There are too many rabbits in Victoria!

Did you know that rabbits are increasing global warming? According to a recent study in North-West Victoria rabbit browsing on native seedlings has resulted in the failure of woodlands to regenerate naturally.

The study found that the continual destruction of Pine-Buloke woodland seedlings by rabbits is instrumental in preventing carbon sequestration (collecting or trapping carbon from the atmosphere) across hundreds of thousands of hectares of land in North-West Victoria. Rabbit numbers need to be extremely low - less than one rabbit per hectare for successful regeneration. A recent assessment of rabbit numbers in the Mallee indicated that rabbits were beginning a resurgence with current population estimates of 1.3 rabbits per hectare at monitoring sites.

Effective rabbit control at just one monitoring site could allow shrub and tree regeneration across 30,000 hectares which has the potential to sequester between 50 – 100 tonnes of carbon per hectare over a 30 year period. The cost of rabbit control is estimated to be as little as $30-50 per hectare including on-going maintenance.

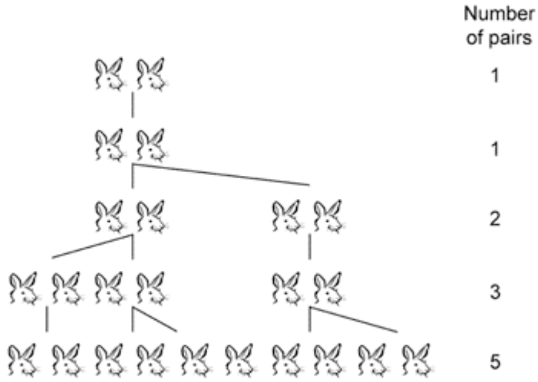
Thomas Austin introduced rabbits to Australia in 1859 for hunting purposes. With no natural predators and litters of five or more kittens up to seven times a year, rabbits quickly became a problem across Australia. As rabbit numbers reached the hundreds of millions, vegetation was stripped of leaves and bark, killing plants and leaving the soil vulnerable to erosion. Farmers and scientists have employed many control methods over time, including ripping and fumigating warrens, trapping, shooting, baiting and introducing biological control agents such as myxomatosis and calicivirus. Effective rabbit control requires the integrated use of all these techniques.

Adapted from information provided by Brett Harrison, Department of Primary Industries

Fibonacci and Rabbit Breeding

(Adapted from 'Fibonacci Numbers and Nature', www.mcs.surrey.ac.uk/Personal/R.Knott/Fibonacci/fibnat.html)

Figure 1: Fibonacci and Rabbit Breeding



Victorian Essential Learning Standards

Use of this learning and teaching activity may contribute to achievement of elements of the Standards in Mathematics (Level 4, 5), Humanities – History (Level 3, 4) and Science (Level 3, 4, 5).

Duration and setting: 30 minutes – 1.5 hours (approximately 2 lessons).

Summary

This activity enables students to understand the Fibonacci sequence and how it occurs in nature by relating it to rabbit breeding trends.

Student outcomes

This activity will enable students to:
Learn about the Fibonacci Sequence and how this relates to rabbit breeding
Research the impact of the introduction of European rabbits to Australia.

Background notes for teachers

Rabbits were first brought into Australia by the First Fleet, however they did not successfully become established until 1859 when Victorian grazier Thomas Austin imported 24 rabbits from England and released them on his farm with the belief that *"the introduction of a few rabbits could do little harm and might provide a touch of home, in addition to a spot of hunting[1]".*

Within a decade of the rabbit release, their numbers had multiplied so much that millions could be eradicated each year without having any noticeable effect on the population. Rabbits held the record for the fastest spreading mammal anywhere in the world and their impact on Victorian agriculture is estimated (in 1998) to be $360 million[2].

Fibonacci, an Italian mathematician investigated how fast rabbits could breed under ideal circumstances. This activity is a way of demonstrating the Fibonacci sequence to students while also showing them how, in a short period of time, rabbit populations under certain conditions can increase to explosive proportions. This can lead to discussions with students about the devastating impacts rabbits have on Australia's environment.

In 1202 Fibonacci recognised mathematical patterns in nature and developed the Fibonacci sequence. A Fibonacci number sequence is a sequence where the subsequent number is the sum of the two preceding numbers: 0, 1, 1, 2, 3, 5, 8, 13, 21, and so on. For example 0 + 1 = 1, 1 + 1 = 2, 1 + 2 = 3. In nature, these values often show up in the form of numbers of seeds, petals, segments or spirals. For instance, pinecones usually have 8 spirals going around in one direction and 13 in the other.

[1] The State Barrier Fence of Western Australia (2001), Department of Agriculture Western Australia website
[2] Rabbits and their Impact (1999), Tim Bloomfield, Department of Primary Industries, Attwood

Materials

Calculator, pen and paper, graph paper or Microsoft Excel

The activity

1. Begin by discussing the Fibonacci sequence, using a simple example like the number of petals on flowers. Introduce the idea of using the Fibonacci sequence to calculate rabbit breeding trends. Fibonacci made the following assumptions when he came up with his mathematical pattern:

   Begin with one male and one female rabbit. Rabbits can mate at the age of one month, so by the end of the second month, each female can produce another pair of rabbits.

   The rabbits never die.

   The female produces one male and one female every month.

2. Work with the class to see if students can develop the sequence themselves. Remind them that they're counting pairs of rabbits, not individuals. Work as a class through the first few months of the problem by referring to Figure 1: *Fibonacci and Rabbit Breeding*

   Begin with one pair of new born rabbits. (1)

   At the end of the first month, still only one pair exists. (1)

   At the end of the second month, the female has produced a second pair, so two pairs exist. (2)

   At the end of the third month, the original female has produced another pair, and now three pairs exist. (3)

   At the end of the fourth month, the original female has produced yet another pair, and the female born two months earlier has produced her first pair, making a total of five pairs. (5)

3. Write the pattern that has emerged on the board:

   1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233...

   Discuss the sequence: Help students understand that to get the next number in the sequence, you add the previous two numbers. As a class, continue the sequence for the next few numbers.

4. Using Excel or graph paper, get students to graph the Fibonacci sequence. Use this graph as a way of introducing types of graphical curves. How many rabbits will there be after two years (24 months)?

5. Have students develop a 'rule' for the Fibonacci sequence in relation to the rabbit breeding example, making up their own symbols for the 'rule'.

Discussion questions

Is the sequence a realistic way of calculating rabbit numbers over a period of time? Make a list of all the errors in Fibonacci's assumptions in relation to what would actually occur in nature.

Research rabbit control methods. Discuss reasons why these methods became ineffective over time and why it is necessary to use a combination of methods for effective eradication.

Investigate why rabbits have so successfully adapted to the Australian environment compared to other countries. This should include demonstrating your understanding of the different types of adaptations – behavioural, structural and physiological.

Extension activities

Use the 'Finding Fibonacci Patterns in Nature' activity (*Learning in the Garden* activity booklet on the *LandLearning CD)* to investigate Fibonacci numbers in the school grounds

Visit www.tallpoppies.net.au/education/pdf/sci_heroes_p46_51.pdf for a number of rabbit-related activities