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Trip Report*

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CHAD RODENT RESEARCH AND RODENTICIDE FIELD TRIALS

October 11-November 11, 1992

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ITINERARY

Date	Location	Activity
Oct 11-13	Philadelphia, Pennsylvania, to N'Djamena, Chad, Africa	Travel
Oct 13-19	N'Djamena	Attended briefing with officials of the U.S. Agency for International Development (USAID).
Oct 19-29	N'Gouri	Conducted field work: rodent monitoring, initiated pitfall traps, continued rodenticide trials, and trapped animals for population studies.
Oct 29-Nov 2	N'Djamena	Briefed USAID, the Office for Rehabilitation Through Training (ORT), and the Ministry of Agriculture (MOA)/Crop Protection Service (CPS).
Nov 2-5	Karal; Guite	Conducted rodent population studies.
Nov 5-10	N'Djamena	Prepared trip report and briefed USAID officials.
Nov 10-11	N'Djamena, Chad, to Philadelphia, Pennsylvania	Travel

INTRODUCTION

The Chad Rodent Control Research Project (RCRP) was initiated, in part, as a result of the 1986-87 rodent population irruption in the Sahelian area of Chad. This Project is a cooperative program among the Chad MOA/CPS; AID/N'Djamena; and the USDA/Animal Plant Health Inspection Service/Animal Damage Control/DWRC. The project is organized to conduct applied research and to provide training to MOA personnel so that safe, effective, and economical rodent control techniques can be implemented when needed in the future.

OBJECTIVES

The objectives of this consultancy were to (1) evaluate the efficacy and appropriateness of alternate control methods, (2) assist the Chad RCRP in rodent population monitoring studies, (3) conduct rodenticide field trials to obtain information on acceptance, efficacy and potential hazards to nontarget species, and (4) continue collecting data on the status of rodent populations in the Sahel region of Chad. Objectives of mammal surveys were to determine the kinds of species present, test methods for sampling abundance of species, and recommend methods for use in research. Monitoring methods will measure the relative abundance of rodent populations, or relative change in rodent activity. Monitoring methods should be adequate to detect changes in the population, either an increase or decrease. Research will continue on the evaluation of a nonpoisonous removal method (pitfalls).

FIELD RESEARCH

N'GOURI

Field work was conducted near N'Gouri, on the northeast side of Lake Chad, from October 19-29, 1992. We installed pitfall traps, conducted rodenticide trials in cultivated and noncultivated dune areas, and monitored rodent populations. We also conducted roadside censuses by vehicle, excavated burrow systems, performed burrow counts, and autopsied adult rodents for reproductive information.

Pitfalls

We installed eight pitfall traps (clay containers about 60-cm deep and 30-cm in diameter at the mouth, used as water jars). These pitfalls were installed on October 22 in the Goural wadi, which contained one previously installed pitfall. Using a water jar that had been transported from N'Djamena as an example, we purchased pitfalls locally in N'Gouri. The jars were installed into the bed of the wadi about 1 m out from the fencerows and approximately 30 m apart with the lips even with the surface. About

10 cm of water was added to each trap. The pit traps were checked on October 28 and contained 23 beetles (*Coleoptera* sp.). A technician living at N'Gouri has been provided with data sheets (Annex I) to record and recover any animals that have fallen in the pit traps. Pit traps will be checked weekly. All captures such as lizards, toads, beetles, and other insects will be recorded, since this removal alternative may seize nontarget animals.

Monitoring

Rodent population sampling and activity monitoring were conducted in six wadis and six dunes from October 20 to 28. Sampling was done at wadis with live traps, rat snap traps, tracking tiles, and bait piles. Dunes, both cultivated and noncultivated, were sampled using mouse snap traps, bait piles, and tracking tiles. Throughout the sampling period a station could consist of any combination of the preceding methods. Baits included maize on the cob in live traps and peanut oil or peanut butter rolled in millet on both rat and mouse snap traps. Bait stations were set by placing about 15 g or one tablespoon of millet at a trapping station. Activity was recorded as positive if ≥20% of the bait pile was removed overnight. Tracking tiles were recorded positive when footprints were present. In wadis, stations were placed at 10-m intervals along the cultivated margin and the cultivated interior of the wadi. In dunes, stations were placed within 1 m of active burrow systems. Two or three mouse traps were used per station.

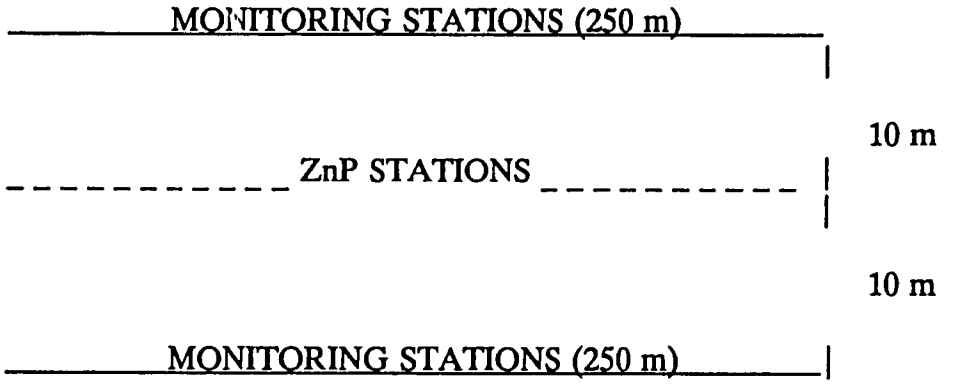
A total of 66 rodents was captured over 410 trap nights in wadis (Table 1). *Arvicanthis niloticus* comprised 66% of the captures; *Mastomys natalensis*, 20%; *Tatera robusta*, 10%; and *Taterillus* sp., 4%, respectively. Rat snap traps had a 10% success rate compared with 41% for live traps, 44% for bait piles, and 46% for tracking tiles. In dunes, 44 rodents were captured over 533 trap nights (Table 2). *Gerbillus* sp. comprised 100% of the captures. Trap success was 8%, even when traps were placed around active burrows. However, this may be explained by not using millet as a bait during early monitoring sessions. When millet was used, capture success increased dramatically. Tracking tiles had a 21% success rate, and bait stations a 41% success rate. No *Jaculus jaculus* were captured in snap traps in the dunes. Given the differences in success rates, it would be well to continue to use several monitoring methods simultaneously rather than relying on only one method.

Rodenticide Trials

A 1%-zinc phosphide (ZnP) bait was formulated (1 g of 94% active ingredient zinc phosphide + 2 g of peanut oil + 97 g of millet) 4 days before using it. The four dunes selected for the trials were within 6 km of N'Gouri. Before the trials began, each dune was inspected for rodent activity (tracks and active burrow systems). In each dune, two transects for monitoring pretreatment activity were established and marked with engineering tape. The transects were 20-m apart and parallel to each other (Fig. 1). Each transect line consisted of 20 live traps, 25 tracking tiles, and 25 bait piles. Monitoring stations were established at 10-m intervals along each 250-m transect line.

Stations were placed within 1 m of signs of rodent activity. Transects incorporated both cultivated and noncultivated exteriors. Tracking tiles were examined for the presence of rodent tracks. Bait piles were recorded as positive if ≥20% of the pile was removed overnight. The observer noted no insects were responsible for the bait removal.

Fig. 1.



After the pretreatment period, baiting with ZnP rodenticide was conducted in the four dunes selected for the trial. Twenty-five ZnP bait stations were placed 10 m apart on a line equidistant between each pretreatment monitoring transect. Baiting with rodenticide was conducted for 3 to 4 nights in the four dunes. About 15 g of ZnP-treated millet was placed on the ground in a pile and monitored daily. All bait stations were covered for the duration of the trial with PVC pipe between 12 and 18 inches long and open at both ends. Bait removal was recorded as positive if ≥20% of the bait pile was removed overnight. The bait pile was replenished to the original amount if ≥50% of the pile was removed. Stations were removed when monitoring ceased. Each dune was searched daily for dead rodents and any nontarget wildlife. Searches were conducted by five people for 20 to 30 minutes each day of the trial. In addition, children were asked to search for any dead animals in the vicinity. No nontarget animals were found on any of the dunes.

A 1-night posttreatment monitoring period using 50 mouse snap traps, 50 tracking tiles, and 50 millet bait piles was then conducted in each dune. Each station consisted of a snap trap, tracking tile, and a bait pile placed along the original pretreatment monitoring transects. Bait acceptance appeared good during both pretreatment and treatment periods (Table 3). Bait consumption showed a decline for all dunes during the treatment period. Bait piles showed the greatest reduction in rodent activity posttreatment. Captures increased slightly in two dunes. However, this may be attributed to the bait (millet) used in mouse snap traps posttreatment vs. corn, potatoes, or cardboard soaked in peanut oil used in live traps pretreatment. Fifteen dead *Gerbillus* were found over the four dunes during the ZnP treatment period and posttreatment monitoring. Autopsies revealed ZnP-treated millet in all stomachs. The

furthest carcass from the ZnP bait line was 17-m. Bait acceptance appeared greater when the 12-inch covers were used vs. the 18-inch covers.

Burrow Counts

Two burrow count transects were established in the Kiri-Kala dune. The transects were 250-m long in representative habitat. While walking along the transect, fresh open and closed burrows were tabulated. Only burrows within 2 m on either side of the transect were counted. Flagging was used to establish the transect lines for future monitoring. On October 25, the two transects contained 31 and 63 fresh burrows. This represents 31 and 63 burrows/1,000 m^2, or 310 and 630/ha. These same transects will be recounted again in December to note any changes in numbers.

Road Counts

We conducted three roadside counts by vehicle at night near N'Gouri to count rodents. *J. jaculus* was the most abundant species seen at night (Table 4). This species was not captured in any snap or live traps. *Jaculus* was most readily spotted adjacent to millet fields. Ten were captured by hand. We sighted an average of 3.2 rats/km.

Miscellaneous Activities

We excavated three burrow systems of *Gerbillus* sp. in the dunes. We found one juvenile in one of the systems. All burrows had *Tribulus terrestris* seeds stored inside them. All captured animals were measured and adult females autopsied (Annex II). Study skins and skulls of all species were prepared. Table 5 summarizes reproductive data for adult female rodents autopsied. Table 6 compares overall success of snap traps, live traps, tracking tiles, and bait stations for monitoring rodent activity and populations around N'Gouri. Overall, snap traps were the least effective means of monitoring rodent populations. All farmers interviewed expressed concern about crop loss to birds. There was a lot of bird activity in and around all of the dunes.

KARAL

Monitoring

Field work was conducted near Karal and Guite on the southeast side of Lake Chad from November 2 to 5. We placed 25 rat snap traps overnight about 500 m east of Beltram in a noncultivated field, where we caught two *Taterillus* sp. Lake Chad had risen to within 1-km of Beltram, flooded the road, and prohibited any monitoring past this location. We then proceeded to Guite where Lake Chad was also unseasonably high. All sorghum, potato, okra, cassava, and rice fields were either planted and irrigated or being prepared for planting. We monitored only noncultivated exteriors.

No cultivated interiors were available for monitoring. We set one trap line of 50 rat snap traps and 25 mouse snap traps. We also set a trap line of 25 rat snap traps (Table 7). Capture success was 53% for these two transects. This exceptional capture success was caused by the rodents concentrating ahead of the advancing flood waters from the lake. Species composition was *T. robusta* (39%), *Taterillus* sp. (33%), *A. niloticus* (12%), *M. natalensis* (12%), *Gerbillus* sp. (2%), and *Mus* sp. (2%). All rodents were measured and mature females autopsied for reproductive data (Annex III). No pregnant or lactating females were seen, but immature animals comprised 35% of the collection, indicating breeding had taken place 6 weeks or more before. Study skins and skulls of representative species were prepared.

DISCUSSION

Field Trials

The ZnP field trials resulted in between 15 and 73% reduction in rodent activity measures on the four dunes. This is about the normal efficacy for this rodenticide when used in the field. No evidence of poisoning of nontarget animals was found despite diligent searches. No dead *J. jaculus* were found, even though this species frequents the dune areas where the poisoning was done. It might be that *Jaculus* are reluctant to enter the covered bait stations.

Rodent Breeding and Population Structure

Unstriped grass rats (*A. niloticus*) and *Gerbillus* sp. were actively breeding at N'Gouri, with 35% of unstriped grass rats visibly pregnant and another 39% lactating with nursing young (Table 5). The gerbils ran 54% pregnant and another 17% lactating. Immatures comprised 16% of the unstriped grass rats, 71% of the fringe-tailed gerbils, 69% of the multimammate rats, and 18% of the *Gerbillus* sp.. At Beltram and Guite, while no pregnant or lactating female rodents were seen, immatures comprised 35% of the collection (50% of *A. niloticus* were immatures; 29% of *T. robusta*; 35% of *Taterillus* sp.; and 50% of *M. natalensis*).

The presence of multimammate rats in the wadis at N'Gouri is exceptional; only rarely in the last 3 years have they been captured in this habitat. Likewise at Guite, *A. niloticus* was collected where it had not previously been seen. Some unusual events appear to be taking place in the rodent populations this season. Several species, such as *A. niloticus* and *M. natalensis* (the former had been rare at the Karal area in the past and the latter, rare at N'Gouri in the previous 2 years) are present now in considerable numbers. This is indicative of actively breeding and dispersing populations.

Comparison of Rodent Monitoring Methods

Snap traps were the least effective means of monitoring rodent population activity, both in the wadis and on the dunes (Table 6). Live traps (41% success), tracking tiles (35%), and bait stations (43%) all showed reasonable agreement and indicated a fairly high population activity. All activity measures had increased from Dolbeer's (1992) observations made in late September. Actually an overall 9% trapping success at N'Gouri for snap traps was the highest seen during the project since December/January 1989-90.

RECOMMENDATIONS

1. Zinc phosphide, at a 1% concentration on millet bait with an added 1 to 2% peanut oil, is an excellent toxicant to use against *Gerbillus* sp. populations on dunes should there be a need to control these rodents. It is likely that *Gerbillus* and *Jaculus* are involved in gathering and eating millet seeds at the time of sowing, resulting in farmers having to replant a second or third time to achieve an adequate planting.

2. The unusual events occurring in the rodent populations at N'Gouri and Karal should be followed up on the next TDY and perhaps into the next year. It appears that the excellent rains and the abundant harvest of millet may have stimulated rodent populations, virtually dormant for a long time, into increased breeding and dispersal in these areas.

ACKNOWLEDGMENTS

I thank Dr. Maho Angaya for his assistance and leadership. I commend our driver, Mr. Mahamet El-Hadji N'Gaba, for his excellent driving skills and assistance with the field work. I am thankful for the able assistance offered by Mr. Djibo Koulangar. His assistance at N'Gouri and Karal is greatly appreciated. I also note the excellent assistance provided by Mr. Omar Maddu, who served as our guide and helper at N'Gouri. I appreciate the assistance provided by Mr. Dezoumbe Djonret, Assistant to the ADO, and to Dr. Trid Mukherjee, ADO at USAID. Many thanks to ORT personnel Mrs. Wendy Asher and Mr. John Smith, Agricultural Cooperative Development International (ACDI) Guesthouse for their excellent hospitality.

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Table 1. Activity monitoring effort and success for rat snap traps, live traps, tracking tiles, and bait stations in wadis near N'Gouri, Chad, October 21-28, 1992.

	WADI						
	Tomossi	Goural	Guini	Madekouri	Assankadori	Kaya	Total
Live Traps							
No. trap nights	25	25	25	0	0	0	75
No. captures	15[b]	8[c]	8[d]	0	0	0	31
% success	60	32	32	0	0	0	41
Rat Snap Traps							
No. trap nights	75	74	73	39	49	25	335
No. captures	15[b]	17[c]	0	2[e]	1[f]	0	35
% success	20	23	0	5	2	0	10
Tracking Tiles							
No. nights	25	50	25	40	25	25	190
No. marked	15	25	14	13	10	11	88
% success	60	50	48	32	40	44	46
Bait Stations							
No. nights	25	50	50	40	25	10	200
No. piles eaten[a]	13	22	27	8	11	6	87
% success	52	44	54	20	44	60	44

[a] At least 20% of bait pile was eaten overnight.
[b] 20 *A. niloticus*, 9 *M. natalensis*, 1 *Taterillus* sp.
[c] 18 *A. niloticus*, 4 *T. robusta*, 3 *M. natalensis*
[d] 4 *A. niloticus*, 2 *T. robusta*, 1 *M. natalensis*, 1 *Taterillus* sp.
[e] 1 *A. niloticus*, 1 *T. robusta*
[f] 1 *A. niloticus*

Table 2. Activity monitoring effort and success for mouse snap traps, tracking tiles, and bait stations in dunes near N'Gouri, Chad, October 21-28, 1992.

	DUNE*						
	Madekouri	Yagra	Wolaldji	Boholi	Assankadori	Kiri-Kala	Total
Mouse snap traps							
No. nights	25	124	97	147	94	46	533
No. captures**	0	4	9	17	5	9	44
% success	0	3	9	12	6	19	8
Tracking tiles							
No. nights	25	50	25	25	25	25	175
No. marked	4	9	5	6	5	8	37
% success	16	18	20	24	20	32	21
Bait stations							
No. nights	25	50	0	25	25	0	125
No. eaten***	8	23	0	12	9	0	52
% success	32	46	0	48	36	0	41

* Totals do not include data from ZnP trials.
** *Gerbillus* sp. were the only animals captured.
*** At least 20% of bait pile was removed overnight.

Table 3. Zinc Phosphide (ZnP) field trials at dunes near N'Gouri, Chad, October 1992. Bait piles were fed upon, tracking tiles marked, and rodents captured. (Bait piles are indicated as positive if ≥20% were removed overnight).

Dune Area		Pretreatment activity			Treatment period				Posttreatment activity		
		Bait piles *N*=50	Track tiles *N*=50	No. live trapped *N*=40	Bait piles eaten/day (*N* = 25) 1	2	3	4	Bait piles *N*=50	Track tiles *N*=50	No. snap trapped *N*=50
Wolaldji	No.	29	11	1*	16	12	12	6	10	3	2*
	%	58	22	2.5	64	48	48	24	20	6	4
Boholi	No.	24	8	0	14	9	8	-	11	3	1*
	%	48	16	0	56	36	32	-	22	6	2
Madeklia	No.	13	7	0	8	9	11	8	11	2	0
	%	26	14	0	32	36	44	32	22	4	0
Yagra	No.	27	10	0	14	13	8	8	14	2	0
	%	54	20	0	56	52	32	32	28	4	0

* *Gerbillus* sp. were the only animals captured.

Table 4. Nightime Rodent Census

Date	Start time	Distance	No. Observed			
			J. jaculus	*Gerbillus* sp.	Total	No./km
10/21/92	1930	5 km	24	1	25	5
10/24/92	1915	5 km	12	0	12	2.4
10/27/92	1900	5 km	15	1	16	3.2

Note: Ten *Jaculus jaculus* were captured by hand.

Table 5. Reproductive data for adult female rodents captured and autopsied at N'Gouri, Chad, October 21-28, 1992.

Species	No. females autopsied	No. pregnant	No. lactating	Avg. litter size	Percent immatures
Arvicanthis niloticus	23	8	9	5.0	16
Tatera robusta	2	0	2	-	71
Mastomys natalensis	2	0	1	-	69
Gerbillus sp.	24	13	4	3.8	18
Jaculus jaculus	1	0	1	-	

Table 6. Overall comparison of snap traps, live traps, tracking tiles, and bait stations for monitoring rodent populations in N'Gouri, Chad, October 1992.*

Monitoring method	No. of trap, baiting or tracking nights	No. of captures, or positive tracks or piles eaten	Percent success
Snap traps	868	79	9
Live traps	75	31	41
Tracking tiles	365	125	35
Bait stations	325	139	43

* Data does not include results from ZnP rodenticide trials.

Table 7. Activity monitoring effort and success for rat and mouse snap traps in noncultivated areas near Beltram and Guite, Chad, November 3-5, 1992.

	GUITE	BELTRAM
Rat snap traps		
No. trap nights	75	25
No. captures	48[a]	2[b]
% success	64	8
Mouse snap traps		
No. trap nights	25	0
No. captures	5[c]	0
% success	20	0

[a] 21 *Tatera robusta*, 15 *Taterillus* sp., 6 *Arvicanthis niloticus*, 5 *Mastomys natalensis*, 1 *Mus* sp.

[b] 2 *Taterillus* sp.

[c] 3 *Taterillus* sp., 1 *Gerbillus* sp., 1 *M. natalensis*

Annex I.

PITFALL TRAP DATA

		Animals Captured					
Date	Wadi	*A. nil.*	*T. rob.*	Other rodents	Toad	Lizard	Ins.
10/28/92	Goural	0	0	0	0	0	23[a]

[a] *Coleoptera* sp.

Annex II. Measurements of Rodents from N'Gouri, Chad

Species	Sex	Wt.	HBL	Tail	H. foot	Ear	Remarks
WADIS:							
Arvicanthis niloticus	M	U	U	130	30	U	-
" "	F	100	150	125	30	15	lactating
" "	F	100	165	125	25	16	-
" "	F	106	175	135	20	16	lactating
" "	F	74	125	120	30	16	-
" "	F	80	140	U	30	15	-
" "	F	72	135	110	30	16	Preg. 6 emb.
" "	F	42	105	100	26	12	Immature
" "	M	118	170	130	30	14	-
" "	F	84	135	115	30	16	lactating
" "	M	162	190	140	31	16	-
" "	F	116	170	110	27	16	-
" "	M	18	95	80	22	12	Immature
" "	F	18	80	75	22	13	Immature
" "	F	130	160	130	27	16	Preg. 5 emb.
" "	F	110	160	125	30	14	-
" "	F	112	160	130	30	15	lactating
" "	M	138	170	135	34	16	-
" "	M	140	170	125	31	17	-
" "	F	88	150	115	30	14	Preg. 5 emb.
" "	M	112	170	125	26	14	-
" "	M	70	130	120	30	14	Immature
" "	F	40	105	105	30	14	Immature
" "	F	112	150	130	30	17	lactating
" "	F	104	140	105	32	13	Preg. 4 emb.
" "	F	80	125	125	30	12	Preg. 4 emb.
" "	F	116	145	130	31	12	Preg. 7 emb.
" "	F	80	135	110	30	13	Preg. 5 emb.
" "	M	U	125	125	31	13	-
" "	M	118	150	130	32	16	-
" "	M	134	160	150	33	16	-
" "	F	102	150	130	33	15	Preg. 4 emb.
" "	M	100	150	125	33	14	-
" "	F	102	150	130	32	12	lactating
" "	M	58	130	115	30	14	Immature
" "	U	U	U	U	U	U	
" "	U	U	U	U	U	U	
" "	M	131	170	132	31	18	-
" "	F	58	132	111	30	16	lactating
" "	F	114	160	135	31	18	lactating
" "	U	U	U	U	U	U	-
" "	F	125	160	130	27	16	lactating
" "	M	105	150	125	30	15	-
" "	F	50	120	110	27	16	Immature

Annex II. (Continued)

Species	Sex	Wt.	HBL	Tail	H. foot	Ear	Remarks
WADIS:							
Mastomys natalensis	U	U	U	U	U	U	Immature
" "	F	U	105	U	22	U	Immature
" "	F	16	80	95	22	14	Immature
" "	F	U	U	100	22	U	Immature
" "	U	U	U	100	24	U	-
" "	U	U	U	U	23	U	-
" "	U	U	U	U	U	U	Immature
" "	F	18	90	100	22	16	Immature
" "	F	56	130	130	25	16	lactating
" "	F	34	110	125	22	16	Immature
" "	M	26	115	145	21	14	Immature
" "	F	32	100	125	24	16	-
" "	F	20	90	105	22	13	Immature
Taterillus sp.	M	38	110	140	32	17	-
" "	U	U	U	U	U	U	-
Tatera robusta	M	132	175	180	37	16	-
" "	M	56	130	150	35	16	Immature
" "	M	50	130	U	37	U	Immature
" "	M	50	115	145	34	18	Immature
" "	F	126	165	185	40	20	lactating
" "	M	22	95	100	31	14	Immature
" "	F	125	150	180	37	17	lactating
DUNES:							
Gerbillus sp.	F	26	90	110	24	12	Preg. 3 emb.
" "	M	18	85	115	24	12	-
" "	F	16	80	100	24	12	-
" "	F	8	70	85	23	11	Immature
" "	F	6	60	80	23	11	Immature
" "	M	22	85	100	25	U	-
" "	M	22	90	105	25	U	-
" "	M	14	75	95	24	12	-
" "	M	18	80	110	26	14	-
" "	M	16	80	100	23	U	-
" "	F	26	90	110	24	12	Preg. 3 emb.
" "	F	20	90	120	24	U	-
" "	F	20	85	105	22	12	-
" "	M	28	100	115	25	13	-
" "	F	28	90	110	23	13	Preg. 4 emb.
" "	F	20	85	110	23	12	Preg. 2 emb.
" "	F	18	80	110	22	12	-
" "	F	18	85	110	24	13	lactating

Annex II. (Continued)

Species	Sex	Wt.	HBL	Tail	H. foot	Ear	Remarks
DUNES:							
Gerbillus sp. "	F	20	85	105	23	12	Preg. 3 emb.
" "	F	28	90	120	24	12	Preg. 4 emb.
" "	F	28	95	120	23	12	Preg. 4 emb.
" "	F	24	85	120	24	12	Preg. 4 emb.
" "	F	20	85	105	23	12	Preg. 3 emb.
" "	F	26	90	120	25	12	lactating
" "	M	18	85	110	24	U	-
" "	M	20	90	110	25	13	-
" "	M	18	80	105	24	13	-
" "	F	U	U	90	22	U	Immature
" "	F	36	90	125	25	12	-
" "	F	8	60	80	22	12	Immature
" "	F	30	95	120	25	13	Preg. 5 emb.
" "	F	28	95	115	24	12	Preg. 6 emb.
" "	M	18	85	110	23	12	-
" "	M	16	80	110	24	U	-
" "	F	18	90	110	24	13	-
" "	M	24	90	120	25	12	-
" "	F	28	100	125	25	13	lactating
" "	F	30	95	120	25	13	lactating
" "	M	18	80	115	25	U	-
" "	F	26	90	120	25	13	Preg. 4 emb.
" "	F	12	75	100	25	U	Immature
" "	M	12	75	90	24	U	Immature
" "	M	9	75	92	25	11	Immature
" "	U	U	U	U	U	U	-
" "	M	32	95	125	25	13	-
" "	F	26	95	115	24	13	Prg. 4 emb.
" "	M	20	80	110	23	12	-
" "	F	20	80	110	23	12	-
" "	F	12	75	95	23	12	Immature
" "	F	5	60	60	18	8	Immature

Annex III. Measurements of rodents captured in Beltram and Guite, Chad.

Species	Sex	Wt.	HBL	Tail	H. foot	Ear	Remarks
Taterillus sp.	M	34	110	125	30	16	-
" "	F	60	120	150	30	18	-
" "	F	U	105	140	25	16	-
" "	F	U	U	125	30	U	-
" "	F	U	U	155	30	U	-
" "	F	U	90	95	25	16	Immature
" "	U	U	105	125	30	U	-
" "	M	64	135	150	30	17	-
" "	M	62	130	170	30	17	-
" "	F	32	120	130	30	18	Immature
" "	M	40	115	140	30	17	Immature
" "	F	32	100	130	30	16	Immature
" "	M	60	130	140	30	17	-
" "	F	56	125	U	30	17	-
" "	F	46	120	145	30	16	-
" "	F	26	100	125	30	16	Immature
" "	F	30	100	130	30	18	Immature
" "	F	U	90	U	30	16	Immature
" "	F	44	115	150	30	17	-
" "	U	U	U	140	30	17	-
Tatera robusta	M	130	165	170	36	20	-
" "	M	126	165	180	32	20	-
" "	F	132	160	165	33	20	-
" "	M	112	155	170	36	20	-
" "	M	94	150	155	36	20	-
" "	M	86	159	170	35	18	-
" "	M	108	145	165	31	18	-
" "	M	108	150	160	35	20	-
" "	M	104	150	170	35	20	-
" "	F	62	130	150	35	18	-
" "	M	120	155	U	35	20	-
" "	M	140	150	140	34	17	-
" "	M	98	130	140	34	17	-
" "	M	86	145	160	35	17	-
" "	M	60	130	140	33	18	-
" "	F	50	125	140	33	17	Immature
" "	M	U	140	165	33	18	-
" "	M	90	150	160	32	16	-
" "	F	60	130	135	33	17	Immature
" "	F	30	100	110	30	17	Immature
" "	M	32	100	115	25	17	Immature

Annex III. (Continued)

Species	Sex	Wt.	HBL	Tail	H. foot	Ear	Remarks
Mastomys natalensis	F	18	90	85	22	18	Immature
" "	F	26	100	105	22	16	Immature
" "	U	18	90	95	21	15	Immature
" "	U	U	U	95	25	15	-
" "	M	76	130	120	27	16	-
" "	F	64	130	110	25	17	-
Arvicanthis niloticus	M	170	170	135	35	15	-
" "	F	72	135	105	28	15	-
" "	F	68	135	105	26	14	-
" "	M	78	130	110	30	16	Immature
" "	F	140	150	125	32	12	-
" "	F	106	145	110	30	15	-
Gerbillus sp.	M	26	100	110	25	13	-
Mus sp.	M	U	U	105	30	U	-