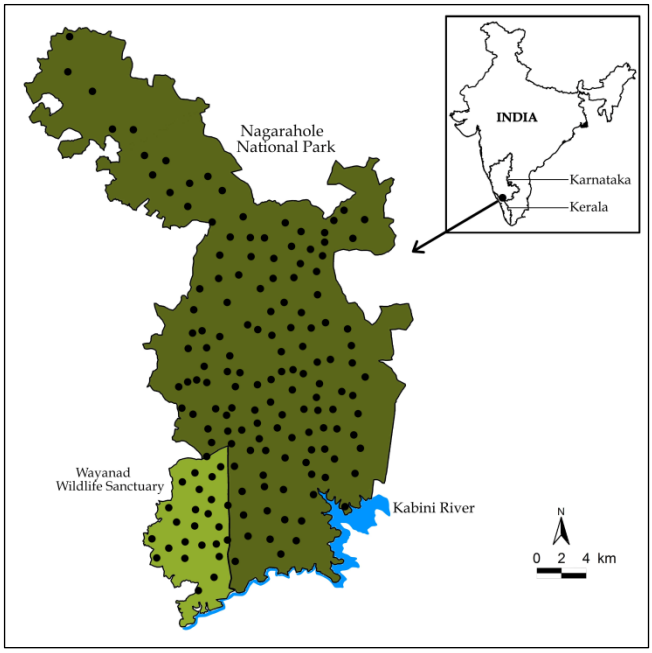

Figure 1: Study areas Nagarahole National Park (State of Karnataka) and Wayanad Wildlife Sanctuary (State of Kerala), in the Western Ghats of India. The black dots are camera-trap locations.
Inset: Location of Karnataka and Kerala in India.

We identified one individual dhole belonging to a pack, which had distinct scars on the flanks, likely from an injury (Figure 2). This individual was first photo-captured on 8 December 2014 within the limits of Wayanad Wildlife Sanctuary and assigned the ID number DHL-101. Using the encounters of DHL-101, we also identified another another individual with distinct white colouration on the lower right forelimb (Figure 3). The second animal was assigned an ID number of DHL-102. Based on these uniquely identifiable marks, uncommon among dholes, we used photo-encounters of either of these two animals to identify the capture events for the entire pack. The pack consisted of a minimum of five individuals (DHL-101, DHL-102, and three unidentifiable members that were photo-captured in a single image). Since we could not distinctly identify the other members, the pack possibly could have had more individuals. The spatial locations of camera-traps and the number of pack encounters in the corresponding locations are presented in Table 1.

Figure 2: Photo-captures of DHL-101 (top row) and DHL-102 (bottom row); the two individuals from the identified pack.

Figure 3: Individuals labelled DHL-101 and DHL-102 from the pack, identified based on an injury mark (yellow circle) and white coloration on the lower right forelimb (blue circle), respectively, photo-captured in a single frame.

Table1: List of camera-trap stations, geographical coordinates and number of encounters of the identified dhole pack in Nagarahole and Wayanad reserves, India. Location code NH refers to Nagarahole National Park, and location code WY refers to Wayanad Wildlife Sanctuary.

Camera-trap location	Longitude	Latitude	Number of encounters
NH001	76⁰5'54.97"	11⁰58'53.04"	1
NH002	76⁰6'56.87"	11⁰58'45.48"	1
NH003	76⁰7'57.35"	11⁰58'28.20"	1
NH004	76⁰7'07.33"	11⁰57'38.52"	1
NH005	76⁰7'28.19"	11⁰56'22.92"	5
NH006	76⁰4'19.21"	12⁰01'42.60"	1
NH007	76⁰4'42.95"	12⁰01'56.28"	1
NH008	76⁰8'49.21"	11⁰55'24.96"	1
WY001	76⁰5'56.77"	11⁰55'55.92"	6
WY002	76⁰5'55.31"	11⁰57'07.20"	2
WY003	76⁰5'03.85"	11⁰57'19.08"	1
WY004	76⁰4'23.51"	11⁰56'51.00"	1
WY005	76⁰5'16.80"	11⁰56'28.68"	3
WY006	76⁰5'43.07"	11⁰55'14.16"	1
WY007	76⁰6'23.77"	11⁰57'34.92"	1
WY008	76⁰6'1.439"	11⁰51'59.76"	1

From these capture data, we sought to estimate the home-range size for the pack. Our data included only those pack-encounters where DHL-101 and/or DHL-102 were captured in a series of photographs. Based on the locations of 28 such confirmed encounters of the pack from 16 locations, we created a Minimum Convex Polygon (MCP; Mohr 1947) home-range for the dhole pack (Figure 4), estimated at ~85km^2 in size. Because of the low number of encounters, we could not apply more sophisticated home-range estimation methods to determine areas of high and low activity/use. The short duration of our study precluded our ability to estimate an annual home range size for the pack, and what we present may be, at best, inferred as the seasonal home-range size. We also submit that our approach does not account for the sampling process of partial detectability, i.e., the pack may have gone undetected in some trap-locations.

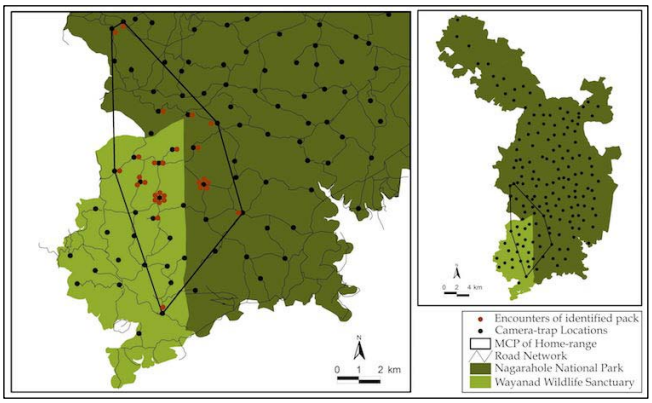

Figure 4: Spatial locations of camera-trap stations and locations of photo-encounters of the identified pack. The red dots indicate the number of photo-encounters and the bounds represent a Minimum Convex Polygon (MCP) for the pack.

Home-range size in dholes may vary as a function of densities of prey species, and possibly other habitat characteristics, as well as pack size (Table 2). For example, dholes in central India have large annual home-ranges, between 40–200km^2, generally showing seasonal variations (Acharya et al. 2010). Studies from southeast Asia suggest that smaller packs in tropical forests of Thailand have home-range sizes between 50 and 100km^2 (Grassman et al. 2005, Jenks et al. 2012). In the central part of Western Ghats (our study area), dhole packs appear to have much smaller home-range sizes (seasonally 20–60km^2; Johnsingh 1982, Venkataraman et al. 1995, Karanth and Sunquist 2000), a likely consequence of high densities of ungulate prey in these well-protected deciduous forest reserves (Karanth et al. 2004). Our estimate presented here is much larger compared to that reported by Karanth and Sunquist (2000), who estimated home-range size of ~27km^2 for a pack of dholes from an adjacent area in Nagarahole between 1988-1991. This is probably an underestimate, because their study relied completely on opportunistic sightings of the pack.

Most dholes do not have distinct identifiable natural markings. This restricts our ability to apply powerful methods used in marked animal studies (Williams et al. 2002) to examine dhole ecology. Although radio-telemetry methods can generate reliable data for estimating home-range size, habitat-use and activity patterns, their application is limited because they are labour-intensive, expensive, and must resolve difficulties of safe capture, immobilization and handling of relatively delicate animals like dholes (Hebblewhite and Haydon 2010). Therefore, the focus of many studies of dholes has shifted to the use of non-invasive sign survey methods (Srivathsa et al. 2014). We note that very few studies have utilized information from camera-trap surveys to obtain estimates of home-range sizes for the focal species (e.g., Maffei et al. 2005, Gil-Sánchez et al. 2011). The approach we have used can potentially be applied to understand spatial ecology of dholes and other rare carnivores that do not have natural markings, based on identification of some individuals from incidental injury-related marks or other uncommon pelage patterns.

Table 2: A review of home-range size estimates for dhole packs from across the species' geographic range, based on published literature.

Authors	Location	Habitat of study area	Prey species	Study duration	Pack size (adults)	Home-range size (km^2)	Methods
Johnsingh 1982	Bandipur, India	Dry deciduous forest - savannah woodland	Same as current study	1976-1978	5-11	20	Direct observations
Venkataraman et al. 1995	Mudumalai, India	Dry deciduous - dry thorn forest	Same as current study$^{\$}$	1990-1992	4-10 3-15	83.3 54.2	Direct observations
Karanth and Sunquist 2000	Nagarahole, India	Mixed deciduous forest	Same as current study	1988-1991	7	23.4	Direct observations; 95%MCP
Grassman et al. 2005	Phu Khieo, Thailand	Mixed evergreen forest	Low densities of mid-large size ungulates*	2000-2002 4 months 14 months	 5 8	 12 49.5	Radio telemetry; 95%MCP
Acharya et al. 2010	Pench, India	Dry deciduous forest	High densities of mid-large size ungulates	2002-2004 5 months 11 months 7 months	 3-12 1-3 14	 79.9-202.8 26.1-105 64.8-66.4	Radio telemetry; 95%MCP
Jenks et al. 2012	Khao Ang Rue Nai, Thailand	Lowland rainforest	Low, declining population of mid-large sized ungulates$^{\$\$}$	2008-2010	6	100	Estimated from camera trap images of a known pack

$^{+}$Karanth et al. 2004; $^{\$}$Venkataraman et al. 1995; *Grassman et al. 2005; $^{\$\$}$Jenks et al. 2012.

Acknowledgements

We acknowledge support provided by the Wildlife Conservation Society, New York, Wildlife Conservation Society, India Program, and the Centre for Wildlife Studies. We are grateful to the following donors: Department of Biotechnology, Government of India, Vision Group of Science & Technology, Government of Karnataka, Liz Claiborne and Art Ortenberg Foundation, USA and Rhinoceros & Tiger Conservation Fund of US Fish & Wildlife Service, USA. State Forest Departments of Karnataka and Kerala, and the Ministry of Environment, Forests, and Climate Change, Government of India, provided the necessary research permits and support. We thank S. Sharma, V. Kantamneni, L. Vinay, K. Yadav, the field researchers, and staff of Centre for Wildlife Studies who assisted in data collection and processing. We thank the two reviewers for their comments, which helped improve our paper.

References

Acharya, B.B., Johnsingh, A.J.T. and Sankar, K. 2010. Dhole telemetry studies in Pench Tiger Reserve, central India. *Telemetry in Wildlife Science* 13: 69–79.

Grassman, L.I., Tewes, M.E., Silvy, N.J. and Kreetiyutanont, K. 2005. Spatial ecology and diet of the dhole *Cuon alpinus* (Canidae, Carnivora) in north central Thailand. *Mammalia* 69: 11–20.

Gil-Sánchez, J.M., Moral, M., Bueno, J., Rodríguez-Siles, J., Lillo, S., Pérez, J., Martín, J.M., Valenzuela, G., Garrote, G., Torralba, B. and Simón-Mata, M.Á. 2011. The use of camera trapping for estimating Iberian lynx (*Lynx pardinus*) home ranges. *European Journal of Wildlife Research* 57: 1203–1211.

Hebblewhite, M. and Haydon, D.T. 2010. Distinguishing technology from biology: a critical review of the use of GPS telemetry data in ecology. *Philosophical transactions of the Royal Society of London. Series B, Biological sciences* 365: 2303–2312.

Jenks, K.E., Songasen, N. and Leimgruber, P. 2012. Camera trap records of dholes *Cuon alpinus* (Canidae, Carnivora) in Khao Ang Rue Nai Wildlife Sanctuary, Thailand. Canid News [online] URL: http://www.canids.org/canidnews/15/Camera_trap_records_of_dholes_in_Thailand.pdf.

Johnsingh, A.J.T. 1982. Reproduction and social behaviour of the dhole, *Cuon alpinus* (Canidae). *Journal of Zoology* 198: 443–463.

Kamler, J.F., Johnson, A., Vongkhamheng, C. and Bousa, A. 2012. The diet, prey selection, and activity of dholes (*Cuon alpinus*) in northern Laos. *Journal of Mammalogy* 93: 627–633.

Kamler, J.F., Songsasen, N., Jenks, K., Srivathsa, A., Sheng, L. and Kunkel, K. 2015. *Cuon alpinus*. The IUCN Red List of Threatened Species 2015: e.T5953A72477893. [online] http://dx.doi.org/10.2305/IUCN.UK.20154.RLTS.T5953A72477893.en.

Karanth, K.U. and Sunquist, M.E. 2000. Behavioural correlates of predation by tiger (*Panthera tigris*), leopard (*Panthera pardus*) and dhole (*Cuon alpinus*) in Nagarahole, India. *Journal of Zoology* 250: 255–265.

Karanth, K.U., Nichols, J.D., Kumar, N.S., Link, W.A. and Hines, J.E. 2004. Tigers and their prey: Predicting carnivore densities from prey abundance. *Proceedings of the National Academy of Sciences* 101: 4854–4858.

Karanth, K.K., Nichols, J.D., Hines, J.E., Karanth, K.U. and Christensen, N.L. 2009. Patterns and determinants of mammal species occurrence in India. *Journal of Animal Ecology* 46: 1189–1200.

Karanth, K.K., Nichols, J.D., Karanth, K.U., Hines, J.E. and Christensen, N.L. 2010. The shrinking ark: patterns of large mammal extinctions in India. *Proceedings of the Royal Society of London. Series B, Biological Sciences* 277: 1971–1979.

Maffei, L., Noss, A.J., Cuéllar, E. and Rumiz, D.I. 2005. Ocelot (*Felis pardalis*) population densities, activity, and ranging behaviour in the dry forests of eastern Bolivia: data from camera trapping. *Journal of Tropical Ecology* 21: 349–353.

Mohr, C. 1947. Table of equivalent populations of North American small mammals. *American Midland Naturalist* 37: 223–249.

Srivathsa, A., Karanth, K.K., Jathanna, D., Kumar, S.N. and Karanth, K.U. (2014). On a dhole trail: Examining ecological and anthropogenic correlates of dhole habitat occupancy in the Western Ghats of India. PLoS One, 9, e98803. [online] http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0098803

Venkataraman, A.B., Arumugam, R. and Sukumar, R. 1995. The foraging ecology of dhole (*Cuon alpinus*) in Mudumalai Sanctuary, southern India. *Journal of Zoology* 237: 543–561.

Williams, B.K., Nichols, J.D. and Conroy, M.J. 2002. *Analysis and management of animal populations*. California: Academic Press, San Diego.

Biographical sketch

Arjun Srivathsa studies carnivores, with particular focus on wild canids, population ecology and intra-guild interactions in tropical forest systems.

N. Samba Kumar studies tropical forest ungulates, with expertise in field methods and analytical approaches for estimation and monitoring of large mammal populations.

K. Ullas Karanth has over two decades of experience studying the ecology of large carnivores, focusing on population modelling and estimation, and integrates research outcomes with practical conservation efforts.