Do leaf-cutting ants (*Acromyrmex octospinosus*) prefer to cut flower petals of a certain colour?

Richard Bottrill 2011

ASAB

Section A

A group of students wanted to investigate whether leaf-cutting ants responded differently when presented with four different coloured rose petals.

The students set up a glass tank with a single tube for the ants to enter and exit. Four glass dishes, each containing one of the four petal colours, were placed at the rear of the tank. The dishes were aligned at an equal distance from the entrance tube. The students also ensured that each dish contained a 3 g mass of rose petals.

The ants were allowed to enter the tank but the students did not take any observations until the ants had been in the tank for 30 minutes.

After this time the students started the timer and they recorded the number of cut fragments of each coloured petal taken by the ants as they exited the tank. The students recorded the frequency of each coloured petal fragment at 10 minute intervals for a total period of 60 minutes.

Task 1

Watch the 10 minute DVD film footage and record your own observations to complete the results table for 50 - 60 minutes.

Time (minutes)	Number of cut fragments for each colour petal			
	White	Pink	Red	Apricot
0 – 10	7	6	9	18
10 – 20	20	14	18	24
20 – 30	28	16	22	26
30 – 40	26	31	18	23
40 – 50	34	35	16	26
50 – 60				
TOTAL				

Task 2

Analyse the data in the results table with a suitable statistical test.

1. State the null hypothesis.

(1)

2. Give your choice of statistical test.

(1)

3. Give reasons for your choice of statistical test.

(1)

4. Calculate the test statistic.

(1)

5. Interpret the test statistic in relation to the null hypothesis being tested.

(2)

Total 6 marks for section

SECTION B

1. After allowing the ants to enter the tank with the coloured petals, they were left for 30 minutes before the students started to collect any data. Explain why the students did this?

(1)

2. The students observed the behaviour of the ants for a total period of 60 minutes. Explain why they chose to record for this length of time.

(2)

3. State **ONE** factor the students controlled in order to make the results comparable.

(1)

4. Explain **TWO** ways in which variation in petals could account for the variation in the number of petal fragments taken by the ants.

(i)

(ii)

(4)

5. Explain **ONE** other way in which the method used by the students may have affected the reliability of the data collected.

(2)

Total 10 marks for section

SECTION C

The behaviour of leaf-cutting ants

Leaf-cutting ants are a particularly successful group of ant species that have evolved a unique relationship with certain fungal species. The relationship between leaf-cutting ants and the fungus is one in which both organisms benefit, and one cannot survive without the other [2].

1. What is the name for the type of relationship that exists between the leaf-cutting ants and the fungus?

(1)

One of the main tasks performed by the leaf-cutting ants is the foraging and collecting of plant material. This material is transported back to the colony and deposited in special chambers known as 'fungal gardens'.

2. Suggest the role of the fungus in this relationship.

(1)

3. Researchers isolated a single species of fungus from a leaf-cutting ant colony. They discovered that only 11 - 27 % of the plant material provided was metabolised [1].

(a) Suggest an explanation for the low percentage metabolism of plant material and explain how this may affect the nutrient availability for the colony.

(2)

(b) Suggest how the ants overcome this problem?

(1)

Leaf-cutting ants

ASAB

The fungal gardens are maintained by 'gardening ants' which remove any contaminants such as yeasts, bacteria, or foreign fungal spores. The fungus itself produces anti-microbial substances to defend itself. However, anti-microbial substances produced by the leaf-cutting ants are thought to be more important.

4. Explain the importance of the leaf-cutting ants removing any foreign contaminants from the fungal gardens.

(1)

5. Researchers wanted to test the response of a leaf-cutting ant colony when presented with toxins. The researchers placed orange peel contaminated with a fungicide along several ant trails of a single colony. Within two days the ants refused to collect any more orange peel regardless of whether it had been contaminated or not. The response is triggered by interactions between the foraging ants and the fungus.

(a) What type of response was exhibited by the ants?

(1)

(b) What is the advantage of this behaviour to the survival of the colony?

(2)

(c) Suggest an explanation of the response by the ants in refusing to collect orange peel. Explain how the interactions between the fungus and ants may have developed through natural selection.

(2)

6. Research was conducted in Trinidad on interactions between leaf-cutting ants of a **single species**. The scientists concluded that ants from widely-spaced colonies were more aggressive towards each other than ants from colonies much closer together.

(a) What might be the reason for the aggressive behaviour exhibited by the ants from widely-spaced colonies?

(1)

It was shown that plant material provided to a colony influences the chemical odour is produces.

In laboratory conditions two separate colonies were supplied with plant material for a period of time and then they were allowed to integrate. When the two colonies had been foraging on similar plant material no aggressive behaviour was exhibited, however, when supplied with different plant materials aggression between ants was observed [3].

(b) The researchers concluded that environmental factors are most important in triggering aggressive behaviour in this species of ant. Explain this conclusion and evaluate the validity of the statement.

(3)

Total 15 marks for section

References:

[1] **Abril A.B., & Bucher E.H**. 2004. Nutritional sources of the fungus cultured by leaf-cutting ants. *Applied Soil Ecology*, **26**, 243 – 247.

[2] **Cherrett J.M., Powell R.J. & Stradling D.J.** 1989. The mutualism between leaf-cutting ants and their fungus. In: *Insect-fungus Interactions* (Ed. by Wilding, N., Collins, N.M., Webber, J.F.), pp. 93 – 120. London: Academic Press.

[3] **Jutsum A.R., Saunders T.S. & Cherrett J.M.** 1979. Intraspecific aggression in the leaf-cutting ant *Acromyrmex octospinosus*. *Animal Behaviour,* **27**, 839 - 844.

[5] **North R.D., Jackson C.W. & Howse P.E.** 1997. Evolutionary aspects of ant-fungus interactions in leaf-cutting ants. *Tree*, **12**, 386 – 389.

Are females better parents than males?

It is known that the amount of parental care provided to offspring differs between different organisms. There is also a great deal of variation in the amount of parental care provided by males and females of the same species.

An investigation was carried out by observing the behaviour of burying beetles (*Nicrophorus vespilloides*). Burying beetles are scavengers that feed on the dead bodies of mammals and birds. The investigators recorded the total time spent by male and female beetles in caring for the offspring. The results were as follows:

Parent number	Sex of parent	Time spent caring (minutes)
1	male	20
2	female	55
3	female	85
4	male	0
5	female	25
6	male	65
7	female	10
8	male	95
9	male	70
10	female	15
11	male	50
12	female	100
13	male	30
14	female	45
15	male	90
16	female	75
17	male	35
18	female	60
19	male	80
20	female	100

Data from 'Parental Behaviour in Burying Beetles' by Melanie Gibbs (University of Manchester). Association for the Study of Animal Behaviour Teaching Resource 2005.

Extension Activity 1

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Analyse the data in the results table with a suitable statistical test.

1. State the null hypothesis.

(1)

2. Give your choice of statistical test.

(1)

3. Give reasons for your choice of statistical test.

(1)

4. Calculate the test statistic.

(1)

5. Interpret the test statistic in relation to the null hypothesis being tested.

(2)

Total 6 marks for section

Extension Activity 2

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Is there a relationship between the forewing lengths of moths?

The large yellow underwing (*Noctua pronuba*) is a moth that is widespread and abundant throughout the British Isles. They are found in a wide variety of habitats, such as gardens, farmland, woodland, heath and moorland.

They are relatively large moths having a forewing length of 20 – 27 mm. A scientist wanted to find out whether there was a relationship between the lengths of the left and right forewings of individual moths. The lengths of the left and right forewings were measured from a random sample of 15 moths and are displayed in the table below.

Sample number	Left forewing length (mm)	Right forewing length (mm)
1	26.1	25.9
2	26.0	27.7
3	25.5	25.2
4	25.8	26.4
5	25.3	25.2
6	25.5	25.1
7	24.0	24.8
8	25.1	24.2
9	24.9	24.8
10	26.1	25.6
11	25.8	25.1
12	24.8	24.8
13	25.8	25.4
14	26.5	25.9
15	26.4	26.0

Data from M. Dockery

Extension Activity 2

ASAB

Analyse the data in the results table with a suitable statistical test.

1. State the null hypothesis.

(1)

2. Give your choice of statistical test.

(1)

3. Give reasons for your choice of statistical test.

(1)

4. Calculate the test statistic.

(1)

5. Interpret the test statistic in relation to the null hypothesis being tested.

(2)

Total 6 marks for section