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Notes on the current distribution and the ecology of wild golden hamsters (*Mesocricetus auratus*)

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Abstract

Two expeditions were carried out during September 1997 and March 1999 to confirm the current existence of *Mesocricetus auratus* in northern Syria. Six females and seven males were caught at different sites near Aleppo. One female was pregnant and gave birth to six pups. Altogether, 30 burrows were mapped and the structures of 23 golden hamster burrows investigated. None of the inhabited burrows contained more than one adult. Burrow depths ranged from 36 to 106 cm (mean 65 cm). Their structure was simple, consisting of a single vertical entrance (gravity pipe) that proceeded to a nesting chamber and at least one additional food chamber. The mean length of the entire gallery system measured 200 cm and could extend up to 900 cm. Most burrows were found on agricultural fields preferentially on leguminous cultures. The distribution of golden hamsters is discussed in association with historical data, soil types, geography, climate and human activities. All 19 golden hamsters were transferred to Germany and, together with three wild individuals supplied by the University of Aleppo, form a new breeding stock.

Key words: golden hamsters, behaviour, ecology, reproduction, Syria

INTRODUCTION

The Syrian or golden hamster *Mesocricetus auratus* (Waterhouse, 1839) is one of the best-established experimental animals and probably among the most popular pets in the western world. A wealth of data on the behaviour, chronobiology, immunology and physiology of the species have been obtained from laboratory-bred individuals. The entire laboratory population of golden hamsters originated from a single brother–sister pairing in 1930 (Aharoni, 1932) with the exception of 12 wild animals brought to the U.S.A. in 1971 (Murphy, 1985). Since then only a few golden hamsters have been caught in Syria and Turkey (Table 1). In contrast to the popularity of the hamster, virtually no data exist concerning its ecology, population genetics or even its recent occurrence in the wild. This is partially because of its narrowly restricted distribution area. Two expeditions were organized to furnish proof of the existence of golden hamsters in northern Syria and if possible to acquire wild animals for behavioural and genetic studies.

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MATERIALS AND METHODS

Joint expeditions by the universities of Halle (Germany) and Aleppo (Syria) were led to northern Syria in late summer 1997 and spring 1999. The aim of the first expedition (30 August–13 September 1997) was to explore the presumed distribution area around Aleppo and to identify suitable hamster habitats. The hamster search included the location of used burrows and an attempt to catch animals with live-traps baited with apple and melon pieces. Interviews with village elders and economists were carried out. A photograph of the golden hamster was shown to the interviewees who then had to describe the typical features of a golden hamster burrow as well as morphological characteristics of the animal itself, including differences from other related species, e.g. the grey hamster *Cricetulus migratorius*.

The second expedition from 4 to 27 March 1999 was led to the most promising hamster sites. Twenty-three burrows were excavated, measured and where possible the animals caught. Means and standard deviations of all measurements are presented. Additionally, a typical soil profile was drawn up in the region near Azaz. The characterization of the soil horizons followed Scheffer & Schachtschabel (1998) and Spaagaren (1994). Two data loggers (OTLM Gemini Data Loggers (U.K.) Ltd) were used to monitor the air temperature 70 cm above

Table 1. List of historic and recent distribution records of golden hamster *Mesocricetus auratus*

Map location[a]	Location	Date	Reference	Remarks
1	Aleppo (?)[b]	1797	Russel & Russel, 1797	Earliest description of the golden hamster
	Aleppo (?)	1839	Waterhouse, 1839	Type specimen, probably caught by the Russel brothers
	Aleppo (?)	1880	Reynolds, 1954	J. H. Skene, Consul General at Aleppo brought living hamsters to Britain
	Aleppo	June 1902	Nehring, 1902	1 preserved ♀ was sent to Berlin by Zumoffen (Beirut)
	Aleppo	12 April 1930	Aharoni, 1932	1 ♀ and 11 juveniles were excavated by I. Aharoni, 3 ♂♂ and 1 ♀ are the ancestors of all captive golden hamsters
	Aleppo (?)	1962/1972	Kumerloeve, 1975	3 hamsters were caught and sent to Turkey (1) and to the U.S.A. (2)
	Aleppo	Autumn 1982	Ch. Henwood, pers. comm.	1 ♂ and 1 ♀ were caught, ♀ was brought alive to London, cross-pairing with laboratory hamsters failed
	Aleppo	May–June 1971	Murphy, 1971	13 hamsters were trapped, 4 ♂♂ and 8 ♀♀ were transferred to the U.S.A. and separate breeding stock established (Coe & Ross, 1997)
	Aleppo	1978	Murphy, 1985	2 ♀♀ were brought to the U.S.A. by B. Duncan
2	Biliramun	April 1930	Aharoni, 1932	Further 3 ♀♀ were collected by I. Aharoni, the skulls are in Berlin
3	Azaz	April 1930		
4	Antakya (?)	Spring 1949	Eisentraut, 1952	According to Eisentraut a gravid ♀ was caught 20 km east of Antakya and 2 ♂♂ offspring were taken to Germany. This finding was not confirmed by others and has to be questioned
5	Jarablus	1986	H. Tichy, pers. comm.	3 ♂♂ were brought to Tübingen (Germany), cross-pairing with laboratory hamsters failed
6	Kesiktas	July 1991, 1996, 1997	Dogramaci *et al*., 1994; H. Kefelioglu, pers. comm.	4 hamsters were collected for taxonomic studies
7	Kilis	Spring 1999	N. Yigit , pers. comm.	1 ♂ and 1 ♀ were sampled for taxonomic studies, further records in Yigit *et al*., 2000
8	Albel	March 1999	This paper	7 ♂♂ and 6 ♀♀ caught at Albel (3,2), Shaykh-Riek (1,1) and Arnaz (3,3); 30 burrows were mapped and 18 measured completely
9	Shaykh-Riek			
10	Arnaz			The hamsters were transported to Halle (Germany) and form the source of a new breeding stock

[a] See Fig. 1.
[b] (?) Unconfirmed reference.

ground and the soil temperature at a depth of 70 cm. Registration was carried out every 12 min. The locations of all hamster burrows were assessed using a GPS-location system (GPSMS1 from μ-blox, Switzerland).

RESULTS

Animals

Altogether 13 hamsters, seven males and six females, were caught at two locations near Albel/Shaykh-Rieh and Arnaz about 50 km north-east and 20 km south-west of the city Aleppo, respectively (Table 2). Average adult body weight was 99.5 ± 5.9 g (± SD) for males ($n = 6$) and 76.0 ± 13.7 g for females ($n = 3$). One female was pregnant (excluded from body measurements) and gave birth to six offspring. Three 2- to 3-week-old juveniles (one male and two females) were found inside burrow 30, which had been used for several years. There were no obvious morphological differences in comparison to laboratory animals except that the coloration of wild hamsters seems slightly more intense.

Eleven animals were excavated from their burrows. Local farmers trapped two other individuals by flooding the burrows. Only one female showed several scabbed bite marks on her back. All other hamsters were in good physical condition without injuries or obvious bite marks and were free of ectoparasites.

Burrow structures

Thirty hamster burrows were found and mapped. Twenty-three were excavated and measured. Complete data are only available for 18 burrows, since not all the tunnels in the remaining burrows were detected. Fully excavated burrows without hamsters were categorized as hamster 'absent' if clear signs of activity (e.g. fresh green plant material) were detected or as 'deserted' when lacking such signs (Table 2).

Burrow depths varied between 36 and 106 cm and averaged 64.8 ± 17.6 cm. The mean total tunnel length was 199.5 ± 92.6 cm and could range for > 9 m (burrow 30). The burrow entrances measured 4–5 cm in diameter and led into a vertical tunnel 18–45 cm long – the

Table 2. Measurements of golden hamster burrows and trapped inhabitants

Burrow	Total tunnel length (cm)	Max depth (cm)	Depth of nesting chamber (cm)	Entrance diameter (cm)	Gravity pipe length (cm)	Depth of the clot (cm)	Inhabitant, body weight, location and remarks
1	90	62	60	4,5	34	20	Adult ♀, 103 g, Albel
3	270	57	50				Deserted, Albel
4	220	55	54	4	19	19	Adult ♂, 88 g, Albel
5	270	48	48	4,5	18		Deserted, Albel
6	170	75	65			None	Absent, Albel
7							Adult ♂, 93 g, Albel; floated to the surface
8							Adult ♀, 67 g, Albel; floated to the surface in bad condition
10	100	36	36	4			Deserted, Albel
12	215	106	55	4,5	25	15	Adult ♂, 97 g, Albel
13[a]		> 90		4	35	17	Not found, Albel
14	126	65	65		36	36	Adult ♂, 99 g, Arnaz
15	235	53	45	4			Deserted, Arnaz
17	150	70	None	5	38		Deserted, Arnaz
18	177	70	70	4	45		Deserted, Arnaz
19[a]	> 150	70	50	5		30	Adult ♀, 114 g, Arnaz; gravid
20	363	69	60	4,5	26		Deserted, Arnaz
21[a]	> 180	80		5		25	Not found, Arnaz
22[a]	> 285	93	93	4,5	24	24	Not found, Arnaz
23	130	58	53	4	25		Deserted, Arnaz
25	105	60	None	4	15	15	Adult ♀, 58 g, Shaykh-Rieh
26	130	100	None	4		20	Adult ♂, 92 g, Shaykh-Rieh
27[a]		63	63	4,5	33	14	Not found, Shaykh-Rieh
28	220	47	47	4,5		23	Adult ♂, 128 g, Arnaz
29	420	70	70	5	25		Deserted, Arnaz
30[a]	> 900	85	65	5	25	17	Juveniles: ♂, 30 g, ♀, 23 g, ♀, 29 g, Arnaz
Mean	199.5	64.8	58.3	4.4	28.2	21.2	
SD	92.6	17.6	12.7	0.4	8.3	6.4	

[a] Burrows with incomplete data that were not included in all calculations.

'gravity pipe'. Occupied burrows were always plugged with a lump of earth, which was missing in unused burrows. On average the sealing was placed about 22 cm below the surface. The smallest plug extended only 5 cm into the burrow but some extended up to 10 cm. After the gravity pipe, the tunnel levelled out and continued at a slight angle further downward to the nest chamber. The 10- to 20-cm-wide nest chamber was located 58.3 ± 12.7 cm below the surface. Its interior consisted of a spherical nest made of dry plant material. Two nests included textile remnants, bird feathers and shredded plastic sack pieces in the nesting material. At least two tunnels divided from the chamber. A 10–15 cm blind-ending tunnel was apparently used for urination. Faeces were found throughout the entire burrow. The remaining tunnels measured about 100–150 cm and ran deeper at varying angles and were partially used for food storage. Ten burrows contained a varying amount of green plant material such as chickpea and were therefore considered as inhabited. In three deserted burrows, only old or rotten grain (barley, weed) was found. The remaining burrows were empty. Three deserted burrows were being used by green toads *Bufo viridis*. No differences between female and male burrows were detected. However, the largest and most complex burrow excavated contained three juveniles and apparently belonged to a female with her litter.

The burrow density for the agricultural fields around Azaz could only be estimated. Fifteen burrows (six occupied, nine 'empty') were located in an area of 30 ha. The shortest distance between burrows measured 38 m. However, the closest distance between occupied hamster burrows was 118 m. Grassy embankments exhibited higher burrow densities but the degree of occupation could not be assessed.

Habitat and geographical distribution

Burrows were found mainly in fields with annual crops comparable with the preferences of common hamsters *Cricetus cricetus* in Europe. Most frequently these were weed, barley, chickpea, lentil and fruits and vegetables such as melon, tomato, cucumber and hibiscus. Fields had to be irrigated depending on the type of culture. Normally, 2 years of cereal crop are followed by a single year of leguminous cultures. Refuge areas like barren bushes or hedges were often missing as a result of the increasing urban spread and extensive farming. Even ridges to mark the field boundaries of neighbouring

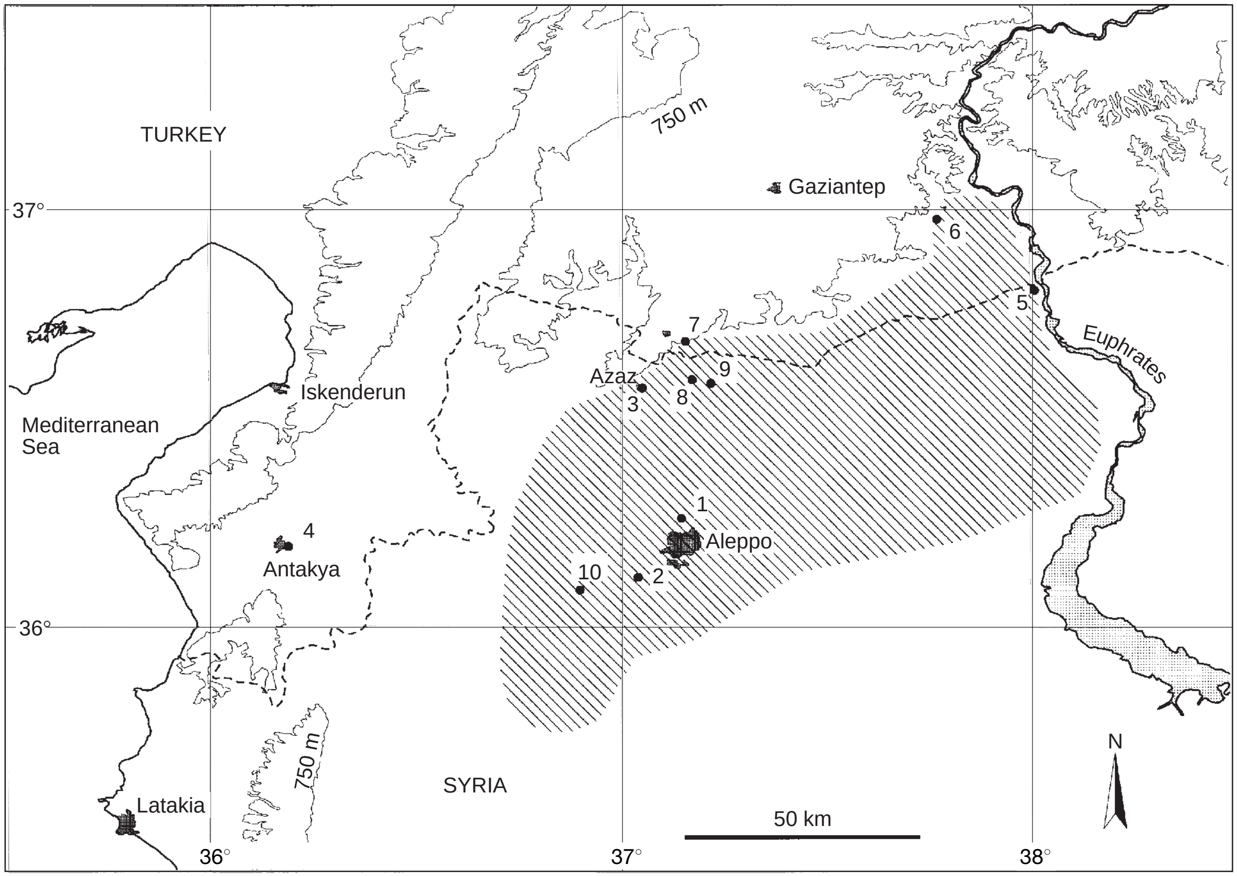

Fig. 1. Distribution map of the golden hamster *Mesocricetus auratus*. Numbers indicate historic and recent records according to literature and personal communication (see Table 1).

villages were restricted. Only roadsides and narrow barren stripes around irrigation wells remained as alternative hamster sites.

The main distribution area (Fig. 1) of the golden hamster lies in the fertile, agricultural and densely populated Aleppinian plateau in Syria, 280–380 m above sea level. The area covers only 10 000–15 000 km^2 and ranges north and south-west of the city of Aleppo. The North-Syrian limestone massif and the Turkish Taurus mountains form the natural western and northern barriers. The River Euphrates limits the range to the east and the stony steppe can be considered as an invincible barrier in the south-east. The south limit has not yet been defined but may reach as far as the beginning of the Syrian desert.

In addition to our observations, sightings of the golden hamster have been reported from Jarablus in Syria, and Kilis and Kesiktas (near Gaziantep) in Turkey (Dogramaci, Kefelioglu & Gunduz, 1994; H. Kefelioglu, pers. comm.; N. Yigit, pers. comm.; Table 1, Fig. 1).

Climate and soil conditions

The climate of the studied area was continental with large seasonal and diurnal fluctuations (Fig. 2) and low rainfall of 336 ± 78 mm/year. The winter season was wet and cold with temperatures of *c.* 10 °C. There were occasional spells of frost or snow. The annual number of frosty days averaged 35.2, with absolute minimum temperatures of −4 to −9 °C (Anonymous, 1991–92). Based on our data, temperatures in August and September reached 35–38 °C at midday and 30–32 °C close to sunset. Along with shading light and the beginning of the hamsters' surface activities (according to laboratory observations), temperatures fall rapidly to 15 °C at midnight and *c.* 6 °C immediately before sunrise. March temperatures varied between 4.6 and 18.4 °C, 70 cm above ground. In contrast, below-surface measurements revealed an almost constant temperature of 12 °C. Only low fluctuations from 11.9 to 12.2 °C were detectable at a depth of 70 cm, where the nesting chamber usually lies.

Soils based on sandy clay materials overlaying limestone are the dominant soil types found in hamster areas. All excavated burrows were on light-brownish chromic cambisols (terra fusca) or red rhodochromic cambisols (terra rossa). Both soil types have a high clay component and the resulting high plasticity provides optimal conditions for fossorial animals. Table 3 shows a chromic cambisol profile with the typical structure found in the regions. The potentially available water capacity is high in comparison to most soil types found in Central Europe. However, the actual capacity is probably much

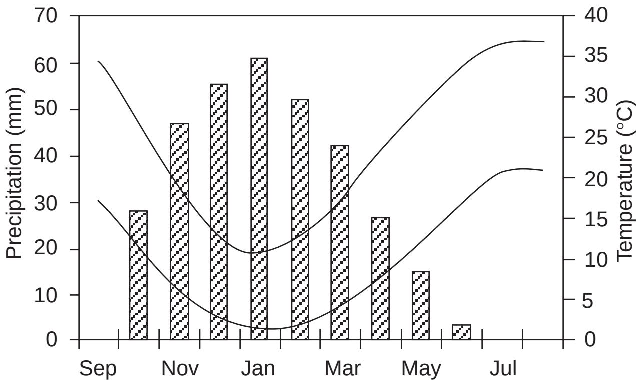

Fig. 2. Maximum and minimum temperatures (lines) and total precipitation (bars), for the natural distribution area of the golden hamster in northern Syria. Mean values are given for 1978–92. Data by the meteorological station Tel Hadya, about 35 km south-west of Aleppo (Anonymous, 1991–92).

lower because of the dry climate. The clay-rich soil exhibits low water conductivity, particularly in the less rooted subsoil.

DISCUSSION

During the two short stays in the main distribution area of the golden hamster, only a limited number of biological data could be obtained. Nevertheless, our findings disprove occasional opinions that the golden hamster has become extinct and the existence of *M. auratus* populations was confirmed.

Aharoni (1932) reported *M. auratus* from three different locations in Syria (Aleppo, Biliramun, Azaz) and Murphy (1971) collected hamsters near Aleppo. We found golden hamsters at two sites about 19 km south-west of Aleppo and 13 km east of Azaz, respectively. Another three males were recorded near Jarablus 90 km east of Azaz (H. Tichy, pers. comm.). Two known populations on the Turkish side exist at Kilis (15 km north of Azaz) and near Gaziantep (54 km north of Azaz). The Turkish and Syrian sites may form a connected distribution area, but data linking the currently known populations are missing, e.g. from the military protected border zone between Syria and Turkey.

The natural habitat of the golden hamster is described as rocky steppe or brushy slopes (Clark, 1987). In contrast, almost all our golden hamsters were excavated from burrows on agricultural land. The search for signs of hamster activities in steppe areas around the town of Afrin during summer 1997 ended without success. This finding corresponds with Aharoni (1932), who described the species from cultivated grain fields. Most burrows were found on plots with leguminous cultures. This may be an indication of existing preferences. Others found *M. auratus* on grassy embankments (Reynolds, 1954; Harrison, 1972). In fact we obtained a single individual from such sloping ground and identified several burrows on embankments near irrigation wells. To our knowledge there is no evidence for current sightings of golden hamsters in true steppe habitats in Syria. Literature reports about steppe populations probably result from confusions with the Turkish hamster *Mesocricetus brandti*, a rather similar species occurring in many other countries of the Near East. The golden hamster, like many steppe animals such as the common hamster *C. cricetus* in middle Europe, has developed a preference for the abundant, food rich and optimal ground conditions provided by agricultural sites in northern Syria. The destruction of natural steppe habitats in Syria has certainly accelerated this process of adaptation. The species distribution is presumably patchy but the hamsters may be locally abundant according to our own observations and those of local farmers.

Previously published burrow structures by Herter & Lauterbach (1955), Dieterlen (1959) and Ropartz (1962) have been obtained under laboratory conditions, e.g. limited space, and do not entirely agree with our measurements. The sole data of a natural hamster burrow belong to that excavated by Aharoni in 1930, who described the location of a nest with pups at a depth of 2–2.5 m (Aharoni, 1932, 1942). These data are not in concordance with our findings either (Table 2) and may represent an extreme value. The relatively simple structure of the golden hamster burrow is rather different from those of common hamsters *C. cricetus*, which often exhibit > 10 branches (Grulich, 1981). The lack of variation between male and female burrows may be due to the early breeding season. For common hamsters it has been reported that sex-specific differences in burrow structures are only observed in female burrows depending on whether they contain litters (Grulich, 1981; Weidling & Stubbe, 1998). This could explain the exceptional structure of burrow 30 (Table 2).

Only a single adult golden hamster was found in

Table 3. Soil profile taken near Albel

No	Horizon[a]	Depth (cm)	Colour	pH ($CaCl_2$)	$CaCO_3$ (%)	Density (g/cm^3)	Sand (%)	Silt (%)	Clay (%)	Structure	Fine roots (per dm^2)
1	Agric	−25	5YR 3/6	7.41	2–4	1.25–1.45	0–45	0–20	40–60	Granular	6–10
2	Chromic cambic 1	−60	5YR 4/6	7.39	2–4	1.45–1.65	0–45	0–20	40–60	Subangular blocky	3–5
3	Chromic cambic 2	−96	5YR 5/6	7.50	2–4	1.45–1.65	45–65	0–10	35–55	Subangular blocky	1–2
4	Calcaric	> −96	5YR 7/4	7.32	> 10	> 1.85	65–80	0–20	20–35	–	0

[a] Horizon description and colour follows Scheffer & Schachtschabel (1998) and Spaagaren (1994).

every burrow, which may be evidence that they are solitary in the wild, supporting the general characterization of this species. Laboratory studies have shown that artificial grouping leads to symptoms of stress (Gattermann & Weinandy, 1996–97).

According to local farmers, hamsters disappear in November and show first signs of activity at the beginning or middle of February. Whether these observations can be interpreted as an indication of the existence of a hibernation period remains unclear. In laboratory experiments, hibernation could be induced by keeping golden hamsters at temperatures below 8 °C (e.g. Smit-Vis & Smit, 1963; Ueda & Ibuka, 1995). Unfortunately, no long-term soil temperatures for the depth of the burrows were available for northern Syria, but air temperatures may drop well below 0 °C during the winter. No data concerning the reproduction of golden hamsters in the wild exist. However, the presence of 2- to 3-week-old juveniles in one of the excavated burrows and the capture of a gravid female which gave birth on 24 March indicate that reproductive activity may start as early as February. This falls well within the time of the animals' reappearance according to our questionnaire. During these interviews the rural population repeatedly mentioned gradations and the last appearances, which occurred in 1995 around Azaz.

Natural predators of hamsters such as foxes, mustelids or owls are scarce or hunted down. The same applies to larger reptiles or snakes. Other birds of prey may only occasionally take a golden hamster because of its nocturnal behaviour, but the presence of hamsters in their diet cannot be quantified since no data are available. Overall, the impact of natural predators on hamster populations can probably be ignored. Stray dogs are abundant but probably do not endanger golden hamsters. In contrast, human activities are drastically affecting the occurrence of golden hamsters in several ways. Hamsters are considered to be the most important agricultural pest besides the vole *Microtus sociales*, which was often found on the same plots. Control measures start in February as soon as the burrow entrances become visible. Animals are trapped or poisoned. The rural population applies large amounts of rodenticides provided by the government. In May–June most fields are harvested, burnt and ploughed. Sheep herds feed on the remaining plants and grain. At this time it may become increasingly difficult for hamsters to find cover, nutrition or sufficient food for winter storage.

Above all, increasing human settlement caused by an immense population growth of 3.34% per year provides the main threat to the golden hamster in Syria. However, until now there are insufficient data to evaluate the abundance and population dynamics of the species and its distribution has not yet been fully clarified.

The captured golden hamsters were brought to the Institute of Zoology in Halle and a breeding stock was set up that has already produced several offspring. Behavioural and genetic studies on potential differences between wild and laboratory hamsters are currently underway and scientific co-operation is welcome. The breeding population of wild golden hamsters in Halle can also be used to enhance the genetic variability of current golden hamster strains.

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Note added in proof:

After submission of this paper Shehab, Kowalski & Daoud (1999) reported that *M. auratus* remains were found in owl (*tyto alba*) pellets collected in the Ebla ruins, 70 km south of Aleppo. The co-ordinates of this site coincide well with the southern edge of our provisional distribution map (fig. 1).

REFERENCES

Aharoni, B. (1932). Die Muriden von Palästina und Syrien. *Z. Säugetierkd.* **7**: 166–240.

Aharoni, I. (1942). Excerpt from memories of a Hebrew zoologist. In Yergganian, G. (1972). History and cytogentics of hamsters. *Progr. Exp. Tumor Res.* **16**: 2–41.

Anonymous (1991–92). *Meteorological reports for ICARDA experiment stations in Syria and Lebanon. Unpubl. Report*. Aleppo: International Centre for Agricultural Research in the Dry Areas (ICARDA).

Clark, J. D. (1987). Historical perspectives and taxonomy. In *Laboratory hamsters*: 3-7. Van Hoosier, G. L. & McPherson, Ch. W. (Eds). London: Academic Press.

Coe, J. E. & Ross, M. J. (1997). Electrophoretic polymorphism of a hamster pentraxin, female protein (amyloid P component). *Scand. J. Immunol.* **46**: 180–186.

Dieterlen, F. (1959). Das Verhalten des syrischen Goldhamsters (*Mesocricetus auratus* Waterhouse). *Z. Tierpsychol.* **16**: 47–103.

Dogramaci, S., Kefelioglu, H. & Gunduz, I. (1994). Karyological analysis of the species of *Mesocricetus* (Mammalia, Rodentia) in Anatolia. *Turkish J. Zool.* **18**: 41–45.

Eisentraut, M. (1952). Beobachtungen über den Winterschlaf der Hamster, insbesondere des Goldhamsters (*Mesocricetus auratus* Waterh.). *Zool. Anz.* **149**: 115–124.

Gattermann, R. & Weinandy, R. (1996–97). Time of day and stress response to different stressors in experimental animals. Part I: Golden hamster (*Mesocricetus auratus* Waterhouse, 1839). *J. exp. Anim. Sci.* **38**: 66–76.

Grulich, I. (1981). Die Baue des Hamsters (*Cricetus cricetus*, Rodentia, Mammalia). *Folia Zool.* **30**: 99–116.

Harrison, D. L. (1972). *The mammals of Arabia*. London: Ernst Benn.

Herter, K. & Lauterbach, G. (1955). Die Überwinterung syrischer Goldhamster (*Mesocricetus auratus* Waterh.) in Norddeutschland. *Z. Säugetierkd.* **20**: 37–54.

Kumerloeve, H. (1975). Die Säugetiere (Mammalia) Syriens und des Libanons. *Veroeff. Zool. Staatssamml. Münch*. **18**: 159–225.

Murphy, M. R. (1971). Natural history of the Syrian golden hamster a reconnaissance expedition. *Am. Soc. Zool*. **11**: 632.

Murphy, M. R. (1985). History of the capture and domestication of the Syrian golden hamster (*Mesocricetus auratus* Waterhouse). In *The hamster*: 3–20. Siegel, H. I. (Ed.). New York: Plenum Press.

Nehring, A. (1902). Über *Mesocricetus auratus*. *Zool. Anz*. **26**: 57–60.

Reynolds, H. W. (1954). *Golden hamsters*. London: Zoological Society of London.

Ropartz, P. (1962). Quelques données sur le terrier du hamster doré (*Mesocricetus auratus*). *Vie Milieu* **13**: 359.

Russel, A. & Russel, P. (1797). *The natural history of Aleppo*. 2nd edn. London: A. Millar.

Scheffer, F. & Schachtschabel, P. (1988). *Lehrbuch der Bodenkunde*. 14th edn. Stuttgart: Ferdinand Enke.

Shehab, A. H., Kowalski, K. & Daoud, A. (1999). Biometrical remarks on the golden hamster *Mesocricetus auratus* (Waterhouse, 1839) (Cricetidae, Rodentia) from Elloa (northern Syria). *Acta zool.Cracov* **42**: 403–406.

Smit-Vis, J. H. & Smit, G. J. (1963). Occurrence of hibernation in the golden hamster, *Mesocricetus auratus* Waterhouse. *Experientia* **19**: 363–364.

Spaagaren, O. C. (1994). *World reference base for soil resources-Draft*. Wageningen, NL: ISSS-FAO-ISRIC.

Ueda, S. & Ibuka, N. (1995). An analysis of factors that induce hibernation in Syrian hamsters. *Physiol. Behav*. **58**: 653–657.

Waterhouse, J. R. (1839). *Cricetus auratus*. *Proc. Zool. Soc. London* **LXXVI**: 57–58.

Weidling, A. & Stubbe, M. (1998). Eine Standardmethode zur Feinkartierung von Feldhamsterbauen. In *Ökologie und Schutz des Feldhamsters*: 259–276. Stubbe, M. & Stubbe, A. (Eds). Halle (Saale). Unpublished report.

Yigit, N., Colak, E., Sözen, M., Özkurt, S. & Verimli, R. (2000). The distribution, morphology, and karyology of the genus *Mesocricetos* (Mammalia: Rodentia) in Turkey. *Folia Zool.* **41**: 167–174.