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Devices for handling small mammals in laboratory conditions

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Wild rodents, and especially rats, are significantly more difficult to handle, maintain and breed than laboratory rats and mice. They can be characterized as more skittish, neophobic and aggressive. While establishing a breeding colony of wild Norwegian rats (*Rattus norvegicus*) I developed some helpful devices and I will describe them here. In this paper I also describe the techniques for transporting animals between their home cages, separating them inside cages, and catching individuals that escape. These devices do not require any home cage modification. They may be modified for size. With size modification these devices may be used for handling animals in any type of laboratory cages. They may be used with all species of small mammals, for example, mice, gerbils, hamster, and opossums. They prove especially helpful when physical contact with humans is a problem (e.g. SPF conditions of breeding, and behavioral procedures that do not allow handling).

Key words: animal handling, wild rat, rodents, laboratory animals' maintenance, animal breeding technology

INTRODUCTION

Wild rats are significantly more difficult to care for and breed than laboratory rats. They may be characterized as more skittish, neophobic and aggressive. Opening wild rats' home cages almost inevitably results in the immediate escape of all resident individuals, which is not true of laboratory rats (King 1939, author's observation). Also, a wild rat is much more likely to bite the handling person than a lab rat. Handling the newly captured animals also carries a considerable risk of infection. Laboratory animals, on the other hand, do not carry the same risk of infection (Webster and Macdonald 1995).

A review of literature covering techniques of wild rat maintenance was published by Boice (1971). However, a majority of the solutions described in that paper require permanent modifications of home cages. Other methods require obtaining special, rare types of cages. Such modifications may later cause problems with standardization of breeding conditions and comparison of data acquired in different laboratories.

For many species of wild mammals, including wild rats, physical contact with humans is extremely stressing. The devices and methods presented in this paper were developed to prevent injuries and stress in both humans and animals. The methods and devices that are described here eliminate the need for physical contact between laboratory staff and animals. This lessens the level of stress for all. These methods are particularly useful in situations where contact between animal and human should be avoided. Reasons for preventing contact may include: germ-free breeding, risk of passing infections from one group of animals to another, high level of stress and/or aggression in handled animals, and experimental procedures that preclude handling. Additionally, the standardization of transferring procedures reduces one of the major sources of both constant and variable errors and confounding variables (e.g. animal escape, high level of stress).

The following paper contains descriptions of devices created and tested while establishing a breeding colony of wild Norwegian rats (*Rattus norvegicus*) in the laboratory. The colony was successfully established in 2006 in the laboratory of The Warsaw School of Social Psychology. The breeding line was named the "WWCPS – Warsaw Wild Captive Pisula Stryjek" (Stryjek and Pisula, in press). In 2007 the name was registered in the Polish Patent Office under the number Z–320033. The WWCPS line is going to be used in a series of comparative studies.

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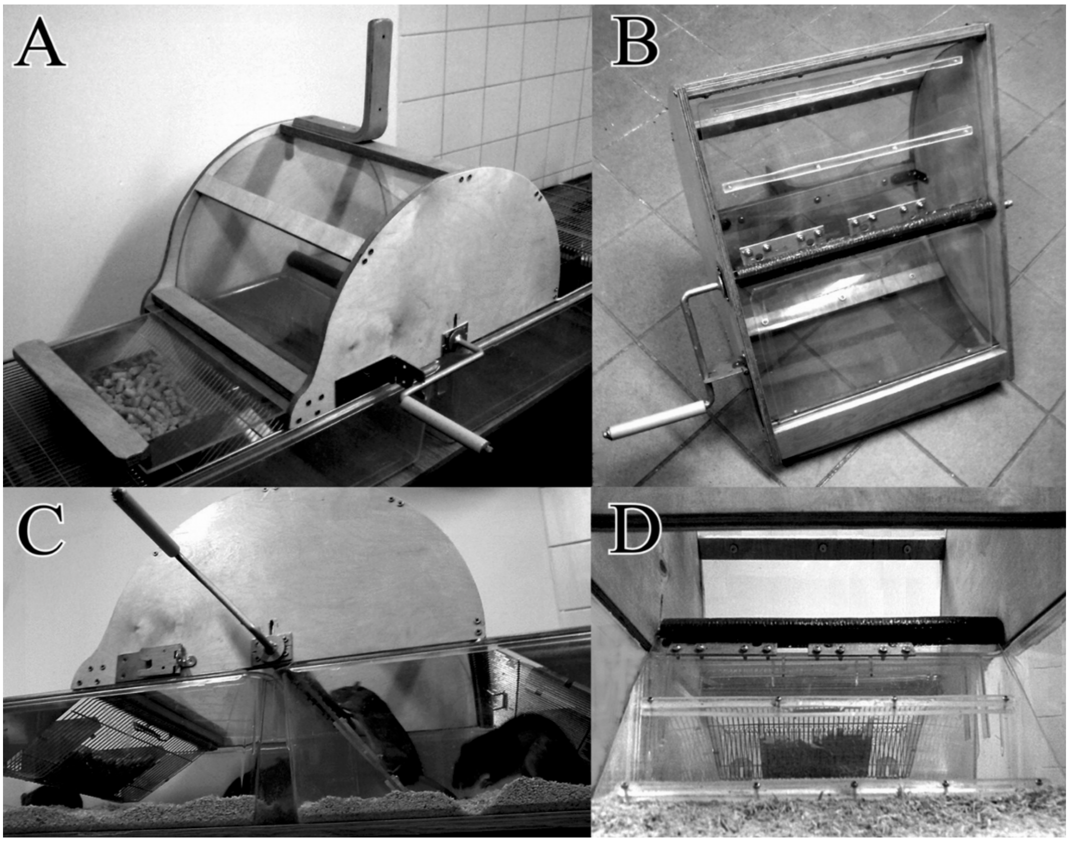

Fig. 1. (A) The Prototype of a Cage-to-Cage Transferring Device; (B) The Prototype of the Cage-to-Cage Transferring Device – bottom view; (C) The rats on the left side are blocked in the cage by a plexiglass cover. One of rats in the right cage is climbing up the plexiglass ramp and can be blocked by turning the crank; (D) The Prototype of the Cage-to-Cage Transferring Device with the ramp lowered. Inside view from the rats' perspective.

CAGE-TO-CAGE TRANSFERRING DEVICE[1]

Using the cage-to-cage transferring device (see Figs 1–2) is an effective way of transferring rats between home cages when cage cleaning. It was also very useful when pairs were coupled for mating and when there was a need to separate fighting animals. The prototype (see Fig. 1) of the device was especially designed for the standard Tecniplast cages (610 × 435 × 215 mm) that were used in the laboratory of The Warsaw School of Social Psychology, but the design may be adapted to any cage of any size (see Table I). The original transferer is 59 cm long, 42.5 cm wide and 29 cm high. The width and length of the ramp is and 39–37.5 cm and 24 cm respectively. The sides were made of 10 mm-wide plywood that was varnished with a waterproof, washable paint. Movable surfaces and casing were made of plexiglass (6 mm) and polycarbonate (2 mm). The crank was made with a bent steel rod (10 mm in diameter). The crank may be kept in the horizontal position by a lock on the side of the device (see Fig. 1A). Pieces of cut-to-size metal which are attached to both sides of the transferer's casing to keep the revolving crank from rubbing the plywood. The described version of the transferer weighs about 7 kilograms. The weight, however, prevents rats from lifting it and escaping.

This cage-to-cage transferer was mainly used to cope with very aggressive or young rats. A lowered surface with attached steps helped smaller rats to climb up. In cases of more docile individuals, a lighter and simpler version of the device was used (see Fig. 5).

The big advantage of the described transferring devices is the high efficiency rate. Proper use of both versions of the cage-to-cage transferer reduces the risk of animal escapes to zero. It reduces the work load of the laboratory staff. Animals are also less

[1] A movie showing the general idea of the transferer can be downloaded from http://www.ane.pl/media/ane-pl-cage-to-cage-transferring-device.avi

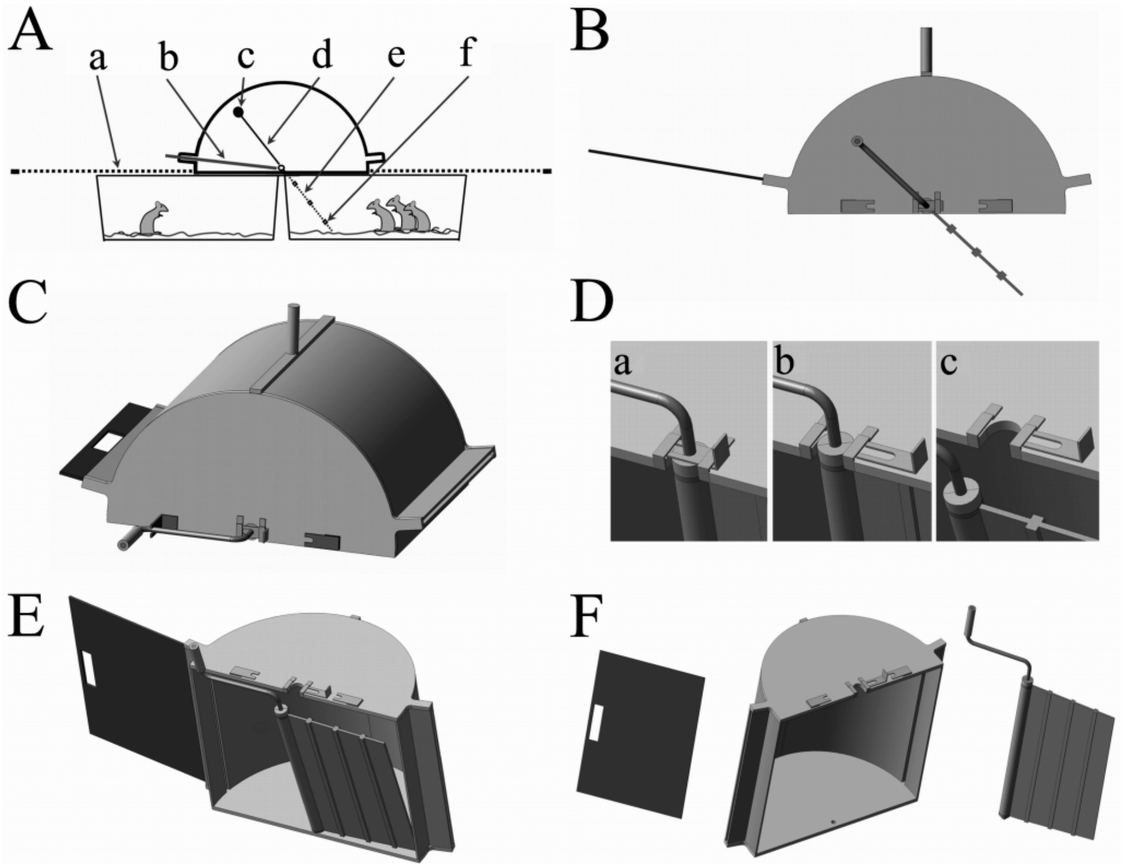

Fig. 2. (A) Scheme of Cage-to-Cage Transferring Device: (a) wire lid of a home cage; (b) insertible cover; (c) handle; (d) crank; (e) ramp which can be swung up and over; (f) steps attached to the ramp; (B) The autoclavable version of the Cage-to-Cage Transferring Device. The plexiglass cover (left) is slid out but it is kept in a still position by the part of the casing that is sticking out. Thanks to symmetry it can be inserted from both sides of the device. The crank can also be locked at the opposite ends of the front sides; (C) The autoclavable version of Cage-to-Cage Transferring Device – seen from above. The crank is blocked on the left side by a locking hinge; (D) Method of disassembling the crank: (a) The crank is locked by the latch; (b) The latch is unlocked; (c) The crank is free; (E) After unlocking the latch the crank leans out and tips upwards; (F) For autoclaving the device should be disassembled into three separate parts.

aroused during transferring. Their locomotor activity is considerably lower, and they do not vocalize, as is frequently the case during manual transfer. Therefore it is assumed that the level of stress experienced by the rats is also lower, compared to manual transferring.

Rats are not forced to move between cages – their only motivation to change places is the urge to flee and/or inquisitiveness (see Figs 3–4). A prolonged waiting time is relatively rare. The wild rats' first exposure to the transferer elicits a mild neophobic reaction (anxiety, avoidance, and freezing) in some animals. After a few trials, however, their freezing or avoidance reactions diminish. In order to make transporting quicker one could force rats to move between cages applying external stimulus such as a puff of air or ultrasonic sound. A specially comb-like device was used in the Warsaw lab to separate the animals (see Fig. 6). It was used when only one animal needed to be transferred. Mechanical pushing was often added. However, it was observed that this increased the rats' stress level.

It is worth mentioning that also transferring laboratory rats with the devices described here is less laborious, but it takes much more time than transferring the WWCPS rats. It probably depends on the lower levels of anxiety, flight and neophobic reactions as well as the general reactivity in the laboratory rats.

The prototype described above was made of plywood, polycarbonate and steel. Plywood however is not

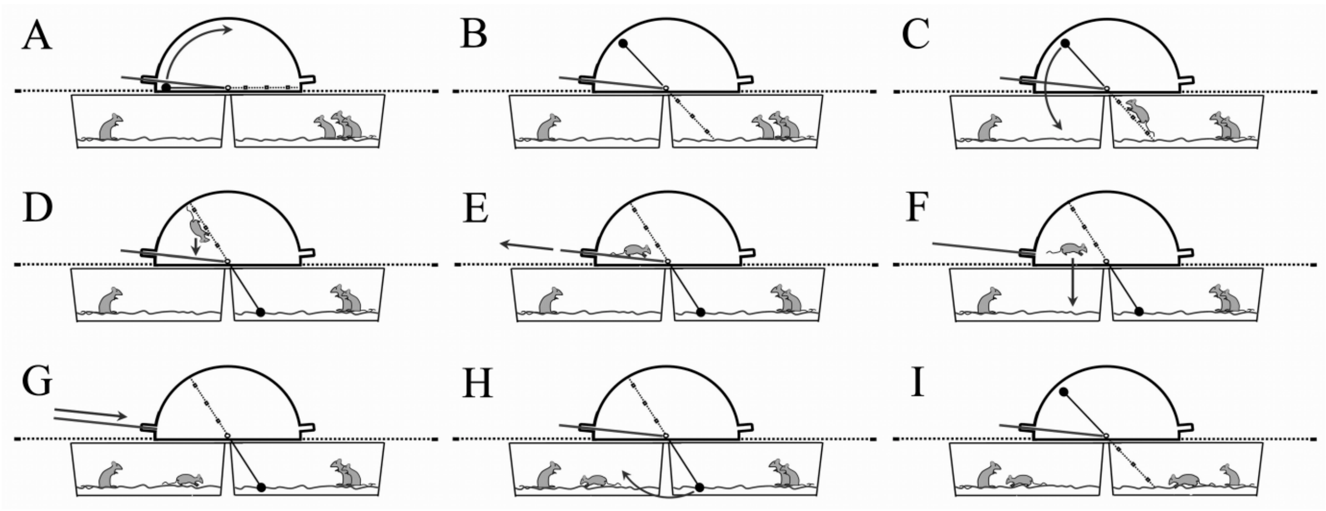

Fig. 3. An example of how to transfer rats (from the right cage to the left one): (A) Turning the crank in the indicated direction will lower the piece with steps, into the right cage; (B) Rats are free to enter the transferer; (C) When one of the rats starts to climb up, the crank is turned down blocking the rat's way back; (D) When the crank is turned further, the rat is forced to jump down on the insertable cover, which prevents the flight of the already transferred rats; (E) The insertable cover is pulled out from underneath the rat; (F) The rat falls or jumps down into the intended cage; (G) Putting the insertable cover back on, closes animals in the intended cage; (H) To proceed, the crank must be put back to the position indicated in point A; (I) To continue transferring, one must wait for next rat(s) to climb up.

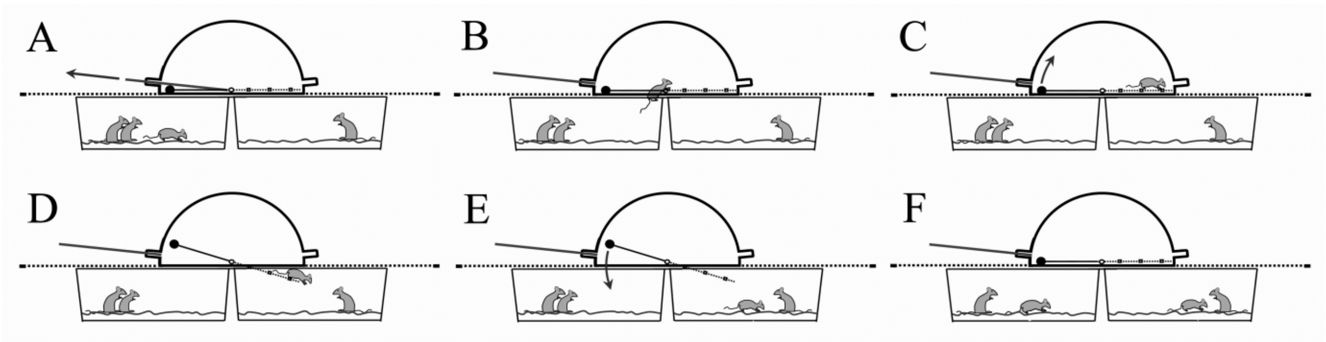

Fig. 4. An example of the alternative way of transferring rats, (from the left cage to the right one): (A) The insertable cover is pulled out; (B) A rat(s) jumps out of the cage onto the revolving ramp; (C) Gently pulling up the crank lowers the ramp; (D) The rat jumps down into the intended cage through a small gap. This small gap makes it difficult for the other rat in the right cage to try to flee; (E) Turning the crank in the opposite direction closes the gap and thus eliminates possibility for escape; (F) To proceed one must wait for the next rat to jump onto the ramp.

recommended for autoclaving. The prototype is additionally relatively hard to disassemble. Therefore the sterilizable version (see Fig. 2) is easy to dismantle and is made of autoclavable materials [e.g. polycarbonate (PC), polysufone (PSU) or polyetherimide (PEI)]. The sides and top of the autoclavable version are designed to be made of 10 mm and 5 mm transparent PC respectively. Both the crank and the lowered ramp should be made of acidproof stainless steel. This version could be easily disassembled into three separate parts (see Fig. 2F). Unlike the wooden prototype the new version is also symmetrical, which means that the crank can be locked in one of two opposite ends of the front side (see Fig. 2C) and the cover can be inserted from both the left and the right side. The symmetry is convenient as it helps laboratory staff transfer animals from a cage and lock them on whichever side is necessary. Another difference is that the ramp is equipped with 3 instead of 2 steps, which will help smaller rats to climb up faster and more easily. The proposed autoclavable ver-

Table I

Dimensions (mm) of the device for different cages

	Eurostandard Type II L	Eurostandard Type III	Eurostandard Type III H	Eurostandard Type IV
home cage dimensions	365 × 207 × 140	425 × 266 × 155	425 × 266 × 185	610 × 435 × 215
casing's length *	350	380	450	520
casing's width	200	255	255	425
casing's heigth **	185	200	235	270
insertable surface's length	290	305	340	375
insertable surface's width	165	225	225	395
ramp's length	160	175	210	245
ramp's width A ***	165	225	225	395
ramp's width B ***	145	205	205	375

* The length does not include the lengths of pieces sticking out for the insertable cover (50 mm each); ** The height does not include handle; *** The revolving ramp is a trapezium. Width A signifies the width near the axis of revolution. Width B is the width at the opposite end of the trapezium.

sion of the device is also much lighter and therefore more handy. Obviously the dimensions of the device can be adapted to cages of any size as it may be used for transferring animals of many species (see Table I).

THE SIMPLIFIED VERSION OF THE CAGE-TO-CAGE TRANSFERRING DEVICE

In daily usage a simplified version of the cage-to-cage transferring device[2] proved to be more handy and efficient, (see Fig. 5). As it was mentioned, the device with the ramp was used mainly with aggressive or young animals. Steps helped young rats climb up. Although there is no crank in the simplified version, the insertable surface piece, which blocks the way out from the intended cage is optionally used. Using the simplified version requires more skill. It is necessary to have quick reflexes to quickly insert the plexiglass surface piece or quickly close the wire lids. Incompetent use may also harm the animals as they may get banged by rapidly moving elements.

For autoclaving the simplified version should also be made of sterilizable materials.

[2] The simplified version differs from the expanded one only by the lack of the crank, and in size. After detaching the crank one can obtain a lighter simpler version of the transferer.

A COMB DEVICE FOR SEPARATION OF ANIMALS WITHIN CAGES

Sometimes it is necessary to separate or confine wild rats within a cage. This may happen, for example, when animals are fighting or when there is a need to give an injection or apply external medication to a specific animal. In such situations a specially devised comb was used. The wide teeth of the comb were lowered between the cage top bars (see Fig. 6). The device may also be applied while pairing wild rats for mating, which at first may elicit a very high level of aggression in the animals. Therefore, it is advisable to allow at first for the visual and olfactory contact only and remove barriers after the phase of adaptation. The need for such a removable barrier was also noted by Evans and others (1968).

The comb was made of steel rods/teeth (6 mm in diameter), that were set in a wooden handle and painted with a waterproof paint. If the handle has to be sterilized at a high temperature, it has to be made of a different material (the author suggests using stainless steel). To reduce the noise of the metal bars scraping on the metal comb teeth, the latter were encased in a thermoshrinkable material that was then warmed up.

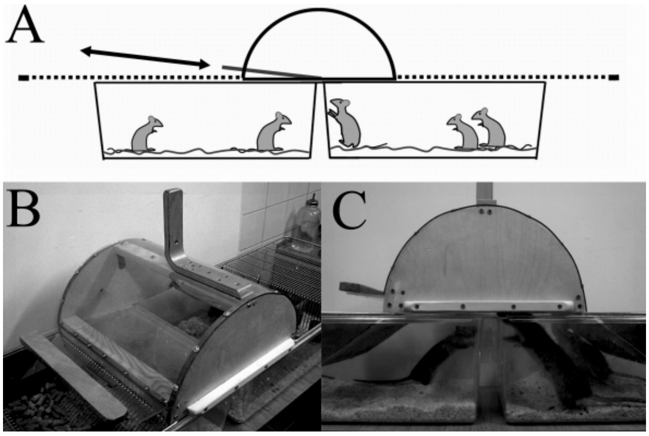

Fig. 5. (A) Scheme of the simplified version of the Cage-to-Cage Transferring Device; (B) Top view of the simplified version of Cage-to-Cage Transferring Device; (C) The rat on the left is blocked in the left cage with the insertable cover. The rats on the right are free to jump up on the cover.

The comb proved to be easy to use and effective in separating and guiding animals in the needed direction. However, some of the wild rats barely tolerated sudden confinement with the comb. They frequently (especially during their first exposures) tried to push themselves through the rods and would bite them fiercely.

HANDLING WILD RATS

Wild rats can be tamed by intense and systematic neonatal handling. Despite the handling, they stay highly reactive and timid (Barnett 1958). The WWCPS rats were handled without safety gloves till about 14 days of age. For safety reasons gloves were always used in case of older pups and adult rats. Commercially available industrial gloves, made of leather and cloth, are strong enough to prevent bites, even of the big rats. However, they do not protect wrists and are clumsy when handling a wriggling animal. This is the reason why gloves made of metal mesh and designed especially for butchers, although costly, are strongly recommended.

A relatively effective method of calming fighting animals is splashing them with water (e.g. with a syringe). However, this method proved to be effective only in cases of low or medium intensity fights. If the fight was an all-out battle, the splashing sometimes only served to increase aggression.

Despite using every safety device available, one cannot avoid the possibility of human-related mistakes. Therefore, escapes from home cages, though seldom, may occur. All rodents, including wild rats show a pronounced thigmotaxis (tendency to move along sides of objects). Barnett (1963) stated that thigmotaxis plays an adaptive role, protecting the animal from predators, especially predatory birds. Rats escaping in a novel environment like to move along walls and hide in small, dark spaces. An effective way of recapturing animals that escaped is to put several cardboard boxes near the walls. These boxes should be cut on one side, so that a flap of the cardboard is displaced, making a hole. The hole should be the species size (about 10 cm for the rat). If it is too big, it will increase the possibility of the second escape. After the rat enters the box, the entrance can be closed by folding the flap of the cardboard back. Using similar kinds of cardboard boxes is also an effective way of transporting single animals from cage to cage or to an experimental chamber. This method is extremely efficient when capturing a rat for the first time. However, after several captures animals tend to avoid entering such boxes.

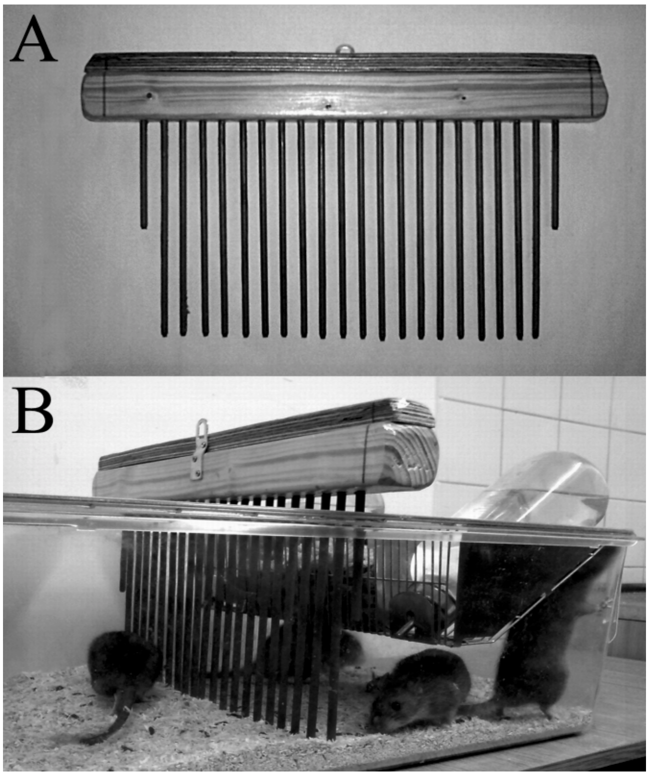

Fig. 6. (A) Comb used to separate rats within cages; (B) Wild rats separated with a comb.

Another effective method of transferring rodents was proposed by Tighe (1965). It requires construction of a special device – a box, which fits closely inside the cage. The box is equipped with a sliding floor that shuts the bottom. It enables safe withdrawal of the box from the cage with the animal inside.

CONCLUSIONS

Working with wild rodents, including rats, requires patience and precaution. It carries the risk of bites, infections etc. Although the devices and techniques that are described here were designed on the basis of the experience with the wild *Rattus norvegicus*, after some modifications they could also be applied to other mammals such as mice, hamsters, opossums, gerbils etc. They could also be used in laboratories, in which physical contact with animals is not advisable (germ-free breeding, experimental procedures preventing handling). If the devices had to be sterilized, the proposed devices should be made of autoclavable materials [e.g. polycarbonate (PC), polysufone (PSU) or polyetherimide (PEI)] and their movable parts should be easy to disassemble.

Patenting procedures for the described devices are in progress.

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