

Accepted Manuscript

Title: A cross-sectional survey to evaluate the pet squirrel population and ownership profiles

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PII: S0167-5877(18)30454-9

DOI: <https://doi.org/10.1016/j.prevetmed.2018.08.018>

Reference: PREVET 4526

To appear in: *PREVET*

Received date: 27-6-2018

Revised date: 30-8-2018

Accepted date: 31-8-2018



Please cite this article as: d'Ovidio D, Pirrone F, A cross-sectional survey to evaluate the pet squirrel population and ownership profiles, *Preventive Veterinary Medicine* (2018), <https://doi.org/10.1016/j.prevetmed.2018.08.018>

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A cross-sectional survey to evaluate the pet squirrel population and ownership profiles

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Highlights

- Squirrels are popular pets capable of actively interacting with their owners
- Invasive species are still kept improperly as pets in Europe in violation of regulations
- Dermatologic and intestinal disorders are the most common health problems reported
- Efforts are to be carried out to help owners understand the importance of responsible ownership

Abstract

While the presence of squirrels in households is growing, little data is published on their status in captivity. A web-based questionnaire for owners was devised eliciting information about them, their squirrels and their squirrels' husbandry and health. One hundred owners answered the survey, with most respondents being located in Europe (n = 81). Only data from these respondents were analysed. Twenty-five percents of the owners housed an invasive non-native species of European Union concern (*S. carolinensis* and *T. sibiricus*), some of which were younger than three years of age and all but one were sexually intact. This is of particular concern, as the acquisition of these invasive species is illegal since 2015 (European Union Regulation 1143/2014), due to the severe threats they pose to biodiversity. Moreover, escapes derived from improper keeping of intact specimens may augment feral populations or establish new colonies. Among 81 cases, only 5% were neutered, mostly for health reasons. Sixty-three percents of the squirrels had health problems, particularly dermatologic (52%) and intestinal disorders (34%). Most owners reported to visit the veterinarian only if their pet was ill rather than for preventive care. This is the first survey on pet squirrel ownership reported to date. Information that emerges from this study will be useful in implementing rational veterinary strategies for managing pet squirrels properly and, in parallel, meeting the challenges arising from private keeping of alien species.

Keywords

Pet squirrels, exotic companion mammals, husbandry, veterinary care, alien species

Introduction

Rodents have become increasingly popular as pets worldwide with approximately 22 million small mammals, excluding dogs and cats, counted in the European Union in 2016 and 11% increase in the number of US households owning rodent pets between 2007 and 2012 (Lennox and Bauck, 2012; FEDIAF, 2017). Amongst these species are squirrels (Family: *Sciuridae*), which comprise 58 genera and 285 species native to the Americas, Africa, Europe and Asia (Thorington et al., 2012). Despite their growing popularity there is a lack of published information on pet squirrels. Very little is known about the species that are held in captivity, their husbandry conditions, behaviour, general wellbeing and veterinary care (d'Ovidio et al., 2015; Fehr et al., 2014). Assisting owners in understanding squirrels' characteristics and natural behaviours might help them meet the welfare needs of their pets and, as for other species, is an important part of veterinary practice to help prevent health and behaviour problems (d'Ovidio et al., 2016).

In addition, alien squirrel species have been introduced in the European continent since the second half of the XIXth century and are progressively replacing the native Eurasian red squirrel (*Sciurus vulgaris*) in Italy as in the United Kingdom (UK) (Bertolino et al., 2014; Tattoni et al., 2005). In particular, native red squirrels are threatened by alien grey squirrels (*Sciurus carolinensis*) through exploitation competition and spillover of squirrelpox virus (SQPV) (Chantrey et al., 2014). Although they are currently being culled as part of invasive species control programs (Bertolino et al., 2016; Chantrey et al., 2014; Schuchert et al., 2014) in the UK, Ireland and Italy, it seems that they are still kept – illegally – as pets (Davenport and Collins, 2016; Romeo et al., 2018). Other alien squirrels in Europe include the Siberian chipmunk (*Tamias sibiricus*) and the Finlayson's squirrel (*Callosciurus finlaysonii*). The Siberian chipmunk is a small semi-terrestrial squirrel, with a natural distribution comprising the Eurasian taiga zone, from Finland and westernmost Russia (Karelia) eastwards to eastern Siberia, Japan and eastern China (Bertolino et al.,

2000). Naturalized colonies derived from escaped animals have become established in Austria, Belgium, France, Germany, the Netherlands, Switzerland, and different sites of North and Central Italy. Although no interaction with other species is known (Bertolino et al., 2000), *T. sibiricus* is already included in the list of invasive alien species of European Union concern (Bertolino et al., 2016).

Finlayson's squirrel is an arboreal rodent native to Thailand, Myanmar, Laos, Cambodia and Vietnam (Ancillotto et al., 2018). A few populations of this squirrel, introduced through the pet trade (Bertolino and Lurz, 2013), have established outside its native range in the last 35-40 years. About 16-18 years ago it has been introduced to Italy, and the effects of this species include tree bark stripping, consumption of fruits and seeds in crops, and damage to electric cables (Bertolino et al., 2015; Mori et al., 2016). Although the population of *C. finlaysonii* has expanded rapidly, monitoring has been practically nonexistent (Bertolino et al., 2015).

In general, despite what has been said so far, there is no official data regarding the acquisition and recommended husbandry for these species, which represent a threat to biodiversity.

The present study aimed to provide a characterization of squirrel ownership and a representative point sample of the current state of care and welfare of pet squirrels in Europe.

Materials and Methods

Participants were recruited via the Internet. The questionnaire used for assessment was posted online and published in the media (pet magazines and web sites, including Facebook) both in Italian (RESCOP, Relazione Scoiattolo-Proprietario) and English language (OSREL, Owner-Squirrel Relationship). Participation was restricted to owners

who were older than 18 years and directly involved in the pet's care. Owners were asked to complete the survey for only one squirrel per household, preferably by choosing one at random (e.g. put their names in a container and select one with eyes closed). A self-selected, convenience sample of 100 squirrel owners completed the online survey. A subset of these data ($n = 81$) consisting entirely of squirrels housed inside of Europe, of either sex and aged 0-6 months to > 10 years old at the time of the study, was selected for analysis.

The survey was adapted from a standardized questionnaire focused on other pet species that have already been included in previous papers and consists of 4 sections (d'Ovidio et al., 2016; Pierantoni et al., 2011; Pirrone et al., 2015a; Pirrone et al., 2015b; Pirrone et al., 2016). The first section contained questions on the participant's demographics, such as sex, age, municipality of residence, country/region of residence, marital status, household, presence and number of children, age of the youngest child, and education. In the second section, owners are asked to indicate demographic variables for their squirrels, including name, species, age, sex, sexual status and main reason for neutering, age at acquisition, and source. Within the third section, 18 common types of behaviours, some of which potentially problematic, were listed. Squirrel behaviour was not addressed in this paper, as it will be the main theme of another article. The fourth section contained single-choice questions related to the housing, husbandry and clinical history of the squirrels (Table 1).

Statistical analysis

Statistical analysis was performed using IBM SPSS Statistics for Windows, version 25.0 (Armonk, NY: IBM Corp). Values were reported as actual numbers and percentages.

One-sample Pearson's χ^2 test and Pearson's χ^2 test of independence in 2x2 contingency tables were applied to analyse significant differences between groups of squirrels. Fisher's exact test was performed when the expected frequency of the observations was lower than 5. A 2-sided $p < 0.05$ was considered statistically significant.

Results

Section 1—Owner factors

Most respondents were female (52%, 42/81) and were between 18 and 30 years of age (37%, 30/81). The majority of participants lived in urban settings (98%, 79/81) and came from Italy (96%, 78/81). Italian owners were drawn from all over the country, although most were from the southern regions (63%). Foreign participants (4%) were from France ($n = 3$). Most of the owners were married or long term committed (44%, 36/81) and resided in a childless household (84%, 68/81). Half of the respondents (54%, 44/81) had a high school diploma, whereas 31% (25/81) had a university degree, and 15% (12/81) had attended secondary school or less. The most common reason for squirrel acquisition was “because I love squirrels” (54%, 44/81).

Section 2—Squirrel factors

Overall, squirrels belonged to 8 different species (Tab. 2): *T. striatus*, $n = 50$; *S. carolinensis*, $n = 6$; *T. sibiricus*, $n = 14$; *Callosciurus prevosti*, $n = 8$; *Callosciurus notatus*, $n = 2$; *S. granatensis*, $n = 2$; *S. vulgaris*, $n = 1$.

Twenty-five percents (20/81) of the respondents owned invasive non-native species of Union concern (*S. carolinensis* and *T. sibiricus*). Of these, 19 lived in Italy and 1 in France. The sample had a balanced sex ratio of squirrels: 43% (35/81) females vs 54% (44/81) males, but 3% (2/81) of the owners were unaware of their pet's sex.

The vast majority of squirrels were intact: 90% (73/81), 5% (4/81) were neutered and for 5% (4/81) of them the sexual status was unknown to the owners.

All the squirrels belonging to alien invasive species, except one, were sexually intact (Tab. 2). Of the 5% of the respondents who opted to neuter, reasons for neutering included health reasons (50%, 2/4), behaviour problems (25%, 1/4), and legal requirement (25%, 1/4). Most squirrels were young (37%, 30/81: 1-3 years, 32%, 26/81: <1 year), 27% (22/81) were 4 to 6 years of age, 3% (2/81) were between 7 and 9 years of age, while only 1% (1/81) was older than 10 years old.

The age at which they were obtained ranged from before 6 months to over 10 years, with the most common age range being 0 to 6 months (72%, 58/81). More squirrels came from a pet shop (44%, 36/81) rather than a friend/relative (27%, 22/81), a breeder (17%, 14/81) or other sources (11%, 9/81).

Squirrels of alien species were more likely to be purchased from a breeder ($p = 0.046$) than from other sources. Seventy-one percents (5/7) of the alien species coming from a breeder were younger than 3 years old at the time of the survey, as were all those coming from private sources, while pet shop-traded squirrels were all older than 4 years at the time of the study.

Section 4 – Squirrel housing and management

Companionship

Fifty-four percents (44/81) of the owners reported that their squirrel had at least one squirrel companion in sight. The majority had one squirrel companion (42%, 34/81), 33% (27/81) had 2 conspecific companions, 17% (14/81) had 3 squirrel companions and 7% (6/81) had >4 squirrel co-habitants. The vast majority of the squirrels were housed individually (75%, 61/81), 7% (6/81) shared the same hutch with another squirrel and 17% (14/81) had 2 cage-mate squirrels.

Fourty percents (8/20) of the cage-mate squirrels were of the opposite sex to that of the squirrel surveyed, 15% (3/20) were of the same sex, 45% (9/20) were of both sexes. Four squirrels, either females or males, belonging to non-native alien species of Union concern (*T. sibiricus* = n. 2, *S. carolinensis* = n. 2) shared the same hutch with another squirrel of the opposite sex.

In most cases (62%, 50/81), other species were also kept as pets in the household, particularly dogs (42%, 21/50), parrots (30%, 15/81) and cats (14%, 7/50).

Housing

Seventy percents (57/81) of the respondents kept the squirrel in an escape-proof hutch for squirrels (1.2 high or base plus length plus height of 3.5-4.5 meters; Meredith, 2002),

others kept it loose in a room (15%, 12/81) or in the house (2%, 2/81), 10% (8/81) kept the squirrel in a big-aviary type cage, and 3% (3/81) in a different, unspecified place.

Hutches were mainly vertical (65%, 47/72) rather than horizontal (35%, 25/81), and located indoors (85%, 61/72) rather than outdoors in the garden or a balcony (15%, 11/72). Ninety percents of the outdoor cages were protected from adverse weather conditions and direct sunlight. The majority of the respondents who kept their squirrel in a hutch (53%, 37/70) never took it out to run around and socialise, 29% (20/70) had it loose in the house for 30 minutes to 2 hours daily, 13% (9/70) for more than 2 hours and 6% (4/70) for less than 30 minutes every day.

One hundred percents of the respondents provided their squirrels with enrichments, such as nest boxes, nesting materials, non-toxic wood, strings or others, and 91% (74/81) with exercise tools, including wheels and tunnels. A significant majority of the owners reported to clean their squirrels' cage 2-3 times a week (68%, 55/81) and 1-3 times per month (19%, 15/81) ($p = 0.001$).

Diet

Thirty-two percents (26/81) of owners fed their squirrels pellet food as part of their diet, with 96% (25/26) opting for a mix-type diet that included either vegetables and fruits (15%, 4/26), seeds (12%, 3/26), both vegetables/fruits and seeds (31%, 8/26) or a combination of seeds, vegetables/fruits and insects (38%, 10/26). Only one owner answered that his/her squirrel ate only pellets, while 68% (55/81) of squirrels had no concentrates at all. Of these, 4% (2/55) received only vegetables and fruits, 4% (2/55) were fed vegetables/fruits and bread/cooked meals, 4% (2/55) were fed only seeds, 75% (41/55) had seeds and vegetables/fruits and 11% (8/55) had a seed, vegetable/fruit, insect, bread and other cooked meal based diet.

Overall, the vast majority of squirrels was fed seeds and vegetables/fruits ($p = 0.001$) (Fig. 1)

Health records

A majority of squirrels had attended a veterinary clinic for health reasons (54%, 44/81) during their lifetime, while 41% (33/81) of owners stated that their pet had no problems, and 5% (4/81) were unaware of any health problems.

The most frequently reported health problems were dermatological (52%, 23/44) followed by intestinal disorders (34%, 12/44) ($p = 0.001$) (Fig. 2).

Sixteen percents (13/81) of the respondents reported that their squirrels had gut parasites (31% [4/13], Coccidia, 23% [3/13] tapeworms, 46% [6/13] others), while 20% (16/81) of the squirrels had ectoparasites, as reported by their owners (50% [8/16] mites, 6% [1/16] fleas, 44% [7/16] others).

The vast majority of the owners reported bring their squirrel to the veterinarian only when it was sick ($p = 0.001$) (Fig. 3).

Discussion

The variety of species involved reflects the wide diversity of squirrels kept in captivity in different countries. However, in agreement with a previous report, the chipmunks represented the majority of the study population, and this is not surprising, as they have become the most popular squirrel species kept as pets worldwide (d'Ovidio et al., 2014). Twenty-five species are part of the *genus Tamias*, including the two species most commonly held as pets, namely the Eastern chipmunk (*T. striatus*) and the Siberian chipmunk (*T. sibiricus*).

In 2015, the European Union (EU) Invasive Alien Species (IAS) Regulation no.1143/2014 came into force, imposing a strict restriction on a list of species considered of “Union concern”, which, as for the squirrel species, includes *S. niger*, *S. carolinensis*, *C. erythraeus*, and *T. sibiricus* (EU, 2014). These animals can not be imported, kept, bred, transported, sold, used or exchanged, allowed to reproduce, grown or released into the European environment. This has been established because the presence and survival of species from different ecosystems is one of the most important reasons for decline of native species (Tattoni et al., 2005).

The results of this study confirm that squirrels belonging to two invasive alien species on the list of Union concern, *Tamias sibiricus* and *Sciurus carolinensis*, were kept as pets in Italy and France. Noteworthy, as the vast majority of the squirrels included in this survey, they were not neutered/spayed. If these animals escaped from pet owners, they would contribute to the now established wild populations, which are known to negatively impact the native Eurasian red squirrel (*S. vulgaris*) populations, particularly in Italy and the UK, through predation and competitive exclusion for space and food resources. Another major threat is the transmission of squirrelpox virus (SQPV) from the gray squirrel reservoir host (Bryce et al., 2001; Gurnell et al., 2004b; McInnes, 2006; Rushton et al., 2000; Tattoni et al., 2005; Wauters et al., 2000). From the analysis of these squirrels’ age at acquisition and age at the time of the survey it emerged that some of them were bought from breeders after the Regulation no.1143/2014 had entered into effect. Thus, these squirrels presumably came from illegal breeding and sale activities, which evidently still exist. Moreover, four sexually intact alien squirrels shared the same hutch with a conspecific of the opposite sex. Unfortunately, in this survey we did not gain information about the sexual status of cage-mate squirrels. Of course, if these were also intact, this would be a further violation of the provisions of the regulation, which establishes that owners of alien species purchased before the entry into effect of the EU regulation are to take appropriate

measures to prevent breeding. Spaying or neutering is appropriate to meet this requirement, but also to prevent the occurrence of several diseases, including mammary tumours, metritis and pyometra in adult or old animals (Meredith, 2002). Ninety percents of the squirrels in our study were intact, and the majority were neutered to treat health problems. Veterinarians should probably stress the value of preventive medicine to increase owners' awareness about its health benefits for their pets.

The squirrels were kept mainly individually, in agreement with the general recommendation that chipmunks and other squirrels should be housed singly to avoid intraspecific aggression, which can potentially lead to severe injuries. This is particularly true for adult males and during autumn, when food-hoarding activity increases (Meredith, 2002). However, there is evidence that these rodents can also be housed in pairs, in harems with one male and more females, or in single sex groups (Meredith, 2002).

Diet was mainly composed of seeds, vegetables and fruit, eventually implemented with pelleted food and insects. Although the most common species (e.g. chipmunks) are omnivorous, and their diet in the wild is made up largely of seeds, buds, leaves and flowers, many commercial dry mixes for rodents (or specifically chipmunks) are often too rich in sunflower seeds and nuts (Meredith, 2002). While these seeds are greatly enjoyed, they are high in fat and low in calcium and should be fed with moderation. According to these recommendations, supplementation with fresh fruit and vegetables was reported in our survey by nearly half of the participants.

The most common housing system was a vertically developed, escape-proof hutch for squirrels, located indoors. Less frequently, animals were kept in outdoor hutches located in a balcony or rarely in a yard, both equipped with a protection from sunlight and bad weather. Interestingly, 30% of the squirrels were left out of their hutch for 30 minutes up to 2 hours daily, 20% for more than 2 hours and another 20% were kept loose in a room or in the entire house. Letting the squirrels loose daily helps meet their need for exercise and

either intra or interspecific social behaviour, which can only have positive impacts on their well-being. Interaction with humans, for instance, has proven to increase eating and decrease inactivity in zoo captive squirrels approaching visitors (Woolway and Goodenough, 2017). Taking together, these findings, along with the early age of squirrels when they were obtained, could suggest a new trend to hand-raise these animals aimed at having very well-socialised and adapted subjects that would make good pets. However, a prey species-oriented interaction (e.g. noise minimizing, slow moving) should always be recommended, especially for children to avoid excessive disturbance (Woolway and Goodenough 2017).

Nearly all the squirrels were provided with enrichment tools, such as nest boxes, nesting materials, non-toxic wood, strings and others, and the majority of the animals had exercise tools, including tunnels and wheels. As all captive animals, pet squirrels need environmental enrichment to increase physical activity and express species typical behaviour. Satisfaction of this psychological requirement may help reduce an animal's stress and therefore promote overall health.

The main reported health problems were dermatological diseases, occurring as a sole condition or along with respiratory or dental problems, followed by intestinal, dental, and respiratory diseases as well as other conditions of unknown etiology. The main endoparasites were coccidia and tapeworms, while the main reported external parasites included mites and fleas. Our findings confirm previous reports of cestode infection (*Hymenolepis* spp.) in pet squirrels in Italy, and highlight the need for frequent veterinary checks, rigid sanitation and the use of antiparasitic treatments to control and prevent the spread of zoonotic parasites to pet owners, especially children (d'Ovidio et al., 2014; d'Ovidio et al., 2015). Unfortunately, the vast majority of the participants did not indicate the type of parasite retrieved in their squirrels, and only 21% stated to have taken the animals to the veterinarian at least once per year for preventive care. In more than half of

the cases, veterinary surgeons had seen the squirrels only to treat a disease. In 12% of the cases the animals had never attended a veterinary clinic, thus the prevalence of squirrel diseases in this survey could have actually been biased by this circumstance. As for all surveys that include only people who use the internet, this research might have biases concerning representativeness of the real population of squirrels owners. Familiarity with Internet technology is not uniform across demographic, cultural, and geographic groups (Yetter and Capaccioli, 2010). Internet users are younger, richer, better educated, and more urban than non-Web users (Reips, 2002). According to this, most of the respondents in our study were in the younger age group (18-30 years old), had high education level and lived in urban settings. As for gender differences, in general Web surveys are more likely to be completed by males than by females (McCabe et al., 2006; Stanton & Rogelberg, 2001). Lower levels of Internet self-efficacy in females than in males has been proposed as one possible explanation for this finding (LaRose, Mastro, & Eastin, 2001). Inconsistent with these reports, the majority of survey respondents in this study were females and, interestingly, this has been the case also in all our previous studies in which we investigated pet ownership using online surveys (Pirrone et al., 2015a, Pirrone et al., 2015b, Pirrone et al., 2016). Research exploring the role that gender plays in people's attitude towards animals has found that women tend to be more empathic and to have a higher concern for animal welfare compared with men (Mariti et al., 2017; Walker et al., 2014). Thus, our finding could be at least partially explained by females being more willing to fill out online surveys on pets than males for their particular sensitivity to animals' issues. And this, in turn, might explain the fact that "I love squirrels" was the most frequently reported reason for squirrel keeping in our study.

In conclusion, here we provided for the first time a description of current housing and husbandry practices of squirrels of various species, some of which, in Europe, represent a well-known challenge to native biodiversity. Owners should be encouraged to take care of

their squirrels' health using preventive medicine rather than deciding to wait until their pet is ill or injured. Gonadectomy should be strongly recommended as a method to prevent health disorders and breeding, the latter particularly for squirrels of non-native alien species. Strict control measures are to be adopted on these species' trade and keeping, which unfortunately are still active.

Acknowledgments

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. The idea for the article was conceived by Dario d'Ovidio and Federica Pirrone. The experimental protocol was designed by all authors. The data were statistically analysed by Federica Pirrone and discussed by the two authors. The article was written by both authors.

Ethical considerations

This study did not require ethical approval as it involved the use of a completely anonymous survey.

Conflict of interest

The authors declare no conflicts of interest.

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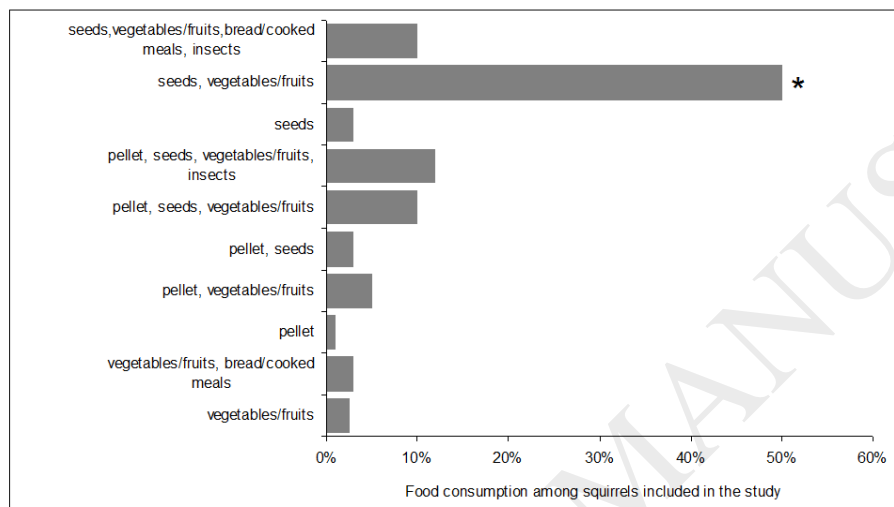
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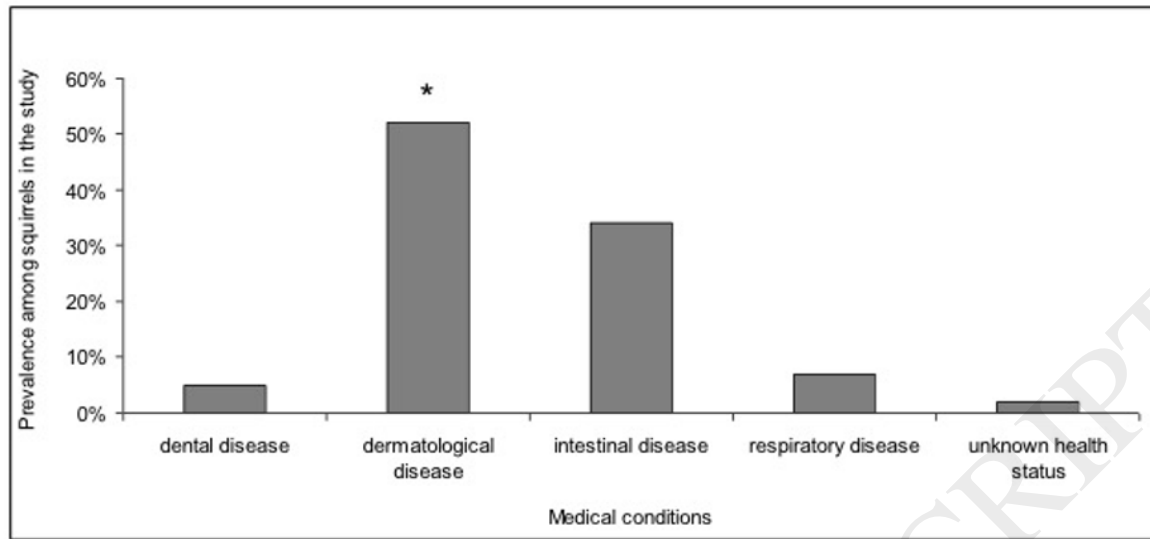
FIG 1: Components of the squirrels' diet in a survey of 81 pet squirrels from Europe.

FIG 2: Prevalence of squirrels' disease as assessed by their owners in a survey of 81 pet squirrels from Europe.

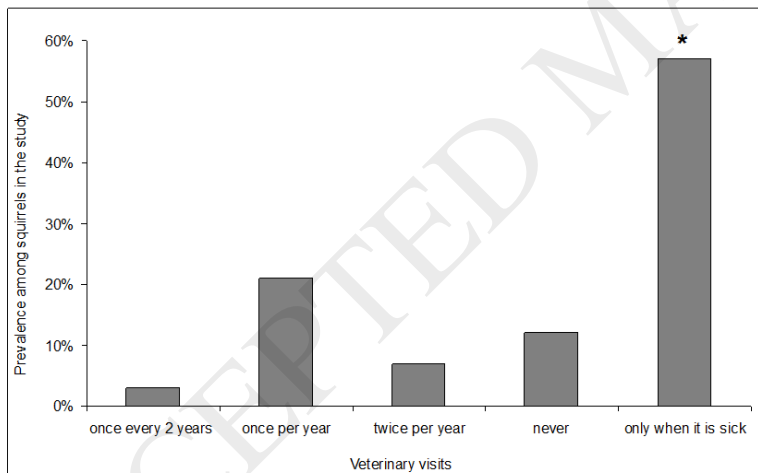
FIG 3: Frequency of veterinary visits in a survey of 81 pet squirrels from Europe.



* versus all other categories, $p = 0.001$.



* versus all other disease conditions, $p = 0.001$.



* versus all other categories, $p = 0.001$.

Table

Table 1

Squirrel housing and management (Questionnaire - Section 4)

Questions	Response options
Are there other squirrels currently living in your household?	yes, no
Including the squirrel surveyed, how many squirrels are currently living within your household?	0,1,2,3,4, more than 4
What is the sex of the other squirrels?	male, female, both, I do not know, N/A
How many squirrels live in the same hutch?	2,3,4, more than 4, my squirrel is housed individually, my squirrel/s does/do not live in a hutch
Are there other household pets?	dog, cat, fish, parrot, hamster, tortoise/turtle, other, no
Where do you keep the squirrel for most of the time?	escape-proof hutch for squirrels, open hutch, small rodent/bird hutch, big aviary-type hutch, loose in the house, loose in a room, other
The hutch is	horizontal, vertical, N/A
Where is the hutch located?	indoors, outdoors (balcony/terrace), outdoors (garden), N/A
If the hutch is outdoors, is it equipped with a protection against bad weather conditions and direct sunlight?	yes, no, N/A
How long is the squirrel out of its hutch a day on average?	less than 30 minutes a day, 30 minutes to 2 hours a day, more than 2 hours a day, never, all day
Does the squirrel have any cage enrichments?	yes, nesting materials (e.g., hay, straw or paper-based); yes, nest boxes; yes, fruit tree branches and other non-toxic woods; yes, stringing ropes; yes, other; all of the above, no
Does the squirrel have any exercise tools?	yes, wheels; yes, tunnels; yes, other; no
What is the frequency for routine cleaning?	at least once a day, 1-3 times a week, 1-3 times a month, 1-3 times a month, never
What type of diet do you feed your squirrel (multiple choice)?	pellet food, seeds, fruits and vegetables, insects, other
Does the squirrel suffer or has ever suffered from one or more of the following common health issues (multiple choice)?	dental diseases, enteritis (e.g., diarrhea, stipsis), dermatoses, anorexia, pneumonia/rhinitis, urinary tract disease, other
Does the squirrel suffer or has ever suffered from intestinal parasites?	yes, coccidia; yes, tapeworms; yes, other; no; I do not know
Does the squirrel suffer or has ever suffered from external parasites?	yes, fleas; yes, mites; yes, other; no; I do not know
How frequently do you take your squirrel to the veterinarian?	At least once a year, at least twice a year, at least once every two years, only when it is sick, never

TABLE 2:

List of the squirrels (n =81) included in the sample according to the country, species, sexual status, source, age at acquisition and age at the time of the survey

COUNTRY	SPECIES	SEXUAL STATUS	SOURCE	AGE AT ACQUISITION	CURRENT AGE
Italy	<i>Tamias striatus</i>	neutered	pet shop	13 mos-3 yrs	7-12 mos
Italy	<i>Tamias striatus</i>	intact	pet shop	0-6 mos	13 mos-3 yrs
Italy	<i>Tamias sibiricus*</i>	intact	private	13 mos-3 yrs	13 mos-3 yrs
Italy	<i>Sciurus vulgaris</i>	intact	found	0-6 mos	13 mos-3 yrs
Italy	<i>Tamias striatus</i>	intact	pet shop	7-12 mos	13 mos-3 yrs
Italy	<i>Tamias striatus</i>	intact	private	0-6 mos	7-12 mos
Italy	<i>Sciurus carolinensis*</i>	neutered	found	0-6 mos	4-6 yrs
Italy	<i>Callosciurus prevosti</i>	intact	pet shop	7-12 mos	13 mos-3 yrs
Italy	<i>Tamias striatus</i>	intact	pet shop	0-6 mos	13 mos-3 yrs
Italy	<i>Tamias sibiricus*</i>	intact	breeder	13 mos-3 yrs	13 mos-3 yrs
Italy	<i>Tamias striatus</i>	intact	pet shop	0-6 mos	13 mos-3 yrs
Italy	<i>Tamias sibiricus*</i>	intact	pet shop	0-6 mos	4-6 yrs
Italy	<i>Tamias striatus</i>	intact	breeder	0-6 mos	7-12 mos
Italy	<i>Callosciurus prevosti</i>	unknown	pet shop	7-12 mos	13 mos-3 yrs
Italy	<i>Tamias striatus</i>	intact	pet shop	7-12 mos	13 mos-3 yrs
Italy	<i>Tamias striatus</i>	intact	breeder	0-6 mos	0-6 mos
Italy	<i>Tamias striatus</i>	intact	private	0-6 mos	13 mos-3 yrs
Italy	<i>Tamias striatus</i>	intact	pet shop	0-6 mos	13 mos-3 yrs
Italy	<i>Tamias striatus</i>	intact	private	13 mos-3 yrs	13 mos-3 yrs
Italy	<i>Tamias striatus</i>	intact	private	7-12 mos	13 mos-3 yrs
Italy	<i>Tamias striatus</i>	intact	altro	13 mos-3 yrs	13 mos-3 yrs
Italy	<i>Tamias sibiricus*</i>	intact	breeder	7-12 mos	4-6 yrs
Italy	<i>Tamias striatus</i>	intact	altro	13 mos-3 yrs	4-6 yrs
Italy	<i>Tamias striatus</i>	unknown	pet shop	0-6 mos	7-12 mos
Italy	<i>Tamias striatus</i>	neutered	private	>10 yrs	>10 yrs
Italy	<i>Tamias striatus</i>	neutered	pet shop	0-6 mos	7-12 mos
Italy	<i>Tamias sibiricus*</i>	unknown	altro	7-12 mos	7-12 mos
Italy	<i>Tamias striatus</i>	intact	pet shop	0-6 mos	13 mos-3 yrs
Italy	<i>Tamias striatus</i>	unknown	breeder	7-12 mos	13 mos-3 yrs
Italy	<i>Tamias striatus</i>	intact	private	13 mos-3 yrs	13 mos-3 yrs
Italy	<i>Tamias striatus</i>	intact	breeder	0-6 mos	13 mos-3 yrs
Italy	<i>Tamias striatus</i>	intact	private	13 mos-3 yrs	4-6 yrs
Italy	<i>Tamias striatus</i>	intact	private	7-12 mos	13 mos-3 yrs
Italy	<i>Tamias sibiricus*</i>	intact	breeder	7-12 mos	7-12 mos
Italy	<i>Tamias striatus</i>	intact	private	7-12 mos	13 mos-3 yrs
Italy	<i>Tamias striatus</i>	intact	private	0-6 mos	4-6 yrs
Italy	<i>Tamias striatus</i>	intact	altro	13 mos-3 yrs	13 mos-3 yrs
Italy	<i>Tamias striatus</i>	intact	pet shop	0-6 mos	0-6 mos
Italy	<i>Tamias striatus</i>	intact	breeder	0-6 mos	13 mos-3 yrs
Italy	<i>Tamias striatus</i>	intact	breeder	0-6 mos	13 mos-3 yrs
Italy	<i>Tamias striatus</i>	intact	breeder	0-6 mos	13 mos-3 yrs
Italy	<i>Tamias sibiricus*</i>	intact	private	13 mos-3 yrs	7-9 yrs
Italy	<i>Tamias striatus</i>	intact	pet shop	0-6 mos	4-6 yrs
Italy	<i>Tamias striatus</i>	intact	pet shop	0-6 mos	13 mos-3 yrs
Italy	<i>Tamias sibiricus*</i>	intact	private	0-6 mos	13 mos-3 yrs
Italy	<i>Callosciurus prevosti</i>	intact	pet shop	0-6 mos	4-6 yrs

Italy	<i>Callosciurus prevosti</i>	intact	pet shop	0-6 mos	4-6 yrs
Italy	<i>Tamias striatus</i>	intact	pet shop	0-6 mos	7-12 mos
Italy	<i>Tamias striatus</i>	intact	pet shop	0-6 mos	7-12 mos
Italy	<i>Tamias striatus</i>	intact	pet shop	0-6 mos	13 mos-3 yrs
Italy	<i>Tamias striatus</i>	intact	pet shop	0-6 mos	13 mos-3 yrs
Italy	<i>Sciurus carolinensis</i> *	intact	altro	0-6 mos	0-6 mos
Italy	<i>Sciurus carolinensis</i> *	intact	breeder	0-6 mos	0-6 mos
Italy	<i>Tamias sibiricus</i> *	intact	breeder	0-6 mos	7-12 mos
Italy	<i>Tamias sibiricus</i> *	intact	breeder	0-6 mos	7-12 mos
Italy	<i>Callosciurus notatus</i>	intact	altro	0-6 mos	7-12 mos
Italy	<i>Callosciurus notatus</i>	intact	altro	0-6 mos	7-12 mos
Italy	<i>Tamias sibiricus</i> *	intact	pet shop	0-6 mos	4-6 yrs
Italy	<i>Tamias sibiricus</i> *	intact	pet shop	0-6 mos	4-6 yrs
Italy	<i>Tamias sibiricus</i> *	intact	pet shop	0-6 mos	7-12 mos
Italy	<i>Sciurus carolinensis</i> *	intact	pet shop	0-6 mos	4-6 yrs
Italy	<i>Sciurus carolinensis</i> *	intact	pet shop	0-6 mos	4-6 yrs
Italy	<i>Callosciurus prevosti</i>	intact	pet shop	0-6 mos	4-6 yrs
Italy	<i>Callosciurus prevosti</i>	intact	pet shop	0-6 mos	4-6 yrs
Italy	<i>Tamias striatus</i>	intact	pet shop	0-6 mos	7-12 mos
Italy	<i>Tamias striatus</i>	intact	pet shop	0-6 mos	13 mos-3 yrs
Italy	<i>Tamias striatus</i>	intact	pet shop	0-6 mos	4-6 yrs
Italy	<i>Tamias striatus</i>	intact	pet shop	0-6 mos	4-6 yrs
Italy	<i>Tamias striatus</i>	intact	private	0-6 mos	7-12 mos
Italy	<i>Tamias striatus</i>	intact	private	0-6 mos	7-12 mos
Italy	<i>Tamias striatus</i>	intact	private	0-6 mos	0-6 mos
Italy	<i>Sciurus carolinensis</i> *	intact	breeder	13 mos-3 yrs	7-9 yrs
Italy	<i>Tamias striatus</i>	intact	private	0-6 mos	4-6 yrs
Italy	<i>Tamias striatus</i>	intact	private	0-6 mos	4-6 yrs
Italy	<i>Tamias striatus</i>	intact	private	0-6 mos	4-6 yrs
Italy	<i>Tamias striatus</i>	intact	private	0-6 mos	4-6 yrs
France	<i>Callosciurus prevosti</i>	intact	pet shop	0-6 mos	0-6 mos
France	<i>Callosciurus prevosti</i>	intact	pet shop	0-6 mos	0-6 mos
France	<i>Tamias sibiricus</i> *	intact	pet shop	0-6 mos	4-6 yrs
Italy	<i>Tamias striatus</i>	intact	private	0-6 mos	0-6 mos
Italy	<i>Tamias striatus</i>	intact	private	0-6 mos	0-6 mos

* = invasive non-native species of Union concern included on the EU Regulation (1143/2014) list.