

How a harvest mouse builds a bottom nest  
-A case in the condition with accumulated litter-

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### Introduction

It's well known that a harvest mouse *Micromys minutus* builds a spherical nest on a high rise in the plant sward (spherical aerial nest hereafter). There are also a few reports which indicates that some of this species' nests are being built on the surface of the ground in the plant sward that has withered up in the winter (Ishiwaka et al. 2010; Nishio 2013). Ishiwaka and Masuda (2013) recorded a harvest mouse building a nest on the surface of the ground (bottom nest hereafter) and using it with a video camera in the winter in the wire netting cage installed in the field. They suggest that a harvest mouse builds a bottom nest as a part of habitual nesting and uses it.

While the nest mentioned as completed was domed in the laboratory mouse *Mus musculus* (Hess et al. 2008), an ellipsoid or almost spherical bottom nest was noted in the harvest mouse (Ishiwaka et al. 2010; Nishio 2013). How to build a nest on flat space might therefore be different in these two species.

There is no available information on what condition the harvest mouse builds a bottom nest in, except for a fact that bottom nests are often found where plant sward above the ground has withered up in winter. Beside the plant species composition, the amount of litter and the kind of the soil and its moisture content could have effects on shape and structure of a bottom nest. Living situations of the other animal species and climate conditions also could be linked it as well.

The aim of this study is to examine the procedure of bottom nest being built through analysis of movie that recorded a captive harvest mouse in the cage. This report shows building of a bottom nest in a condition with accumulated litter.

### Materials and methods

#### Observation cage

Each of three sides of the observation cage was a clear acrylic board and one side is plywood, its ceiling and floor made of wire netting (5 mm square mesh). The cage was 50 cm in width, 40 cm in length and 40 cm in height. In this observation, each harvest mouse was kept under the natural light and room temperature condition of 3 to 15 °C and food and water was given ad lib using a bottle and a feeder.

#### Preparation of nest material

In Case 1 and Case 2, we put another wire netting on the floor and stood stems and leaves of gramineous plant to establish a few imitated short plant stubbles in the observation cage. A rest of the floor was covered with litter 2 to 3 cm in depth made of cogon grass *Imperata cylindrica* and green foxtail *Setaria viridis* and others, collected in the field. The litter was composed of withered stems and leaves 5 to 20 cm in length.

#### Observed individuals

In Case 1 and 2, a non-pregnant female at the age of about 180 days was observed, and in Case 3, likewise a non-pregnant female at the age of about 90 days recorded. We recorded the female's behavior from 28<sup>th</sup> November until 1<sup>st</sup> December 2016 in Case 1, from 4<sup>th</sup> until 7<sup>th</sup> December 2016 in Case 2 and 16<sup>th</sup> December 2016 until 1<sup>st</sup> January 2017 in Case 3. Each female was introduced into the observation cage on the first day of every case.

In Case 3, we planted several withered rootstocks of cogon grass and others on a tray with wet soil and put the potted plant on the floor of the observation cage, covering the soil with the litter completely about 3 cm in depth. We introduced a male 6 days following the introduction of the female (22<sup>nd</sup> December), after the copulation occurred the male was gotten out of the cage and the observation was continued until 1<sup>st</sup> January 2017. This female gave birth on 8<sup>th</sup> January 2017 in her bottom nest in the cage.

Instruments for recording the female's behavior

In this study, the behavior of the female was video recorded by SD card recorder DVF-7 type (made of Corona electrical industry) using a high-definition miniature camera (WM-SB041MG the type f=2.8-12mm/F1.4 the mini lens). When subject's movement was detected, it was recorded by a motion recording system (30 frame/second). This report carries movies of nesting behavior of the female harvest mouse for its bottom nest. You can see the movie of the nesting behavior by clicking a picture (wmv file).

Results and Discussion

Case 1



Photo 1-1. Left, a spherical bottom nest; right, a spherical aerial nest which had been made in November by the same individual.



Photo 1-2. The outer litter of the nest was removed. There is a somewhat dense spherical nest composed of fine torn litter at the upper center of the picture.



Photo 1-3. The bottom nest is being opened from one of its openings. There is another opening in the back.



Movie 1-1. A female harvest mouse walks around the litter, and then dives into and explores under it. At last, she builds a bottom nest under the litter at the lower left of the picture where she emerges (2016/11/28).



Movie 1-2. Under the lump of litter, the female retracts dispersed surrounding litter into nesting position (2016/12/1).



Movie 1-3. The nest under the litter seems to have some opening by which a mouse can pass through the nest.



Movie 1-4. The female cut out a long clip from a lump of litter. A dense botanical fiber sphere seems not to exist under the litter from the appearance.

**Case 2**



Photo 2-1. A completed bottom nest (2016/12/8)



Photo 2-2. An outer appearance of the bottom nest taken out of under the litter (2017/1/8).



Photo 2-3. This bottom nest has a structure in which a harvest mouse can pass through the nest.



Movie 2-1. The female harvest mouse chose under this side of the litter as the nesting position.



Movie 2-2. She slips into the nesting position and then tears litter around herself using incisors and both hands, stretching the torn litter to get it to hold herself.



Movie 2-3. She drags another surrounding clump into the nesting position and repeats tearing and stretching it around herself like a silkworm spin a cocoon. The lump of litter on the nest is lifted largely with this movement.



Movie 2-4. Litter is brought into repeatedly. Seeing from another angle, the spherical shape of the nest comes up to the surface.



Movie 2-5. Picture from the left side of the previous movie. Outside litter is being brought into the nest.



Movie 2-6. The female can be seen tearing brought litter into thread-like nest materials in the nest.



Movie 2-7. The female repeats bringing litter from outside to the nest.

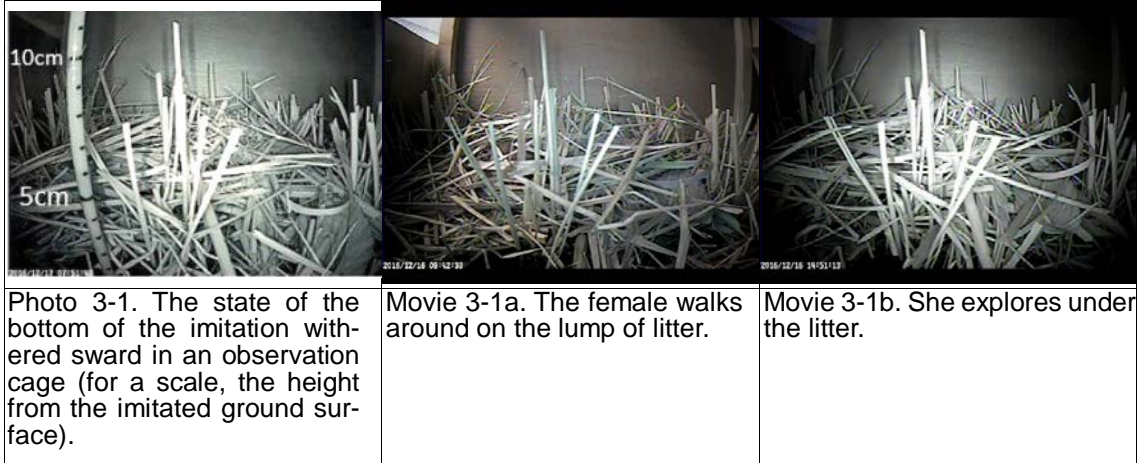


Movie 2-8. The bottom nest is almost completed. The female takes litter to another opening opposite as well.

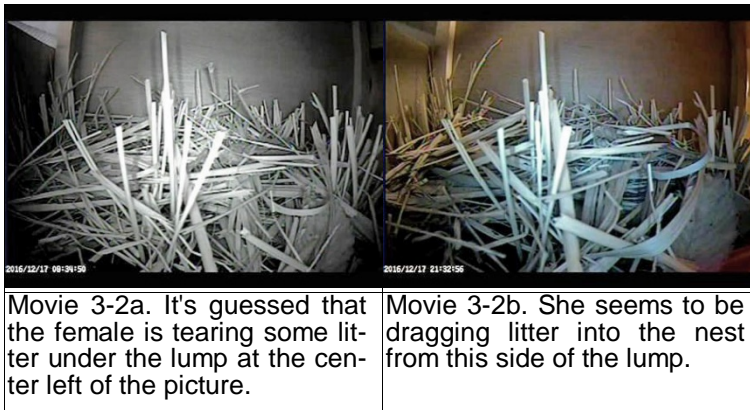


### Case 3

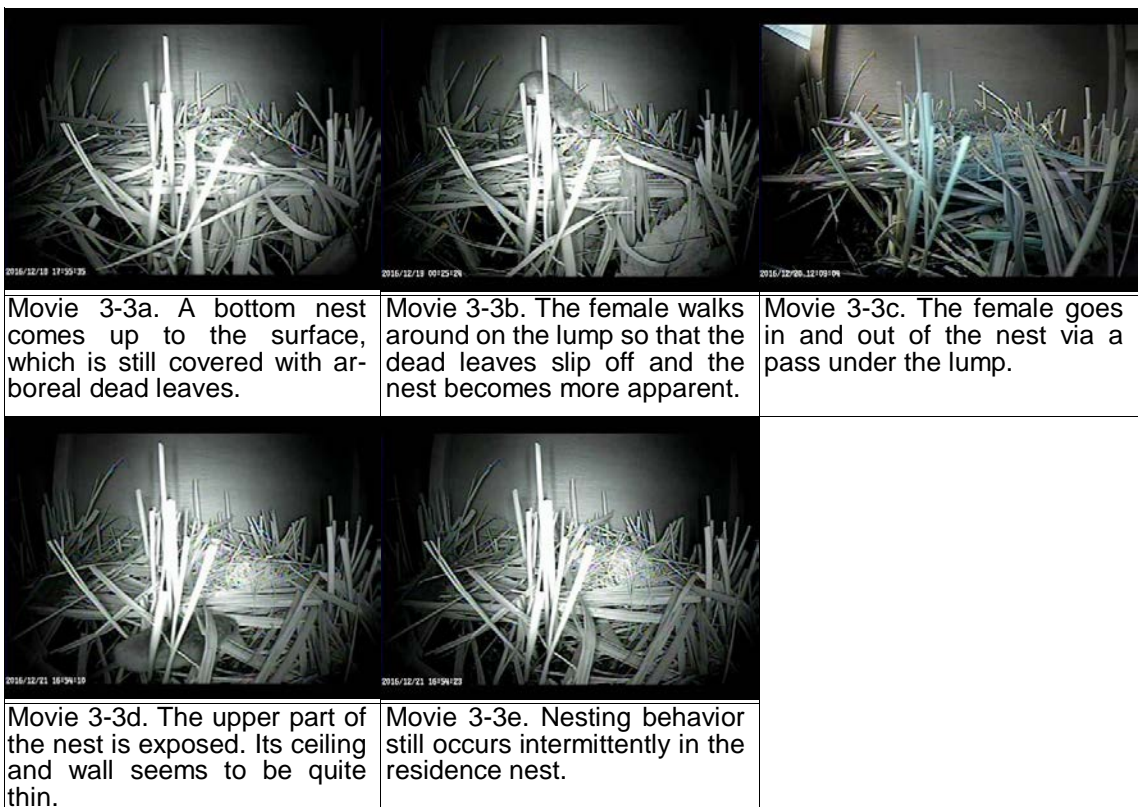
Decision of the nesting position:



A beginning of nesting behavior:



Provisional completion of a residence bottom nest:



A distortion of the nest shape following an affair:



Movie 3-4a. A self-grooming is frequently performed on the nest, and thus the top of the nest has become flat a little.

Movie 3-4b. The female sometimes jumps off from the top of the feeder onto the nest.

Movie 3-4c. She also moves on and around the nest without cease.



Movie 3-4d. The nest is damaged because the female in estrus and an introduced male move on and around the nest vigorously.

Even after copulation, the nest is used and maintained as a residence one until a renovation occurs:














Movie 3-5a. Three days after copulation, the female is repairing the nest around the opening on the left of the picture.

Movie 3-5b. She occasionally slips into under the object such as the lump of litter or the nest on the imitated surface.

Movie 3-5c. There is a way through in this nest, and the female gets on and in the nest to take a rest.



A major renovation of a residence nest to a breeding one:

		
<p>Movie 3-6a. The female harvest mouse repeats tearing brought litter in the nest, and trusting those nest materials against inner wall with her whole body.</p>	<p>Movie 3-6b. As the female trusts more materials against the inner wall, the nest expands gradually.</p>	<p>Movie 3-6c. The nest increases the size, being expanded intensely from inside of the nest.</p>
		
<p>Movie 3-6d. The female brings surrounding litter to the nest repeatedly.</p>	<p>Movie 3-6e. The brought litter is torn and trusted against inner wall intensely.</p>	<p>Movie 3-6f. The female draws litter from your right opening into the nest.</p>
		
<p>Movie 3-6g. The female persistently repeats making and trusting nest materials so that the nest becomes still larger.</p>	<p>Movie 3-6h. A new opening is made. The female shows her nose and drags outer wall materials around the opening into the nest.</p>	<p>Movie 3-6i. She seems to confirm the state of the nest wall by getting on the nest sometimes.</p>
		
<p>Movie 3-6j. The female seems to fair outer wall superficies by cutting off some materials.</p>	<p>Photo 3-2. The outer appearance of the spherical bottom nest for breeding on 2017/1/1.</p>	

### Conclusion

In this study, the harvest mouse built a bottom nest under a lump of litter. Where a nest is built under more accumulated litter in the field, most won't be discovered, hidden by litter cover. Nests of the harvest mouse come in various shapes (unpublished), and the following traits allow its particular nest in spherical or ellipsoidal shape formed and kept. The harvest mouse can tear a litter mostly from gramineous plants into fine thin but long nest materials. In the nest, a female tears litter from outside into nest materials and pushes them against inner wall. Each material has many strayed thinner threads, frays, and splits, each of which has the same structure as the main body. Long nest materials with many respective threads and others are caught by each other and therefore extremely useful for forming a domed ceiling and a spherical or ellipsoidal outer shape of a nest. Outer nest materials come to be stretched and to hold the whole nest, and the wall to be denser and tougher, as a female pushes more materials against inner wall. Even the nest taken from under litter thus keeps its shape. The nest with thick ceiling and wall is likely to hold the inner temperature and to lead to success of reproduction in result.