Island Conservation's Standard Operating Procedure for Calibrating Spreader Buckets

The purpose of this document is to provide guidance to Island Conservation (IC) staff on why, when and how bait spreading buckets should be calibrated prior to undertaking a rodent eradication operation. A glossary of technical terms is provided in Appendix 1.

Why calibrate spreader buckets prior to an eradication operation?

The two most important reasons for calibrating spreader buckets prior to an eradication operation are:

- To ensure that bait is applied at the rates specified in the operational plan.
- To minimize the potential for gaps in bait spread.

If IC's buckets have been used previously with the same bait at the same swath width and at a similar application rate then it may not be necessary to recalibrate them prior to an operation. Time since the buckets were last used, recent changes made to the buckets, the helicopter type to be used and pilot experience will be some of the factors considered in any decision about whether a bucket calibration is or is not required.

What must be achieved in a spreader bucket calibration?

The key objectives of a bucket calibration are as follows.

- Determine the size/s of the bucket aperture/s required to deliver the desired application rate/s.
- Determine the RPM of the spinner and the belt size and pulleys required to deliver the effective swath width desired.
- Confirm the effective swath width and bait spread pattern produced by the bucket.
- Confirm the function and compatibility of bucket and helicopter operating systems. **Note that this step must always be completed even when a bucket calibration is not required.**

When should a spreader bucket calibration be undertaken?

Buckets should be calibrated shortly before an eradication operation but with sufficient time (*c.* 2 weeks) allowed so that changes to both buckets and helicopters can be made if necessary or further calibration work is required.

How should a spreader bucket calibration be undertaken?

The following series of steps outlines the process for undertaking a spreader bucket calibration. A list of essential equipment, a data sheet for recording information and other resources are provided in the Appendices.

Step 1. Locate a suitable site

Locating a suitable site is critical to meeting the objectives of a bucket calibration. Choose a site that has the following characteristics.

a) A large area (at least 150m x 200m) of level ground. Ideal sites include airports, sports fields, race courses etc.
b) The substrate should allow bait to be easily observed and counted. Grass is not ideal unless it is mowed extremely short (<20mm).
c) The site is relatively sheltered.
d) The area is inaccessible to the public or public access can be controlled.
e) Aircraft activity is limited and predictable.
f) If it cannot be guaranteed that the non-toxic bait to be used for calibration is free of all traces of toxin then pets and live stock must be able to be excluded from the site until the bait has fully degraded.

Step 2. Assemble resources

Using the list provided in Appendix 2, assemble the team and the required equipment.

Step 3. Select a day when the weather conditions are suitable

Bait spreading cannot be undertaken in rain because of the impact that moisture has on the flow of bait through a spreader bucket. Wind speed and direction affect bait spread and will impact the results of a bucket calibration if not taken into account. Ideally select a perfectly calm day for calibrating spreader buckets. If this cannot be achieved, then flying the helicopter directly into or out of the wind will reduce the potential for bait drift. Do not calibrate spreader buckets if this is not possible and wind speeds exceed 15kts at 100ft above ground level.

Step 4. Prepare site

a) Preparation of the site should be completed before the helicopter arrives. Allow four person hours for this task.
b) Set up a loading zone at least 100m away from the intended bait spreading area.
c) Mark out a 10m x 10m grid across a 10m x 100m area within the area designated for bait spreading as depicted in Appendix 3. Use rope, string, chalk, paint, pin flags or other means to clearly define the lines of the grid. *If an application rate above 20kg/ha is required, consider using the alternative methodology outlined in Appendix 7.*
d) Visibly mark the flight path through the center of the grid so that the pilot can line the helicopter up. Mark the start point at which the pilot should begin bait application, at least 100m before entering the grid. Mark the endpoint, 50m past the end of the grid, where the pilot will stop applying bait.
e) Clear all bait from previous bucket calibrations from the grid.

Step 5. Check bucket

a) Ensure the inside of the bucket is clean and dry.
b) Fit the aperture that is most likely to deliver the desired application rate.
c) Ensure the pulleys are clean and free of anything that could dislodge a belt.
d) Confirm that the correct belts are fitted to the right pulleys and that the tension is correct.

e) Check that all bucket mounted motors are topped up with fuel and oil and are running well.
f) Check all cables and air hoses for wear or defects.

Step 6. Set up helicopter GPS

a) Load the planned flight path for the bucket calibration into the helicopter GPS.
b) Assess satellite coverage and accuracy. The average error should ± 7m or better with a DOP of less than 10. Ideally DOP values will be less than 5.
c) Ensure the swath width settings are as planned.

Step 7. Confirm helicopter and bucket compatibility

a) Connect helicopter to bucket.
b) Toggle switches to open and shut the slide (to start and stop bait application).
c) Check that the agitator works only when the slide is open otherwise it will cause excessive fragmentation of bait.
d) Check GPS to ensure that track logging occurs when the slide is open.

Step 8. Select disc size

Using information from Appendix 6 or from a previous calibration run select and place a disc on the slide.

Step 9. Load bait into bucket

Make sure that the slide is closed before loading bait into bucket. Load only enough bait for one run. Generally this will be no more than 50kg or two bags of bait but will be dependent on the application rate. Record the amount of bait loaded into the bucket.

Step 10. Instruct pilot

Brief pilot on the flight path that will be flown, the flight speed (<60kts) and altitude (<300ft) and when to start and stop bait application. The bucket calibration should be completed at the same speed and altitude as is planned for the operation. The pilot will need to note their actual speed on each run.

Step 11. Start spinner

Start the spinner motor and adjust the throttle until the spinner's RPM is at the speed expected to produce the desired swath. Use a tachometer to assess the spinners RPM. Record this information on the data sheet in Appendix 3.

Step 12. Station someone on the flight line

This person's role is to judge how far off the flight line the helicopter was and to which side of the grid. Having this information will facilitate interpretation of the pattern of bait spread on the ground. Note this information on the data sheet in Appendix 3.

Step 13. Take wind recordings

If available use a pole mounted anemometer to record wind speed and direction at the time of bait spread. Note this information on the data sheet in Appendix 3.

Step 14. Fly flight line

If required the pilot can fly the flight line across the grid a couple of times before starting the calibration to become familiar with the route. When applying bait the pilot should start spreading bait well ahead (at least 100m) of crossing the grid and shut off once the pilot is sure they are have passed the grid to ensure the area is targeted correctly.

Step 15. Count the number of bait pellets within each square across the grid

a) Collect all pellets (including all retrievable fragments) and count the number or record the weight of bait pellets found within each 10m x 10m square of the grid on the data sheet in Appendix 3. Pellets should be counted rather than weighed if the ground is damp and the bait has absorbed moisture. Use Appendix 5 to quickly identify the weight or number of pellets expected in a 10 x 10m plot for a specific sow rate. *If a sow rate above 20kg/ha is required, consider using the alternative methodology outlined in Appendix 7.*

b) Make sure that everyone involved records the information in the same way or put one person in charge of this activity. When counting pellets, it is the total number of whole pellets that is important. Fragments should be added as a fraction of the amount of the whole pellet that they represent. Weighing bait removes this subjectivity.

c) With a measuring tape measure the effective swath width. The borders of the effective swath are the points where the amount of bait starts visibly tapering off.

d) With a handheld GPS, waypoint the observed flight line, the furthest points on the grid where bait reached and the limits of the effective swath width. This information will be used to ground truth the GPS data retrieved from the helicopter.

e) Make a note if bait pellets appear excessively fragmented and later assess whether this is because of the bait or the bucket. Most bait pellets should be intact.

Step 16. Clear the grid for the next calibration run

It is important to ensure that no bait pellets are still within the grid prior to the next run to avoid skewing subsequent data.

Step 17. Download GPS data

Download the data from the helicopter GPS.

Step 18. Analysis and application

a) Confirm the effective swath width. The effective swath width as defined in the glossary can be established from the points on the grid where the amount of bait tapers off to below the desired application rate. The effective swath width will dictate how far apart the flight lines are for the eradication operation.

b) The application rate achieved can be calculated from the following equation:

$$\frac{\text{Total weight of bait collected from the grid (kg) x 10,000}}{\text{Effective swath width (m) x 10 (m)}}$$

e.g. $\frac{\textit{0.7kg x 10,000}}{\textit{80m x 10m}}$ *= 8.75kg/ha*

c) Use the degree of overlap outlined in the operational plan to calculate the on island application rate that will be achieved.

d) Download the data from the helicopter GPS and compare this against the information gathered on the observed flight path and bait spread.

e) Graph the data as a bar graph with the X axis representing the different squares of the grid from left to right and the Y axis depicting the kg/ha achieved in each grid square to illustrate the pattern of bait spread as shown in Appendix 4. The pattern should be relatively consistent across the effective swath width. Add to the graph the flight path of the helicopter and take into account wind speed and direction when interpreting the graph.

f) Some criteria for passing or failing and when to repeat

Step 19. Repeat

Repeat the exercise with all buckets to be used in the planned operation including the spare. Buckets modified to produce a trickle or a partial swath (with a deflector) should also be calibrated. All buckets and modifications should be tested at each of the applications rates to be applied in the operation. If a bucket fails to produce the desired swath it should be recalibrated with an adjusted spinner speed. If a bucket fails to produce the desired application rate (is out by a factor of > 10%) then it should be recalibrated with a different aperture size.

Step 20. Clean Up

A post-operation cleanup effort should remove as much of the bait as possible from the site and ensure that stock, pets and wildlife are excluded if required.

Appendix 1. Glossary

Agitator	The rotating arm located inside the bucket close to the aperture that prevents bait from bridging.
Bridging	Bait flow from the spreader bucket is prevented by bait forming a bridge above the aperture. This can occur if the agitator is not working, if the bait is too moist or if the aperture is too small.
Bucket aperture	The interchangeable disc that regulates the rate at which bait flows out of the bucket. The diameter of the hole inside the disc (mm) is used to measure the size of the aperture.
Effective swath width	The width of swath achieved by the bucket over which a consistent application rate is achieved.
RPM	Revolutions per minute.
Slide	The slide moves the bucket aperture into and out of place thereby starting and stopping bait flow out of the bucket. The slide is moved by a compressed air ram.
Spinner	The rotating disc with fins that sits under the bucket and disperses the bait.
Swath	The 'swath' or 'bucket swath' is the strip of bait created by the spreader bucket as it is flown over a site. The swath is measured by the width of the strip.

Appendix 2. Resources required for a bucket calibration

Equipment

- Location for completing spreader bucket calibration
- Helicopter fitted with the TracMap system (preferably the helicopter to be used in the operation)
- All buckets to be tested (including modifications such as the deflector)
- Bucket spares
- Tools for adjusting/repairing buckets and bucket motors.
- Fuel and oil for bucket motors
- Bait (order a sufficient quantity to complete several runs with each bucket and each modification at the application rates required)
- Materials for marking the grid. This could be rope, string, flagging tape, pin flags, chalk or paint.
- Materials for marking the flight line. Highly visible objects such as day glow orange material can be used for this purpose
- Buckets or bags and marker pens for collecting and carrying bait
- Notebooks and pencils for staff involved in collecting and counting bait
- Electronic scales for weighing bait (accurate to 0.1g and able to weigh up to 200g)
- Radio comms for air to ground communications are useful
- 50m or 100m measuring tape for marking out the grid
- Camera
- Tachometer
- Calculator
- Data sheets and clipboard
- Pole mounted anemometer
- Hand held GPS

Personnel

- Pilot
- Helicopter mechanic
- Bucket mechanic (this could be the same person as the helicopter mechanic)
- Helicopter ground crew
- Staff for setting up the site and counting bait. The actual number should be a reflection of the application rate or the method.

Appendix 3. Bucket Calibration Data Sheet Bucket No and Identification…… Pass / Fail ……. Recorder……..

Date	Location	Spinner speed (rpm)	Aperture Size (mm)	Amount of bait in bucket (kg)
Wind speed (kts)	Wind direction	Helicopter flight speed (kts)	Helicopter altitude (ft)	Helicopter track (L/R m)

Run	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60 - 70	70 - 80	80 - 90	90 - 100
1										
2										
3										
4										
5										

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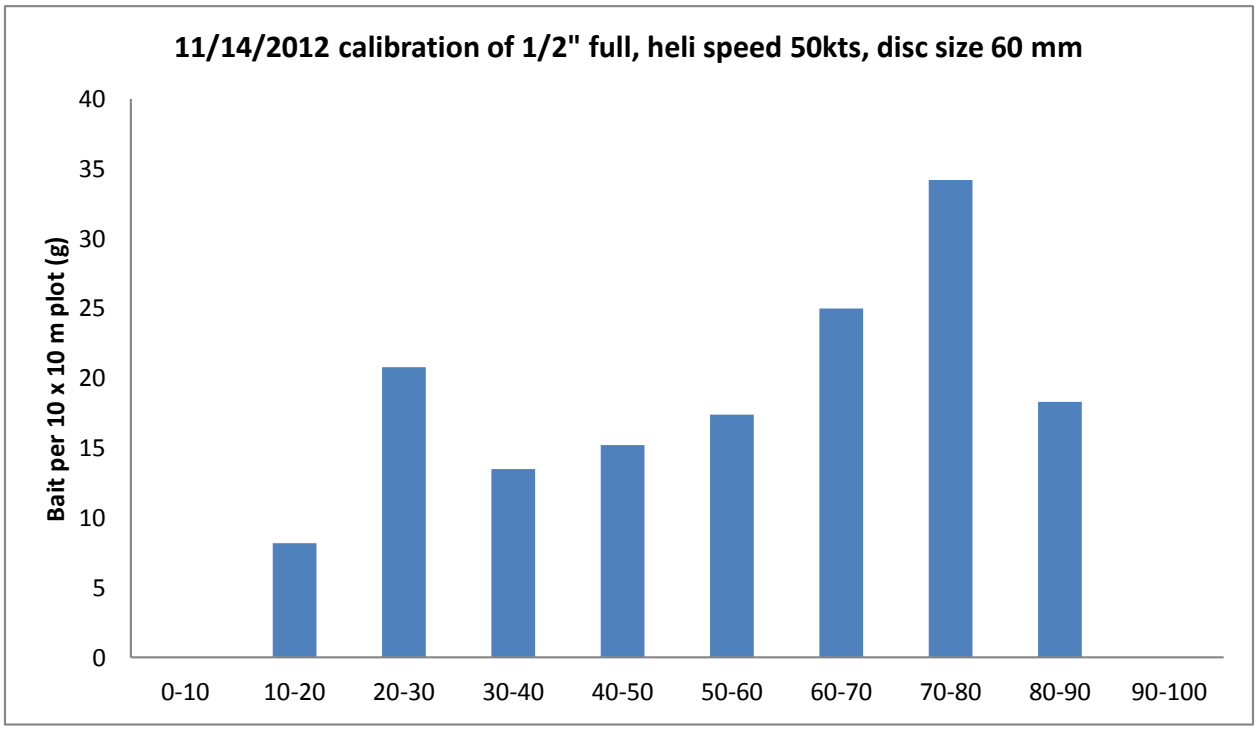
Helicopter Flight Path

Modifications required

Appendix 4. Example of bait spread in a bucket calibration plotted as a bar graph.



Appendix 5. Table of expected bait amounts in 10 x 10m plots.

Sow Rate (kg/ha)	Bait per 10 x 10m plot (g)	# of 2.2 g pellets per plot	Sow Rate (kg/ha)	Bait per 10 x 10m plot (g)	# of 2.2 g pellets per plot
1	10	4.5	*16*	160	72.7
2	20	9.1	*17*	170	77.3
3	30	13.6	*18*	180	81.8
4	40	18.2	*19*	190	86.4
5	50	22.7	*20*	200	90.9
6	60	27.3	*21*	210	95.5
7	70	31.8	*22*	220	100.0
8	80	36.4	*23*	230	104.5
9	90	40.9	*24*	240	109.1
10	100	45.5	*25*	250	113.6
11	110	50.0	*26*	260	118.2
12	120	54.5	*27*	270	122.7
13	130	59.1	*28*	280	127.3
14	140	63.6	*29*	290	131.8
15	150	68.2	*30*	300	136.4

Appendix 6. List of aperture sizes and application rates for IC's buckets.

To choose the aperture size most likely to provide the desired application rate, graph the figures for same bait and bucket type on an X-Y plot as shown in Fig. 1. below. Locate the desired aperture size from the X-axis of the graph.

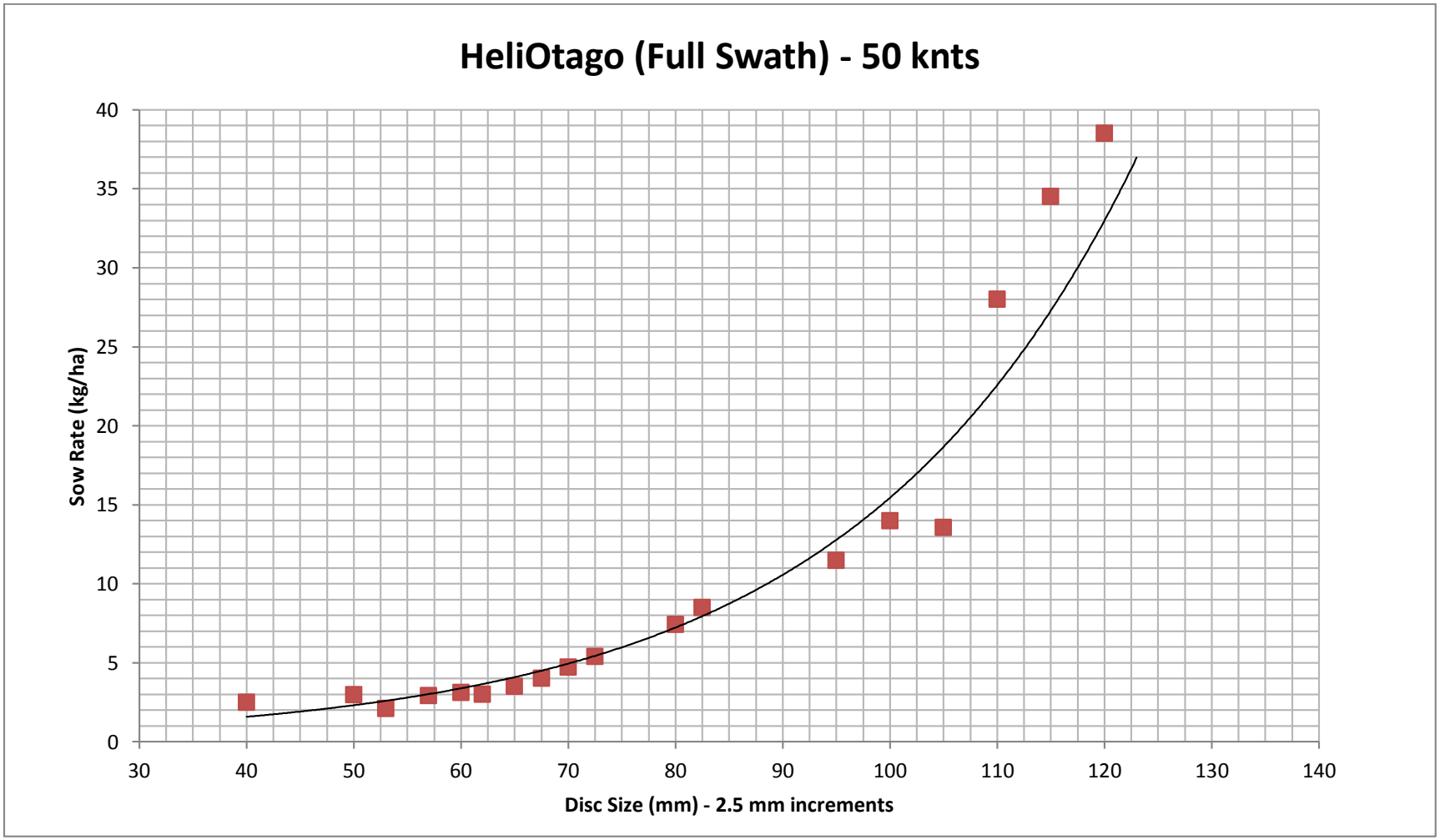


Fig 1. Sow rate vs. aperture size Heli Otago style full swath spreader buckets. Note that sow rates will be at half the desired target application rate when using 50% overlap. Updated July 2015.

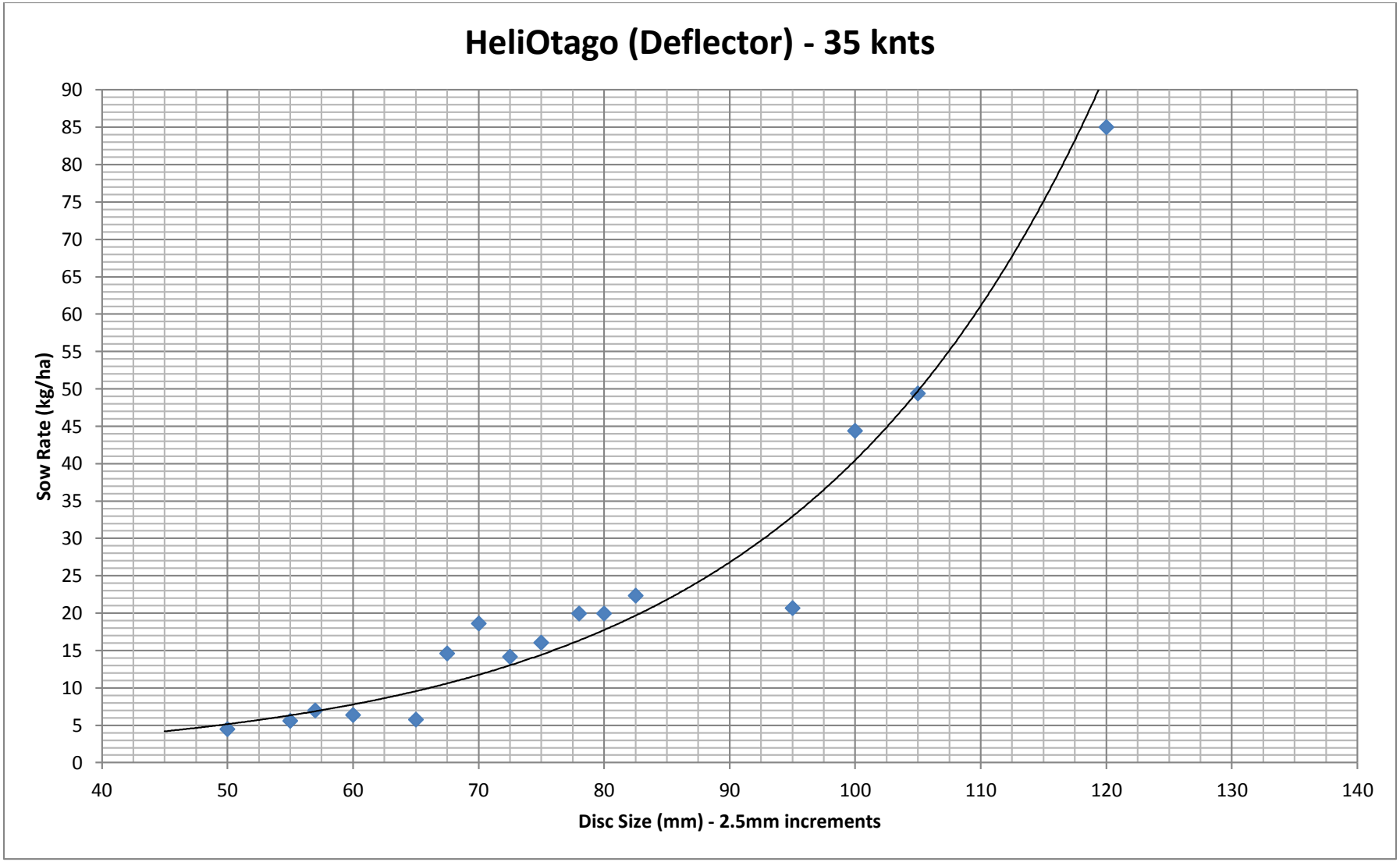


Fig 1. Sow rate vs. aperture size for Heli Otago style deflector spreader buckets. Updated July 2015.

Appendix 7. Alternative Method for Counting Bait when Calibrating Spreader Buckets at High Sow Rates.

To reduce effort when calibrating spreader buckets at high application rates a sample of bait can be collected rather than making a total count. A recommended method for sampling is as follows:

a) Mark the vertices of a 5m x 3m grid over an area of 100m x 15m as depicted in Fig 2. below. The dimensions of the grid and the number of sampling points can be varied depending on the swath width and the accuracy required.
b) Use plastic hoops ($1m^2$) centered on the grid's vertices to sample bait spread.
c) Count or weigh the bait and bait fragments collected from within the hoop at each of the grid's vertices.
d) Use the average count or weight divided by the area sampled to calculate the application rate.

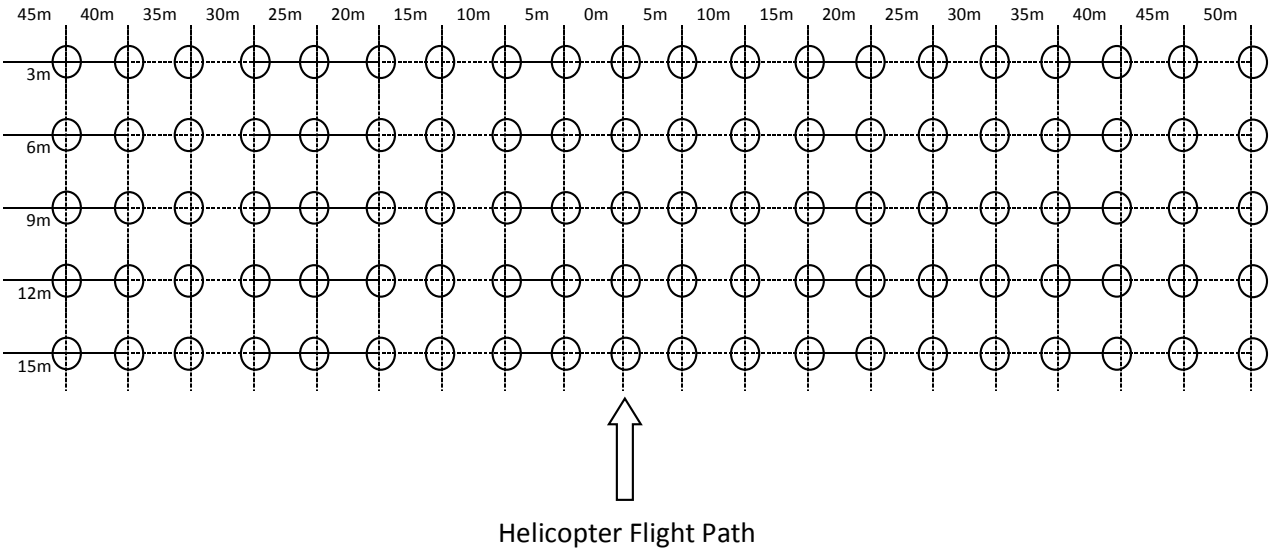


Fig. 2. Sample design for calibrating spreader buckets at high sow rates (> 20kg/ha).