LINCOLN UNIVERSITY
TE WHARE WĀNAKA O AORAKI

Pugged Paddocks

A science simulation modelling activity

Compaction of the ground commonly occurs through stock grazing or heavy machinery on moist pastures. It is difficult to observe as it occurs in in the subsurface soil (5–10 cm). So, an awareness of how pasture growth and paddock conditions (drainage) change over time is a good indicator if the paddock is becoming compacted.

*A **compacted** soil (left) and a **non-compacted** soil (right). (Photos John Drewry)*

Source: Land Care Research: https://www.landcareresearch.co.nz/assets/Discover-Our-Research/Land/Soil-health-resilence/factsheet-compaction-pugging.pdf

When paddocks are saturated pugging is more likely to occur which results in the destruction of the soil structure and pasture plants. It also creates areas where weeds take advantage of the bare ground to grow and invade your paddocks.

Pasture showing the effects of pugging on the right *(Photo Nadia Laubscher).*

Source: Land Care Research: https://www.landcareresearch.co.nz/assets/Discover-Our-Research/Land/Soil-health-resilence/factsheet-compaction-pugging.pdf

Although compaction and pugging are undesirable, the risk of it occurring must be weighed up against maintaining pasture quality through grazing. There are areas of the paddock where compaction and pugging are more likely to occur, and management practices like break fencing and feeding out can also change what areas are affected by changing stock behaviour. Weather is also a factor with wet weather and strong winds driving animals towards the fence line (away from the wind). The area along the fence then experiences pugging.

A lactating (milking) cow will visit the water trough 6 times to drink, but most other stock would visit the trough 2-3 times a day if temperatures are not too hot. This is partly due to grass being 75-85% water, so as they eat, they also consume water.

In science, simulation models allow us to change the variables to explore how they influence the outcomes. This can lead to interesting insights and patterns that allow us to plan and manage the land better.

Aim: In this activity you will be investigating where pugging is concentrated.

The variables are…

- location of the water trough	- location of the gate
- location of the feed troughs	- the location of break fences

Resources: A paddock sheet, 5 different coloured felt pens to track the five animals' movement, a black felt pen to track number of drinks and mark break fences and gates. Twenty-sided dice (you can roll dice digitally on-line if needed). You can either roll one dice multiple times for each animal or you can roll one dice per animal.

How to play…

1) Cut out the animals, the water-trough, and the feed trough.

2) Allocate one colour pen for each animal. Colour your animal in the same colour so you can track them.

3) Roll the twenty-sided dice until it one of the numbers on the edges of the paddock is rolled. This is the location of the gate, and all animals will start at the gate.

4) Roll the twenty-sided dice and the number you roll is the location of the water trough. Place the water-trough in that square. This square is no longer available for feed.

Round 1: Where does compaction occur?

5) To replicate the animal's decision on where to feed, you roll the dice to determine which square the animal goes to. Once an animal has been on that square cross out the number because there is no longer feed available. If you roll a number that doesn't have feed, then the animal still travels through that square (they realise there is no feed) and then moves onto the closest square with food. Each animal needs its own square, so roll again if there is an animal already on the square. This is because the animal would see that there is another cow there and decide to go somewhere else. If you roll the number where the trough is, then roll again.

6) Between each feed period there will be three drinking periods.

Sequence is…

gate(start) – feed –water – feed – water – feed – water – feed – gate (finish)

7) If there is no room on one side of the trough the animals will need to move around to the other side, this movement should also be tracked with the coloured pen.

8) Complete the first simulation.

Reflection…

a) Outline and label the different areas of compaction/ pugging in your field from the following 3 categories.

	Looks like…	**Treatment**
Category 1: Severe pugging	Mud with little or no pasture growing. 	Sub-soiling or ripping followed by cultivation. Soil needs to be dry.
Category 2: Medium Pugging	Soil surface rough but not churned up. Plant density is low, gaps between plants. 	May need to roll the ground before direct drilling seed to improve the accuracy of seed depth placement.
Category 3: Light Pugging	Reduced plant growth but a good quantity/ number of plants are in the paddock. 	Roll and use urea (nitrogen fertiliser) to encourage pasture growth.

Information Source: https://www.dairynz.co.nz/feed/feed-management/managing-pugging-damage/

Image Source: https://vgls.sdp.sirsidynix.net.au/client/search/asset/1017146

b) compare your stock movement with another two groups, what are the similarities and differences?

c) where are you most likely to see soil compaction?

Round 2: Including a Break Fence

9) This time you can choose where the water trough and gate go, with consideration that you will be splitting the paddock into two (am and pm feedings). Add in a break fence (black line) to show where the split occurs.

10) Redo the simulation. The dice will be rolled for each animal until they hit a feed square they can access. Refer to step 4 if you roll a square that has no feed or a water-trough on it.

Sequence is…

gate (start) – feed – water - feed – water – remove break fence – feed – water - feed – gate (finish)

Round 3: Including a feed-trough.

11) Redo the simulation but this time there is no break fencing and you can choose where the water trough, gate and feed trough go. The grass growth isn't as good in winter so animals will need to visit 2 squares to meet their food requirements (eg. Each square has half as much feed).

12) You can place a feed-trough in the paddock at any point of time, just note when this happened in the grazing sequence. Wherever it is placed there is no longer grass feed available on that square. This feed-trough supplies 12 extra feed points. Because it is highly desirable feed **all** animals will visit the feed-trough to meet their feed needs for that grazing period. You do not have to roll a dice to access the feed-trough, it is accessible whenever the animal wants to go.

Reflection

a) When did you decide to add in the supplement feed and what was your reasoning around timing?

b) What happened to the area around the feed trough.

c) Brainstorm ways to reduce or minimise the risk of compaction and pugging.

To learn more…
- Landcare Research, Soil Health Factsheet. https://www.landcareresearch.co.nz/assets/Discover-Our-Research/Land/Soil-health-resilence/factsheet-compaction-pugging.pdf - State Government of Victoria (Australia), Pasture Recovery from pugging damage. https://vgls.sdp.sirsidynix.net.au/client/search/asset/1017146 - DairyNZ, Managing pugging damage. https://www.dairynz.co.nz/feed/feed-management/managing-pugging-damage/