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PASSIVE INTEGRATED TRANSPONDERS FOR MARKING THE GARDEN DORMOUSE *Eliomys quercinus*

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In our feld study on the ecology of *Eliomys quercinus* we marked the animals with Passive Integrated Transponders (PIT) tags. Animals were captured in a larch woodland at 1600 m a.s.l. inside the Val Troncea Natural Park (Piedmont region, Turin district). Garden dormice were trapped using 144 Sherman live traps, from May to September, during 1995–96. A total of 44 animals were marked. The high number of first recaptures occured one or two nights after the implanting of the PIT tags and allows us to think that the animals did not modify their behaviour because of the marking experience.

Key words: *Eliomys quercinus*, passive integrated transponders, marking technique

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U našem terenskom istraživanju vrtnog puha *Eliomys quercinus* markirali smo životinje pasivnim integriranim radioodašiljačima (PIT). Životinje su lovljene u šumi ariša na visini od 1600 m.n.m. u parku prirode Val Troncea (Pijemont, okrug Torino). Vrtni puhovi su lovljeni pomoću 144 živolovke tipa Sherman, od svibnja do rujna, tijekom 1995–96. godine. Markirane su ukupno 44 životinje. Na temelju visokog broja ponovno uhvaćenih životinja jednu ili dvije noći nakon implantiranja PIT, zaključujemo da životinje nisu promijenile ponašanje zbog prethodnog markiranja.

Ključne riječi: *Eliomys quercinus*, pasivni integrirani radioodašiljači, tehnika markiranja

INTRODUCTION

In studies of the population dynamics, ecology, and the behaviour of small mammals more information can be obtained if identification at an individual level is possible. For example, permanent marks are used when animals need to be identified over a long period, as in capture-mark-recapture studies. With respect to this necessity, small mammals are not easy to mark, because of their small size, the possibility of external tags being gnawed or torn, and because of their ecology, with many species being partially fossorial or used to moving in cavities.

Several types of marks and tags have been used with small mammals, e.g.: ear and toe clipping, fur clipping, fur dyeing, leg rings, ear tags, tattooing. Some of these techniques, like fur dyeing or clipping, are temporary and limit individual identification to a short time. Tagging includes all techniques which consist of placing a mark on the animal; the marks may be of metal or plastic and are placed on legs (rings) or ears. With dormice, tagging is not certain because the animals can nibble the ring and tear the mark from the ear. In fact there is a great possibility that some of the tags will get lost; PILASTRO (1990) for example reported that about thirty percent of animals had torn the tags. Toe clipping is sometimes criticized for the probability of the animal being damaged, its behaviour being modified and its fitness altered (MÜLLER, 1989; SCHOOLEY et al., 1993). In England, tissue removal methods of marking, like toe clipping and ear punching or notching, because of the implications that they may have for the welfare of the animals, must be discussed and authorized by a special Office (GURNELL & FLOWERDEW, 1990).

As an alternative technique we marked the Garden dormouse (*Eliomys quercinus*) in our field study, with Passive Integrated Transponder tags. This relatively new technique has been tested in the field and in captivity on several species, like sea otters (THOMAS et al., 1987), amphibians and reptiles (CAMPER & DIXON, 1988), salmonids (PRENTICE et al., 1990), captive mice (RAO & EDMONDSON, 1990), and squirrels (SCHOOLEY et al., 1993), and shown to be useful for long- term studies. This tag system was adopted by the Captive Breeding Specialist Group and the Species Survival Commission of the IUCN for marked captive animals in zoological gardens and acquaria (BULMER, 1993). Clynical observations, X-ray, and histological examinations were made for three years in zoo animals, showing a good tolerance and revealing that tissue fixation takes place in one day (BEHLERT, 1990).

In this paper we report the result of our experience and consider the pro and con arguments of this tagging technique, concerning: security of tagging, quality of data collected, animal welfare and cost of the apparatus.

MATERIALS AND METHODS

The Passive Integrated Transponder (PIT) system comprises three different parts: the microchip or transponder, the implanter and the reader.

PIT tags are small cylindrical capsules of biocompatible glass (12 x 1.8 mm), containing a microchip programmed with a unique identification code (10 alpha-numeric characters) incised with a laser. The implantation into the animals is made using a special syringe, which can be fitted with a sterilized needle containing a pre-positioned PIT tag. Microchips are passive and do not need any internal power source, so the life of PIT tags is not limited by an energy requirement. When tags are activated by an electromagnetic field supplied by a portable reader, they respond with a signal that is converted into the code and visualized on a display. It is possible to read the code if the distance of the animals from the reader is about 5–20 cm.

The study was conducted in a larch woodland, at an altitude of 1600 m of altitude, inside the Val Troncea Natural Park which is located in the West Alps (Piedmont region, Turin district). We captured Garden dormice using 144 Sherman live traps, baited with hazelnuts, cheese and carrots. Animals were trapped from May to September, in 1995 and 1996; every month the traps were set up for 5–6 days; BERTOLINO et al. (1996) provide a more detailed description of the research.

Animals caught for the first time were slightly anesthetized with ethylic ether and then the transponder was implanted subcutaneously, dorsolateraly on the back; we also made an additional mark by a fur clipping, to have the possibility of control during recaptures if any individual had lost the PIT tag. Afterwards, we kept the animals in a glass box to observe their behaviour before releasing them. During each recapture the individuals were identified using the reader and the site of the injection was controlled to check if any infection had developed.

RESULTS

During the study 44 animals were marked: 14 adults in 1995, 16 adults and 14 juveniles in 1996. During 1995 the study was stopped at the end of August, because the very low temperature was dangerous for the welfare of the trapped animals;

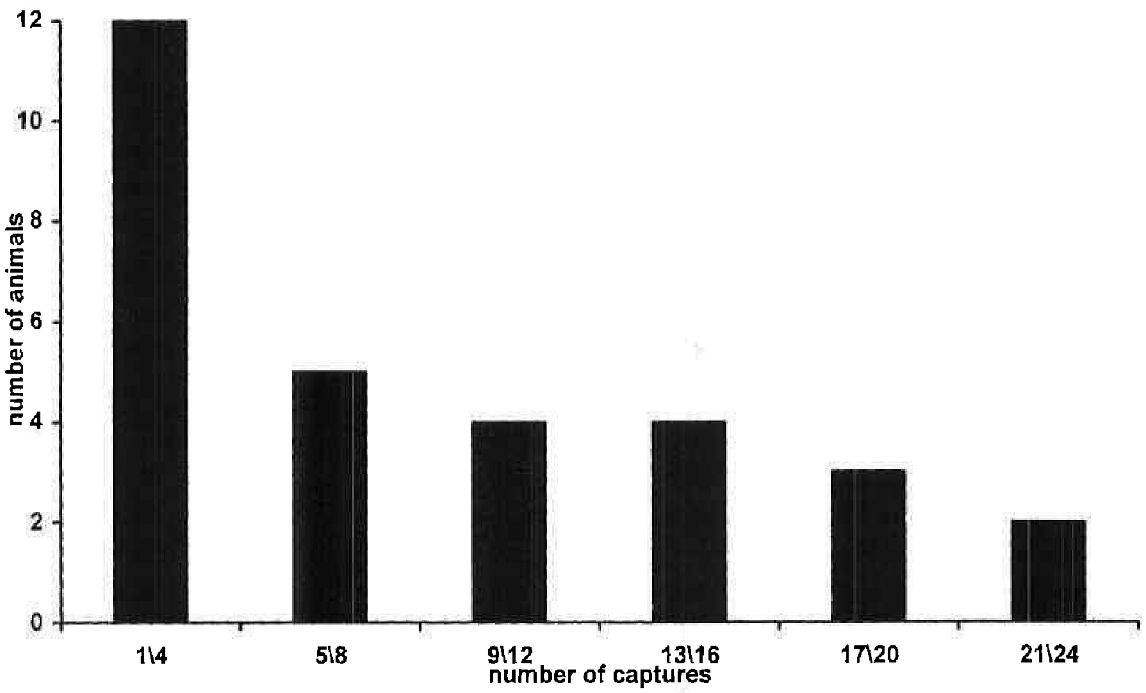

Fig. 1. Number of captures for Garden dormice, 1995–1996 data pooled together (N = 30 animals).

for this reason we could not mark juveniles. In 1996 juveniles were caught in August and September. We preferred to mark them with PIT tags in September when their weight had increased: from 28–37 g in August to 38–58 g in September. For this reason we had only 1–2 days to recapture them and we caught again just two juveniles, so in this work we consider only data concerning adults. A number of 24 adults were recaptured once or more times. In Tab.1 the recapture number for every individual is reported; none of the controlled animals, including the two juveniles, had lost the PIT tag. In 12 cases adults were recaptured 24 hours after marking and in 5 cases they were recaptured for the first time 48 hours after marking; they represent 57.1 % and 23.8 % respectively of the animals that we know were resident in the area during at least one trapping session. In this count we did not consider 9 animals that were never recaptured or that were caught on the last day of the session, making it impossible for us to verify the possibility of recapturing them one or two days later. Tab. 1 shows the time elapsed between the first and the last capture for every animal recaptured; it ranged from 2 to 459 days; many animals were trapped during all the seasons of the year and four of them marked in 1995 were also caught in 1996.

The use of ethylic ether for anesthetizing did not create any problem for the animals. The effect of the anesthetic finished in 5–10 minutes and the animals recovered their physiological condition: in a little time the animals quickly recovered their sensorial attention and the capacity to react to external stimuli, and began feeding, so we could release them. The handling of the animals during recapture was very easy. The number of the microchip could be read through the metal traps only occasionally, when the animals were near the drain opening. Therefore we would put the animals into a transparent bag, where it was possible to detect the code, check the wound, their breeding condition and weight. On these occasions no external infection was detected.

Table 1. Time elapsed between first and last capture for animals caught more than once; 1995–1996 data pooled togheter

animal code	days from first to last capture	animal code	days from first to last capture
00013BA5F7	459	00013COD38	64
000142CA4F	442	00013C27D5	63
00013C3B4D	417	00013B4AZE	62
00013C3EO7	368	00013AB251	58
00013BB432	98	00013B8E70	58
0001453OC9	98	00013C3D62	50
00013C3818	98	000142DAA5	37
000142DDCD	95	00013A8529	36
00013C2E67	95	00013BABBB	35
00013B91F2	91	00013C3BE2	3
00013A8F41	66	00013B53DO	2
00013C207A	65	00013C2449	2

DISCUSSION

In field studies, before deciding to use a particular type of mark or tag, the researcher must consider the pro and cons of the different techniques. Marks and tags must be easy to make or put on the animal, they must be easy to read without stressing the animal and should not reduce its ability to survive nor influence its behaviour or ability to reproduce; marks and tags must be permanent and allow individual identification if the study programme needs this information; furthermore, in a situation in which the budget of the project often constrains the development of the research, the cost-benefit of the technique needs to be evaluated.

Our experience showed that the handling of the animals for implanting the transponder is very quick, about 2–3 minutes. We preferred to anesthetize the animals to avoid any unforeseen movement that might be attended by a risk of their being hurt. The use of a little quantity of ethylic ether assured us that we could have the animals immobilised for the time necessary to inject the microchip, take some body measurement and control the sex and breeding status. If the handling and anaesthesia caused the animals stress in this first experience, they needed little time to recover. Our hypothesis is confirmed by the behaviour showed by the animals when the effect of the anesthesia wore off and by the number of animals recaptured only one day after. Comparing the effects of toe-clipping and ringing (FAIRLEY, 1982) or toe-clipping and ear- tagging (WOOD & SLADE, 1990) in some small mammals, researchers found that toe-clipping has a greater impact on the animals. This kind of marking resulted in a decreased incidence of day-after trapping; this effect may be the result of decreased activity in toe-clipped animals or their avoidance of traps. In our study we found a high number of recaptures during the first night after the implantation of PIT tags, which allows us to think that the animals did not modify their behaviour because of the experience. Moreover, we believe that all the animals resident in the trapping area were recaptured; the animals caught only once probably had their home range outside the trapping area or must be considered in dispersal phases. During the recapture all the operations were quick; we were able to keep the animals only a few minutes, in order to read the code and control their status.

The use of PIT tags opens to the possibility of experimental design. For example, fixing the reader near nestboxes or foraging boxes it is possible to detect marked animal movements inside and outside the boxes. In predator-prey study with the owl, another possibility is the marking of small mammals with PIT tags and then searching for the microchips in the owl's pellets. Vogel (pers.com.) verified the presence of microchips in pellets, after the ingestion of marked small mammals by the owl.

The main limit of PIT tagging is the cost of the system, especially if compared to other marking systems. Neither reader nor microchips are cheap, but we think that scientific institutions can buy this equipment and make it available for many researchers. Furthermore the cost of the system may also be evaluated in terms of security of data collections and animal welfare.

Finally we may consider the pros and cons of different mark and tag systems used with dormice and other small mammals (Tab. 2). Only toe clipping, tattooing, and PIT tags appear to be employable with dormice in long term studies. About toe clipping we might recall that the Committee on Acceptable Field Methods in Mammalogy (1987) recommended this technique only if no other suitable method is available. For TWIGG (1975) ear tattooing involves a degree of damage to the ani-

Table 2. Advantages and disadvantages of some marking methods used with dormice and other small mammals

Advantages	Disadvantages
Fur clipping • easy to do • easy to detect • no cost	• limited duration • limited number of combinations
Ear clipping • easy to do • no cost	• possibility of confusing natural cuts with marks • limited number of combinations
Toe clipping • easy to do • easy to detect • permanent • high number of combinations • no cost	• sometimes criticized for causing damage to the animals
Leg rings • easy to apply • easy to detect • high number of combinations • cheap	• poor retention • problematic with juveniles during growth
Ear tags • easy to apply • easy to detect • high number of combinations • cheap	• poor retention
Tattooing • easy to do with tweezers • easy to detect • high number of combinations • permanent • not expensive	
PIT tags • easy to implant • easy to detect • high number of combinations • high retention • possibility of detecting animals' movements through obligatory passages	• sometimes problematic with juveniles • expensive

mals and must be considered carefully, but Bieber (pers. comm.) used simple tattooing tweezers for marking *Myoxus glis*, writing a number on the ears, and obtaining good results. As an alternative, researchers can consider the possibility of using PIT tags in their field studies when individuals must be monitored over a long time, expecially for species, like dormice, which show medium-low densities and a low replacement of individuals in the area.

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SUMMARY

Passive integrated transponders for marking the garden dormouse *Eliomys quercinus*

S. Bertolino & I. Currado

Long term capture-mark-recapture studies need the possibility of identifying individuals to collect better information. With respect to this necessity, dormice are not easy to mark because they nibble or tear all external tags. In our field study on the ecology of *Eliomys quercinus* we marked the animals with Passive Integrated Transponder (PIT) tags. The system is composed of three different parts. The tags are small cylindrical glass capsules containing a microchip programmed with a unique identification code. Microchips are passive and do not need an internal power source, so the life of the PIT tags is not energy limited; their implantation is made using a special syringe containing a pre-positioned PIT tag. We preferred to anesthetize the animals with a small quantity of ethylic ether, to avoid the chance of an unforeseen movement causing a risk of their being hurt. During recapture, the code is detected using portable reader.

Animals were captured in a larch woodland at an altitude of 1600 m, inside the Val Troncea Natural Park (Piedmont region, Turin district). Garden dormice were trapped using 144 Sherman live traps, from May to September, during 1995–96. A total of 44 animals was marked: 14 adults in 1995, 16 adults and 14 juveniles in 1996; only the data concerning the adults are considered. Twenty four adults were recaptured, from 1 to 22 times; the lapse from first to last capture ranged from 2 to 459 days. Our experience showed that the handling of the animals for implanting the transponder required only 2–3 minutes, and that the effects of the anestethic finished in 5–10 minutes. On the occasion of each recapture the implanting site was checked and we did not detect any external infection. We believe that all the animals resident in the area were recaptured; the animals caught only once probably had their home range outside the trapping area or must be considered in dispersal phases. The high number of first recaptures occurred one or two nights after the implanting of the PIT tags (57.1 % and 23.8 % respectively of the animals that we know are resident in the area during at least one trapping session) and allows us to think that the animals did not modify their behaviour because of the marking experience.

The PIT tag marking system appears to be: easy to implant and to detect, permanent, and well tolerated by the animals; the main limit is the cost of the apparatus, but this must be evaluated in terms of security of data collection and animal welfare. We consider PIT tagging a good alternative for marking dormice, expecially when individuals must be monitored over a long time.

SAŽETAK

Pasivni integrirani radioodašiljači za markiranje vrtnog puha *Eliomys quercinus*

S. Bertolino & I. Currado

Tijekom dugotrajnih capture-mark-recapture proučavanja moramo moći identificirati pojedine jedinke da bi se sakupilo što više informacija. Puhovi se teško markiraju jer odgrizu ili rastrgaju sve vanjske oznake. U našem terenskom istraživanju vrtnog puha *Eliomys quercinus* markirali smo životinje pasivnim integriranim radioodašiljačima (PIT). Sustav se sastoji od tri dijela. To su male cilindrične staklene kapsule s mikročipom koji je programiran s jedinstvenom identifikacijskom šifrom. Mikročipovi su pasivni i ne trebaju unutarnji izvor energije, pa im je vijek trajanja neovisan o energiji; implantiraju se pomoću posebne igle koja sadrži pre-pozicionirani PIT. Životinje smo radije anestetizirali s malo etera, da bi smo spriječili neke nepredviđene događaje pri kojima bi se one mogle ozlijediti. Tijekom ponovnog ulova šifra se očitava pomoću prijenosnog čitača.

Životinje su lovljene u šumi ariša na visini od 1600 m.n.m. u parku prirode Val Troncea (Pijemont, okrug Torino). Vrtni puhovi su lovljeni pomoću 144 živolovke tipa Sherman, od svibnja do rujna, tijekom 1995–96. godine. Markirane su ukupno 44 životinje: 14 odraslih 1995. godine, 16 odraslih i 14 mladih 1996. godine; uzimani su u obzir samo podaci koji se tiču odraslih životinja. Ponovno su uhvaćene 24 životinje, i to od 1 do 22 puta; razmak između prvog do posljednjeg ulova trajao je od 2 do 459 dana. Naše iskustvo je pokazalo da je za obradu životinje potrebno samo 2–3 minute, i da se posljedice anestetiziranja gube za 5–10 minuta. Prilikom svakog ponovnog ulova provjereno je mjesto implantiranja i nije primijećena nikakva vanjska infekcija. Vjerujemo da su ponovno ulovljene sve životinje iz područja u kojem se lovilo; životinje ulovljene samo jednom imale su svoj životni prostor vjerojatno izvan lovnog područja ili su bile u fazi širenja areala. Na temelju visokog broja ponovno uhvaćenih životinja jednu ili dvije noći nakon implantiranja PIT (57.1% odn. 23.8% životinja s lovnog područja bar u jednoj lovnoj sezoni), zaključujemo da životinje nisu promijenile ponašanje zbog prethodnog markiranja.

Markiranje pomoću PIT sustava je: lako za implantaciju i očitavanje, trajno, i čini se da ne smeta životinjama; glavni ograničavajući faktor je cijena aparata, ali to se mora vrednovati imajući na umu sigurnost podataka i dobrobit životinja. Smatramo da je markiranje pomoću PIT dobra alternativa za markiranje puhova, posebno kad se životinje moraju pratiti dulje.