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DISTRIBUTION AND CONSERVATION OF THE PATAS MONKEY *ERYTHROCEBUS PATAS* IN KENYA

Yvonne A. de Jong
Eastern Africa Primate Diversity and Conservation Program
Nocturnal Primate Research Group, Oxford Brookes University
P.O. Box 149, 10400 Nanyuki, Kenya
yvonne@wildsolutions.nl

Thomas M. Butynski
Eastern Africa Primate Diversity and Conservation Program
Conservation International
P.O. Box 149, 10400 Nanyuki, Kenya
tbutynski@aol.com

K. Anne-Isola Nekaris
Nocturnal Primate Research Group, Department of Anthropology
School of Social Science and Law, Oxford Brookes University
Oxford OX3 0BP, United Kingdom
anekaris@brookes.ac.uk

ABSTRACT

From December 2003 through May 2004, a survey was conducted on patas monkeys *Erythrocebus patas* in Kenya to determine the historic distribution, current distribution, conservation status, and threats. Patas were found in Laikipia District, Busia, West-Pokot, Turkana, Makueni and Taita Taveta Districts. Historically, patas were present in west, northwest, central and south Kenya. The geographic range of patas in Kenya has declined from *ca*. 88 800 km² to roughly 48 200 km² and the gaps among populations has increased. The current geographic range is *ca*. 54% of the known historic range, or *ca*. 8% of Kenya's land surface area. All survey sites have their unique patas conservation challenges. Patas are occasionally killed as a consequence of crop raiding and for consumption. Water shortage is a threat to the survival of patas at some sites in Kenya. Habitat loss and degradation (due to human activities or wildlife) are the primary conservation problems for patas at all sites. This study and its recommendations should be taken as a basis for patas conservation action in Kenya.

Keywords: *Erythrocebus,* patas, biogeography, distribution, crop raiding

INTRODUCTION

Patas monkeys *Erythrocebus patas* (von Schreber, 1774) (figures 1 and 3) have, for at least the last 40 years, occurred at low densities throughout their range in East Africa (Hall, 1965,

de Jong *et al.*, 2007). Their shy behaviour, speed (55 km/h; Hall, 1965), cryptic pelage, low density, and large home ranges [from 23 km² (Chism & Rowell, 1988) to 80 km² (Hall, 1965)] make them difficult to find and observe. Patas have a preference for open savannah woodland dominated by acacia *Acacia* spp., an ecosystem marginal for agriculture (Chism & Rowell, 1988; Enstam & Isbell, 2002). Tall *Acacia* trees, in particular whistling thorn *Acacia drepanolobium* Y.Sjøstedt, are commonly used as feeding and sleeping trees (Chism & Rowell, 1988; Isbell, 1998) but patas also commonly use magic gwarra *Euclea divinorum* Hiern (Burnham, 2004).

Patas occur north of the equatorial forests and south of the Sahara, from western Senegal to Kenya and northern Tanzania (Hall, 1965; Hill, 1966; Wolfheim, 1983). In Tanzania, however, only small, isolated populations occur at present (de Jong *et al.*, 2007). The 'eastern patas' *E. p. pyrrhonotus* (Hemprich & Ehrenberg, 1829) ranges in central and eastern Africa (southeast Sudan, northeast Democratic Republic of Congo, west Ethiopia and north Uganda) including west, northwest, south and central Kenya. Most reports of patas in Kenya come from the Laikipia Plateau (Laikipia District), which supports the largest subpopulation (300-450 animals over the past 25 years; Isbell & Chism, 2007).

Little is known about the current distribution of patas in Kenya. Most surveys of patas in Kenya have been conducted on the Laikipia Plateau, with occasional surveys undertaken in other parts of the country. Historically, in western Kenya, patas were abundant (Isbell & Chism, 2007) and the distribution was most likely continuous with the population in eastern Uganda. However, patas were not found during surveys in western Kenya by Chism and Olson in 1981 (Isbell & Chism, 2007), and by K. Ngece (pers. comm.) in 2000. Chirchir (1993) conducted a preliminary survey around Lake Baringo and Lake Bogoria using questionnaires. He reported four groups in the vicinity of Lake Bogoria. M. Roberts (pers. comm.), a life-long resident of the area, has not seen patas in the vicinity of Lake Baringo (*ca.* 40 km north of Lake Bogoria) for at least 25 years. Kirathe and Maranga (2002) conducted a questionnaire survey in southern and central Kenya; 79% of their respondents (n=475) had never seen patas. Chirchir (1993), and Kirathe and Maranga (2002) recommended that more research be undertaken to better determine patas abundance as well as historic and current distributions in Kenya.

In the past, patas rarely came into conflict with humans, but the growing human population in Kenya has forced farmers to exploit dryer areas, converting patas habitat (*Acacia* woodlands) into agricultural land (Isbell & Chism, 2007). Patas are reported to raid crops in many parts of their range (Hall, 1965; Bourlière *et al.*, 1974; Wolfheim, 1983; Chism & Rowell, 1988; Weladji & Tchamba, 2003) but it is unknown where crop raiding is currently occurring in Kenya.

Patas need to drink water every day and the location of water sources affects their movements, especially in the dry season (Struhsaker & Gartlan, 1970; Chism & Rowell, 1988). Patas are highly depended on human-made water sources on the Laikipia Plateau (Chism & Rowell, 1988; Isbell & Chism, 2007) and also drink from human-made water sources in Cameroon (Struhsaker & Gartlan, 1970).

To take effective conservation action for patas in Kenya, current information is needed on the species' distribution and abundance. This study builds upon previous surveys of patas in Kenya. The aims were to: 1) review the historic distribution of patas in Kenya; 2) determine the current distribution, relative abundance, conservation status and threats to patas in Kenya; and 3) assess the use of human-made water sources and the incidence of crop raiding by patas in Kenya.

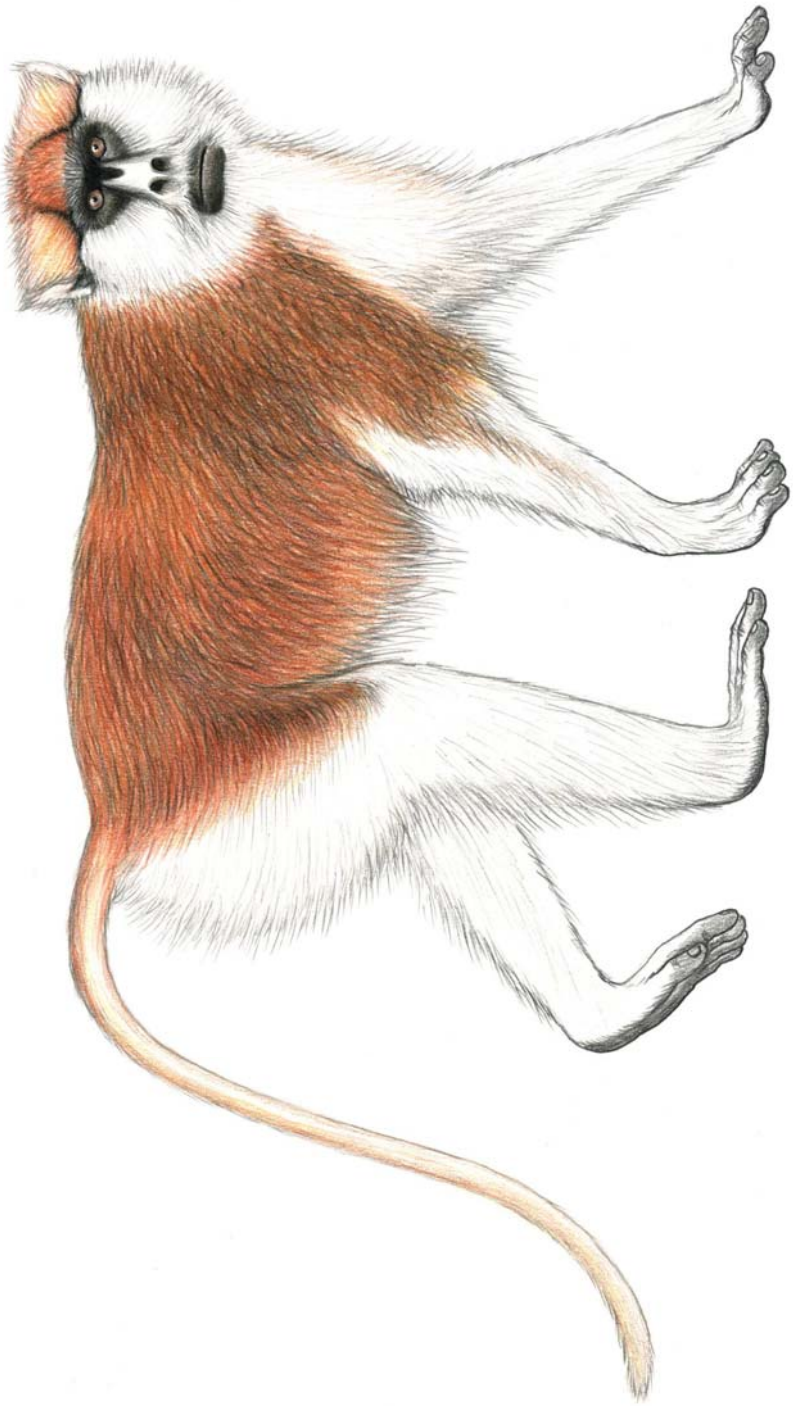

Figure 1. Adult male eastern patas monkey Erythrocebus patas pyrrhonotus. *Drawing by Stephan Nash.*

METHODS

Study area

For this study, five survey sites were selected within the known historic range of patas in Kenya: Ol Pejeta Conservancy in Laikipia District; Busia District; Southern Turkana District; West-Pokot District; and Chyulu Hills in Makueni District. The survey sites were chosen to resolve patas presence or absence questions from earlier surveys (Ol Pejeta Conservancy; Busia District; West-Pokot District), and to confirm their presence after receiving reports by others (Busia District, 2000 by H. Gomez de Silva, F. Ng'weno & C. Kariuki; Southern Turkana District , 2003 by J. Lint; Chyulu Hills, 2003 by R. Bonham).

Ol Pejeta Conservancy (hereafter referred to as 'OPC'; includes the Sweetwaters Wildlife Sanctuary) is a 360 km², privately owned, cattle ranch and wildlife sanctuary, where the main vegetation type is 'Mosaic of East African Evergreen Bushland and Secondary *Acacia* Wooded Grassland' (White, 1983). OPC was last surveyed for patas in 1996 (Burnham, 2004). Additionally, OPC was included in a questionnaire survey conducted in Laikipia District in 1981 by Chism and Olson, and in 2000 by Isbell (Isbell & Chism, 2007). Busia District and West-Pokot District were surveyed for patas in 1981 by Chism and Olson (Isbell & Chism, 2007), and in 2000 by K. Ngece (pers. comm.). In Busia District, surveys were conducted throughout the District (mainly cropland) and at the Alupe Agricultural Research Institute (hereafter referred to as 'Alupe'), a *ca.* 1.2 km^2 hectares compound managed by the Kenya Agricultural Research Institute (KARI). In West-Pokot District, surveys took place outside protected areas, except for one day in Nasalot National Reserve. The vegetation in the District is mainly 'Somalia-Masai *Acacia-Commiphora* Deciduous Bushland and Thicket' (White, 1983). Much of West-Pokot District is used for agriculture and livestock. Southern Turkana District had never been surveyed for patas. The survey here was conducted outside protected areas in 'Somalia-Masai *Acacia-Commiphora* Deciduous Bushland and Thicket' (White, 1983). Chyulu Hills had never been surveyed for patas. Here the survey took place inside the Chyulu Hills National Park and the surrounding area. The main vegetation type here is 'Mosaic of East African Evergreen Bushland and Secondary *Acacia* Wooded Grassland' (White, 1983).

Field surveys

Field surveys were conducted from December 2003 through May 2004 by YDJ, accompanied by an experienced field assistant and, occasionally, by a ranger or guard. In order to confirm the presence and assess the relative abundance of patas in the five survey sites, and the need to cover large areas in a limited time, rapid assessment survey methods were used. Differences in research conditions, constraints, and opportunities in the five survey sites required a variety of methods and approaches (table 1).

Reconnaissance surveys

Reconnaissance (recce) surveys were conducted from a vehicle or on foot by two people (White & Edwards, 2000). Each survey site was sectioned into 1 km² blocks and each block entered and searched for more than 0.5 km was considered to have been surveyed (Butynski & Koster, 1994; table 1). Transects ran along roads and animal trails that led to water. Surveys took place during daylight hours. The driving speed ranged from 9-15 km/h, while the average walking speed was *ca*. 1 km/h. The number of patas groups encountered/km was the index used to assess relative abundance (Butynski & Koster, 1994; White & Edwards, 2000; Nekaris & Jayewardene, 2004). When patas were encountered during a survey, the

following data were collected: number of animals seen, group composition, habitat type and tree density. Each group of patas was observed until the group moved out of sight.

Table 1. Summary of survey methods used, distances travelled, and areas surveyed for the patas monkey Erythrocebus patas *in each survey site in Kenya (2003-2005).*

Survey site	Ol Pejeta Conservancy, Laikipia District	Alupe Agricultural Research Institute, Busia District	Southern Turkana District	West-Pokot District	Chyulu Hills, Makueni District	Total
Number of transects	197	16	8	0	10	231
Distance travelled (km)	518	13	113	0	148	792
Number of 1km² blocks surveyed (% of total area)	197 (53)	4 (100)	69 (27)	0	121 (23)	391 (34)
Total area surveyed (km²)	372	4	254	0	517	1147
Fixed point counts (h)	0	21.4	0	0	0	21.4
Number of interviews	0	85	71	53	11	220

To determine the extent of each vegetation type along recce transects, a 'vegetation ranking' was assigned to the vegetation on each side of the transect. The vegetation rankings are based on the dominant tree species, tree height, and tree density. Vegetation was ranged as: 1 'very good' when patas are known, from literature, to prefer this vegetation, 2 'good', when patas are known to use this vegetation on a regular basis, or 3 'minimal' when patas only rarely or never use this vegetation type.

All water sources in the survey sites were described and mapped using a GPS. Patas in East Africa are reluctant to enter riverine vegetation or to drink from rivers (Hall, 1965; Chism & Rowell, 1988). Due to the fact that they provide a large area of water and can not be considered as one source, rivers were not included in the water source survey.

Fixed point counts

The presence of patas, and the number of patas groups per hour, were assessed by fixed point counts (National Research Council, 1981; Brockelman & Ali, 1987; White & Edwards, 2000; Nijman & Menken, 2001; table 1). Fixed point counts were only conducted in Alupe. Strategic vantage points were located in the crop fields. The observer scanned the area for a recorded amount of time. When patas were encountered during a survey, data were collected on the number of animals seen, group composition, habitat type and tree density. When a group was seen, the fixed point was abandoned to follow the group by foot to collect additional data on habitat use and *ad libitum* behavioural observations.

Interviews
Members of the local communities in the survey sites were interviewed using a questionnaire and pictures of primates [*E. patas*, olive baboon *Papio anubis* (Lesson, 1827), vervet monkey *Chlorocebus pygerythrus* (F. Cuvier, 1821), Sykes's monkey *Cercopithecus mitis* Wolf, 1822, de Brazza monkey *Cercopithecus neglectus* Schlegel, 1876, black and white colobus monkey *Colobus guereza* Rüppell, 1835, potto *Perodicticus potto* (Müller, 1776), small-eared greater galago *Otolemur garnettii* (Ogilby, 1838), and northern lesser galago *Galago senegalensis* É. Geoffroy, 1796]. The same collection of primate photos was used at all survey sites. To test accuracy, the collection included photos of primates that were known to be absent in the area. Interviewees were asked about patas presence, abundance, threats, crop raiding activities, and the occurrence of other primates in the area. Additionally, rangers, naturalists, ranch owners, and camp/lodge operators at the survey sites were asked about patas in the survey sites, as well as in other areas in Kenya. The number of interviews conducted at each survey site depended on the available time and the security situation in the area. No interviews were conducted in OPC, although pastoralist and rangers were always asked about the presence of patas in OPC.

Literature survey, museum review, and communications
Literature and museum data were searched by YDJ and TMB to obtain records on patas in Kenya in order to compile information on the historic geographic range. Researchers, naturalists, ranch owners, tour operators, camp/lodge managers, and others, were asked (by e-mail or in person) about the presence and abundance of patas in Kenya, and for the details of their encounters with patas. A request for information on patas in East Africa was published in *Swara* (de Jong, 2006), the widely-read magazine of the East African Wild Life Society.

Distribution mapping
The patas locality information obtained from field surveys, literature surveys, museums and communications was stored in a Microsoft Access database (XP) and categorised as either historic (all records before December 31, 1995; hereafter referred to as 'pre-1996') or current (all records after December 31, 1995; hereafter referred to as 'post-1995'). A zone with a radius of 30 km was arbitrarily selected and plotted around each locality point in order to simulate the distribution of patas at each locality. All distribution records were plotted on a map using Garmin MapSource (6.10.2) and MapInfo Professional 8.0.

RESULTS

Field surveys
A total of 391 1-km² blocks were surveyed (table 1). This represents 34% of the area (1147 km²); of the five survey sites (outer boundary of the study sites was determined by plotting the boundary on the map before starting the survey in each area). Eight fixed-point counts at Alupe were conducted for a total of 20.9 h (mean duration = 2.6 h, range = 0.7 - 6.5 h). Fixed point counts were conducted during four days, covering all hours of the day at least once.

Patas were observed at two of the five survey sites. A total of nine patas groups were encountered in OPC (seven encounters) and Alupe (two encounters). Interviews indicated the presence of patas in other parts of Busia District, West-Pokot District, southern Turkana District, and northwest of the Chyulu Hills (figure 2, tables 2 & 3). During reconnaissance

surveys, transects were abandoned seven times in OPC to follow an encountered group of patas by foot (x=53 min, SD=39, range 15-118 min).

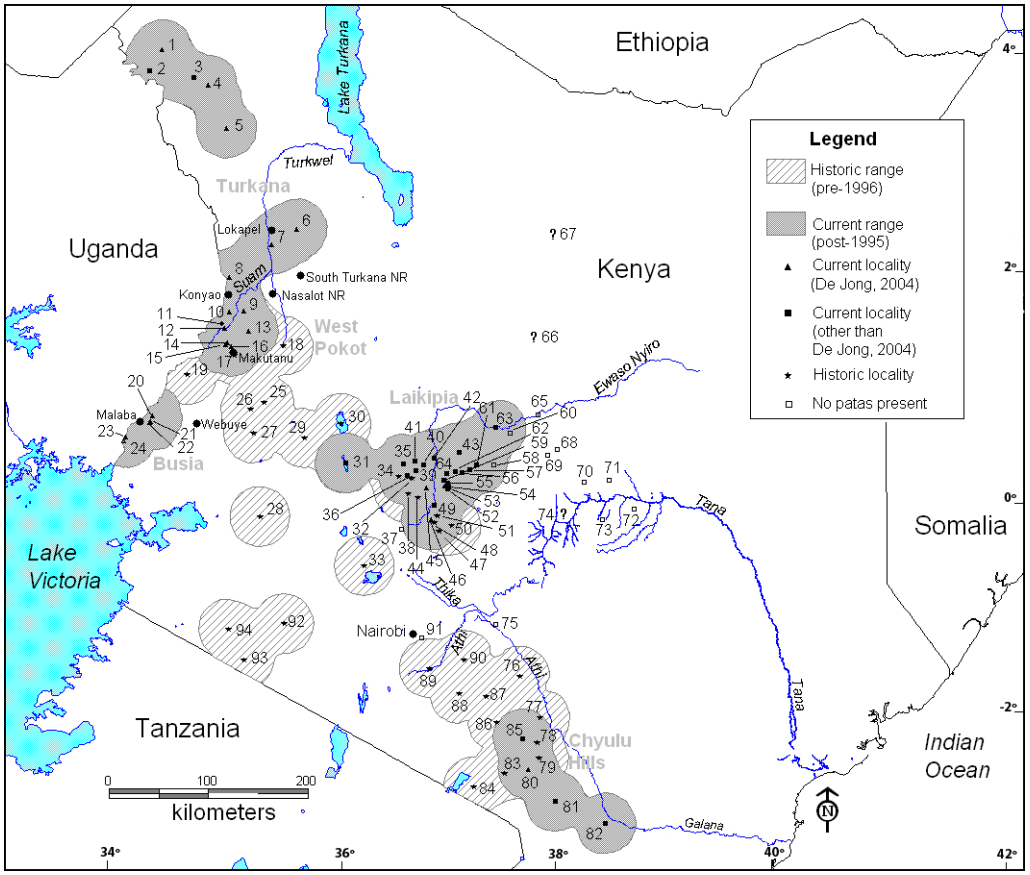

Figure 2. Known historic and current distribution of the patas monkey Erythrocebus patas *in Kenya. The entire current range lies within the historic range. The shaded area around each locality point extends out 30 km. See table 2 to match locality number with locality name and source of the data.*

Ol Pejeta Conservancy, Laikipia District

OPC has at least two groups of patas and a minimum of two solitary patas (figure 3, table 2). One group is comprised of at least eight individuals, including an adult male, and was encountered six times within an area of 12.5 km². The second group was encountered by rangers and no count was conducted. Six of the encounters were in *A. drepanolobium* dominated woodland and one encounter was in *E. divinorum* dominated woodland. The average flight distance was 102 m.

Busia District

One group, with a minimum of 10 individuals (including an adult male), was encountered twice at Alupe. During both encounters the group was in tall grass with scattered trees on the edge of maize, sweet potato and cassava fields. The presence of this group was surprising as

the human population density here is high (table 2) and the area is intensively used for agriculture. The flight distances during the two encounters were 60 m and 90 m.

Figure 3. Adult male patas monkey Erythrocebus patas pyrrhonotus *in* Acacia drepanolobium *woodland, Ol Pejeta Conservancy, Laikipia District, Kenya. Photograph by Robert Copeland.*

Interviews conducted in Busia District (n=85) indicate that 68% of the interviewees had seen patas in the area. Patas are said to be present not only in Alupe, but also in and around Amagoro, Awata, and Chelelemuk (north of the Malaba – Webuye Road, 23 km northeast of Alupe; figure 3, table 3).

Southern Turkana District

Patas were not encountered in southern Turkana District during this survey. J. Lind (pers. comm.), however, observed patas near Lokichar, southern Turkana District, in January 2003. The interviews in southern Turkana District (n=71) indicated that 46% of the residents had seen patas in Kenya, either inside or outside the survey area (table 2). Patas are probably present (at least occasionally) in Lopur. Interviews conducted in Lopur (n=30), yielded reports of three sightings within the last 5 years. Interviewees claim that patas are most often seen on the west side of the Turkwell River. Interviewees throughout southern Turkana District claim to have seen patas in the Loima Hills, central Turkana District, in the Songoti Mountains, northern Turkana District, and near Kakuma, northern Turkana District, within the last 5-10 years (figure 2, table 3).

Table 2. Survey results for the patas monkey Erythrocebus patas *in Kenya (2003-2005).*

Survey site	Ol Pejeta Conservancy, Laikipia District	Alupe Agricultural Research Institute, Busia District	Southern Turkana District	West-Pokot District	Chyulu Hills, Makueni District
Present/ Absent	Present	Present	Present	Present	Likely present
Encounter rate	0.01 groups/km	0.09 groups/h	0	0	0
Presumed number of groups	2 groups, 2 solitary ind.	1 group	?	?	?
% area with suitable vegetation	47	12	91	?	54
% of residents who claim they have seen patas	n/a	68 (n=85)	46 (n=71)	83 (n=53)	0 (n=11)
Altitude (m) asl	1775–2031	1109–1172	651–876	850–2050	926–1901
Mean annual rainfall (mm)	800	1435	270	675	300
People/km² (CBS, 2001)	3	330	7	34	19

West-Pokot District

Patas were not encountered in West-Pokot District during this study. Patas are absent in Nasalot National Reserve and South Turkana National Reserve (located in the north of the District) according to the Senior Warden and rangers (n=32) patrolling in both Reserves. In other parts of the District, R. Barnley (pers. comm.), resident in the area for many years, saw patas as recently as 2004 between Makutano and Konyao, and also between Makutano and Chepkobeh (figure 2, table 3). In addition, 83% of interviewees (table 2) stated that patas are present in the areas where R. Barnley observed them.

Chyulu Hills, Makueni District

Patas were not encountered in the Chyulu Hills during this study. R. Bonham (a naturalist and tour operator resident in the area for 16 years), however, saw patas off the northwest side of the Chyulu Hills in 1992 (one individual), 1995 (five individuals), and 1996 (five individuals) while piloting his light aircraft. J. Mutiso (pers. comm.), a Kenya Wildlife Service ranger for 31 years, encountered patas once (2004) in the vicinity of Kiboko, just to the north of the Chyulu Hills, and once (2005) just to the south of the Chyulu Hills near the

northwest boundary of Tsavo West National Park (figure 2, table 3). Interviews with 11 residents, however, gave no indication for patas in the area (table 2).

Table 3. Historic (pre-1996) and current (post-1995) distribution records for patas monkey Erythrocebus patas *in Kenya. The numbers correspond with the site numbers on the map in figure 1. Historic = H; Current = C; N = Patas never reported present.*

Number	Locality	Status, year	Reference
1	Songoti Mountain	C, 2003	de Jong, 2004
2	Oropoi	C, 2006	G. Powys, pers. comm.
3	Kalobeyei	C, 2006	R. Masongo, pers. comm.
4	Kakuma	C, 2003	de Jong, 2004
5	Loima Hills	C, 2003	de Jong, 2004
6	Lokichar	C, 2003	de Jong, 2004; J. Lind, pers. comm.
7	Lopur	C, 2003	de Jong, 2004
8	Losam	C, 2003	de Jong, 2004
9	Nagujit	C, 2003	de Jong, 2004
10	Kodich	C, 2003	de Jong, 2004
11	Suam River	H, 1990	J. Fjeldså, pers. comm.
12	Kongelai	C, 2003	Williams, 1967; de Jong, 2004; H. Gomez de Silva Garza, F. Ng´weno, C. Kariuki, pers. comm.
13	Chepkobeh	C, 2003	de Jong, 2004
14	Mtembur	C, 2003	de Jong, 2004
15	Serewo	C, 2003	de Jong, 2004
16	Mnarere	C, 2003	de Jong, 2004
17	Kenya West A	H	Kingdon, 1971
18	Kapenguria Escarpment	H, 1995	B. Finch, D. Martins, pers. comm.
19	Mount Elgon (east)	H	Lönnberg, 1912
20	Chelelemuk	C, 2003	de Jong, 2004
21	Awata	C, 2003	de Jong, 2004
22	Amagoro	C, 2003	de Jong, 2004
23	Alupe Agricultural Research Institute	C, 2003	de Jong, 2004; H. Gomez de Silva Garza, F. Ng´weno, C. Kariuki, pers. comm.
24	Busia Town (vicinity)	N	de Jong, 2004
25	Sirgoit Rock	H	Lönnberg, 1912
26	Guas Ngishu (Nzoia River)	H	Hollister, 1910; Hollister, 1924; British Museum of Natural History; Smithsonian National Museum of Natural History
27	Uasin Gishu Plateau	H	Lönnberg, 1912
28	Mau Escarpment	H	Winton, 1902 in Matschie, 1905
29	Kabernet Escarpment	H, 1990	R. Barnley, pers. comm.
30	Lake Baringo	H, *ca*. 1980	M. Roberts, pers. comm.
31	Lake Bogoria National Reserve	C, 2006	Chirchir, 1993; K. Ngece, W. Kimasop via C. Withey, pers. comm.
32	Nyahururu – Nanyuki Rd	H, *ca*. 1995	J. Mather, pers. comm.
33	Kekopey	H, 1979	D. Nightingale, pers. comm.
34	Pesi Swamp	H, 1981	Isbell & Chism, 2007
35	Lombala Ranch	C, 2000	Isbell & Chism, 2007
36	ADC Mutara Ranch	C, 2006	Chism *et al*., 1983; Harding & Olson 1986; Chism & Rowell, 1988; Sommerlatte, 2006; Isbell & Chism, 2007
37	Aberdare Range Foothills	N	T. Butynski & Y. de Jong, pers. obs.
38	Suguroi Estates	H, 1981	Isbell & Chism, 2007
39	Eland Downs	C, 2000	Isbell & Chism, 2007

Number	Locality	Status, year	Reference
40	Segera Ranch	C, 2005	Isbell, 1998; Isbell *et al*., 1999; Pruetz & Isbell, 2000; Enstam & Isbell, 2002; de Jong, 2004; Isbell & Chism, 2007; Y. de Jong & T. Butynski, pers. obs.
41	Thome B	C, 2000	Isbell & Chism, 2007
42	Mpala Wildlife Conservancy	C, 2004	Isbell & Chism, 2007; N. Georgiadis, R. Olivier, P. Winter, pers. comm.
43	Dol Dol area	C, 2000	Isbell & Chism, 2007
44	Ngobit	H, 1980s	D. Turner, pers. comm.
45	Ol Pejeta Conservancy	C, 2008	Burnham, 2004; de Jong, 2004; Isbell & Chism, 2007; R. Vigne, R. Copeland, pers. comm.; Y. de Jong & T. Butynski, pers. obs.
46	Solio Ranch	C, 2005	de Jong, 2004; Isbell & Chism, 2007; E. Parfet, pers. comm.
47	Kiganjo	H, 1992	H. Douglas-Dufresne, pers. comm.
48	Mweiga	H, 1979	T. Young, pers. comm.
49	Lewcetia (Tharua) Farm	C, 2000	Isbell & Chism, 2007; E. Parfet, pers. comm.
50	Kenya Central A	H	Kingdon, 1971
51	Naro Moru	H, *ca.* 1995	J. Mather, pers. comm.
52	Laikipia Air Base Reserve Land	C, 2000	Isbell & Chism, 2007
53	Nanyuki Ranching	C, 2003	de Jong, 2004; Isbell & Chism, 2007
54	Allus Farm	C, 2000	Isbell & Chism, 2007
55	Nanyuki (vicinity)	C, 2007	H. Larkin, I. Fischhoff, J. Powys, pers. comm.
56	Lolldaiga Hills	C, 2006	Isbell & Chism, 2007; L. Tomlinson, R. Wells, L. Depew, pers. comm.
57	Ole Naishu	C, 2000	Isbell & Chism, 2007
58	Lewa Wildlife Conservancy	N	B. Low, pers. comm.
59	Endana/Kimuri/John Jessel's Farm	C, 2000	Isbell & Chism, 2007
60	Buffalo Springs National Reserve	N	Y. de Jong & T. Butynski, pers. obs.
61	Borana Ranch	C, 2004	Isbell & Chism, 2007; I. Craig, K. Carr-Hartley, B. Low, D. Martins, G. Powys, pers. comm.
62	Enasoit	C, 2000	Isbell & Chism, 2007
63	Samburu National Reserve	C, 2007	I. Douglas–Hamilton, D. Lentipo, pers. comm.
64	Naibor Rd, Laikipia	C, 2000	Isbell & Chism, 2007
65	Shaba National Reserve	N	Y. de Jong & T. Butynski, pers. obs.
66	Kenya North	H, questionable	Kingdon, 1971
67	Marsabit National Reserve	H, questionable	Williams, 1967; Kingdon, 1971
68	Ngaia Forest	N	Y. de Jong & T. Butynski, pers. obs.
69	Meru District	N	de Jong, 2004; M. Jenkins, pers. comm.
70	Meru National Park	N	Y. de Jong & T. Butynski, pers. obs.; M. Jenkins, pers. comm.
71	Bisanadi National Reserve	N	Y. de Jong & T. Butynski, pers. obs.; M. Jenkins, pers. comm.

Number	Locality	Status, year	Reference
72	Kora National Park	N	Y. de Jong & T. Butynski, pers. obs.; M. Jenkins, pers. comm.
73	Mwingi National Reserve	N	Y. de Jong & T. Butynski, pers. obs.; M. Jenkins, pers. comm.
74	Kenya Central B	H, questionable	Kingdon, 1971
75	Yatta area	N	de Jong, 2004
76	Kenya South A	H	Kingdon, 1971
77	Kenya South B	H	Kingdon, 1971
78	Makundi	H	Percival, 1928
79	Kenya South C	H	Kingdon, 1971
80	Chyulu Hills	C, 1996	de Jong, 2004; R. Bonham, pers. comm.
81	Chyulu Hills South	C, 2005	J. Mutiso, pers. comm
82	Tsavo West	C, 2006	J. Mutiso, pers. comm
83	Kenya South D	H	J. Altmann, pers. comm.
84	Amboseli National Park	H, *ca*. 1983	Chism & Rowell, 1988; L. Isbell, T. Struhsaker, pers. comm.
85	Kiboko	C, 2004	J. Mutiso, pers. comm
86	Emali	H	J. Root through D. Nightingale, pers. comm.
87	Kenya South E	H	Kingdon, 1971
88	Ulu - Kui	H	Lönnberg, 1912; Percival, 1928; Heller, 1911 in Hill, 1966
89	Athi Plains	H	Percival, 1928
90	Kenya South F	H	Kingdon, 1971
91	Nairobi National Park	N	Y. de Jong & T. Butynski, pers. obs.
92	Loita Plains	H	Harvard University, 2007 (MCZ Mammal Collection Database)
93	Masai Mara National Reserve	H	Williams, 1967; Kingdon, 1971
94	Kichwa Tembo	H, 1987	J. Mutiso, pers. comm

Literature survey, museum review, and communications

This study generated 81 patas site localities (including those of the field surveys) in Kenya, of which 36 (44%) are historic (pre-1996; including three questionable) and 45 (56%) are current (post-1995; figure 2, table 3). Only a small proportion of the historic range was surveyed in 2003. It is, therefore, possible that patas are still present in some of the areas that are here given as part of the historic range.

It appears that patas historically occurred in the west, northwest, central and south of Kenya, and occupied an area of roughly 88 800 km², or *ca*. 15% of Kenya's land surface area (including the 30 km zone around each locality). Both the known historic and current range are between 04°00'N - 03°00'S and 34°06' - 38°27'E (figure 2; excluding the 30 km zone around each locality point). Patas are still present in west, northwest, central and south Kenya, but the size of the geographic range has declined to roughly 48 200 km². Thus, the known current geographic range is *ca*. 54% of the known historic range, or *ca*. 8% of Kenya's land surface area. The current populations are more isolated than they were before 1996 (figure 2); the West-central Population has since split in to three smaller populations and the gaps among them range from 100 - 200 km.

Water sources

During field surveys, a total of 110 water sources were recorded (table 4), of which 65% were human-made. About 77% of all recorded water sources contained year round water.

Surveys revealed that throughout their range in Kenya, patas drink from human-made water sources (*e.g.* water tanks, troughs, and dams placed for livestock). All patas groups encountered during the surveys were within 1.2 km of a water source (x=524 m, n=9), and all of these were year round human-made water sources. All patas observed during this study were somewhat habituated to humans, mainly to pastoralists, farmers, and 'monkey chasers' in crop fields.

Table 4. Water sources (WS) recorded in four of the patas monkey Erythrocebus patas *survey areas in Kenya (2003-2005).*

	Total WS	Human-made WS[1]	Semi-natural WS[2]	Natural WS[3]	Permanent WS	Permanent WS per km²
Ol Pejeta Conservancy, Laikipia District	76	51 (67%)	16 (21%)	9 (12%)	61 (80%)	0.16
Alupe Agricultural Research Institute, Busia District	2	1 (50%)	0	1 (50%)	2 (100%)	0.50
Southern Turkana District (only Lokichar, Lopur, Lokapel)	27	18 (67%)	0	9 (33%)	20 (74%)	0.02
West-Pokot District	Not Recorded	-	-	-	-	-
Chyulu Hills, Makueni District	5	(20%)	1 (20%)	3 (60%)	(40%)	0.001
Total	110	71 (65%)	17 (15%)	22 (20%)	85 (77%)	0.028

[1] Artificial water sources: trough, pump, water tap and water tank,
[2] Semi-natural water sources: dam and water drinking pond created for wildlife
[3] Natural water sources: stream, river, mud pool, pond, swamp and rainwater pool

In Lokapel, southern Turkana District (figure 2), people collect ground water by digging a tunnel in a dry river bed. According to the local field assistant, collecting water this way is a common practice. Tunnels are sometimes up to 24 m long and are attractive to primates and other wildlife. According to the field assistant, the Turkanas catch and consume the animals that enter the tunnels, including *P. anubis*. It is highly likely that patas are also captured in these tunnels.

Crop raiding and hunting

In Busia District, 88% (75) of the 85 interviewees mentioned patas as crop raiders. In Alupe, patas have adapted surprisingly well to an area with a high human population and little natural vegetation (table 2). According to the interviewees in and around Alupe, as well as

the staff of Alupe, patas prefer maize, but they also eat cassava, sweet potato, and ground nut. Patas used the fields on a daily basis (according to interviewees and staff of Alupe) and are the most obvious, if not the most important, crop pests. Some patas are killed as a result but they are not eaten by people. Patas in this area were reported to sometimes act aggressively when chased by humans, especially women and children.

In southern Turkana District, 15% (11) of the 71 people interviewed said that patas raid crops and that some are killed in response to this damage. Three of those records are from the west of the District, one from Lopur, and one outside the survey site (Uganda). Crop raiding occurs mainly on farms along the Turkwell River (figure 2) and patas are killed as a result. Six people in southern Turkana District said that people there eat the patas that they kill.

In West-Pokot District, 94% (51) of the 53 people interviewed mentioned patas as crop raiders. The patas are said to enter the crop fields in the wet season, and to forage in the hills during the dry season. Patas are hunted in West-Pokot District in response to crop raiding but they are not eaten by people.

DISCUSSION

Historic and current distribution

This study provides an overview and new information on the historic and current distribution of the patas in Kenya. Although J. Chism & D. K. Olson (Isbell & Chism, 2007) found no evidence for patas in Busia District or in West-Pokot District, patas are now known to be present at low densities in both districts. Some of our findings contradict those presented in the published literature. For example, Kingdon (1971) and Williams (1967) both reported patas in Meru National Park, whereas this study found no support for this. An expedition through Meru District (among many other places), led by Lönnberg in 1911 (Lönnberg, 1912), revealed no evidence for patas in this area. M. Jenkins (pers. comm.), raised in Meru National Park and Warden of this Park for several years, never encountered patas or heard of their presence in Meru District. S. Braude (pers. comm.), who has conducted biological research in Meru National Park for >20 years, has never seen patas in Meru District. Additionally, no evidence for patas was found by TMB and YDJ during visits to the following protected areas in the region to the north and northeast of Mount Kenya: Meru National Park (10 days of survey), Kora National Park (5.5 days), North Kitui National Reserve (0.5 days), Shaba National Reserve (5 days), Buffalo Springs National Reserve (2 days), and Samburu National Reserve (0.5 days). In conclusion, there is no evidence that patas have ever been present in Meru District.

Kingdon (1971) mentions a site for patas 140 km north of Laikipia District (called Kenya North; figure 2, table 3). Williams (1967, p. 71) reports patas ("Reputed to occur but not confirmed.") from Marsabit National Reserve (240 km north of Laikipia District; figure 2, table 3). Kingdon (1971), however, questions Marsabit National Reserve as a patas locality. No details are provided in these reports. Although both areas have yet to be surveyed, there is no evidence for patas in either of them. As such, both localities must be considered 'questionable' patas localities.

Isbell and Chism (2007) speculate that the northern boundary of patas in Kenya is the Ewaso Nyiro and Ewaso Narok Rivers. However, in October 2007, a single adult patas was encountered in open *Acacia* bushland in southwestern Samburu National Reserve by I. Douglas–Hamilton & D. Lentipo (pers. comm., figure 2, table 3) *ca*. 50 km north of

Laikipia District. This is the first and only report of patas in Samburu National Reserve and likely concerns a solitary male. This is also the only detailed record of patas north of the speculated 'boundary' decribed by Isbell and Chism (2007).

Williams (1967) and Kingdon (1971) do not mention Lake Bogoria National Reserve and Lake Baringo as patas localities. However, patas historically did occur in the vicinity of both Lakes (Chirchir, 1993; W. Kimasop, pers. comm.; K. Ngece pers. comm.; M. Roberts, pers. comm.). The latest record from Lake Bogoria is for 2006 (W. Kimasop via C. Withey, pers. comm.).

It is unclear if the population in the south of Kenya (the 'Southern Popullation')was once connected to the population of centre, west, and northwest of Kenya (the 'Central Population'). No records were found for patas between the Athi Plains and Kekopey, which are 120 km apart, or between Athi Plains and Kiganjo which are 135 km apart (figure 2, table 3). The area today supports a high human population. The vegetation is degraded, fragmented, and destroyed in many places by humans and/or domestic animals (White, 1983). Currently (post-1995), the shortest known distance between the Southern Population (Kiboko) and the Central Population (Solio Ranch) is 240 km. The patas population, once present in Loita Plains and in the Masai Mara (figure 2, table 3), was probably once connected with the 'Northern Tanzania Population' (de Jong *et al.*, 2007).

Conservation

Water sources, crop raiding, and hunting

Although the natural habitat over much of Busia District, and to a lesser extent over West-Pokot District, has been severely degraded or converted to agriculture in many places, some patas take advantage of human-made water sources, crops, and a reduced (non-human) predator population. Patas are positively affected by certain human modifications to their environment; for instance, the introduction of water sources, crops, fence posts (used to navigate through woodlands), and prickly pear cactus *Opuntia vulgaris* Mill. (source of food and water) (Chism and Rowell, 1988).

The introduction of agriculture and tourism in their historic range may have benefited some patas populations due to a constant supply of water, year-round food, and security from predators. This has been observed for *C. pygerythrus* around a tourist lodge in Amboseli National Park, Kenya, where they 'raid' the lodge for food. *C. pygerythrus* density is greater around the lodge than away from lodge (Brennan *et al.*, 1985). Also, crop raiding *P. anubis* in Gilgil, Kenya, are heavier than those that do not raid crops (D. Nightingale, pers. comm.). However, the consequences of agricultural conversion on or near patas distributions can outweigh the benefits. Not only are natural food sources, sleeping trees, etc. lost, but farmers often respond to crop raiding by killing raiding individuals, or groups, as occurs in Busia District, West-Pokot District and Turkana District.

Patas are "...justly reported to be one of the most difficult animals in the world to hunt." (Tappen, 1960, p. 102). However, patas are killed and eaten by people in Ivory Coast (Bourlière *et al.*, 1974), Ghana (Asibey, 1974), and Cameroon (Gartlan, pers. comm. in Wolfheim, 1983). Most people in Kenya do not eat patas or any other primates. We are, however, aware of three exceptions. As mentioned above, the Turkana eat primates, including patas. The Teso consider the meat of patas to be good for old people and those suffering from leprosy (Watson, 1950). The people in and near Arabuko-Sokoke Forest (Kenya coast) eat *C. mitis* and yellow baboons *Papio cynocephalus* (Linnaeus, 1766) (Fitzgibbon *et al.*, 1995; N. Moinde, pers. comm.).

Decline of patas due to other wildlife species and habitat degradation

Patas typically have numerous sleeping sites throughout their large (23 - 80 km²) home ranges. In Laikipia District, *A. drepanolobium* are important to patas not only as a year-round source of food but also as sleeping trees (Isbell, 1998). In 1996, Burnham (2004) found a total of four groups of patas in Sweetwaters Wildlife Sanctuary (96 km²; hereafter referred to as 'Sweetwaters') of OPC,. Also found was an abundance of predators, mainly black-backed jackal *Canis mesomelas* Schreber, 1775, and leopard *Panthera pardus* (Linnaeus, 1758). During our 2003-2004 survey, patas were not encountered in Sweetwaters; although, there were reports of one group occasionally using the area. However, during a primate survey of Sweetwaters in 2005-2006 (De Jong, pers. obs.), one group of patas was present in one of the four areas where they ranged in 1996 (i.e., eastern part of Sweetwaters). Sweetwaters continues to have an abundance of predators. Since 1996 there has been severe degradation of *A. drepanolobium* woodlands in Sweetwaters due to over-browsing by large mammals, mainly giraffe *Giraffa camelopardalis* (Linnaeus, 1758), black rhinocerus *Diceros bicornis* (Linnaeus, 1758), and elephant *Loxodonta africana* (Blumenbach, 1797) (Birkett, 2002; Burnham 2004; Y. de Jong & T. Butynski, pers. obs.). Most of the *A. drepanolobium* trees that patas slept and foraged in during 1996 are now over-browsed ,stunted, produce few, if any, flowers and fruits, and may, overall, provide less food for patas than healthy *A. drepanolobium* trees. The one patas group present in 2005-2006 occupies an area where *A. drepanolobium* trees remain unaffected. In short, it appears that patas no longer use large areas of Sweetwaters because suitable trees for food, sleeping and refuge from predators are now absent (Burnham, 2004; Y. de Jong & T. Butynski, pers. obs.). The current absence of healthy *Acacia* spp. probably accounts for much of the decline in abundance and geographic range of patas in Kenya.

Recommendations for conservation

The geographic range of the patas in Kenya (*ca*. 48 200 km²) has declined roughly 54% since 1996 and is now highly fragmented (figure 2, table 3). This study also found that all sites currently inhabited by patas have their unique combinations of threats and conservation challenges (table 5). Habitat degradation, loss, and fragmentation remain primary threats, not only for patas, but for all species of primate in Kenya. For instance, on the Laikipia Plateau, large tracks of tall *A. drepanolobium* woodland are being destroyed for the production of charcoal (Y. de Jong & T. Butynski, pers. obs.).

Conservation actions, including research and monitoring, are required if Kenya's populations of patas are not to suffer further range restriction, fragmentation, and decline. Patas have never been the focus of conservation activities in Kenya, particularly those patas outside Laikipia District. Some indirect activities have (unintentionally) benefited patas, such as the installation of artificial water sources for livestock and/or wildlife, maintaining large areas of tall *A. drepanolobium* woodland for cattle ranching, and keeping predator populations low on behalf of livestock production. In recent decades, the density of large predators has decreased on all of the survey sites (outside the protected areas) due to reduced prey populations, killings in retaliation for livestock depredation, and habitat loss, degradation, and fragmentation (L. Frank, pers. comm.).

Well managed, large (200 – 600 km²) cattle ranches, with livestock densities that do not degrade the environment, numerous water sources, and extensive areas of relatively undisturbed woodlands, are compatible with the long-term conservation of patas (also see Isbell & Chism, 2007). Many such ranches exist on the Laikipia Plateau and they are often contiguous. In contrast, small-hold farms and community lands, which are usually over-

stocked (with cattle, sheep, goats, camels) typically have highly degraded habitats and are marginal or unsuitable for patas, and for many other indigenous species. In order to maintain or provide suitable habitats for patas and other indigenous species, small-hold farms and community lands need to be used in a sustainable manner, providing long-term benefits both to domesticated and wild species.

Table 5. Known and potential threats facing the patas monkey Erythrocebus patas *in five sites in Kenya (2003-2005).*

Survey site	Ol Pejeta Conservancy	Busia District	Southern Turkana District	West-Pokot District	Chyulu Hills
Water for drinking			√	√	√
Hunting in response to crop raiding		√	√	√	
Hunting for bushmeat			√		
High human disturbance		√	√	√	
Habitat loss and degradation by humans		√	√	√	√
Habitat loss and degradation due to other wildlife species	√				

At present, research, monitoring, conservation education, reduction of patas-human conflict, water provisioning (*e.g.* cattle troughs), and maintaining large tracts of natural woodland are priority actions for the conservation of patas in Kenya.

During this study, a database ('PatasBase') for patas in Kenya was established. PatasBase is updated whenever new information is received. PatasBase serves as an accessible 'living' database to support patas research and conservation initiatives, such as the periodic *IUCN Red List* Degree of Threat Assessments by the IUCN/SSC Primate Specialist Group. PatasBase can be accessed at www.wildsolutions.nl.

Recommendations for immediate conservation action include:

1. Determine the distribution and abundance of patas northeast of Lake Baringo and Lake Bogoria, and in Turkana District and West-Pokot District.
2. Survey Kenya's patas populations every 10 years to determine distribution, abundance, and population trend, and reassess priorities for conservation action.
3. Assess the impact of hunting, both for bushmeat and in defence of crops, on patas distribution and abundance, find ways to ameliorate the impact, and implement the findings.
4. Assess the impact of patas on crops, find ways to reduce the damage, and implement the findings.

5. Halt unsustainable charcoal production practices within the range of patas.
6. Determine how best to manage small-hold farms and community lands as habitat for maintenance of patas and implement the findings.
7. Establish a network of interested and knowledgeable people throughout Kenya who will assess the size and age/sex composition of those patas groups that they encounter, and report the details to the patas database ('PatasBase'). See above.

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