# final report

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## Cattle Handling Systems

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# Table of Contents

# Part 1. Abstract

*Project Title* Cattle handling systems

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*Objectives*

To develop to a commercial manufacturing stage:

- a cow/calf separator
- the 'Lapweigh' walkover scale
- the North Queensland weight drafting system
- a weight drafting capability of the 'Lapweigh' walkover scale.

To evaluate the feasibility of using EID signals for operating drafting systems.


*Summary*

The project aimed to improve enterprise profitability and reduce stress on cattle by completing development and commercialisation of a cow/calf separator, walk-over scale and weight-based drafting system. These systems were developed to facilitate improved weaning procedures and the collection of liveweight data for management decision-making. All of the devices are intended to operate in conjunction with a trap-mustering management system. Although these systems have mainly been developed for application in extensive beef production in north Australian, it is apparent that the technology could also easily be transferred to other aspects of the cattle industry, as well as other animal industries.

The cow/calf separator has been tested in both experimental and commercial situations, with drafting accuracies of 95-100% achieved. The technology is being promoted through Producer Demonstration Sites throughout Queensland and a 'package' has been developed for sale to producers. The 'Lapweigh' walk-over scale has been tested in both controlled, experimental situations and in the paddock and has achieved good levels of precision in both situations. A prototype of the North Queensland weight-drafter has had limited testing with small groups of cattle and appears to have the potential to accurately draft animals on the basis of liveweight.

# Part 2. Executive Summary

## *(i) Background and Industry Context*

This project aimed to improve enterprise profitability and reduce stress on animals by completing development and commercialisation of a cow/calf separator, walk-over scale and weight-based drafting system. Although these systems have mainly been developed for application in extensive beef production in north Australian, it is apparent that the technology could also easily be transferred to other aspects of the cattle industry as well as other animal industries.

The cow/calf separator system allows self-drafting of different classes of animal at a trap mustering yard. Calves and weaners are drafted into portable yards for processing on site or removal to yards. Handling time and costs, as well as stress on operators and animals, are all reduced, which means that a number of weanings can be carried out during the year depending on seasonal variation in rainfall, pasture growth, herd health and body condition. Thus, calves can be removed from cows at the optimal time, reducing lactational stress on breeders and conserving body condition, leading to decreased mortality and improved fertility. The management problems and supplementary feeding costs associated with early weaning will also be reduced.

The 'Lapweigh' walk-over scale will allow cattle to be weighed without operator intervention and without the necessity of holding cattle on a weighing platform. It will provide producers with regular updates on animal weights, allowing them to make better-informed management decisions, such as when to start feeding supplement, mate heifers and the timing of turn-off. The data can also be used to predict when the cattle will meet target weights and enable description for sale. Thus, animals do not have to be mustered to yards for weighing, so reducing handling stress and costs, and making the whole process more efficient.

The NQ weight-drafter system will allow automatic drafting of cattle on the basis of liveweight and, if placed at a site that the animals pass through regularly, will also provide a regular record of animal weight changes. Thus, it would make the selection of cattle for sale more efficient and the requirement for traditional musters to yards would be reduced as it would be possible to trap the selected cattle in to temporary yards at the water enclosure. As with the Lapweigh scale, handling stress and costs would be reduced. It would also allow different feeding regimes to be targeted to particular cattle making supplementary feeding more efficient, with the food being directed to where it is needed.

## *(ii) Objectives*

To develop to a commercial manufacturing stage:

- a cow/calf separator
- the 'Lapweigh' walkover scale
- the North Queensland weight drafting system
- a weight drafting capability of the 'Lapweigh' walkover scale.

To evaluate the feasibility of using EID signals for operating drafting systems.

## *(iii) Methods*

**Cow/calf separator**

Testing the accuracy of drafting was carried out under both experimental and commercial conditions. At Gleeson Station, Cloncurry, separators were installed at the entry to seven fenced waters in two paddocks. Records were kept of the drafting accuracy achieved and a number of modifications were made to the separators to improve accuracy.

For experimental testing, small groups of cattle were used. A study was conducted to simulate the situation of calves born during the wet season which would be some months old before they first encountered the separator. Cows which had experience of using both spear gates and the separator, and their naive calves which were between 4 and 6 months of age were placed in a paddock containing a separator on the entrance to the water yard. The animals were given a two week period to become used to the new paddock and were then trapped. This same trial also assessed the potential use of the separator by stranger cattle. Six steers ranging in body weight from 172 kg to 405 kg were put in the paddock with cows and calves which were familiar with the separator.

We felt that the most appropriate way to promote the separator in the industry was by demonstration. To this end a Producer Demonstration Site (PDS) was established at Gleeson Station and a field day was held at there in May 1995.

**'Lapweigh' walk-over scale**

The Lapweigh scale eliminates the requirement for an animal to be stationary on the scale. It will weigh cattle heavier than 32 kg as they walk across a platform.

Testing of the accuracy and precision of weighing was conducted at three sites:

(a) Rocklea

The scale was set up in the race at the Research Station. A group of 19 animals were used. On each testing day a static weight was obtained for each animal using the Station scale before the animals were put through the race and over the Lapweigh scale on five successive occasions. Four weighing trials were conducted in February and March 1994.

(b) Swan's Lagoon

For the first tests, a group of 31 cows with EID implants were used and the scale system was set up at the entrance to the water yard. Later tests were conducted with a group of 32 steers, which were fitted with EID ear-buttons, to enable us to link weights to individuals.

(c) Brian Pastures

Ten steers in each of three weight groupings were used. The cattle were weighed on 13 occasions, with both a static weight and a Lapweigh weight being obtained for each individual.

**NQ weight-drafter**

In conjunction with Allflex New Zealand a system of drafting cattle (two-way) in the basis of liveweight has been developed and constructed. Initially this system was positioned at the entrance to a water yard for testing with a small mob (31) of dry cows fitted with EID. Later, the system was moved to the exit from a water yard and tested with a group of 32 steers fitted with EID.

Monitoring of behaviour by video showed there were two main problems with the system. Firstly, many animals backed off the scale and secondly, the weigh cycle was initiated before the animals were fully on the scale. These problems were overcome by the incorporation of an anti-backing gate which also served to trigger the weigh cycle.

During the period of 23 January to 6 February 1996, over 1000 weighings and draftings were conducted automatically.

## *(iv) Results and Conclusions*

**Cow/calf separator**

During commercial testing, with calf group sizes ranging between 86 and 208, drafting accuracies of between 88% and 100% were obtained. Experimental testing with small groups of cattle achieved drafting accuracies of 100%. Drafting of strangers appears to be partially size-related; smaller strangers used the calf-side or did not pass through the separator, whereas the larger animals used the cow-side. However, these findings are based on a very small number of observations. Testing of the cow/calf separator has been conducted in both commercial and experimental conditions and results have been sufficiently satisfactory to promote the system.

Following the field day at Gleeson Station, an action plan for commercialisation of the separator was drawn up. The essence of this plan was that:

1. Design drawings and specifications be prepared.
2. An information/promotional video be made.
3. A number of potential PDSs be identified and established.
4. Separators for PDSs to be manufactured.
5. An information package including 'Guidelines for use', information video and design drawings and specifications be put on sale (at approximately $30).

The separator package was launched at the Meat Profit Day in Alice Springs on 7 October 1995 and the separator was featured in the television program 'Cross Country' in October 1995. A package on the operation of the system has been developed, although we feel that the video in the package is rather light-weight and does not instruct on use. It should be made clear in the package that producers need to read the "Guidelines for Use" to fully appreciate the working of, and problems with, the system. We believe that the issues of marketing the separator package (advertising, where it can be obtained, support staff to clarify queries) should be urgently addressed, with the package made available as soon as possible.

Work is ongoing to establish a number of other PDSs throughout Queensland. We believe that this is the best method of promoting the separator and establishment and operation of the PDSs should receive continuing support from DPI and MRC.

**'Lapweigh' walk-over scale**

(a) Rocklea

In March 1994, 98.8% of weighings were within 5% of the static weights. For weighings conducted during June and July 1994 the percentage of weighings with less than a 5% error from the static weight ranged between 88.6% and 90.6%. In January and February 1995 the percentage of weighings with less than a 5% variance ranged between 94.8% and 99.0%.

(b) Swan's Lagoon

There was considerable variability between and within days in the number of incorrect weights obtained for cows. The percentage of weighings that were incorrect ranged between 0% and 33%, with an overall value of 5.6%. For individual animals there was less variability, with the percentage incorrect ranging between 0% and 20%. Seven records needed to be obtained to be 95% confident that the weight was within 5% of an animal's 'true' weight. Comparisons within days and between weights showed that 84% of recordings had a -5% to +5% change.

For steers, the percentage of incorrect weights ranged between 0% and 26%, with an overall value of 7%. On average, correct weights were obtained on any one day for 53% of the group of steers, with the range being 14% to 90%. For an individual animal, the percentage of incorrect weights ranged from 0% to 25%. The proportion of times that a correct weight was obtained for a particular animal ranged between 32% and 70%.

Comparisons between pairs of liveweights recorded for individuals on the same day indicates an error of 4.3% for a single weight and 3.0% for a pair of weights.

(c) Brian Pastures

The Lapweigh weights were, on average 0.2 kg less than the static weights (i.e. a percentage error of -0.21%). Eighty-five percent of Lapweigh weights were within 5% of the static weights. The data collected allowed estimates to be made of the number of Lapweigh weighings needed to achieve a specified precision. For example a group of 50 weaners would have to be weighed three times to ensure that there will be a 95% chance that the error would not be greater than 2%.

Testing of the Lapweigh was conducted in two very different situations: (1) in the paddock without the presence of people and where the cattle walked over the scale under their own volition and (2) in a race, where the cattle were blocked to ensure only one animal crossed the platform at any one time. The data from these two situations are not comparable. In the paddock variability in precision may be connected with how thirsty the cattle are and differences in gait and speed with which the animals cross the platform. Such situations would be impossible to control and, therefore, this type of variability must be accepted.

Although the current system appears to be sufficiently accurate and precise if the requirement is for mean weights of groups of cattle some of the incorrect weights may have resulted from the scale being unable to determine occasions when there was more than one animal on the platform, but the signal profile produced passed the checks. It would be possible to overcome this problem in two ways: (a) to develop and store a weight history for individuals and check weights against that or (b) to develop a system which automatically separates individuals so that only one animal crosses the platform at any one time. A weight history would only be of use if all animals were fitted with EID and the developers of the system need to be approached to establish the difficulty of incorporating a weight history in to the system. It appears from a review of literature, that developing a system for automatically separating cattle for weighing may not be easy and may be the weak part of the overall system.

The Lapweigh system has the potential to obtain a correct weight for all individuals within a few days and such results must be considered in relation to the costs and stress involved in mustering cattle from large paddocks, walking them to yards for weighing on a conventional scale and then returning them to the paddock.

Cattle weights can change significantly from day to day and within days. Thus, the accuracy required from a system must also be considered within those constraints. Our findings indicate that if cattle were coming in to water on a daily basis, a 'true' average weight for each animal would be obtained weekly.

Weighing the cattle in a crush provides more control over the animals and allows a greater in-depth assessment of the capabilities (accuracy and precision) of the system. The results compared very favourably with results quoted by other groups working on such systems. In the field testing the major problem appeared to be in the power supply to the system and the reliable operation/integration of EID reader and scale.

Missed weights in the field is a constraint of the way that the system operates, but our results suggest that a weight should be obtained on all of the group (about 30 animals) in about a week. The system now needs to be tried with large groups of cattle (200 - 300) in order to assess the potential for capturing data in a commercial situation. We believe that this should be done through the establishment of PDSs; there appears to be the interest amongst producers to do this. It should also be possible to put the system through further testing at research establishments as part of other experimental work. Again there appears to be the interest from researchers to do this. The system should be set-up in a range of situations: extensive grazing with large and small groups of cattle of varying weight ranges, feedlots and dairies.

In its current form the data output of the scale is not easy to read and interpret. There needs to be work carried out on making the system more user-friendly, particularly in terms of data summaries.

We believe that there are still some problems with establishing ownership of the intellectual property of this system. This matter needs to be resolved urgently if commercialisation of the product is to be pursued.

The next step in achieving adoption of the system is to, again, approach potential manufacturers with the results from the testing at Brian Pastures and Swan's Lagoon so that they can make their own assessment on the potential. We believe that further testing of the system (through PDSs and research) would be enhanced with the support of a commercial company.

**NQ weight-drafter**

Although the system has not been fully evaluated, we believe that we have produced a system that achieves accurate weighing, in accordance with the specifications of the commercially available scale, and drafting. We have had the system running continuously for various lengths of time up to a maximum period of 3 weeks, during which time the system weighed and drafted the equivalent of about 1000 animals. During this period there was no indication of failure of any part of the system. Further, the cattle appeared to be using the system with no indication of having developed any aversion to it.

Although we have achieved drafting of cattle on the basis of liveweight, the system requires further testing. Again the best option for achieving this would be to incorporate the system in to other experimental work at research establishments. We believe that it may be premature, until this is done, to establish PDSs although there may be the option to incorporate this system with the Lapweigh scale on PDSs.

Support from a potential manufacturer would be highly desirable in order to take the weight-drafter further as it requires refinement. We suggest that potential manufacturers are approached again to determine the level of interest now that we have achieved drafting by weight.

**Electronic identification**

The key to automated data acquisition and equipment control such as for weighing and drafting is EID. There is great potential for EID in self/automated-drafting, and this facility would have an impact across all the livestock industries. There are commercial scale systems currently available which integrate with EID readers and apparently link weights to EIDs. However, the literature accompanying these scale systems do not make it clear whether or not it is currently possible to draft by EID, or whether the potential is there. This needs to be explored with the manufacturers.

In the more extensive industries animal ownership is perceived to be of importance and EID could certainly have a role to play in this; brands can be changed, eartags can be easily removed, but it is impossible to tell from looking at an animal whether or not it has a rumen EID pellet.

We see that there is also a considerable potential market for drafting by EID in the area of research. One of the difficulties that is repeatedly encountered is how to apply different treatments to individuals within a group. Drafting by EID would very easily overcome this problem.

# Part 3. Report

## *(i) Background and Industry Context*

Labour costs, particularly on the extensive properties of northern Australia, have a significant impact on the profitability of enterprises. Thus, there has been a trend in the beef industry to innovate and adopt labour-saving technology. Traditional mustering on horseback, motorcycles or other motor vehicles can be extremely labour intensive and therefore costly. Mustering by helicopter was perceived to be a labour-saving method and whilst it was initially effective on many properties it was quickly realised that there were problems with it. The method relies on the fear and flight responses of the cattle to the helicopter (i.e. negative reinforcement), but animals can habituate to the presence of the helicopter and the desired flight response may be reduced. Indeed, some animals learned how to actively avoid the helicopter (by 'hiding' in dense scrub). Additionally, the process of helicopter mustering is stressful for both animals and operators, resulting in losses in productivity and reduced efficiency.

In areas where there is seasonal rainfall, it is possible to control access to water during the dry season by fencing watering points. This provides the opportunity to self-muster cattle by trapping them in the water yards when they enter to drink. Cattle enter and exit the water yard through one-way 'spear' gates, so it is simply a case of closing off the exit spear in order to trap the cattle in the yard. This method of mustering is low cost because there is low labour input. Additionally it is less stressful for operators and, because it works on the basis of positive reinforcement (being able to drink when thirsty), is also less stressful than other mustering methods. The project 'Automatic Cattle Management' (within NAP1) started with the further promotion of this concept of self-mustering, together with the investigation of the potential for exploiting the behaviour of cattle using such a system for reducing labour input for other husbandry procedures.

The current project (DAQ.074) built onto the technologies already partially developed in NAP1, with the aim being to improve enterprise profitability and animal welfare by completing development and commercialisation of the cow/calf separator, walk-over scale and weight-based drafting systems which were developed to facilitate improved weaning procedures and the collection of liveweight data for management decision making and research purposes. All of the devices developed in this project are intended to operate in conjunction with a trap-mustering management system, with the devices being positioned at the entrance to or exit from the trap watering yard. Although these systems have mainly been developed for application in the north Australian beef industry, it has become apparent during the course of this project that the devices have the potential to function not only in extensive beef production, but the technology could also easily be transferred to other aspects of the cattle industry (e.g. quality pasture, feedlotting, crop fattening and dairy) as well as other animal industries (e.g. pig).

**Cow/calf separator**

The system allows self-drafting of different classes of animal at a trap mustering yard. Calves and weaners are drafted into portable yards for processing on site or removal to yards. The system reduces the need to perform traditional musters, thus making management more efficient and cost effective. Handling time and costs, as well as stress on operators and animals, are all reduced, which means that a number of weanings can be carried out during the year depending on seasonal variation in rainfall, pasture growth, herd health and body condition. Thus, calves can be removed from cows at the optimal time, reducing lactational stress on breeders and conserving body condition, leading to decreased mortality and improved fertility. The management problems and supplementary feeding costs associated with early weaning will also be reduced. The system may be particularly beneficial during droughts, as weaning and branding can still be effected without imposing mustering stress on drought-affected stock.

**Lapweigh walk-over scale**

This system will allow cattle to be weighed without operator intervention and without the necessity of holding cattle on a weighing platform. The scale can obtain weights for cattle as they walk across the weighing platform. The scale can be set-up in the paddock at a site where the cattle have to pass over it on a regular basis (e.g. at an entrance to or exit from a water yard). It will provide producers with regular updates on animal weights, allowing them to make better-informed management decisions, such as when to start feeding supplement, mate heifers and the timing of turn-off. The data can also be used to predict when the cattle will meet target weights and enable description for sale (as for CALM). Thus, animals do not have to be mustered to yards for weighing, so reducing handling stress and costs, and making the whole process more efficient.

Training cattle to use the Lapweigh scale is relatively simple and rapid (more so than for the NQ weight-drafter). For this reason the Lapweigh may be particularly suitable for feedlots. With the scale positioned in the pens, in an area through which the cattle must pass, it would provide regular information on weight gains without disturbing the cattle, as well as possibly assisting with identifying 'non-eaters' or 'poor-doers'. If too costly or impractical to place scale units in every pen, then placing one or two units in lane-ways would allow weighing of cattle on a more frequent basis and cause less disturbance to the animals than conventional weighing.

**NQ weight-drafter**

This system will allow automatic drafting of cattle on the basis of liveweight. If placed at a site that the animals pass through regularly (e.g. at a water yard entrance or exit) it will also provide a regular record of animal weight changes. Thus, it would make the selection of cattle for sale more efficient and the requirement for traditional musters to yards would be reduced as it would be possible to trap the selected cattle in to temporary yards at the water enclosure. As with the Lapweigh scale, handling stress and costs would be reduced. It would also allow different feeding regimes to be targeted to particular cattle. For example, cattle over a certain weight could be drafted into a yard where they would receive supplementary feed for 'finishing', or cows that have recently calved (and would, therefore, weigh less than the rest of the herd) could be drafted in to a yard for supplementary feeding. Thus the system would make supplementary feeding more efficient with the food being directed to where it is needed.

**Relevant literature**

The research areas which are of relevance to this project come under three main headings: firstly, methods for remotely separating cattle in to sub-groups, secondly, systems for the remote weighing of animals, and, thirdly, the combination of these two, that is, the remote drafting of animals based on weight. The majority of effort appears to have been put into the area of remote weighing.

(i) Remote separating/drafting

*Drafting cattle of disparate body size (cows and calves)*
The drafting of calves from cows is conceptually relatively simple as the large difference in body size and physical strength can be exploited. Whilst a variety of designs of separators are reportedly operating or being tested on properties in northern Australia, there appears to be no documentation on them. To our knowledge, the separator developed and commercialised from the QDPI/MRC 'Cattle Handling' project is the only one which has been extensively tested in both research and commercial conditions.

It appears that other separators that have been constructed have relied on the difference in height between cow and calf. A lever system moved by tall animals (cows) operates a gate to direct the cow one way, whilst the smaller calves pass below the lever and move in a different direction. The separator designed within this project relies on the breeder animals being trained to push open a self-closing door and for them to ignore the small calf-opening. When the young calves start to follow their mothers to water, the cow-door acts as a barrier to the calf, as it has not been trained to push open the door and may not have the strength to do so. The calf seeks an alternative way through the separator, the small calf-opening, which provides a clear visual exit. Thus, the system exploits both height and strength during the period when animals are initially being separated. Thereafter, the system also relies on 'habit strength'; animals become conditioned or trained to go in certain directions. This is probably also the case for other separator systems, although designers may not fully appreciate this fact.

Body size differences have also been exploited for creep-feeding calves. Rails or bars are placed at a height or width under or through which calves can pass, but adult animals cannot. Thus calves are able to enter a fenced area containing feed, but their mothers cannot (e.g. see Fordyce et al., in prep.).

*Drafting cattle of similar body size*
This is a conceptually more difficult task to achieve because, unlike the cow/calf separator, it is not possible to exploit a difference in body size/liveweight/physical strength in order to achieve the separation.

Karn and Lorenz (1984) used electric shock to train cattle to enter or avoid particular pens. Using this method they divided a group of 30 steers into three smaller groups for supplementary feeding of two of the groups, and a group of 53 first-calf heifers into two groups for supplementary feeding. This technique was not, however, 100% successful, with some animals entering the wrong pen. Data were only provided for the heifers and, in this case, over a 40 day feeding period there were 11 instances of shocked animals entering the wrong pen. Although this technique was essentially effective it does raise ethical issues; one of the objectives of the Cattle Handling project was to reduce stress and promote better animal welfare. Karn and Lorenz (1984) reported that 'generally 2 shocks during training were adequate ... but if an animal persisted in entering an incorrect pen it received additional shocks', which makes it difficult to equate this method with the objective of alleviating stress on the animals.

Anderson et al. (1992) used individual electronic identification (EID) to draft cattle to receive supplementary feed as the animals came to water. The system comprised a 'maze' (the terminology used by the researchers) of bayonet (spear?) gates, races, an animal spacing device and pneumatic gates operated by photocell beams. The authors found the mechanical and automatic spacing of individuals to be the biggest problem; the device was frequently unable to cope with cattle following closely in single file. Additionally, rainfall during the test period resulted in free-standing water being available to the cattle, so that they did not have to enter the maze to drink. Although not cited by the researchers as a problem, a long training period, of 3 months, was required for the cattle to use the maze. This is perhaps not too surprising considering its complexity and indicates the need for a simple system in order to keep training to a minimum. Further, the workers reported that it was not possible to train all of the 74 cattle, although no data were provided. Currie et al. (1989) used scale units which obtained a liveweight while cattle were drinking and reported culling less than 5% of yearling steers per year due to the animals not using the scale units or behaving in ways which interfered with the use of the scales (details were not provided). These results also indicate the need for a system which most animals will readily learn to use and continue using. Considering natural biological variation in temperament and learning ability, it may be unrealistic to expect to achieve 100% success.

Again using EID, Carrano (1994) developed a system for automatically drafting dairy cows. The antenna for identifying the cattle was placed in the exit lane from the milking parlour. The need for animals being separated was also appreciated by this worker, and to aid this the system incorporated self-locking stanchions in which the cattle obtained a quantity of feed. The operator was, thus, able to release the cows as required. With this system, the operator had the opportunity to draft off cows based on a number of selection criteria, which were entered into a computer. As the cows exited the parlour their transponders were interrogated by an antenna and the identity of the cow was sent to the computer which checked to see if that cow matched the pre-set parameters. If the information matched, a signal was sent to open the sorting gate, then, as the cow entered the trapping pen, the gate closed behind her, apparently by means of a switching device activated by her passing. The results of a survey of dairies incorporating this system gave a sorting accuracy of 96%. Of those surveyed, 31% of respondents reported 100% accuracy and 7% reported drafting of additional cows. Drafting by this method reportedly saved an average of 5.4 hours per week per farm. The author reported that this saving in time amounted to an average financial saving of $US 2800 per year.

(ii) Remote weighing

*Static*
A number of groups world-wide have been working on systems for the remote or automatic weighing of cattle for many years. In 1974, Low and Hodder reported a system for weighing cattle as they entered a water yard. However, this system could hardly be considered to be remote or automatic as it required the presence of operators in a tower to read cattle tags and the weight display, as well as to operate a slide gate (with a rope). The paper does, however, provide some useful notes on the training of cattle to use such systems.

Electronic scale systems are now commonplace and are the basis for automatic weighing systems. The system used by Currie et al. (1989), cited above, was described in a paper by Adams et al. (1987) and was termed an automated range-animal data acquisition system (ARADS). The system comprised seven portable electronic scales, a weather station and a computer, all of which were linked via a radio communication network. This system used EID in order to match liveweights with individual animals; transponders were fixed to the ear of each animal and the scale unit contained an interrogator. The scale units were essentially weigh crates which the cattle voluntarily entered in order to obtain water. Entry and exit was from the rear and the cattle were locked into the crates by pneumatic rear gates. Initiation of the weighing cycle was determined via photocells detecting when the gates were closed and open, thus weighing took place both when the cattle entered and exited the scale. For training cattle, a 'mock' stall was placed in the drylot, so that the cattle became accustomed to drinking from the stall. The authors reported that it took cattle just 2-3 days to make the transition from using the training stall to using the scale units, but they did not report the length of time that the training stall had been available in the drylot. The liveweights obtained with the ARADS, in the study by Currie et al. (1989), were highly correlated ($r = 0.85$ and 0.87 for the years 1986 and 1987 respectively) with the weights obtained from a conventional scale. This study also highlighted the liveweight differences that could be obtained from weighing at different times of the day; in one instance an increase of 40 kg was associated with a water intake of 34.5 litres during the day, plus forage intake and minus the loss due to urination and defecation.

The maze complex which allowed remote drafting (Anderson et al. 1992) described above, also allowed static weights to be obtained remotely. An animal stepping onto the platform broke a photobeam which triggered a solenoid to control pneumatic rams, which closed and secured a gate in front of the animal. The gate was held closed by a time relay for 11 seconds, thereafter the air rams were vented and the gate sprang open. The breaking of the photobeam also initiated the weighing cycle (see Anderson et al. 1981 for further details of the integration of the electronics with EID).

*Dynamic*

The systems described above have all required animals to be stationary on the weighing platform. In recent years the challenge has been to obtain an accurate weight as the animal walks over the scale unit. In 1967, Martin et al. pointed out the problems with conventional mustering and weighing, that is that the process is costly and cattle often lose weight during the process. These workers determined the minimum criteria for an automatic weighing system: a platform which animals would cross naturally to get to feed or water; weight-sensing devices and a remote recorder that could be quickly connected to any platform wherever it was positioned. The scale should weigh animals individually as they crossed the platform; the system should not disturb the normal routine of the animals and the system must be operable in remote locations not served by 'mains' electricity.

The system which these workers developed comprised a platform and strain gauges on load rings. Weights on the platform caused differential stretching and compression of the strain gauges resulting in changes in the electrical output of the load-ring system. The magnitude of the electrical signal was recorded on an oscillograph. The system was tested at the entrance to a watering yard and demonstrated that it was possible to obtain good oscillograph traces, reflecting animal liveweight, although there were problems with animals that jumped or ran across the scale.

The weighing of moving animals is not easy because the forces between the scale plate and an animal's feet are variable, with the pace of movement being the main frequency component. Further, a rapidly moving animal causes vibrations which result in rapidly changing and large variations in the readings recorded by the scale.

When an animal first steps onto a weighing platform a force is exerted which is essentially equivalent to half the weight of the animal. If the platform is of sufficient length to support the whole animal, the total weight will be recorded. Then, as the animal steps off the platform, there will be a drop in force reflecting the weight on the hind legs. It is this pattern of forces that must be detected and analysed in order to obtain an accurate weight for the animal. Japanese workers reported that a trotting pace resulted in a single load peak, compared to the two at a slower pace (Long et al. 1991). A larger number of steps on the platform also permits greater accuracy in measurement (Peiper et al. 1993; Long et al. 1991).

Further difficulties occur when cattle follow one another in rapid succession, as an animal may step on to the platform before the preceding animal has fully stepped off. Thus, the length of the scale platform is critical; it must be of sufficient length to allow one animal to be fully on it at some point in time, but short enough to deter more than one animal from being on it at any one time. Peiper et al. (1993) used a platform of 2.5 m, whereas Long et al. (1991) found a platform of 3.5 m to provide sufficient accuracy (individual error, accuracy and precision reported as being $\pm$ 1.01% of liveweight, $\pm$0.4 kg and 2.04 kg respectively).

The only certain way of ensuring that a single animal is on the weighing platform at any one time is to use a method of automatically separating animals. However, Anderson et al. (1992) reported that the automatic separation of cattle was the weakest link in their system for remote drafting and weighing.

A further requirement is that the scale undergoes automatic zeroing before each animal is weighed when there is no weight on the weighing platform.

Although the initial work on dynamic weighing was carried out with free-ranging beef cattle, the majority of work since then has been done with dairy cows, possibly because the early work with EID concentrated on dairy cows with the use of transponder collars. The development of implantable transponders and, subsequently, those contained in ear-tags and rumen boluses has opened the way for the work to be extended to free-ranging cattle.

As early as 1979, Filby et al., working with dairy cows, demonstrated that dynamic weighing in conjunction with EID was possible, although these workers appreciated the many problems with this method. They found that the length of the platform was critical and that separation of animals could be a major difficulty in obtaining accurate weights for individuals. Indeed, in their tests it did not always prove possible to record data when cows passed over the platform in rapid succession. These workers also found that weights could not be obtained if cows moved too rapidly over the platform. They also recognised the importance of weighing at a fixed time each day; dairy cows of 600 kg liveweight can produce 30 kg of milk/day and have a dry matter and water intake of 80 kg, and must remove a similar amount as urine, milk, faeces etc. Filby et al. (1979) also cited information suggesting that variations of 7-10 kg can be expected when cattle are weighed at the same time of day. During their own trials, which lasted about 9 months, they determined that the limits of acceptability of data could be $\pm$ 30 kg from the previous weight and that morning weights tended to be 5-10 kg lower than evening weights.

The method of recording, analysing and storing data described by Filby et al. (1979) can be summarised as follows: at each weighing the current weight was compared with the current running average (CRA) and accepted if it was $\pm$ 30 kg (this value was based on the finding of a standard deviation of about 8.5 kg for a cow which was walked over the scale on 11 successive occasions). The accepted value was added to the $n$ previous records for that session (morning or evening) taken during the week and to the previous week's average (PWA). The total was divided by $n+2$ to provide the new CRA. At the end of the week the CRA was put into memory as the PWA for the next week and the displaced PWAs were averaged to provide a weekly average weight for the annual file of weekly averages.

In their work with 58 cows over 66 milking sessions, the longest break in data was for one cow which had no acceptable weights over 13 successive sessions. On average, acceptable weights were obtained for 34 cows per session (60.5% capture rate). Comparisons with data collected by manual weighing suggested that the system was capable of producing weekly or monthly trends with an equal if not better degree of reliability than weekly or monthly manual weighing where day-to-day variations can obscure true trends. The data obtained from this trial indicated that four readings from the dynamic scale were required to establish a similar accuracy to one manual weighing of a docile animal. As the capture rate of acceptable data was equivalent to about 8 records/week, the system appeared capable of providing as much data as a weekly manual weighing. The workers did point out, however, that the 'nature' (presumably referring to temperament) of individuals would mean that some records would not be as good as others, but this would also be the case with conventional weighing.

Later work described by Ren et al. (1990a; 1990b), Ren et al. (1992) and summarised in a paper published in 1993 (Peiper et al. 1993) also linked automatic dynamic weighing of dairy cows with EID. The work of Ren et al. (1990a) described the software used for the system and explained the need for an intelligent program to analyse the recorded raw data to determine the true weight for each cow. To achieve this, a so-called reference weight for each animal was needed which was stored in a reference table along with the EIDs. Unfortunately this paper did not describe how this reference weight was obtained, but the paper by Peiper et al. (1993) explained that this reference weight was a recorded history weight which was continuously updated. Manual weighing at morning and afternoon milkings had shown that a difference of up to 30 kg (for animals in the range of 400-800 kg) was possible. Thus, if the current weighing, when compared with the previous three weights in the reference table, was within 30 kg the weight was taken as 'relevant'. Once three relevant weights were derived, their average replaced the previous reference weight stored. When a new animal joined the mob it had no weight history and so the reference weight was derived from manual weighing.

The paper by Ren et al. (1990a) also described the criteria used to judge the reliability of the computed weights. If at least eight data points were used to compute the average and the standard deviation was less than 5% of the computed weight then this new weight was stored in the reference table replacing the old weight. If the weight was computed from fewer than eight data points then it was considered accurate if it was within 5% of the reference weight, but it was not used to update the reference table. In this study, about 65 cows passed over the scale twice daily. During each milking acceptable weights were obtained for more than 80% of the cows and an acceptable weekly average was obtained for all of the cows.

In the study by Ren et al. (1990b) two groups each of five cows were weighed six times in 20 minutes. These weights were compared to static weights taken before and after the dynamic weighings. A computer averaged the readings from the six passes over the scale, discarding those readings considered unreliable due to an excessive difference from the reference weight. Errors (the difference between the static and dynamic weight) ranged from -1.95% to +1.68%, with 34% of the weights being sufficiently reliable and accurate to update the reference weights. Seventy-three percent of the weights were within 5% of the animals' reference weights. The authors pointed out that accuracy differed between individual animals, with some consistently weighing accurately every time and others rarely doing so. This, they said, was due to the speed with which the cows crossed the platform, with accuracy being improved if the cattle were slowed.

Further details and the use of this system in a commercial dairy herd are described in a paper by Peiper et al. (1993) and the reader is directed to this paper for details of algorithms, the 'decision tree' used in the computer program to obtain weights and the method by which load cell values were sampled. As a result of the findings by Ren et al. (1990b), the researchers recognised the need for slow moving animals and introduced a step in front of the scale to achieve this. The work also showed that a difficult mis-measurement to filter out of the system was when two animals were both half on the scale, as the total weight was within the boundary limits. These errors were eliminated by comparing the current weight with the reference weight of individuals.

To test the weighing system it was combined with an automatic EID system and installed for use with a commercial milking herd with the cows being weighed three times daily. The study lasted 3 years. The cows were in two groups each containing 60-65 animals. Successful weights were obtained 55.8, 53.1 and 52.4% of occasions for the morning, noon and night milkings respectively. An average of 76.5% of successful weights was obtained at least once a day. Once every 3 months five cows were manually weighed to compare with the dynamic weights and these comparisons were found to be within $\pm$ 1.5% of each other. These researchers also noted the importance of considering the time of day that the weighing took place, concluding that diurnal weight fluctuations mean that weights should be taken at the same time of day.

Overall there are four main requirements in order to achieve accurate dynamic weighing of cattle: (1) slow moving animals, (2) a weighing platform of an appropriate length, that is, one which allows an animal to have all four feet on the platform, but is sufficiently short to reduce the chance of more than one animal being on the platform at any one time, (3) some means of ensuring separation of animals and (4) weighing at the same time of day in view of the considerable diurnal variations in liveweight which occur.

(iii) Remote drafting/separation based on weight

There appears to be no documentation in the scientific literature of research on drafting cattle on the basis of liveweight. We know of two commercially available systems in Australasia for achieving this with sheep. One of the companies producing such as a system kindly provided us with information to be included in this review.

*Ruddweigh Auto Drafter*
Prior to weighing, the operator enters into the system the targeted weight range. Animals falling within that range will be drafted automatically one way, while animals outside that range will be drafted the other way. The system comprises a weighing crate below which are placed standard weigh bars (Model 1200), which are accurate to 1%. As an animal enters the crate, its weight forces the moveable floor of the crate downwards, which automatically closes the gate through which the animal has entered. When the weight of the animal has been

obtained the front gate opens automatically to draft the animal to the appropriate side, depending on the pre-determined weight range. Once the animal has left the crate, the front gate closes and the rear gate opens to allow the next animal to enter. The weight information is recorded and sorted automatically.

The system is driven by the Model 1200 Data Collecta (KD1) which allows 'fast and accurate weighing of moving animals' and the manufacturers claim that 'it is practically impossible to get false readings with a KD1'. The information provided did not give any details of how the system determines valid weights.

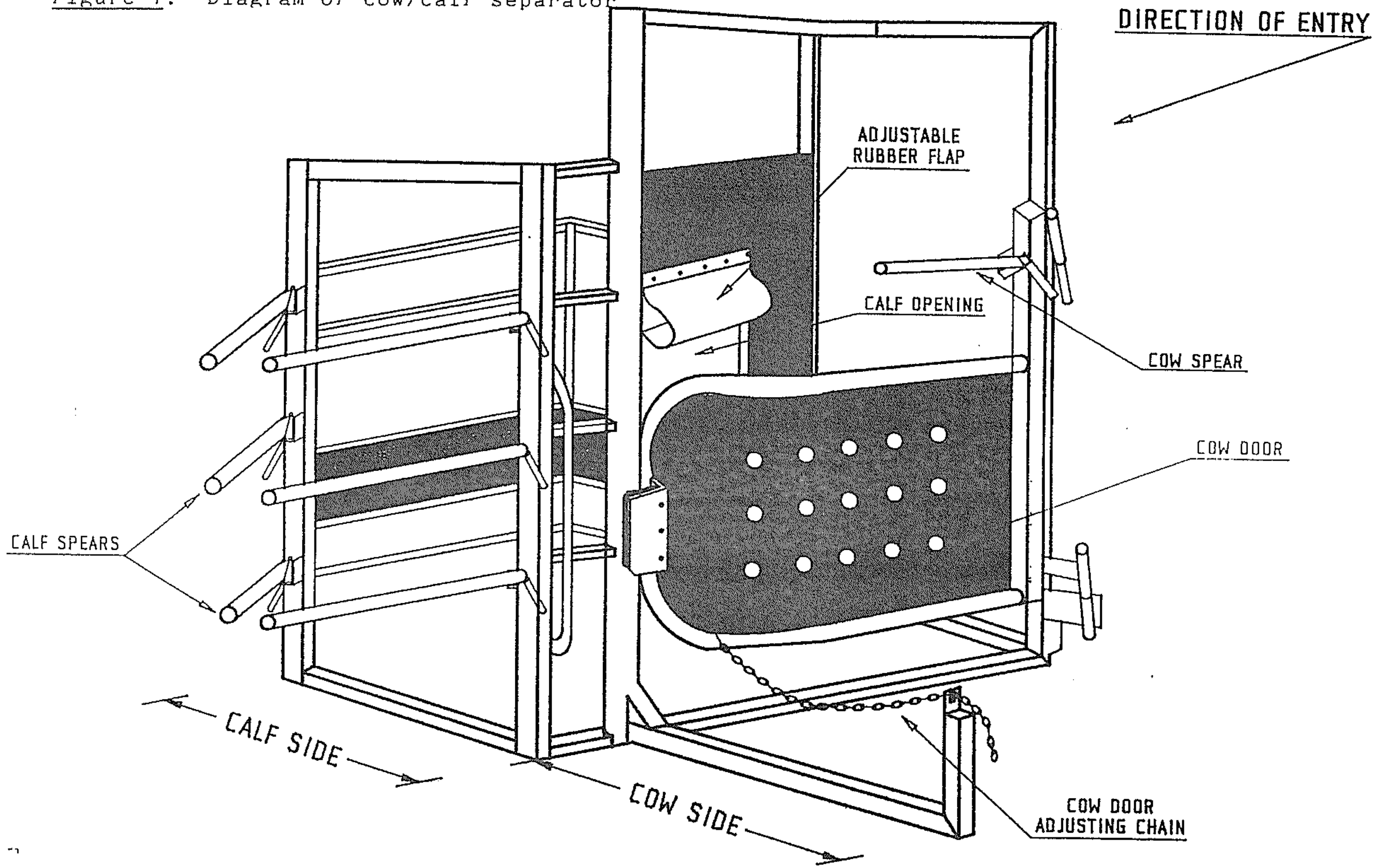
*Allflex 3-Way Auto Sheep Crate*
As this system is still under development, Allflex New Zealand Ltd declined to provide any information on this system for the report.

### *(ii) Objectives*

- To develop the 'Lapweigh' walkover scale to a commercial manufacturing stage (July 1994)
- To develop a cow/calf separator to a commercial manufacturing stage (July 1994)
- To evaluate the feasibility of using EID signals for operating drafting systems (September 1994)
- To develop the North Queensland (NQ) weight drafting system to a commercial manufacturing stage (June 1995)
- To develop a weight drafting capability of the 'Lapweigh' walkover scale to the commercial manufacturing stage (June 1995)

The dates given in parentheses are for the completion of the objectives.

Figure 1. Diagram of cow/calf separator




PICTORIAL REPRESENTATION

NOT TO SCALE

## *(iii) Methods and Results*

## Cow/calf separator

### *(i) Equipment*

Description

The system comprises two main sections, one for use by the breeders (the cow-side) and the other for use by the calves (the calf-side). The cow-side consists of a self-closing door which the breeders are trained to push open. The calf-side is an opening with a spear-gate arrangement to prevent calves exiting the way that they enter (see Figure 1).

Operation

Training of breeders should be done before calves are born, and with bulls and heifers this can be done in cattle yards when they are weaners, or in the paddock. Yard training can be achieved by placing a separator at some point where the cattle have to pass on a regular basis, e.g. between two areas, one containing food and the other water. With paddock training all cattle must be using fenced waters with the separator at the entrance to waters and spear gates at the exits, or *vice versa*. Therefore, training is best carried out during the dry season when the cattle are watering regularly, and prior to calving.

Separators are installed initially with the spear arms removed from the calf-side (see Figure 1), the rubber flap on the calf-side lowered and the spear below this flap in place. The door on the cow-side is held fully open by the adjusting chain at the bottom of the door. This arrangement provides a block to the animals on the calf-side and an easy passage through the separator on the cow-side. Over a number of weeks the chain is gradually let out, thus reducing the size of the opening, until the door closes fully against the upright post and the animals have learned to push against the door to open it. At this stage the chain can be completely removed, the rubber flap raised fully (by hooking it in place, with the adjusting chains as short as possible) and the spear in the calf-opening (below the rubber flap) removed. The separator is now in its normal operating mode; the cow-door should always be fully closed after the initial training. Once trained, an animal will remember how to operate the door at least 12 months after it has last used it (and probably for life), so there should be no necessity to retrain breeder animals.

Calves born in the dry season will begin to follow their mothers to and from water through the separator: the door on the cow-side closes behind the cow forming a barrier to the calf, but the open calf-side provides an easy passage for it. Repeated use ensures the calf becomes accustomed to taking this route. Calves born during the wet season may be several months old before first encountering the separator, but they will also choose to go through the calf-side, as it provides a clear passage.

Young animals that will be retained in the herd for breeding will require re-training. As calves and weaners they will have learned to pass through the calf-side of the separator, but as adults will need to go through the cow-side. This re-training is carried out exactly as for the initial training of breeding stock. Adult breeding animals brought on to the property from elsewhere will probably be unfamiliar with spears and separators and will, therefore, require training, as described above.

The spears should be put in place on the calf-side 2 to 3 weeks prior to trapping, so that the animals get accustomed to pushing through them. Initially the spears should be put in place at their wide, training setting and then, a week or so later, changed to the narrow, trapping setting. This is achieved by simply changing the spears from one side of the frame to the other, which alters the gap between the spear tips.

Trapping simply involves setting up a calf yard, using portable panels, around the calf-side. If the separator is placed at the entrance to water then the main mob can also be trapped by closing the out-spear. The setting of the trap is done in the late afternoon, after the cattle have moved out of the water enclosure, and is left for approximately 36 hours to catch maximum numbers of animals. Portable equipment can then be used to brand calves and load weaners onto trucks for transport to the cattle yards. Alternatively, calves, weaners and strangers can be trapped straight into a permanent yard complex, if this is available, where they can be processed in the usual way.

Siting

The separator should be placed on a well-used pad either into or out from a water yard, with spear gates on pads out from or into the water. These two arrangements both have advantages and disadvantages:

*Separator in, spear out*

With this arrangement, at the time of trapping animals will be held in the water enclosure itself and it is therefore possible to determine whether or not the whole mob has come through and have been caught. It may also be an advantage for calves, after processing, to be released to their mothers in the water enclosure as it may be easier for them to find their mothers. The main disadvantage is that 'stranger' animals (those that have entered the paddock from elsewhere and are unfamiliar with separators and spears) may refuse to pass through the separator to water (because of the visual barrier, noise of the cow-door as it shuts etc.) and so there is the risk that they may perish.

*Separator out, spear in*

With this arrangement there is less risk to strangers, as they are more likely to pass through a spear than the separator, to water. Another advantage is that these strangers, and any other animal that will not use the separator, will be held in the water enclosure, and can easily be identified. Also, at the time of trap-mustering they will be more easily caught for processing. With this configuration it is more difficult to assess whether or not the whole mob have been through the separator. Another drawback with this arrangement is the possibility of mis-mothering after processing. If calves are released out to the paddock, rather than the water enclosure, they may be less likely to find their mothers.

When going to and from water, young calves are sometimes unable to locate the separator and spear gates and will push through the enclosure fence. This problem can be minimised with well-designed and maintained enclosures. If the separator is placed going in to water the use of a lead-up 'V' to the separator will help calves to find it, and having one or more spear gates in the enclosure corners, from which the cattle normally graze away, will assist them with finding a way out of the enclosure. The same principles should be applied if the separator is positioned going out from water. There are seldom any problems with older cattle locating entrances and exits, as they will be experienced with the use of spears and following pads to and from water.

Further details of this system are provided in the 'Guidelines for Use' (Appendix I).

***(ii) Testing accuracy of drafting***

During the development of the separator a number of studies were conducted to assess its efficacy. Work was carried out in both a commercial situation (Gleeson Station, Cloncurry), with large groups of cattle and in an experimental situation with small numbers of cows and calves (Swan's Lagoon and a neighbouring property in Millaroo).

(a) <u>Commercial testing</u>
At Gleeson Station single separators were installed at the entry to seven fenced waters in two paddocks. In early 1993 a number of modifications were made to the existing separator as a result of low accuracy in drafting achieved by the existing prototype. These changes resulted in a separator (prototype II) similar to that described above, except that the calf-side consisted only of the opening with the rubber flap and spear.

By the June of 1993 all of the cattle using the prototype II separators had adapted to the changes and in late June, cattle in two paddocks were mustered by trapping them in the water yards. The separators were in place at this time, but the calves were not trapped in a separate temporary yard. Use of the separators by the cattle at this time was video-recorded and the records showed 100% drafting accuracy (92 calves) when the flap was raised and the spear removed. On a second trapping the following day, with the flap lowered and the spear in place, two calves from 86 went through the cow-side.

The second weaning of the year for these same two paddocks took place at the end of September and at that time the calves were trapped in a temporary yard. The cattle were trapped over a 20 to 36 hour period and at the end of this time, of 208 calves, 12 were in the water yard with the breeders and 16 were outside the water yard (did not pass through the separator). The drafting accuracy was thus approximately 87%.

As accuracy was reduced with the flap and spear in place it suggested that this system was not the most suitable. Video-recordings indicated that some calves baulked at the spear and flap and would not pass through. Some means to prevent the calves going back out through the separator was required and we thought that a possible solution was to place this obstacle away from the 'decision point' of the calf (i.e. away from the calf-opening). Once through the opening a hesitant calf would be out of the way for cows coming through, reducing the chance that it would be pushed through the cow-door. In late June 1994 the separators were modified to include rails and a spear gate on the calf-side, giving rise to prototype III. The flap and spear were therefore required only for initial training of breeders.

In early November 1994, prototype III was tested on two water yards trapping the calves in a temporary yard. After approximately 24 hours of trapping at one water no cattle were outside the water yard, five calves were in with the breeders and 95 were trapped in the temporary yard. At the other water one cow and two calves were outside the water yard, nine calves were in with the breeders and 130 had been trapped. These figures give drafting accuracies, for the calves, of 95% and 92.2%, although the calves in with the breeders were small (below weaner age) and may have pushed through the fence.

(b) <u>Experimental testing</u>
The prototype III separator was installed on the entry to a fenced water yard being used by a herd of approximately 70 cattle of mixed age, weight and sex. The older cows and bull had previously been trained to use a separator, but had not used one for approximately 12 months. The cattle were not highly motivated to use the yard as there was surface water available, so molasses was used to attract the animals and the cattle were also 'pushed' by motorcycle. Video-recordings were made of the cattle passing through the separator under three conditions:

(i) spears removed from calf-side
(ii) spears present on calf-side
(iii) spears present and portable panels in place for trapping calves

*Results*
(i) One hundred and three observations were made of cattle passing through the separator. Only the adult animals which had previously been trained to use a separator passed through the cow-side. All others, including young heifers and cows which had used the separator as calves, and 'stranger' animals (those from another property and which had no experience of separators), went through the calf-side. Twelve animals, mostly strangers, did not pass through the separator.
(ii) Forty-seven observations of cattle passing through the separator were made. The previously-trained adult animals did not hesitate and passed through the cow-side. One animal (a large steer) was mis-drafted; after considerable hesitation and vacillation it went through the cow-side. Approximately 30 animals, mostly strangers, did not enter the yard.
(iii) Fifty-one observations of cattle passing through the separator were made. Of these cattle, 25 entered the calf trap yard and all were calves, weaners and young cows. All of the cattle that went through the cow-side were the older cows which had been previously trained to the separator.

This study raised issues regarding:
(a) Use of separator by calves born away from water and several months old before first encountering it.
(b) Use of the separator by strangers.

A study was conducted to simulate the situation of calves born during the wet season which would be some months old before they first encountered the separator. Cows which had experience of using both spear gates and the separator, and their naive calves which were between 4 and 6 months of age were placed in a paddock containing a separator on the entrance to the water yard. The animals were given a two week period to become used to the new paddock and were then trapped. During 21 hours of trapping all 26 cows and 22 calves were correctly drafted and trapped. Trapping of these animals a second time a few days later did not affect accuracy. One calf was outside the yard at the time of mustering, but passed through the separator into the calf yard as stock people approached.

This same trial also assessed the potential use of the separator by stranger cattle. Six steers ranging in body weight from 172 kg to 405 kg were put in the paddock with cows and calves which were familiar with the separator. At trapping and mustering one week later the two largest steers were in with the cows, the two medium sized steers were trapped in the calf yard and the two smallest steers were outside the yard. These latter two animals entered the calf yard when stock people approached.

***(iii) Commercialisation***

<u>Identification of Commercial Companies</u>
As required by the contract, 'letters of intent' expressing interest in the manufacture and promotion of the cow/calf separator, were obtained from four companies and forwarded to MRC in June 1994. Ultimately, following discussions with MRC and DPI extension staff, the decision was made not to award manufacturing rights to particular companies, but to market

the separator by providing engineering drawings and specifications as part of a package on sale to interested producers, so that the producers could select the engineering workshop of their own choice.

Producer demonstration site

We felt that the most appropriate way to promote the separator in the industry was by demonstration. The Keats family and station staff (Gleeson Station, Cloncurry) had supported the development of the separator and Tom Keats has a good standing amongst the cattle producers in the Cloncurry area. The logical approach was therefore to determine if there was the interest amongst the producers in that area to establish a Producer Demonstration Site (PDS) at Gleeson Station. This was done at a meeting at the end of November 1993 and Gleeson was approved as a PDS in 1994. During the latter part of 1994 and the early part of 1995 a further four waters were fenced and separators installed.

On May 22 1995 a field day was held at Gleeson Station and was well attended by invited producers and DPI personnel. Unfortunately, not all cattle had been trained to the separators, but producers were able to see the separators *in situ*. DPI staff gave brief talks on the principles of the separator technology and discussions on the setting up of sites, animal training and problems that may be encountered were held.

Also demonstrated at this field day was a transportable cattle handling module which had been developed and constructed by Tom Keats and Jack Beach (Beach Built Engineering, Julia Creek). This module was designed to function in conjunction with the separator, so that cattle could be processed at the trapping site. Brief details of this module are given later in this section.

The field day was also attended by a commercialisation consultant to MRC (Gary Livermore) who prepared a report detailing an action plan for commercialisation of the separator. The essence of this plan was that:

1. Design drawings and specifications be prepared.
2. An information/promotional video be made.
3. A number of potential PDSs be identified and established.
4. Separators for PDSs to be manufactured.
5. An information package including 'Guidelines for use', information video and design drawings and specifications be put on sale (at approximately $30).

Launch of separator

The separator package was launched at the Meat Profit Day in Alice Springs on 7 October 1995. In addition, the separator was featured in the television program 'Cross Country' which was screened during October 1995.

Recent developments

Since the Meat Profit Day at Alice Springs work has been ongoing to establish a number of other PDSs throughout Queensland. Two separators have been constructed at Mt Isa, one of which has been installed at Escot Station, Burketown. The other one will be installed at Melrose Sation, Winton. A third separator is due to be manufactured by an engineering company in Longreach and will be installed on a property (yet to be determined) in the Longreach/Aramac district. The operation of the separator on these sites will be assessed for

12 to 18 months and a number of field/ demonstration days will be held during this period. The work on Gleeson Station will be finished this year, with a visit to the station being part of a field day to be held in that area later this year.

In SW Queensland two PDSs are being established; Moothandella at Windoora and Omicron on the SA-Queensland-NSW border. Both sheep and cattle are run on Moothandella, so it will be interesting to see if the sheep use the calf side. At this time the enclosures have been built and the stock are being trained. The intention is to use separators next year. On Omicron, cattle are normally mustered to the waters and then walked in. The intention is to trap the cattle at the water enclosures and wean there. The enclosures should be established early this year, with the cattle introduced to the separators next year.

The separator package will be held by all DPI Information Offices and sold to interested producers who can then take the plans/specifications to an engineering workshop of their choice for separator manufacture.

**Transportable Cattle Handling Module**

This was a Producer Initiated Development Project from Tom Keats which arose from his work with the cow/calf separator. Tom perceived a need for a system for processing calves and weaners at the site of trapping. The perceived benefits were:

- to increase labour efficiency, thus reducing the time and costs of cattle handling
- to reduces stress on both operators and animals during cattle handling

Discussion between QDPI staff, Tom Keats and Jack Beach of Beach Built Engineering (Julia Creek) resulted in a number of objectives for a transportable cattle handling module. It should be:

- quickly and easily relocatable
- simple and quick to set up
- sufficiently robust
- allow drafting of different classes of cattle
- allow loading of cattle onto trucks
- allow husbandry operations (branding, tagging, de-horning, castration etc.) to be carried out on calves
- allow calves (and others) to be returned to the main herd.

An initial meeting was held in November 1993 to discuss the proposed project, with the proposal being put to MRC in February 1994. The prototype module was manufactured, tested at Gleeson Station and then displayed at the field day held there on 22 May 1995. The module was featured on a 'Cross Country' television program which went to air in October 1995.

## (b) Lapweigh walk-over scale

The Lapweigh scale features new technologies which eliminate the requirement for an animal to be stationary on the scale for a short period. It will accurately weigh cattle heavier than 32 kg as they walk across a platform.

*(i) Equipment*

Description

The general features of the system are:

- Platform of approximately 2150 mm in length
- Autozeroing
- Facility for calibration of load cells or beams (i.e. compatible with any brand of load cell)
- Remote operation with each weight being aligned with an accuracy rating
- Powered by 12V battery
- Accepts signals from an electronic identification (EID) system and correlates each individual identity (ID) with the weight of the animal
- Stores ID and the time of day it was read, weight, and time of day and date of weighing for the equivalent of 500 animals per day over a period of 30 days
- Data including current calibration settings, thresholds and date are retained even if power is lost
- The default weight of 460 kg for the platform can be altered by computer command
- A recalculation of the threshold limits takes place every time a calibration occurs

Installation

There should be sufficient space and, if necessary, baulks should be installed before the weigh platform to slow the animals and space them so that they are not nose to tail. It is important that only one animal is on the platform at any one time. The weight platform or weigh bars should be positioned on a firm and level foundation.

Appendix II provides instructions for the operation of the Lapweigh scale, some examples of the signal patterns obtained from cattle moving over the scale and an explanation for the need to dampen the signal because of high frequency 'noise' resulting from the impact of the animals' hooves on the platform.

***(ii) Testing accuracy and precision of weighing***

(a) Rocklea

The scale was set up in the race at the Research Station. A group of 19 animals were used. On each testing day a static weight was obtained for each animal using the Station scale before the animals were put through the race and over the Lapweigh scale on five successive occasions. An attempt was made to obtain a static weight on the cattle on the Lapweigh scale but due to the design of the race it was not possible to hold cattle on the scale. Two animals were excluded from the trial as they consistently ran rapidly over the scale and no weights could be obtained. Variability in the numerator in the results given in the Tables below arose because weights were occasionally missed (for example, when cattle crossed too quickly for a weight to be obtained, or when more than one animal crossed the platform at the same time).

Four weighing trials were conducted in February and March 1994. In the first trial, concrete blocks were used in the scale in an attempt to dampen the output signal, but the concrete proved to be too smooth and the cattle slipped and slid, resulting in highly variable gaits as they crossed the platform. Rubber mats replaced the concrete in the second trial. These were effective at dampening the signal and cattle maintained their footing, but the matting was expensive. For the final two trials, mats of shredded rubber embedded in resin were used. These were effective and were cheaper than the rubber mats used previously.

*Results*
Tables 1 to 3 show the errors obtained during the various tests conducted at Rocklea.

**TABLE 1. Weighing errors from Lapweigh scale testing in March 1994 at Rocklea**

| Error from static weight | Percentage of weighings |
|---|---|
| <1% | 78.8 (67/85) |
| <2% | 84.7 (72/85) |
| <3% | 96.5 (82/85) |
| <5% | 98.8 (84/85) |

**TABLE 2. Weighing errors from Lapweigh scale testing in June and July 1994 at Rocklea**

| Date | Error from static weight | Percentage of weighings |
|---|---|---|
| 1/6/94 | <5% | 89.4 (93/104) |
| 16/6/94 | <5% | 90.3 (93/103) |
| 14/7/94 | <5% | 88.6 (93/105) |
| 18/7/94 | <5% | 90.6 (96/106) |

For the test on 1/6/94 and 16/6/94, 21 animals were used and on the other two dates 24 cattle were used.

**TABLE 3. Weighing errors from Lapweigh scale testing in January and February 1995 at Rocklea**

| Percent Variance | 27/1/95 | 3/2/95 | 10/2/95 | 17/2/95 | 24/2/95 |
|---|---|---|---|---|---|
| <1% | 58.3<br>(56/96) | 55.5<br>(66/119) | 62.6<br>(62/99) | 70.3<br>(71/101) | 79.6<br>(78/98) |
| <2% | 80.2<br>(77/96) | 86.5<br>(103/119) | 90.9<br>(90/99) | 91.1<br>(92/101) | 75.9<br>(94/98) |
| <3% | 89.6<br>(86/96) | 93.3<br>(111/119) | 98.0<br>(97/99) | 97.0<br>(98/101) | 96.9<br>(95/98) |
| <4% | 92.7<br>(89/96) | 95.8<br>(114/119) | 99.0<br>(98/99) | 99.0<br>(100/101) | 98.0<br>(96/98) |
| <5% | 94.8<br>(91/96) | 98.3<br>(117/119) | | | |
| >5% | 5.2<br>(5/96) | 1.7<br>(2/119) | 1.0<br>(1/99) | 1.0<br>(1/101) | 2.0<br>(2/98) |
| Total Wt/ animal (kg) | | 59215 | 46320 | 47393 | 45348 |
| % Variance | | -0.46 | -0.20 | -0.34 | -0.29 |
| Variance/ weighing (kg) | | -2.28 | -0.93 | -1.59 | -1.34 |

A group of 21 animals were used for these tests, but on 3/2/95 they were weighed 6 times in succession.

Mean difference between static and dynamic weighings expressed as a % of the mean static weight on the day. Differences between the single static weight and the valid weights from each of 5 (or 6) dynamic weighings on each day (with + or - signs preserved) were summed for each animal and these sub-totals were summed across animals. The grand total was then divided by the mean of the static weight. This approach reflects an interest in how close the group mean dynamic weight was to the group mean static weight.

(b) Swan's Lagoon

The scale was set up initially (July 1994) at the exit from a water yard so that the cattle passed through a spear gate and then walked across the platform. For testing, a group of 31 cows with EID implants were used. There were no problems in training the cows to walk over the platform although, initially, dirt was put over the matting.

For the remainder of 1994 and early 1995 considerable changes were made to the Lapweigh system as a result of the problems that we encountered during testing. Additionally there were problems with the EID reader during this time which meant that we were unable to interpret any data obtained from the scale. It was not until March 1995, when the system was set up at the entrance to the water yard, that we were able to collect weights and IDs that could be linked enabling data analyses. Even so, the amount of data was relatively small because of the intermittent problems with either the scale, the EID reader or power supplies failing.

In June 1995 we removed the cows from the paddock and replaced them with a group of 32 steers, which were fitted with EID ear-buttons, to enable us to link weights to individuals. Data were collected for various periods of time during August, September, October and November. Again, due to intermittent problems as described above, the longest continuous period of data collection was about one week.

*Results*

Cow data

The raw data are given in Appendix III.
Note the following:

- There is no static weight with which to compare dynamic weights; comparisons have been carried out between Lapweigh weights (checking one against the other) within days and between consecutive days.
- No comparisons have been carried out between months as the animals were gaining weight during this period.
- Some data were removed prior to analyses. These were those that were "flagged" by the data logger as being unreliable and weights to which we could not definitely link an individual animal (i.e. when a number of IDs were read and printed out followed by a number of weights being printed).
- The data does include weights that were evidently wrong, but were not flagged as such by the logger.
- 'Errors' have been scored when a weight changed by more than 10% from the preceding weight and then changed back again by more than 10% at the next weighing.
- These could have arisen from cattle not being separated as they crossed the scale (as the system was operated un-manned) and animals being weighed when only partially on the scale.

**TABLE 4. Number of data checks and % assumed incorrect for individual samplings**

| Sampling | Number of checks | Number incorrect | % incorrect |
|---|---|---|---|
| 1 (a) | 0 | - | - |
| 1 (b) | 5 | 0 | 0 |
| 2 | 8 | 0 | 0 |
| 3 (a) | 20 | 0 | 0 |
| 3 (b) | 11 | 0 | 0 |
| 3 (c) | 1 | 0 | 0 |
| 4 (a) | 27 | 0 | 0 |
| 4 (b) | 7 | 2 | 29 |
| 5 (a) | 18 | 4 | 22 |
| 5 (b) | 12 | 3 | 25 |
| 5 (c) | 3 | 1 | 33 |
| Overall March | 112 | 10 | 8.9 |
| 6 (a) | 0 | - | - |
| 6 (b) | 13 | 0 | 0 |
| 6 (c) | 2 | 0 | 0 |
| 7 (a) | 23 | 1 | 4 |
| 7 (b) | 15 | 0 | 0 |
| 7 (c) | 8 | 0 | 0 |
| 8 | 2 | 0 | 0 |
| Overall April | 63 | 1 | 1.6 |
| 9 | 0 | - | - |
| 10 (a) | 6 | 0 | 0 |
| 10 (b) | 6 | 1 | 17 |
| 11 (a) | 18 | 2 | 11 |
| 11 (b) | 17 | 0 | 0 |
| 11 (c) | 9 | 0 | 0 |
| 12 | 15 | 1 | 7 |
| 13 (a) | 22 | 0 | 0 |
| 13 (b) | 2 | 0 | 0 |
| 14 | 4 | 0 | 0 |
| 15 (a) | 25 | 2 | 8 |
| 15 (b) | 7 | 0 | 0 |
| Overall May | 131 | 6 | 4.6 |
| Overall | 306 | 17 | 5.6 |

In Table 4, the numbers in the 'Sampling' column indicate the day and the within day (in lower case letters) weights, for example, on the fifth day in March on the first occasion of the day (5(a)) there were 18 weights which could be checked with weights from the previous day. Similarly, the number of checks and errors have been determined for individual animals (Table 5). It can be seen that there are far more errors on some days/times than others, but that individual animals did not differ much in creation of errors (although sample sizes were small).

**TABLE 5. Number of data checks and % assumed incorrect for individual animals**

| EID | Number of checks | Number incorrect | % incorrect |
|---|---|---|---|
| 10 | 4 | 0 | 0 |
| 11 | 7 | 0 | 0 |
| 40 | 12 | 0 | 0 |
| 53 | 13 | 0 | 0 |
| 55 | 15 | 0 | 0 |
| 66 | 10 | 1 | 10 |
| 67 | 13 | 1 | 8 |
| 73 | 8 | 0 | 0 |
| 75 | 6 | 0 | 0 |
| 76 | 12 | 1 | 8 |
| 78 | 13 | 1 | 8 |
| 80 | 12 | 1 | 8 |
| 82 | 9 | 0 | 0 |
| 86 | 9 | 0 | 0 |
| 94 | 10 | 1 | 10 |
| 96 | 15 | 1 | 7 |
| 99 | 15 | 2 | 13 |
| 100 | 15 | 1 | 7 |
| 103 | 16 | 1 | 6 |
| 134 | 10 | 0 | 0 |
| 150 | 10 | 2 | 20 |
| 151 | 14 | 1 | 7 |
| 160 | 13 | 1 | 8 |
| 165 | 12 | 1 | 8 |
| 166 | 14 | 0 | 0 |
| 167 | 11 | 1 | 9 |
| 174 | 8 | 0 | 0 |
| Overall | 306 | 17 | 5.6 |

Figure 2. Example of recorded liveweights being similar

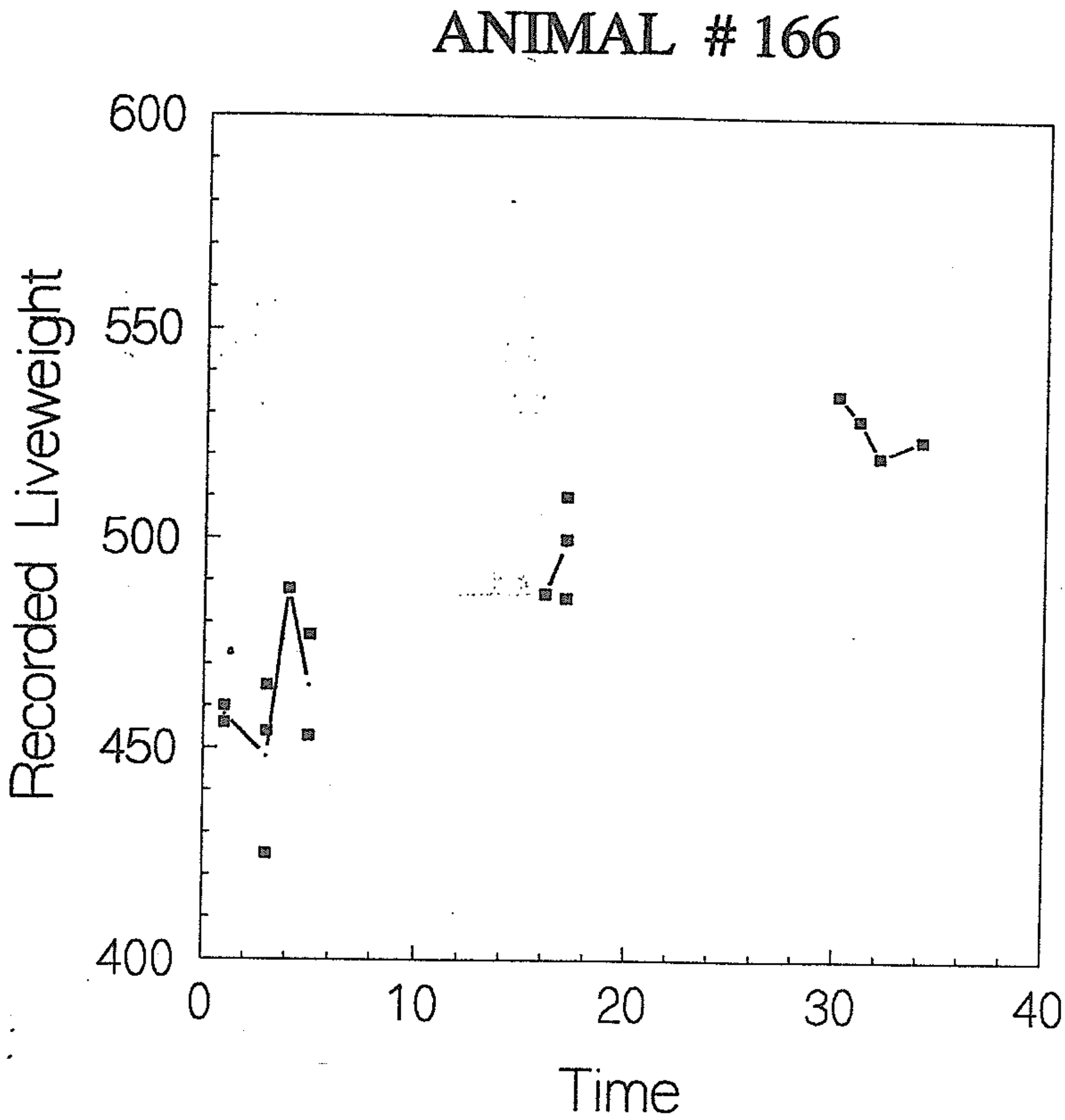
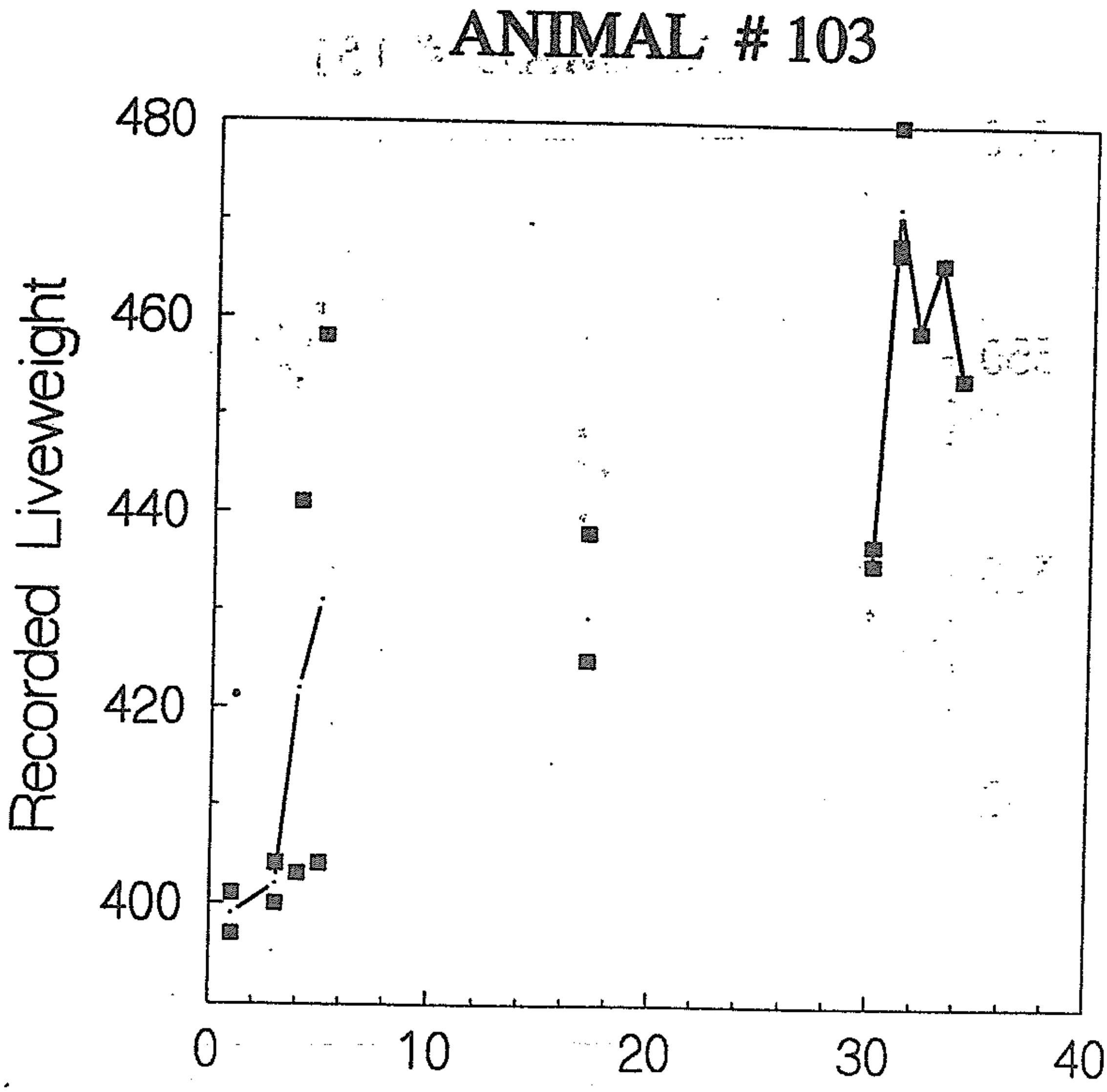


Figure 3. Example of recorded liveweights being variable



Figures 2 and 3 are some examples of plots of individual animals which illustrate this huge individual variability. For some individuals (Figure 2) the weights were all very close (within a month), but for others (Figure 3) they were very variable.

**TABLE 6. Number of sequential recordings for an animal (multiple recordings per day and/or readings over consecutive days) required so that 'the average of such readings will be within K% of the animal's true average weight, with a confidence of 95%'**

| K% | Uncensored data | Censored data* |
|---|---|---|
| 1 | 172 | 20 |
| 1.5 | 77 | 9 |
| 2 | 43 | 5 |
| 2.5 | 23 | 4 |
| 3 | 19 | 3 |
| 4 | 11 | 2 |
| 5 | 7 | 1 |
| 6 | 5 | 1 |
| 7 | 4 | 1 |
| 8 | 3 | 1 |
| 9 | 2 | 1 |
| 10 | 2 | 1 |
| 11 | 1 | 1 |
| ≥12% | 1 | 1 |

* Same basis as was used to 'censor' the test data set

The data shown in Table 6 indicate the number of weights of individual animals which would be needed to be confident that the overall average figures are accurate. The 'censored' data exclude those weights according to the 10% change criterion described above. Thus, it can be seen that with the uncensored data, seven records of weight would have to be obtained to be 95% confident that the average weight was within 5% of the animal's true weight. This number drops to one record if the censored data are used.

Comparing weights within days and weights between consecutive days, Figure 4 shows the number of recordings that had the range of % liveweight changes shown (i.e. 255/305 had a -5% to +5% change).

*Steer data*
The raw data are given in Appendix IV. The data were analysed in a similar way to those of the cows in that 'incorrect' readings were based on the same criterion of a 10% change. We anticipated that the cattle would be changing weight over time; therefore, data were compared only within the following time periods: 17-24/8/95, 7-15/9/95, 29/9-8/10/95, 13-15/10/95, 25-30/10/95, 9-10/11/95 and 17-20/11/95 (periods 1 to 7 respectively). Data were not compared between these periods. On many occasions the EID of an animal was read, but we were unable to link it to a weight because it appeared that a number of steers had crossed the scale in rapid succession. These occurrences are marked by ticks in the raw data.

The number and percentage of incorrect weights were determined and these are summarised in Table 7 (the complete data set is given in Appendix V).

Figure 4. Percentage change in liveweights in March, April and May

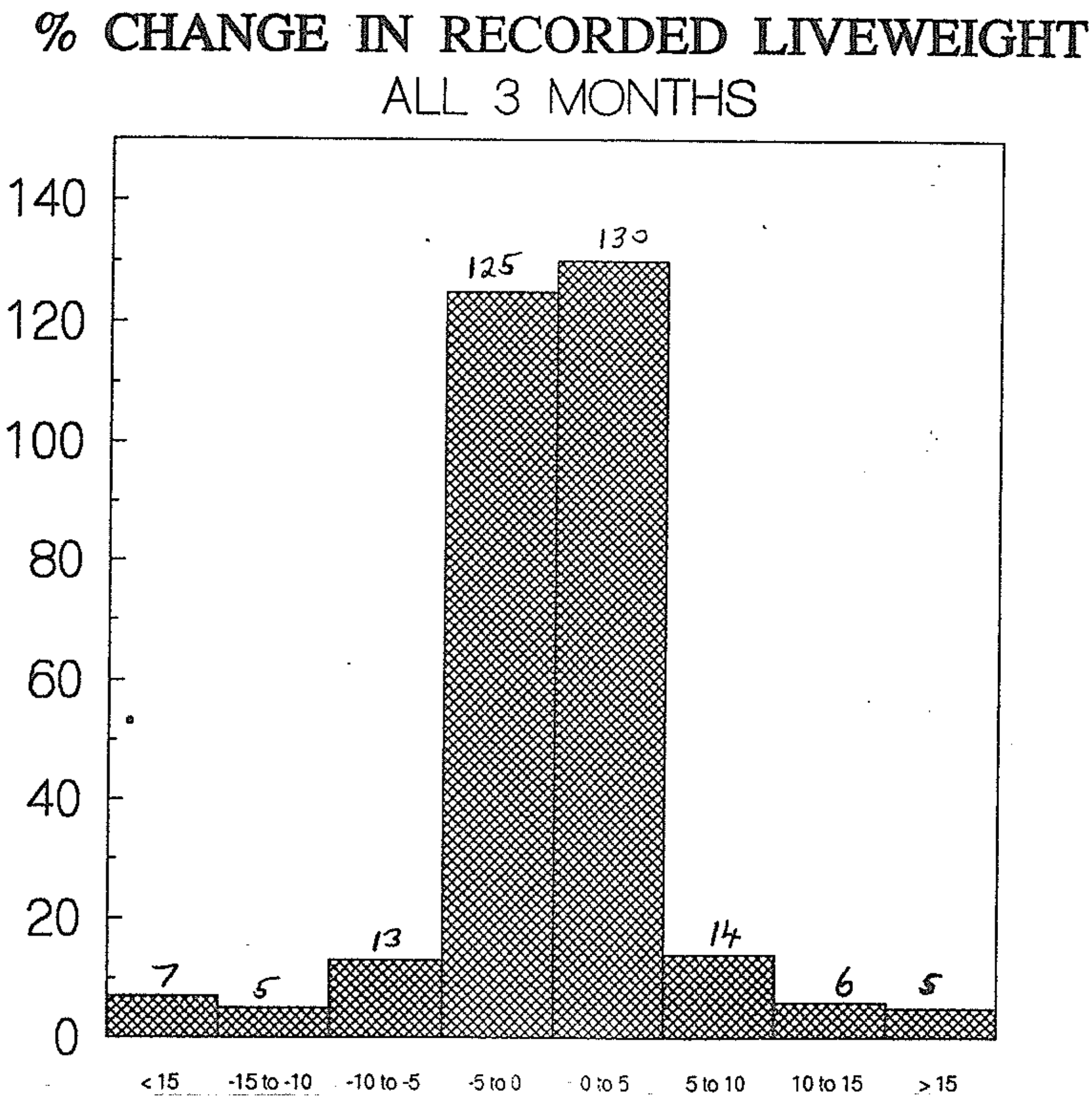


**TABLE 7. Number and percentage of incorrect weights obtained during time periods**

| Time Periods | Number of Weights | Number Incorrect | Percentage Incorrect |
|---|---|---|---|
| 17-24/8/95 | 90 | 23 | 26 |
| 7-15/9/95 | 61 | 4 | 7 |
| 29/9-8/10/95 | 228 | 7 | 3 |
| 13-15/10/95 | 48 | 0 | 0 |
| 25-30/10/95 | 84 | 8 | 10 |
| 9-10/11/95 | 63 | 2 | 3 |
| 17-20/11/95 | 95 | 4 | 4 |
| Total | 669 | 48 | 7 |

There was a tendency for more incorrect weights to be obtained initially, with numbers declining over the time periods, although there was a slight rise again during 25-30/10/95. On average there were about 7% incorrect weights.

On any given day (or part day) the number of EIDs that were read once, twice, more than twice and at all were listed (the data are given in Appendix V) in order to determine the percentage of the group being weighed (regardless of whether or not the weight was correct according to the criterion of 10% change). During the seven time periods, the ranges were 42-57%, 62-73%, 14-89%, 37-62%, 24-100%, 73-78% and 34-71% respectively. Overall the proportion of the group weighed on any one day was, on average, 75%. If only correct weights are considered then the ranges were 25-43%, 59-69%, 14-89%, 37-62%, 21-90%, 73% and 32-70% for time periods 1 to 7 respectively. The proportion for which a correct weight was obtained on any one day was, on average, 53%.

The data were considered in the same way for individual animals rather than during time periods to determine individual variability in being able to obtain correct weights. These data are also given in Appendix V. Throughout the entire time of recording the least number of weighings for an individual was 12 (steer 82) and the most 29 (steer 5), with modes of 17, 20 and 21. The percentage of incorrect weights ranged from 0% (steers 5, 7, 10, 11, 14, 21, 23, 31 and 35) to 25% (steer 82), although the actual numbers of incorrect weights were small (a range of 0 to 4). The proportion of times that a weight was obtained for a particular animal ranged between 39% (steer 32) and 76% (steer 69), but for correct weights the range was 32% (steer 82) to 70% (steer 34).

As data were collected on a total of 35 days and part-days, it appeared that most steers were, on average, walking over the scale at least daily; the fewest total times the EID for an animal was read was 26 (steer 21) and the greatest was 45 (steers 5 and 42). The number of days which passed, in a time period, before all the EIDs had been read and a weight recorded are shown in Table 8 (for this analysis period 2 was split in to (a) 7/9/95, which was a part-day only and (b) 14-15/9/95).

**TABLE 8. Number of EIDs read and steers weighed (in italics) on days in each time period**

| | Day | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Period | 1 | 1,2 | 1-3 | 1-4 | 1-5 | 1-6 | 1-7 | 1-8 | 1-9 |
| 1 | 24 *10* | 25 *15* | 30 *23* | 32 *26* | 32 *28* | 32 *28* | 32 *28* | 32 *31** | |
| 2(a) | 9 *7* | | | | | | | | |
| 2(b) | 32 *28* | 32 *30* | | | | | | | |
| 3 | 32 *27* | 32 *32* | 32 *32* | 32 *32* | 32 *32* | 32 *32* | 32 *32* | 32 *32* | 32 *32* |
| 4 | 32 *12* | 32 *22* | 32 *29* | | | | | | |
| 5 | 31 *15* | 31 *16* | 32 *23* | 32 *30* | 32 *31* | 32 *31** | | | |
| 6 | 30 *25* | 31 *28* | | | | | | | |
| 7 | 9 *7* | 32 *30* | 32 *32* | 32 *32* | | | | | |

* not the same steer missing being weighed; period 1 it was steer 10, period 5 it was steer 1

In these trials in the paddock it was not possible to compare the weights obtained on the Lapweigh scale with those obtained on a static scale. However, during this period of data collection there were 93 occasions on which two weights were obtained on individuals in the same day. Analysis of these pairs gave a standard deviation (SD) of 7.65 and a standard error (SE) of the mean of the two readings of 5.41. Thus, for any individual the 95% confidence limit on a single weighing would be approximately 2 x SD, i.e. the weight $\pm$ 15.3 kg and for the mean of a pair of weights it would be approximately 2 x SE, i.e. $\pm$ 10.8 kg. For the steers in this trial (with a mean weight of about 362 kg) this equates to about a 4.3% error for a single weight and a 3.0% error for a mean of two weights.

(c) Brian Pastures

The scale that was tested at Brian Pastures had a platform constructed from a folded, galvanised steel sheet, which made it approximately 50% lighter, so that it could be lifted by one person (the original needed two to lift it). This platform was developed early to mid-1995. The scale went to Brian Pastures in September 1995.

The cattle used comprised 30 head of high grade Brahman steers which were running in one paddock. There were 10 animals in each of three weight groupings: no. 5s (10 months old), no. 4s (22 months old) and no. 3s (33 months old). The cattle were weighed on 13 days between 19/09/95 and 27/10/95.

Prior to a weighing session the scale was calibrated with test weights (23 x 20 kg weights). On the first three weighing sessions (19/09/95, 21/09/95 and 25/09/95) the 30 head were allowed to walk through the crush and over the platform once prior to weighing. For weighing, the steers were put through the crush twice; on the first trial a static weight was obtained for each individual on the Station scale, which immediately preceded the Lapweigh scale in the crush. After the static weight was obtained the animal was released from the crate, allowed to walk on to the Lapweigh scale and held there in order to obtain a static weight. On the second trial only a dynamic weight was recorded on the Lapweigh. On this second trial, a slide gate positioned prior to the station scale was used to slow the animals and ensure that the cattle were separated so that only a single animal at a time crossed the platform.

Animal weights were recorded together with a note of the gait of the animal (e.g. walk, slow trot, fast trot) and the code assigned to each Lapweigh weight. Data were analysed to investigate the precision of the system using all the weights regardless of the code (D) and those only assigned 0, 1 and 2 (i.e. the reliable weights: V).

*Results*
Figures 5 and 6 are plots of the Lapweigh weights (Moving) versus the static (obtained from the Station scale) for all Lapweigh weights recorded (Figure 5) and those flagged by the machine as being reliable or valid i.e. codes 0,1 and 2 (Figure 6).

**TABLE 9. Means and errors of static and Lapweigh weights**

| | Static (S) | Dynamic All (D) | Dynamic Valid (V) | Difference (S-D) = d | Difference (S-V) = v | % Error d/S*100 | % Error v/S*100 |
|---|---|---|---|---|---|---|---|
| Mean | 374.9 | 379.5 | 368.9 | -4.2 | -0.2 | -1.61 | -0.21 |
| n | 386 | 377 | 287 | 377 | 287 | 377 | 287 |

The values obtained for d and v are not equal to S-D and S-V respectively because, whilst all animals contributed to the S mean, not all contributed to the D or V means (weights were not always obtained). The same applies for % errors.

Table 9 shows that Lapweigh weights were, on average, 4.2 kg less than the static weights when all weights were considered. This difference was reduced to only 0.2 kg when only the valid weights were used, giving a percentage error of -0.21% from the static weight.

Figure 5. All Lapweigh weights vs. static weights

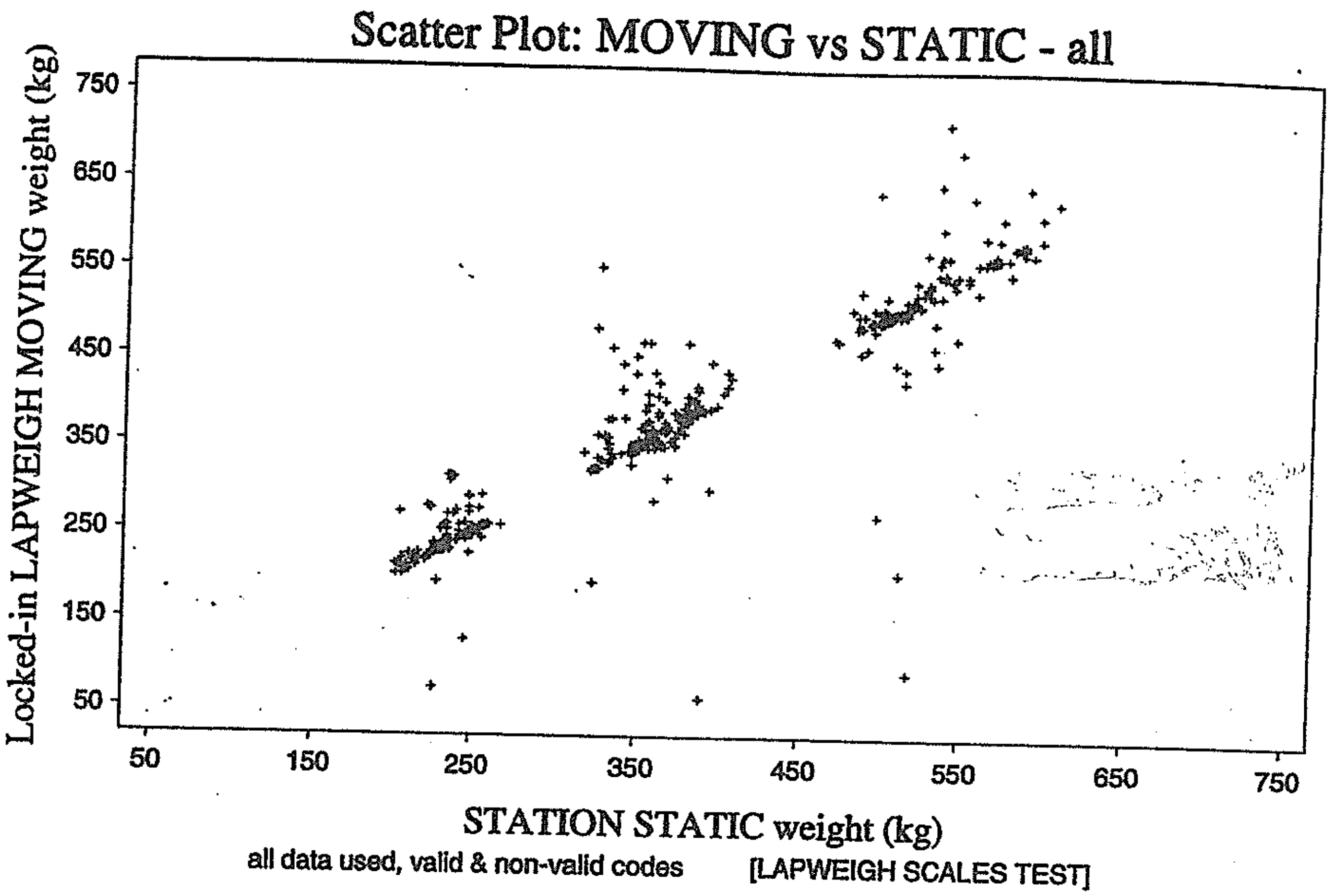


Figure 6. Valid Lapweigh weights vs. static weights

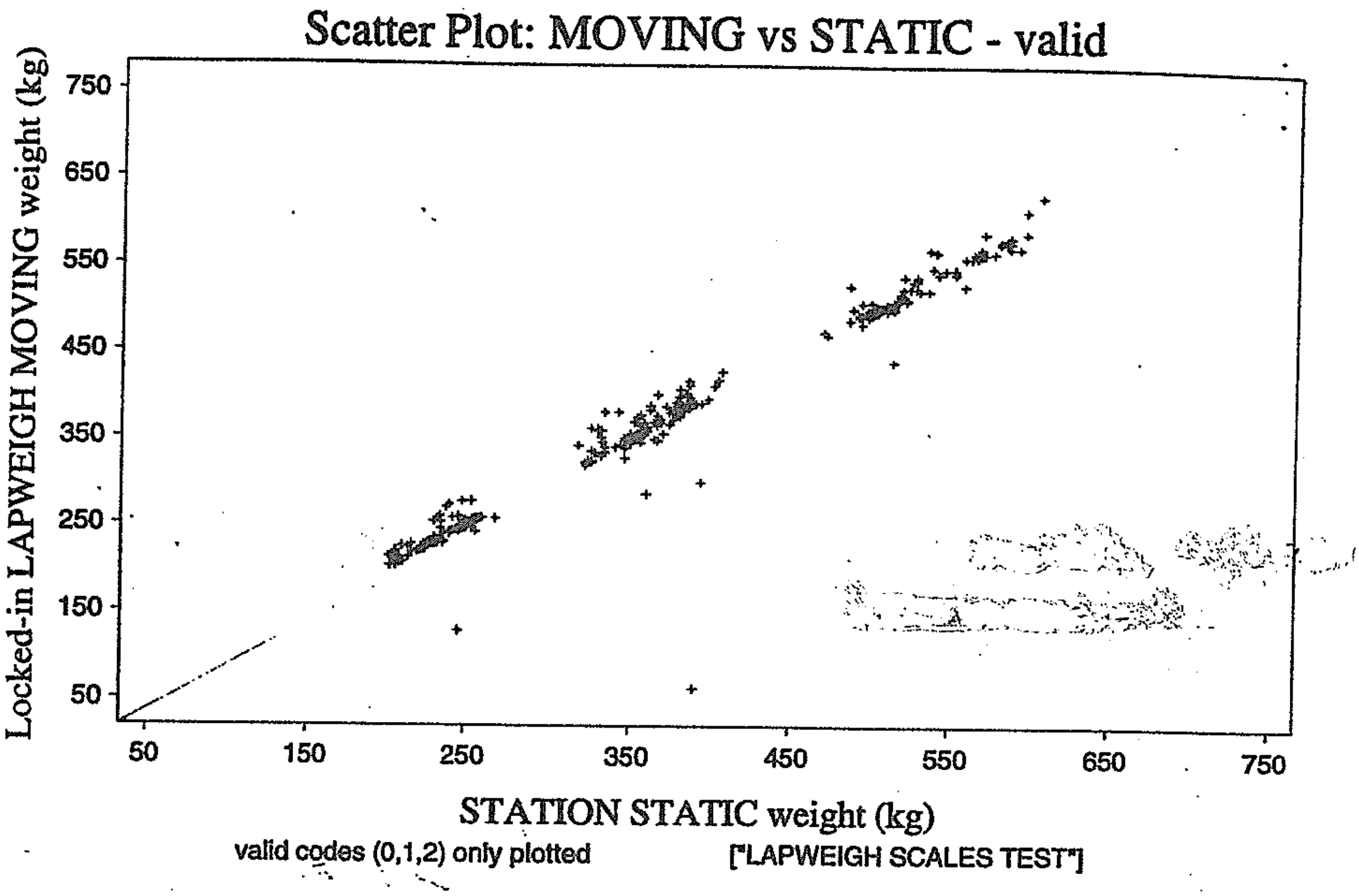


**TABLE 10. Standard deviations of static and Lapweigh weights by dates and weight groups**

*No. 5s*

| Date | SD S | SD D | SD V | no. valid | mean S | mean D | mean V |
|---|---|---|---|---|---|---|---|
| 19/9 | 15.2 | 23.8 | 19.6 | 6 | 241 | 258 | 248 |
| 21/9 | 18.0 | 24.0 | 18.2 | 5 | 236 | 247 | 244 |
| 25/9 | 17.8 | 12.1 | 3.5 | 3 | 235 | 261 | 252 |
| 27/9 | 14.0 | 31.9 | 17.3 | 8 | 232 | 238 | 234 |
| 28/9 | 15.4 | 20.0 | 21.4 | 8 | 235 | 240 | 240 |
| 2/10 | 15.0 | 31.0 | 20.7 | 9 | 235 | 245 | 237 |
| 4/10 | 14.9 | 45.5 | 36.7 | 9 | 233 | 229 | 219+ |
| 9/10 | 17.0 | 15.9 | 15.9 | 9 | 231 | 231 | 231 |
| 13/10 | 16.1 | 29.6 | 18.8 | 9 | 237 | 245 | 237 |
| 18/10 | 14.4 | 26.2 | 16.5 | 8 | 237 | 250 | 244 |
| 20/10 | 12.8 | 13.0 | 13.0 | 10 | 233 | 237 | 237 |
| 24/10 | 14.7 | 15.6 | 16.2 | 9 | 237 | 234 | 235 |
| 27/10 | 14.0 | 52.4 | 11.2 | 9 | 234 | 219 | 235 |
| pooled | 15.3 | 29.2 | 19.6 | 102 | 235.2 | 240.5 | 236.6 |

*No. 4s*

| Date | SD S | SD D | SD V | no. valid | mean S | mean D | mean V |
|---|---|---|---|---|---|---|---|
| 19/9 | 24.2 | 35.7 | 20.7 | 5 | 375 | 403 | 392 |
| 21/9 | 25.1 | 46.1 | 31.1 | 7 | 369 | 390 | 371 |
| 25/9 | 21.9 | 25.5 | 26.0 | 5 | 364 | 387 | 384 |
| 27/9 | 23.6 | 61.3 | 25.4 | 9 | 357 | 354 | 371+ |
| 28/9 | 21.0 | 44.5 | 34.8 | 7 | 360 | 347 | 335+ |
| 2/10 | 20.8 | 25.7 | 25.7 | 10 | 359 | 367 | 367 |
| 4/10 | 21.8 | 35.0 | 26.0 | 9 | 356 | 371 | 363 |
| 9/10 | 21.3 | 53.1 | 24.9 | 7 | 356 | 383 | 359 |
| 13/10 | 19.4 | 109.1 | 109.1* | 8 | 359 | 329 | 329 |
| 18/10 | 18.0 | 38.8 | 26.9 | 6 | 357 | 374 | 365 |
| 20/10 | 18.4 | 62.5 | 18.6 | 8 | 353 | 382 | 360 |
| 24/10 | 20.0 | 26.4 | 22.1 | 7 | 356 | 365 | 357 |
| 27/10 | 17.8 | 43.1 | 22.3 | 7 | 351 | 371 | 351 |
| pooled | 21.2 | 50.1 | 40.3 | 95 | 359.5 | 371.2 | 360.7 |

*No. 3s*

| Date | SD S | SD D | SD V | no. valid | mean S | mean D | mean V |
|---|---|---|---|---|---|---|---|
| 19/9 | 34.3 | 133.1 | 43.4 | 5 | 548 | 516 | 560 |
| 21/9 | 35.0 | 96.7 | 39.8 | 7 | 539 | 517 | 542 |
| 25/9 | 31.1 | 40.3 | 42.8 | 3 | 536 | 531 | 536 |
| 27/9 | 34.2 | 36.0 | 35.2 | 7 | 524 | 519 | 521 |
| 28/9 | 34.1 | 140.6 | 42.8 | 7 | 525 | 481 | 527 |
| 2/10 | 31.0 | 30.6 | 28.9 | 8 | 527 | 524 | 519+ |
| 4/10 | 31.3 | 44.8 | 35.1 | 7 | 524 | 535 | 538+ |
| 9/10 | 32.5 | 72.9 | 34.1 | 6 | 527 | 559 | 533 |
| 13/10 | 31.8 | 51.8 | 36.6 | 7 | 518 | 532 | 518 |
| 18/10 | 34.5 | 59.7 | 37.8 | 8 | 529 | 550 | 531 |
| 20/10 | 35.1 | 31.6 | 31.6 | 10 | 523 | 520 | 520 |
| 24/10 | 30.9 | 34.7 | 32.6 | 8 | 522 | 515 | 523 |
| 27/10 | 34.8 | 47.4 | 48.6 | 7 | 521 | 500 | 510 |
| pooled | 33.1 | 73.1 | 37.2 | 90 | 527.8 | 523.2 | 527.6 |

Table 10 shows that if all of the Lapweigh data are considered (as opposed to those which are coded as valid) then the weights are more variable than the static weights. However, variability is reduced to levels similar to the static weights when only the valid weights are used. In most instances the mean Lapweigh liveweights were closer to the static liveweights if only the valid records were used. However, in some instances (e.g. see those marked by +) dropping out the non-valid records resulted in a mean Lapweigh weight further from the static weights. The results, however, in general indicate that the codes do serve a purpose. There was a single occasion (marked with *) where the code evidently failed, with no change to the SD, but overall, the coding functioned well.

There was also variability within groups of animals and days on the number of valid weights obtained, with a range of 33.3% to 100% in the percentage valid weights (a mean of 73% and a mode of 70%). There appeared to be a tendency for more valid weights to be obtained with younger (lighter) animals.

The mean Lapweigh weights (valid) were within 0.2 kg for the no. 3s, 1.2 kg for the no. 4s and 1.4 kg for the no 5s.

From the data it was possible to determine the percentage of Lapweigh weights which were within a specified percentage error (k%) of the static weights (Table 11).

**TABLE 11. Percentage of Lapweigh weights within a specified percentage error (k%) of the static weights**

| k% | 10 | | 5 | | 2 | |
|---|---|---|---|---|---|---|
| all weights (D) | 84% | 314/375 | 72% | 270/375 | 56% | 211/375 |
| valid weights (V) | 95% | 274/287 | 85% | 245/287 | 69% | 199/287 |

Based on the finding that the codes serve a purpose and that only valid data should be used it is possible to calculate the necessary number of weighings needed to achieve a specified precision (Table 12).

**TABLE 12. Group size needed to achieve a specified precision in estimating the average herd weight of a group of animals**

*No. 5s (static mean weight=235.2 kg, SD=19.59)*

| | | | | | | |
|---|---|---|---|---|---|---|
| Allowable error (%) | 10 | 5 | 4 | 3 | 2 | 1 |
| Allowable error (kg) | 20 | 10 | 8 | 6 | 4 | 2 |
| Necessary number | 4 | 16 | 25 | 43 | 97 | 387 |

*No. 4s (static mean weight=359.5 kg, SD=40.28)*

| | | | | | | |
|---|---|---|---|---|---|---|
| Allowable error (%) | 10 | 5 | 4 | 3 | 2 | 1 |
| Allowable error (kg) | 40 | 20 | 16 | 12 | 8 | 4 |
| Necessary number | 5 | 17 | 26 | 46 | 102* | 406* |

*No. 3s (static mean weight=527.8 kg, SD=37.25)*

| | | | | | | |
|---|---|---|---|---|---|---|
| Allowable error (%) | 10 | 5 | 4 | 3 | 2 | 1 |
| Allowable error (kg) | 60 | 30 | 24 | 18 | 12 | 6 |
| Necessary number (n) | 2 | 6 | 10 | 18 | 39 | 155 |

** these numbers are high as a result of the data obtained on 13/10 when an unreliable weight was not flagged*

Allowable error (kg) is the percentage of 200 kg, 400 kg and 600 kg for no. 5s, 4s and 3s respectively.

The necessary number is found by controlling the width of the 95% confidence interval for the sample mean and is equivalent to solving for n in 2 x standard error of the mean = allowable error (Snedecor and Cochran 1971).

*Example:* There is a group of 50 no. 5s. How many weighings are needed for a 5% chance that the error will exceed 2% (of the mean)? Only valid weights will be used, the incidence of which is approximately 75%. The necessary number of weighings is [97 (obtained from the table) * 4/3 (75%) =] 130. Weighing the group of 50 head three times will provide 150 weights. Therefore this would be sufficient **providing there was at least one valid weight for each animal.**

Similar analyses were carried out on the data in order to determine the number of consecutive weighings required for individual animals to achieve a specified precision. Table 13 summarises the within animal variation in a similar manner to Table 10.

Figure 7. Static weights of cattle showing weight loss (downward trend) in the early part of the testing period

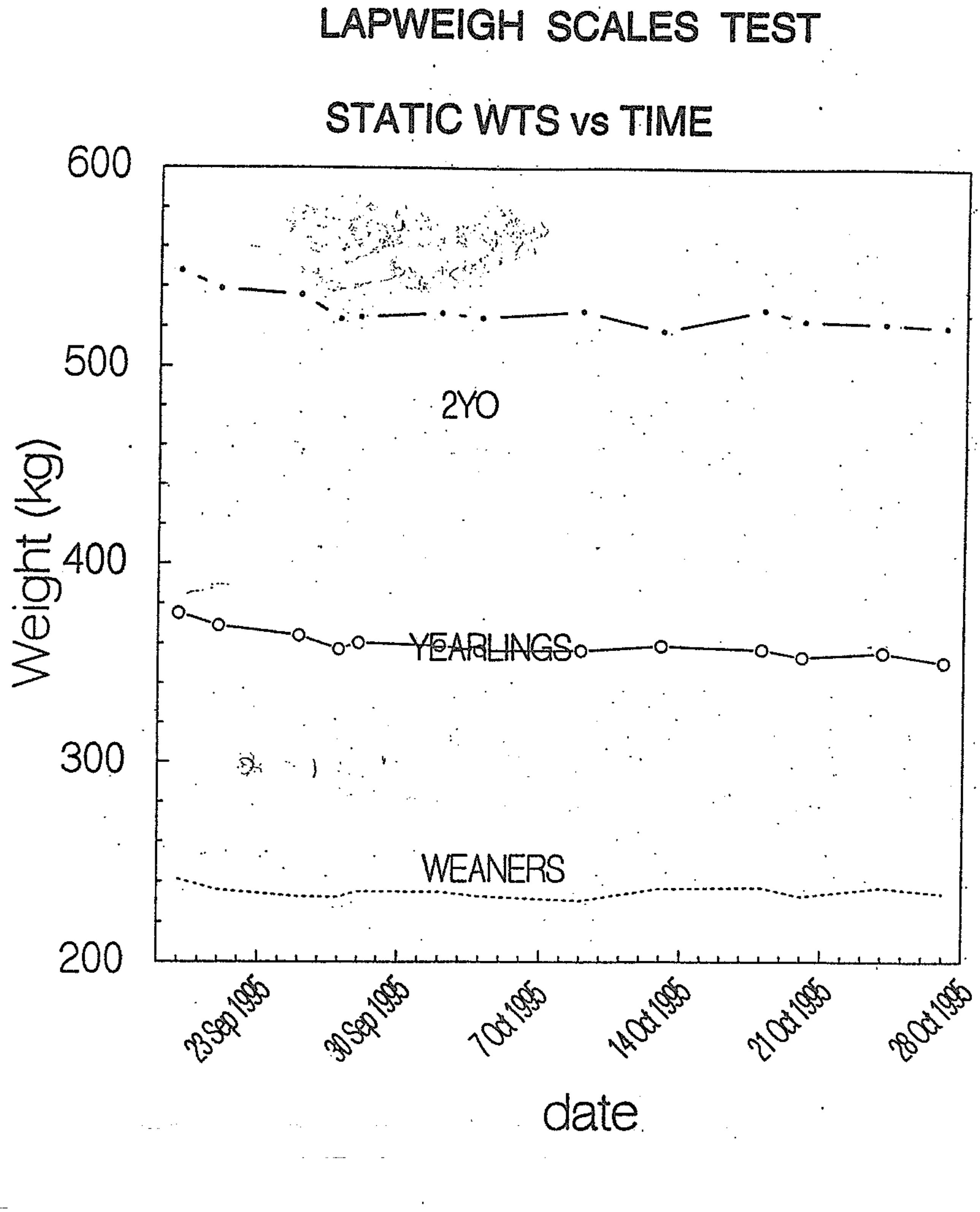


**TABLE 13. Standard deviations of static and Lapweigh weights by animals and weight groups**

*No. 5s*

| Animal | SD S | SD D | SD V | no. valid | mean S | mean D | mean V |
|---|---|---|---|---|---|---|---|
| 5162 | 7.18 | 36.91 | 35.69* | 12 | 250.6 | 244.5 | 240.7+ |
| 5164 | 2.95 | 4.17 | 1.12 | 9 | 230.0 | 230.2 | 228.0+ |
| 5188 | 5.11 | 4.69 | 4.69* | 13 | 255.5 | 252.8 | 252.8 |
| 5192 | 7.24 | 5.57 | 5.57* | 12 | 220.5 | 221.1 | 221.1 |
| 5193 | 4.39 | 40.38 | 2.31 | 3 | 235.8 | 273.2 | 229.3 |
| 5196 | 3.16 | 49.42 | 13.80 | 11 | 232.0 | 225.5 | 242.3+ |
| 5206 | 4.70 | 5.63 | 5.70* | 12 | 243.5 | 244.3 | 243.9 |
| 5208 | 4.12 | 18.10 | 8.98 | 11 | 208.2 | 217.5 | 212.6 |
| 5229 | 3.69 | 17.58 | 12.85 | 10 | 247.4 | 258.4 | 257.4 |
| 5241 | 4.48 | 22.73 | 11.20 | 9 | 226.5 | 240.6 | 229.2 |
| pooled | 4.90 | 25.79 | 14.82 | 102 | 235.2 | 240.5 | 236.6 |

*No. 4s*

| Animal | SD S | SD D | SD V | no. valid | mean S | mean D | mean V |
|---|---|---|---|---|---|---|---|
| 4278 | 5.82 | 7.18 | 7.18* | 12 | 351.7 | 352.3 | 352.3 |
| 4280 | 7.94 | 41.07 | 13.09 | 4 | 360.9 | 404.2 | 372.0 |
| 4282 | 11.87 | 20.36 | 21.05* | 12 | 382.2 | 390.5 | 391.3+ |
| 4286 | 7.25 | 93.26 | 93.26* | 13 | 388.3 | 359.1 | 359.1 |
| 4287 | 6.56 | 49.08 | 16.58 | 7 | 347.1 | 380.8 | 346.3 |
| 4289 | 5.04 | 16.94 | 16.94* | 13 | 327.5 | 335.2 | 335.2 |
| 4290 | 9.54 | 26.16 | 9.99 | 9 | 380.9 | 389.5 | 385.9 |
| 4291 | 6.95 | 25.91 | 21.17* | 6 | 366.2 | 366.7 | 368.5+ |
| 4292 | 6.55 | 29.94 | 25.11* | 12 | 358.2 | 361.6 | 356.7 |
| 4294 | 9.75 | 87.57 | 13.72 | 7 | 332.2 | 380.1 | 349.0 |
| pooled | 7.98 | 49.04 | 38.58 | 95 | 359.5 | 371.2 | 360.7 |

*No. 3s*

| Animal | SD S | SD D | SD V | no. valid | mean S | mean D | mean V |
|---|---|---|---|---|---|---|---|
| 3148 | 9.32 | 43.59 | 9.71 | 3 | 537.5 | 528.5 | 536.3 |
| 3156 | 8.10 | 48.66 | 9.72 | 8 | 500.6 | 502.8 | 497.6+ |
| 3158 | 8.12 | 121.41 | 17.42 | 10 | 521.7 | 491.1 | 522.6 |
| 3160 | 7.14 | 8.23 | 8.46* | 12 | 504.8 | 502.1 | 501.7+ |
| 3162 | 7.47 | 27.11 | 8.30 | 10 | 569.1 | 575.6 | 567.2 |
| 3163 | 17.16 | 74.15 | 44.83 | 8 | 543.7 | 576.2 | 538.5 |
| 3164 | 7.41 | 17.89 | 17.89* | 12 | 588.2 | 587.4 | 587.4 |
| 3172 | 6.28 | 98.18 | 5.84 | 10 | 499.5 | 457.4 | 497.5 |
| 3183 | 15.03 | 36.65 | 11.65 | 11 | 525.8 | 526.1 | 516.0+ |
| 3190 | 12.29 | 23.96 | 22.21* | 6 | 487.4 | 490.0 | 494.5+ |
| pooled | 10.40 | 61.38 | 18.27 | 90 | 527.8 | 523.2 | 527.6 |

Table 13 shows that if all of the Lapweigh data are considered (as opposed to those which are coded as valid) then the weights are more variable than the static weights. However, variability is reduced to levels similar to the static weights when only the valid weights are used. In most instances the mean Lapweigh liveweights were closer to the static liveweights if only the valid records were used. However, in some instances (e.g. see those marked by +) dropping out the non-valid records resulted in a mean Lapweigh weight further from the static weights. The results, however, in general indicate that the codes do serve a purpose. There were a number of occasions (marked with *) where the code evidently failed, with little or no change to the SD The code appeared to function less well in reducing within animal variation than between day variation.

The within animal variation shows a component due to a downward trend in weights early in the trial (see Figure 7), which inflates it to a certain degree.

There was also variability in the number of valid weights obtained for individual animals, with a range of 23% to 100% in the percentage valid weights (a mean of 74% and a mode of 92%). There appeared to be a slight tendency for more valid weights to be obtained with younger (lighter) animals.

Compared to the static weights the mean Lapweigh weights (valid) ranged between -9.8 kg and +7.1 kg for the no. 3s, -29.2 kg and +16.8 kg for the no. 4s, and -9.9 kg and +10.3 kg for the no 5s. There was a tendency for the Lapweigh scale to produce lower weights than the static scale for the no. 3s, higher weights for the no. 4s and no. 5s.

From the data it was possible to determine the necessary number of serial weighings on an individual for a 5% chance that the error of the resulting mean exceeded an allowable error (see Table 14).

**TABLE 14. Number of consecutive Lapweigh weighings of individuals needed to achieve a specified precision in estimating the weight of an individual animal**

| | | | | | | |
|---|---|---|---|---|---|---|
| *No. 5s (static mean weight=235.2 kg, SD=14.82)* | | | | | | |
| Allowable error (%) | 10 | 5 | 4 | 3 | 2 | 1 |
| Allowable error (kg) | 20 | 10 | 8 | 6 | 4 | 2 |
| Necessary number | 3 | 9 | 14 | 25 | 55 | 220 |
| *No. 4s (static mean weight=359.5 kg, SD=38.58)* | | | | | | |
| Allowable error (%) | 10 | 5 | 4 | 3 | 2 | 1 |
| Allowable error (kg) | 40 | 20 | 16 | 12 | 8 | 4 |
| Necessary number | 4 | 15 | 24 | 42 | 94 | 374 |
| *No. 3s (static mean weight=527.8 kg, SD=18.27)* | | | | | | |
| Allowable error (%) | 10 | 5 | 4 | 3 | 2 | 1 |
| Allowable error (kg) | 60 | 30 | 24 | 18 | 12 | 6 |
| Necessary number (n) | 1 | 2 | 3 | 5 | 10 | 38 |

Allowable error (kg) is the percentage of 200 kg, 400 kg and 600 kg for no. 5s, 4s and 3s respectively.

The necessary number is found by calculating the width of the 95% confidence interval for the sample mean and is equivalent to solving for n in 2 x standard error of the mean = allowable error.

*Example for no. 5 animals:* How many consecutive weighings of a particular animal are needed for a 5% chance that the error will exceed 2% (of the mean)? Only valid weights will be used, the incidence of which is approximately 75%. The necessary number of weighings is [9 (obtained from the table) * 4/3 (75%) =] 12.

**(iii) *Commercialisation***

Identification of Commercial Companies
In July 1994, letters were sent to ten scale companies in Australia advising them of our project and its progress and requesting from them expressions of interest to commercialise the walkover scale. Replies were received from six companies of which three were quite keen (Allflex, Ruddweigh and Tru-test), one was interested and wished to be kept up to date (Ranger Instruments) and one (SASTEC) could see the potential of their customers using the scales and needing to interface with their electronic data retrieval systems to give a complete operational overview. The sixth company said it was not in their line of business (Toledo).

Allflex New Zealand, with whom we have been working on the weight-drafting system, requested a set of scales be sent to New Zealand for them to evaluate. It was thought best to wait until the MRC Review (27/2/95) and seek guidelines from the panel as to the best direction and course of action to take for commercialisation. There was some concern with the equipment being so far away and maintaining our intellectual property, particularly as the EPROM could be easily copied in its present form.

Demonstration day
A day for the demonstration of both the Lapweigh and NQ weight-drafter systems was held at Swan's Lagoon on 11 May 1995. This day was attended by representatives from MRC (commercialisation), Allflex Australia, Ruddweigh and Sunbeam/Tru-test.

We understand that the outcome of that day was the request for further testing of the Lapweigh scale. To this end, further testing was conducted at Brian Pastures (see above) and data collection continued in the same paddock at Swan's Lagoon with the steers.

## (c) NQ weight-drafter

### *(i) Equipment*

Description
Plate 1 shows the system comprises a weigh crate, which has a platform 800 mm wide, with sheeted sides to 900 mm in height and a length of 2050 mm. Commercial load bars (Allflex) are located under the crate and all structures into which animals may come in contact during

use are supported by the load bars, including drafting gates and anti-backing device. Two drafting gates form an inverted V, into which the animal enters, at the front of the crate. The gates are similar to those of the cow/calf separator, that is hinged in such a way as to be self-closing and with a length of chain attached so that the gates can be held open to varying degrees. The gate latch is an electromagnetically powered pawl which engages in a lug on an arm extending from the posterior section of each drafting gate. The lug is ramped so that the gate will close and lock if the pawl is engaged. The engaging section of the pawl is a roller bearing designed to reduce friction, so that if a cow is pushing hard against the draft gate the lock will still be released when a signal is sent to the electromagnetic articulator.

Anterior to the crate is a short platform, which serves as a step-down to ground level for the animals. This section is not tared and is supported by the ground. In the centre of this section is a post to which panels can be attached for setting up trapping yards. During drafting the cattle pass to the left or right of this post, depending on the draft limits which are entered into the control unit by the operator (see Plate 2). The post is removable if cattle are not being drafted.

An animal spacing device is also included. This consists of two hanging rubber flaps at the rear of the unit immediately in front of the anti-backing device. When either drafting gate is pushed open by an exiting animal these flaps rotate from their resting position at the sides of the entrance across the path of any following animal causing a visual barrier, which is sufficient to cause the animal to baulk (Plate 3). When the animal being drafted has moved off the weigh platform these rubber flaps return to their resting position so that the following animal is free to move onto the weigh platform.

Attached to the top of the weighing module are the power supply batteries and solar panels and a metal box containing the electronic control components.

Electronics

The scale used to weigh the animals is an Allflex FX 31 version #2.07. This standard cattle scale is marketed internationally by Allflex New Zealand and has proved to be an effective and reliable system for weighing cattle in the yards. This scale has a memory which will store weights and other information. Drafting limits can be set by the operator and are simply changed by pushing buttons on a user-friendly key pad. Stored information can be printed from the memory or transferred to a computer using a linker cable and software. The appropriate sections from the Allflex operators manual for weighing and drafting are given in Appendix VI (with permission from Allflex New Zealand).

A drafting board also supplied by Allflex is connected to the scale via a communication cable. This drafting board has a series of relay switches which can be used for various functions required for automatic weighing and drafting of livestock including opening and closing blocking gates and drafting gates.

Plate 1. Side view of NQ weight-drafter

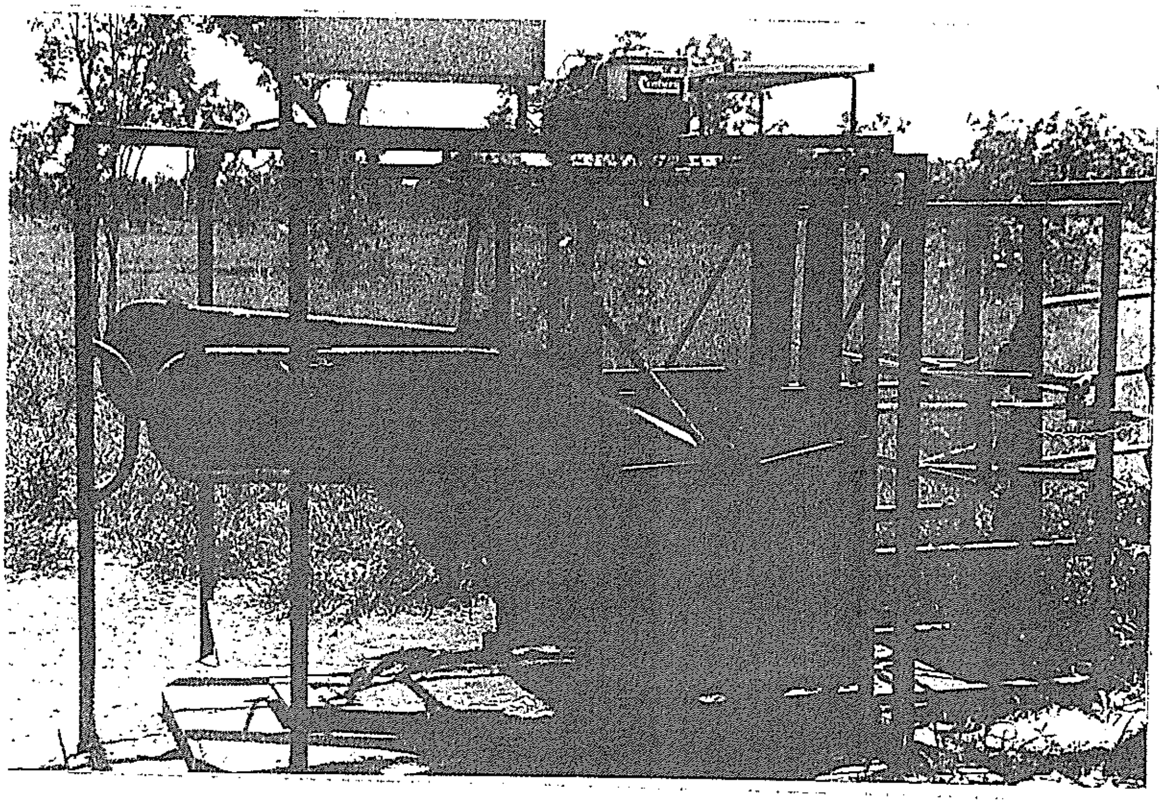


Plate 2. Front view of NQ weight-drafter with one exit gate held open

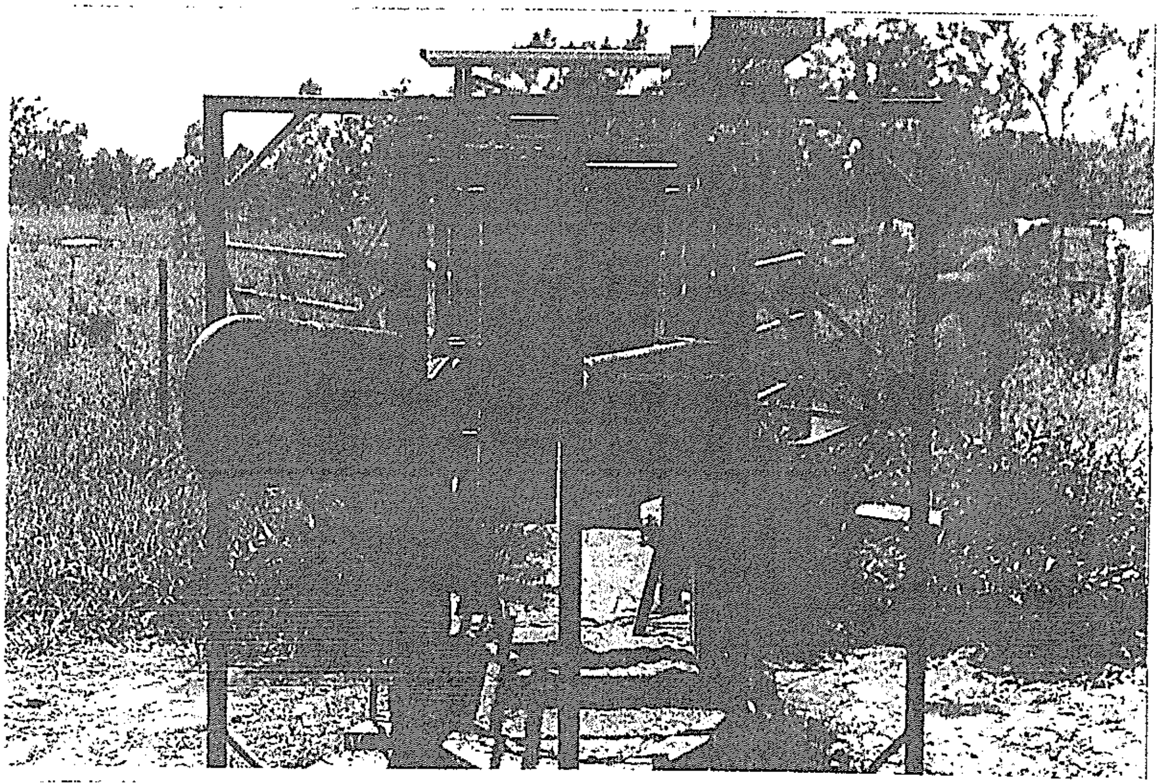


Plate 3. Rear view of NQ weight-drafter showing animal spacing device

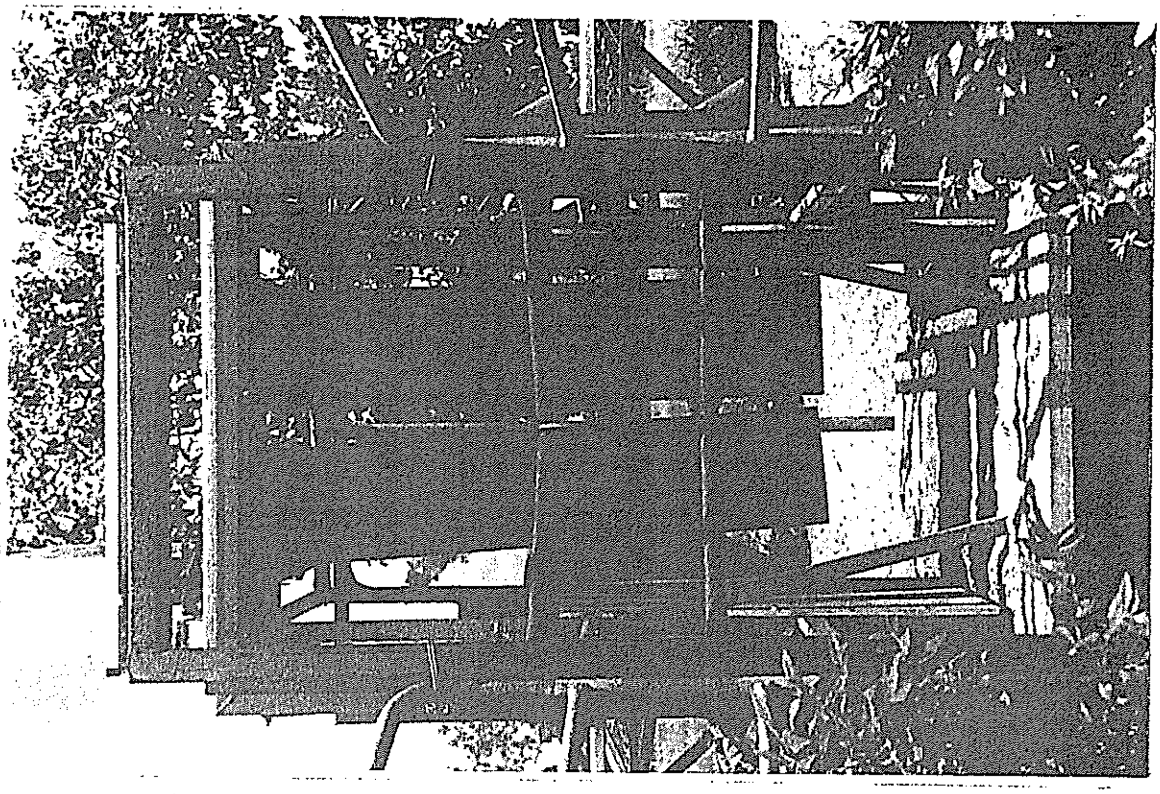
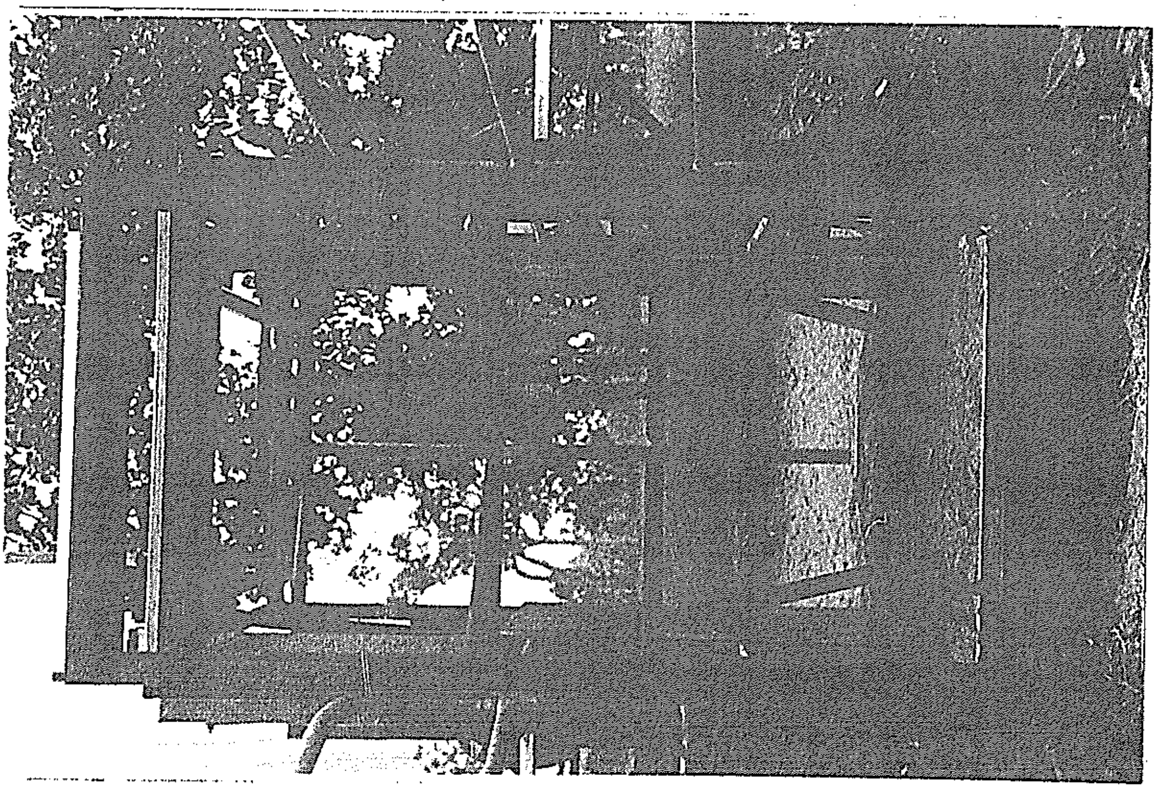


Plate 4. Rear view of NQ weight-drafter showing anti-backing device which also serves to initiate weighing cycle



There are three relay switches in the drafting board to control drafting gates, i.e. high, medium and low, so that a three-way draft can be achieved on draft limits which are entered by the operator. As the drafting module is only two-way, i.e. left or right, a switch box was constructed so that these three signals could be used in any combination to control the draft direction, e.g. high right, medium left and low right. This will effectively select a weight range of animals to be drafted to the left. Alternatively if automatic weighing only is required both draft gates could be connected to all three signals and when the animal was weighed both draft gates would unlatch so the animal could exit straight ahead with the centre post removed.

The only modification required to the standard Allflex equipment was to use an external signal to initiate the FX31 weigh cycle when the animal was on the platform. This signal was achieved by having a switch on the anti-backing device at the rear of the platform (Plate 4) so that when this self-closing gate closed behind the animal it sent a signal via a relay switch to the scale which instructed it to start weighing.

The weigh cycle is the same as it would normally be when manually weighing cattle in a standard yard weighing facility, therefore the automatic weighing accuracy is identical to that which would be achieved in a manual facility. The weight is achieved in approximately 2-3 seconds depending on how stable the weight is on the platform. Animals which stand still are weighed slightly faster than animals which move when the scale is weighing. Once the animal is weighed one of three signals is sent to the drafting board i.e. low, medium or high, depending on the weight and the pre-set weight limits. This signal then unlatches one drafting gate via a series of relay switches which turns off the power to the electromagnet releasing the appropriate gate. The animal is then free to push this drafting gate open as it exits. Once the animal is off the platform and the scale returns to zero the other draft gate is also unlatched.

(ii) ***Testing***

In April 1994 we determined that remote drafting was feasible from an animal behaviour aspect. Using an early prototype of the NQ weight-drafter we used an electrical signal to lock and unlock the gates at random as cattle passed through the machine and observed the responses of the cattle.

In mid-May 1994 we determined that Allflex NZ had developed a scale system that made it possible to draft on the basis of weight, although they had only attempted to do this with sheep. Until this time there had been no system appropriate to our needs available. We finally obtained the load beams and prototype switching mechanism, to allow drafting, in August 1994. This system was incorporated in to a two-way drafting system and positioned at the entrance to a water yard for testing in early November 1994.

For the remainder of 1994 testing of the system with a small mob (31) of dry cows was conducted, with video-recordings being made and adjustments made to both hardware and the electronics. The cows were trained to the device with little difficulty; with the drafting gates held open, all moved across it on their first exposure to it. Over a period of a week the gates were gradually closed until the cows were pushing them open to pass through to water. The weighing mode of the system (without the drafting mode) was tested with the cows moving over the scale and exiting straight ahead (both gates unlocked). We then exposed the cows to the situation where one gate was locked (changed randomly from day to day) in order that they learned to use both gates to exit.

The main change made to the weight-drafter was to reverse the logic of the system to ensure that, in the event of a power failure, the gates unlocked so that cattle were not shut out from water.

In the first quarter of 1995 we experienced a number of malfunctions of the Eprom and an updated version was obtained from Allflex New Zealand. When the weight-drafter was returned to the paddock it was placed at the exit from the water enclosure (as the Lapweigh was being tested at the entry).

With continued use of the system and monitoring of behaviour by video we determined that there were two main problems. Firstly, when confronted with two locked gates (the mode to allow weighing and drafting) many animals backed off the scale. However, a few took this to an extreme; they would get on to the scale, discover both gates locked, back-off move away from the device, return to it again some time later, get on to it, find both gates locked, back-off and this process would be repeated many times until, it seemed, that these animals had developed an aversion to the system. The second problem was that we were getting incorrect weights because the cattle were slow to fully stand on the scale. The weigh cycle was initiated before the animals were fully on the scale. The Allflex system allows the setting of a time-delay before starting the weigh cycle. This appeared to be a possible solution to the problem. We examined video-recordings of the cattle entering the weigh-drafter and from these determined how long it took the cattle to stand fully on the platform. We determined that a time delay of 6 seconds would cover 95% of weighings.

In early April 1995 we introduced a time delay of 1 second and over a period of approximately 2 weeks the time delay was gradually increased to 6 seconds. However, it was apparent from the video-recordings taken during this time that the cattle responded to the time delay by becoming increasingly slower to stand on the weighing platform. We, therefore, had to consider an alternative way of initiating the weigh cycle.

In June 1995 we removed the cows from the paddock as it was felt that because of their experiences with the weight-drafter they were no longer appropriate animals for testing the system. Since that time, testing has been conducted with a group of 32 steers. Prior to being moved to the paddock these steers had been using spear gates and walking over a scale platform. For training to the NQ weight-drafter, the gates of the drafter were held wide open for about 2 weeks. Thereafter, on a random basis, one gate was locked for 2 or 3 days whilst the other was held open. For the next 2 months the chain on the open gate was gradually lengthened so that the cattle became used to pushing through the opening, until they were pushing open a closed (but unlocked) gate. During the next 2 months the cattle were then exposed to the noise of the gates locking up with the gate through which the cattle could exit being randomly changed every few days.

During this period an idea was developed for solving the problems of initiating the weigh-cycle and cattle backing-off the scale. In mid December 1995 the machine was modified to incorporate an anti-backing gate which also serves to trigger the weigh cycle (Plate 4).

Since this time we have made some video-recordings when the machine has been in operation and between 23 January and 6 February this year the system was run continuously with the cattle using it at least once each day. During this period, over 1000 weighings and draftings were conducted automatically. There were no problems with breakdowns and as far as we could judge (as we do not have a another scale in the paddock with which to compare weights) we obtained accurate weights and drafting of the cattle.

*Commercialisation*

Demonstration day

A demonstration day for the Lapweigh scale and the NQ weight-drafter was held at Swan's Lagoon on 11 May 1995. The day was attended by representatives from the main scale manufacturers in Australia (Allflex, Ruddweigh and Sunbeam (Tru-test)), as well as MRC representatives. The systems were seen operating and discussions held about their potential uses, accuracy and any problems. It was hoped that this day would encourage one or more of the manufacturers to support the further development and commercialisation of the items. We understand, however, that there was little interest in the system from the manufacturers.

## *(iv) Discussion*

**Cow/calf separator**

We believe that this cow/calf separator is the only one currently available which has been extensively tested in both commercial and experimental situations. In experimental situations with small groups of cows and calves we have regularly achieved 100% drafting accuracy, but we think it unrealistic to expect to achieve this accuracy when drafting large numbers of animals in a commercial situation. However, even with about a 90% accuracy this method is cost effective, as it has been estimated, by Tom Keats and David Hirst, that the labour requirement to trap and draft using the separator is about half that needed with conventional mustering and handling.

There are advantages and disadvantages in placing the separator at either the entrance to or exit from a water yard. At the entrance, strangers may not use the separator and there is the risk that they will perish. The advantage with this set-up is that the breeders can be trapped too (in the water yard) and, if calves are processed on site they can be returned to the water yard and time given to mother-up before the cattle are released to the paddock. With the separator at the exit, it is possible that strangers may enter the yard and be trapped there with access to water. The disadvantage may be a greater risk of mis-mothering if cows can exit to the paddock whilst the calves are trapped in a yard.

Experimental testing has demonstrated that cattle retain a memory for using the separator for at least 12 months. This has the advantage that no retraining is necessary for breeders, but the drawback is that young animals to be retained in the herd for breeding require retraining. However, this is a simple process which can be done in the same way as for the original breeders (by lowering the calf-flap, installing the calf-spear, initially holding open the cow-door and then gradually reducing the gap), preferably in yards when they are weaned.

The system seems to function well with naive, older calves, as demonstrated in our small experimental groups. Even with just a two week period to become accustomed to the system, we achieved 100% drafting accuracy.

For strangers the effectiveness appears influenced by body size; small animals tended to use the calf-side, but large animals may push through the cow-side or not use the separator at all. The latter could be a serious problem if the separator is at the entrance to water (see above).

Our recommendation is for the close monitoring of paddocks for strangers and their removal as soon as possible.

The separator has been officially 'launched' and has been a feature on a television program. PDSs are being established in various regions of Queensland and the current PDS at Gleeson Station will be concluded this year. There has been the additional spin-off from this work of the development of a transportable cattle handling module which enables cattle to be processed at the trapping site. The combined use of the separator and module will thus have the potential to further reduce labour input and costs.

**Lapweigh scale**

As pointed out in the literature review, there have been problems with training animals to use complex systems. Our approach has been to keep the system as simple as possible to maximise the chances that all animals will learn to use it and continue using it (not develop an aversion to it). One significant advantage of the Lapweigh scale is its simplicity as far as animal training is concerned. Although we have seen variability in the way in which cattle cross the platform we have never observed animals baulk and refuse to walk over it. Animals do require some time to get used to the system, as is evidenced by the greater number of errors obtained during the early stages of the Swan's Lagoon steer trial (Table 7). This trend in errors was not seen in the cow data as these animals had been walking across the platform for some time before we started collecting data. The people involved in the testing of the scale at Brian Pastures also reported that it took the cattle a few passes through the race and across the platform to become used to it. It is likely that the presence of the people themselves in that situation may have added to the pressure on the animals, resulting in larger variability in gait and greater errors in the system (although this does not appear to be reflected in the group differences between means of static and Lapweigh weights shown in Table 9).

Testing of the Lapweigh was conducted in two very different situations: (1) in the paddock without the presence of people and where the cattle walked over the scale under their own volition and (2) in a race, where the cattle were blocked to ensure only one animal crossed the platform at any one time. The data from these two situations are not comparable. The paddock trials show that few incorrect weights were obtained (5.6% with cows and 7.2% with steers) although there was considerable variation between and within days. It is difficult to explain the daily variability, although it may be connected with how thirsty the cattle are and, hence, the speed and degree of bunching together when they cross the platform. Individual variability is probably due to differences in gait and speed with which the animals cross the platform, which may, again, be related to thirst as well as the social relationships between the animals. For example, a cow may rush across the platform because she is being followed by a more dominant cow, or a steer may cross the platform very hesitantly because a more dominant animal is standing near the end of the platform. Such situations would be impossible to control and, therefore, this type of variability must be accepted.

Some of the incorrect weights may have resulted from the scale being unable to determine occasions when there was more than one animal on the platform, but the signal profile produced passed the checks. It would be possible to overcome this problem in two ways: (a) to develop and store a weight history for individuals and check weights against that history (as described in the literature review) or (b) to develop a system which automatically separates individuals so that only one animal crosses the platform at any one time. However, it appears from the review of the literature, that developing such a system may not be easy and may be the weak part of the overall system. Even with our limited data set, the results show that on any given day a correct weight was obtained for between 25% and 90% of the group. We appreciate that this is a huge variation, but it falls within the range obtained with dairy cows, whose movements were much more closely controlled (Filby et al., 1979; Ren et al., 1990a; Peiper et al., 1993). It illustrates that the Lapweigh system has the potential to obtain a correct weight for all individuals within a few days. This is further supported by the data in Table 8. Such results must be considered in relation to the time, labour (and hence costs) and stress (on both operators and animals) involved in mustering cattle from large paddocks, walking them to yards for weighing on a conventional scale and then returning them to the paddock.

The review of the literature illustrated that cattle weights can change significantly from day to day and within days. Thus, the accuracy required from a system must also be considered within those constraints. Table 6 showed that to be 95% confident that a weight was within 5% of the animal's 'true' average weight, seven weight records would have to be obtained; i.e. if cattle were coming in to water on a daily basis, a 'true' average weight for each animal would be obtained weekly.

Weighing the cattle in a crush provides more control over the animals and allows a greater in-depth assessment of the capabilities (accuracy and precision) of the system. The data obtained from Rocklea showed that for between 89% and 99% of the weighings the Lapweigh weights were within 5% of the static weight (Table 1 to 3). The data from the testing at Brian Pastures supported these findings, with 85% of the valid weights (those flagged as correct by the data logger) being within 5% of the static weights (Table 10). The testing also demonstrated that the valid weights were, on average, just 0.2 kg (a percentage error of -0.21%) from the static weights (Table 8). Again, these results compared very favourably with results quoted by other groups working on such systems (see literature review).

The Brian Pastures data allowed us to estimate the number of weighings required to achieve a particular precision for both groups of animals and individual animals (Tables 11 and 13). For example, to be 95% confident that the error for a group average will be within 5%, a group of 50 number 4 cattle would have to be weighed once, provided a valid weight was obtained for each animal. In order to achieve the same kind of precision for individuals, a number 4 animal would have to be weighed 20 times.

**NQ weight-drafter**

Although the system has not been fully evaluated, we believe that we have produced a system that achieves accurate weighing, in accordance with the specifications of the commercially available scale, and drafting. We have had the system running continuously for various lengths of time up to a maximum period of 3 weeks, during which time the system weighed and drafted the equivalent of about 1000 animals. During this period there was no indication of failure of any part of the system. Further, the cattle appeared to be using the system with no indication of having developed any aversion to it.

## *(v) Achieving Objectives*

Although it has taken longer than originally thought, we have achieved all of the objectives as given in section (ii) above.

The cow/calf separator has been extensively tested and proved sufficiently robust and accurate to be made available to producers. Promotion of this technology has been and continues to be achieved mainly through PDSs. There appears to be some delay in the marketing of the cow/calf separator package.

The Lapweigh scale has been tested in both controlled, experimental conditions (Rocklea and Brian Pastures) and in the field with no intervention by people (Swan's Lagoon). The data obtained indicate that the system has the potential to achieve accurate weighing of cattle on both a group and individual basis. In the field, the main difficulties have been with the power supplies and integration with EID.

The NQ weight-drafter is operational and appears to work well, but we feel it requires refining and more extensive testing. Due to lack of funds we are in no position to continue with this system unless there is support from a manufacturer.

## *(vi) Intellectual Property*

The cow/calf separator is currently covered by a patent (number 616559), which is held by the State of Queensland (inventors D.J. Hirst and L.T. Wicksteed).

There is currently some dispute regarding the ownership of the intellectual property for the Lapweigh scale. This dispute involves QDPI and the people responsible for the development of the electronics and software program for the system.

The NQ weight-drafter utilises some commercially available components, but the system as a whole is not covered by any patent.

## *(vii) Commercial Exploitation*

The aim of the project was to commercialise three pieces of equipment. This has been achieved with the cow/calf separator, although it is perceived that there will be little monetary return to MRC from this technology. We believe that commercial exploitation is of minor importance compared to the potential benefits to producers adopting this system. The system is much more than just a piece of hardware, which may have some monetary value; it means a change to cattle management which allows producers to be more flexible in their weaning management and improves cattle handling efficiency (see Industry Impact below).

The Lapweigh scale certainly appears to have the potential for commercial exploitation. After the Demonstration Day held at Swan's Lagoon, there was a request for further testing of the system as it was perceived that the data from Rocklea were insufficient. This additional testing has now been completed and the information should be forwarded to interested companies.

Several large pastoral companies have expressed keen interest in the scale, as they perceive a potential to give each company a marketing edge by allowing them to forward plan and predict with accuracy. One company intimated it was seriously considering buying a large number of units for use on its properties. Feedlotters have also shown particular interest in its potential to increase their efficiency.

The NQ weight-drafter also has the potential for commercial exploitation, but there was little interest from manufacturers following the Demonstration Day. We believe that this was because they saw a system with which we were still trouble-shooting. The current prototype may be a more attractive proposition if manufacturers were provided with the details.

## *(viii) Industry Impact*

The systems detailed in this report facilitate remote, unattended drafting of different classes of animals: calves from cows in the case of the separator or predetermined weight classes using the weight based systems. All of these systems were designed to operate with trap mustering systems on extensive properties, but it is evident that they could also be used in other situations.

The systems reduce the necessity for traditional musters, thus reducing labour inputs and costs. Additionally, the stress on both animals and operators will be reduced, resulting in improved efficiency.

**Cow/calf separator**
The separator will make an impact in two major ways:
(a) allow regular and appropriate timing of weaning of calves
(b) improve the efficiency of cattle handling.

*(a) Weaning Management*
Weaning improves body condition of cows, thereby increasing fertility and the probability of dry season survival. Fordyce (1992) reports that good weaning practices at properties south of Townsville have maintained average annual pregnancy rates in the vicinity of 90%, and on a property north of Charters Towers have increased branding/weaning rate to 80%. Weaning calves to 3 months of age in June/ July and again in November produced increases in branding from 47% to 59% on an extensive beef property in Cape York, probably as a result of improved cow body condition (Boorman and Hosegood 1986). Liveweight advantages to cows weaned at the end of the wet season rather than the mid-dry can be 25-40 kg (Holroyd et al. 1988; Fordyce 1992). Non-pregnant cows in backward store condition or better can be triggered to cycle by weaning; work on properties in Northern Queensland has shown that cows which were empty at the first weaning muster have increased their pregnancy rates at the second muster from 20-40% to 70-90% (Fordyce, 1992).

Studies on very early weaning of calves (to 55 kg), whilst not having direct relevance to the separator system, are useful in illustrating trends in what may be expected with more frequent and appropriately timed weanings. For example, Schlink *et al.* (1988) showed that a reduction in lactational anoestrous following early weaning significantly improved cow conception rates. Further studies (Schlink *et al.* 1994 ) showed that early weaning resulted in improved body weights of cows between January and May of each year, and at the end of 3 years these cows were 79 kg heavier than conventionally weaned cows. By the end of the third year conception rates were significantly higher in the early weaned animals (76% vs. 47%).

*(b) Handling Efficiency*
Costs will be reduced as a result of less stockpersons being required for the handling and drafting of different classes of animals. It is envisaged that, for the main muster of the year, animals will still have to be moved to yards for processing. However, the separator will result

in considerable savings in subsequent musters, as animals can be processed at the trap site. Use of the separator system at Gleeson Station in October 1993 resulted in a labour requirement of approximately half that required for a trap muster (using spears). Thus, two separator musters can be carried out for approximately the same cost as one trap muster. This means that additional musters can be carried out throughout the season at little additional cost.

Fordyce (1992) considers it imperative that weaning be carried out at least twice yearly; one muster per year in a continuously-mated herd may result in more cow deaths and no fertility improvements. This is because cows which conceive in response to weaning do not have a calf which is old enough to wean at the same muster the following year. This leads to more cows lactating in the dry season with the consequent increased mortality risk for these animals.

The separator system allows flexibility in weaning and breeder management. Because of the lower labour inputs required it is possible to cater for seasonal variation in rainfall, pasture growth, and cow and calf condition simply by carrying out extra weanings whenever they are needed. This will allow producers to be responsive to prevailing conditions and may be particularly beneficial in drought periods, as weaning and branding can be effected without the imposition of mustering stress on drought-affected stock.

**Weighing and drafting**

The main benefits from the Lapweigh scale and the NQ weight-draft system is in targeting specific markets. Cattle will be described and listed for sale without mustering. Cattle need not be held pending outcome of sales and, once sold, can be drafted in the paddock without the necessity of a muster. The benefits in terms of reducing costs and promoting efficiency have already been discussed.

Liveweight estimates define when management decisions should be made, for example the time to start providing supplementary feed, mate heifers or remove animals for finishing. Failure to carry out these procedures at the appropriate time could result in weight loss or reduced efficiency. With the narrow profit and loss margin frequently encountered by livestock producers, the timing of such decisions is critical, as it would have a significant impact on the relative success of the enterprise.

## *(ix) Funding*

**REPORT of DPI CONTRIBUTION to 31 MAY 1996**
**(STAFFING and $)**

**MILESTONE NO:** 21

**PROJECT NO:** DAQ.074

**RESEARCH ORGANISATION:** Department of Primary Industries, Queensland

**PROJECT TITLE:** Cattle Handling Systems

**PROJECT START:** 1/07/91

**PROJECT FINISH:** 31/05/96

**AUTHORISED REPRESENTATIVE:** J McArthur

**PROJECT SUPERVISOR:** Les Wicksteed

**DPI CONTRIBUTION (STAFF and $)**

| FINANCIAL YEAR | STAFFING (Staff Mths) | | DPI CONTRIBUTION ($) | CORPORATION FUNDS ($) | |
|---|---|---|---|---|---|
| | Contracted | Actual | Actual | Contracted | Actual |
| 1991/92 | 12.0 | 12.0 | 103,582 | 40,000 | 40,000 |
| 1992/93 | 12.0 | 19.2 | 151,550 | 30,000 | 30,000 |
| 1993/94 | 12.0 | 26.4 | 212,660 | 20,930 | 20,930 |
| 1994/95 | 12.0 | 19.8 | 170,985 | 23,115 | 23,115 |
| 1995/96 | 0.0 | 18.0 | 155,375 | *4,625* | |
| TOTAL | 48.0 | 95.4 | 794,152 | 118,670 | 114,045 |

**Note: in 1995/96:**
*$4,625* *Final Payment yet to be received from Corpoation*

## FINANCIAL REPORT TO 31 MAY 1996

**MILESTONE NO:** 21

**PROJECT NO:** DAQ.074

**RESEARCH ORGANISATION:** Department of Primary Industries, Queensland

**PROJECT TITLE:** Cattle Handling Systems

**PROJECT START:** 1/07/91

**PROJECT FINISH:** 31/05/96

**AUTHORISED REPRESENTATIVE:** J McArthur

**PROJECT SUPERVISOR:** Les Wicksteed

### CORPORATION FUNDS

| FINANCIAL YEAR | CORPORATION FUNDS | | | | | | YEARLY |
|---|---|---|---|---|---|---|---|
| | OPERATING | | CAPITAL | | TOTAL CASH FLOW | | |
| | Corp Funds received | Expenditure | Corp Funds received | Expenditure | Corp Funds received | Expenditure | CARRYOVER |
| 1991/92 | 40,000.00 | 2,936.31 | 0.00 | 0.00 | 40,000.00 | 2,936.31 | 37,063.69 |
| 1992/93 | 30,000.00 | 19,852.67 | 0.00 | 0.00 | 30,000.00 | 19,852.67 | 47,211.02 |
| 1993/94 | 20,930.00 | 62,799.38 | 0.00 | 0.00 | 20,930.00 | 62,799.38 | 5,341.64 |
| 1994/95 | 13,875.00 | 22,902.80 | 9,240.00 | 9,240.00 | 23,115.00 | 32,142.80 | -3,686.16 |
| 1995/96 | 4,625.00 | 6,177.27 | 0.00 | 0.00 | 4,625.00 | 6,177.27 | -5,238.43 |
| TOTAL | 109,430.00 | 114,668.43 | 9,240.00 | 9,240.00 | 118,670.00 | 123,908.43 | |
| | | | BALANCE | (Corp Funds - Expenditure) | | *-5,238.43* | |

**Note: in 1995/96:**

| | |
|---|---|
| *$4,625* | *Final Payment yet to be received from Corpoation* |
| *($5,238.43)* | *This balance will be met by Departmental funds* |

Certified by........................................................ on behalf of L Wicksteed

## *(x) Conclusions and Recommendations*

**Cow/calf separator**

Testing of the cow/calf separator has been conducted in both commercial and experimental conditions and results have been sufficiently satisfactory to promote the system. A package on the operation of the system has been developed, although we feel that the video in the package is rather light-weight and more of a promotional video than one which instructs on use. It should be made clear in the package that producers need to read the "Guidelines for Use" to fully appreciate the working of, and problems with, the system.

We believe that the issues of marketing the separator package (advertising, where it can be obtained, support staff to clarify queries) should be urgently addressed, with the package made available as soon as possible.

We believe that the best method of promoting the separator system is through PDSs and the establishment and operation of the PDSs should receive continuing support from DPI and MRC.

**Lapweigh scale**

The scale has received testing in both field and experimental situations. The main difference between these situations was that in the field there was no intervention by people; the cattle moved across the scale under their own volition. Thus, there were problems with more than one animal being on the scale at any one time and weights being missed. In the experimental situation, the cattle were physically separated by people operating gates, to ensure that animals crossed the scale singly.

Under both situations the weights obtained by the Lapweigh scale appeared accurate and compared favourably with other systems that have been developed. In the field testing the major problem appeared to be in the power supply to the system and the reliable operation/integration of EID reader and scale.

Missed weights in the field is a constraint of the way that the system operates, but our results suggest that a weight should be obtained on all of the group (about 30 animals) in about a week. The system now needs to be tried with large groups of cattle (200 - 300) in order to assess the potential for capturing data in a commercial situation. We believe that this should be done through the establishment of PDSs; there appears to be the interest amongst producers to do this. It should also be possible to put the system through further testing at research establishments as part of other experimental work. Again there appears to be the interest from researchers to do this. The system should be set-up in a range of situations: extensive grazing with large and small groups of cattle of varying weight ranges, feedlots and dairies. We believe that the system has the potential to operate well in all these situations.

Review of the literature on other systems indicates that there is a method to further reduce the probability of weighing errors; this is achieved by developing and retaining a weight history of individuals with which a current weight can be compared. Evidently this would only be of use if all animals were fitted with EID. The current system appears to be sufficiently accurate and precise if the requirement is for mean weights of groups of cattle. The developers of the system need to be approached to establish the difficulty of incorporating a weight history in to the system.

There is also the possibility to remove some of the high frequency component of the scale signal by the use of new, delta-sigma integrated circuits. This change should reduce some of the variance in weights (when obvious out-liers are ignored).

In its current form the data output of the scale is not easy to read and interpret. There needs to be work carried out on making the system more user-friendly, particularly in terms of data summaries.

To date the potential to draft animals on weights obtained from the Lapweigh scale has not been assessed. Some gates have been developed, but have not been tested due to lack of time and funds.

We believe that there are still some problems with establishing ownership of the intellectual property of this system. This matter needs to be resolved urgently if commercialisation of the product is to be pursued.

The next step in achieving adoption of the system is to, again, approach potential manufacturers with the results from the testing at Brian Pastures and Swan's Lagoon so that they can make their own assessment on the potential. We believe that further testing of the system (through PDSs and research) would be enhanced with the support of a commercial company.

We estimate the cost of a Lapweigh unit to be approximately $4,500 (EID costs are additional to this).

**NQ weight-drafter**

We have achieved drafting of cattle on the basis of liveweight, but the system requires further testing. Again the best option for achieving this would be to incorporate the system in to other experimental work at research establishments. We believe that it may be premature, until this is done, to establish PDSs although there may be the option to incorporate this system with the Lapweigh scale on PDSs.

Support from a potential manufacturer would be highly desirable in order to take the weight-drafter further as it requires refinement. We suggest that potential manufacturers are approached again to determine the level of interest now that we have achieved drafting by weight.

We estimate the market price of a NQ weight-drafter to be in the vicinity of $12,000 to $15,000.

**Electronic individual identification**
The key to automated data acquisition and equipment control such as for weighing and drafting is EID. The concept was demonstrated as early as 1970 with individual feeding for group housed cattle (Broadbent et al. 1970). A brief history of the subsequent development of EID, particularly in the USA, is given by Spahr (1989).

The evidence is that both boluses and eartags are reliable, few problems have been found with damage, retention and recovery of tags and pellets at slaughter. The major limit to the widespread adoption of the technology is cost.

Future research with EID should now be directed to finding uses for it, other than the data collection, recording and establishment of linkages/communication channels, as has been the main emphasis to date.

There is an important role for EID in the feedlot industry and for carcase feedback. Used in conjunction with the Lapweigh scale it could be a useful tool for obtaining regular updates of weight changes of feedlot cattle with minimal disturbance to the animals. We also see a great potential for EID in self/automated-drafting, and this facility would have an impact across all the livestock industries.

In the more intensive industries the weight of animals is often the important criterion for drafting particular individuals. Although EID could be used for this task, with current costs a more cost effective method is likely to be a weight-draft device such as is being developed within DAQ.074. However, if there is a move to the use of EID in industries where it may be important to know the identity of an animal (for carcase feedback) as well as its weight, then drafting by EID would be an additional option. There are commercial scale systems currently available which integrate with EID readers and apparently link weights to EIDs. However, the literature accompanying these scale systems do not make it clear whether or not it is currently possible to draft by EID, or whether the potential is there. This needs to be explored with the manufacturers

To consider a few examples, just in the cattle industries (beef and dairy), where drafting by EID would improve efficiency, EID could be used in separating bulls from cows, supplement feeding selected animals within a mob and drafting out strangers or individuals which require special attention (e.g. veterinary).

In the more extensive industries animal ownership is perceived to be of importance and EID could certainly have a role to play in this; brands can be changed, eartags can be easily removed, but it is impossible to tell from looking at an animal whether or not it has a rumen EID pellet. It would not be essential to put pellets in all animals, but to do so on a random basis should prove a sufficient deterrent (apparently there is a way to inactivate a pellet, but to do so would indicate that the pellet may have been tampered with!). Thus, EID would provide proof of ownership and could, therefore, also be used for carcase feedback.

We see that there is also a considerable potential market for drafting by EID in the area of research, particularly rangeland research. One of the difficulties that is repeatedly encountered is how to apply different treatments to individuals within a group. Drafting by EID would very easily overcome this problem. For example, if different nutritional treatments are to be given to animals within the same paddock they could be drafted into yards containing the different feeds and then, when they moved out of these yards, would form a single group again. The application would not be restricted to nutritional treatments; the possibilities are limited only by the imagination.

Although it may not be strictly necessary to combine the two drafting criteria (weight and EID) in to a single device, a more flexible system would be created by doing so. We have attempted to match EIDs with weight and draft records using the NQ weight-drafter, but have encountered difficulties with the aerial reading the transponders in the presence of considerable amounts of metal. However, we have had discussions with people with expertise in this field and are confident that this problem could be overcome.

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# APPENDICES

## APPENDIX I. Cow/calf separator - Guidelines for use

Queensland Department of
Primary Industries

# COW/CALF SEPARATOR

## Guidelines For Use

(DRAFT COPY ONLY)

Swan's Lagoon
Beef Cattle Research Station
Millaroo, via Ayr
Queensland 4807

# *COW/CALF SEPARATOR*

## Application

This system is designed to operate in conjunction with spear gates on holding enclosures around watering points. It self-drafts calves and weaners from cows in to a holding yard for branding and weaning.

## Advantages

This system reduces the need to perform traditional musters, thus making management more efficient and cost effective. Handling time and costs as well as stress on both operators and animals are all reduced. This means that a number of weanings can be carried out during the dry season depending on seasonal conditions and herd health. Thus, weaners can be removed at the optimal time, reducing lactational stress on breeders and the management problems and supplement costs associated with early weaners.

***The funding for this work was provided by the Meat Research Corporation***

# Installation

**All waters in a paddock must be fenced and separators and spear gates of the same type installed at each location. This ensures that all cattle become familiar with separator and spear use, and they are able to access water at every point in the paddock.**

## *Watering Enclosures*

The size and design of watering enclosures has considerable effects on the behaviour of cattle which can affect the efficiency of the cow/calf separator.

(a) Size

**Enclosures should be sufficiently large to allow most, if not all, of the cattle to "camp" (rest) within the enclosure during the day.** If it is too small cows will leave their calves and enter the enclosure long enough only to drink, returning to their calves outside the enclosure to rest. In these circumstances some calves may not learn to use the separator, and will, therefore, not be caught at the time of trap-mustering. If too small, bulls may be forced in to close proximity resulting in fighting and fence damage. When the separator is set up on the entry to water, an appropriate sized enclosure will also allow all the cattle to camp when the out-spears are closed for trap-mustering, thus reducing stress on the animals and preventing undue pressure on fences.

There are no set rules on the size of yard for a given size mob of cattle, as the area around water used by cattle will vary according to such factors as cattle breed, amount of shade, air temperature and type of terrain. The best way to determine the size of the enclosure is to consider the area that the cattle normally cover when camping and attempt to include this in the enclosure. Sizing enclosures in this way means that they need not be as strongly built as smaller enclosures, and may, therefore, be relatively cheaper to construct. The minimum fence normally required for trap-mustering is a well-maintained 4 barb fence, with post spacing no greater than 5 metres apart. Additional barb-wire may be put in to deter calves from pushing through, but, ideally, a calf-proof enclosure should be constructed from hinge-joint or K-wire.

**(b) Siting of Separator and Spear Gate**

**The separator should be placed on a well-used pad either in to or out from water, with spear gates on pads out from or in to the water.** These two arrangements both have advantages and disadvantages:

*Separator In, Spear Out*

With this configuration, at the time of trapping, animals will be held in the water enclosure itself and it is, therefore, possible to determine whether or not the whole mob has come through and have been caught. It may also be an advantage for calves, after processing, to be released to their mothers in the water enclosure; it may be easier for them to find their mothers. The main disadvantage is that "stranger" animals (those that have entered the paddock from elsewhere and are unfamiliar with separators and spears) may refuse to pass through the separator to water (because of the noise of the cow-door as it shuts etc.) and so, there is the risk that they may perish (see section on Stranger Animals below).

*Separator Out, Spear In*

With this set-up there is less risk to strangers, as they are more likely to pass through a spear than the separator, to water. Another advantage is that these strangers, and any other animal that will not use the separator, will be held in the water enclosure, and can easily be identified. Also, at the time of trap-mustering, they will be more easily caught for processing. With this configuration it is more difficult to assess whether or not the whole mob have been through the separator. Another drawback with this arrangement is the possibility of mis-mothering; after processing, if calves are released out to the paddock, rather than the water enclosure, they may be less likely to find their mothers.

When going to and from water, young calves are sometimes unable to locate the separator and spear gates and will push through the enclosure fence. This problem can be minimised with well-designed and maintained enclosures. If the separator is placed going in to water the use of a lead-up 'V' to the separator will help calves to find it, and having one or more spear gates in the enclosure corners, from which the cattle normally graze away, will assist them with finding a way out of the enclosure. The same principles should be applied if the separator is positioned going out from water. There is seldom any problems with older cattle locating entrances and exits, as they will be experienced with the use of spears and following pads to and from water.

# Operation

## *Animal Training*

The separator system relies on the animals drafting themselves, but this a response which the animals must be trained to perform. **Breeder animals (heifers/cows and bulls) must be trained to push open the cow-door to gain access to, or leave water, whereas use of the calf-side, at least to start with, relies on calves simply choosing a clear visual route.** With repeated use of the separator calves will actually learn to use the calf-side.

### (a) Breeders

**Training of breeders should be done before calves are born, and with bulls and heifers this can be done in cattle yards when they are weaners, or in the paddock.** Yard training can be achieved by placing a separator at some point where the cattle have to pass on a regular basis e.g. between two areas, one containing food and the other water. With paddock training all cattle must be using fenced waters with the separator at the entrance to waters and spear gates at the exits, or *vice versa*. Therefore, training is best carried out during the dry season when the cattle are watering regularly, and prior to first calving.

Separators are installed initially with the spear arms removed from the calf-side (see diagram), the rubber flap on the calf-side lowered and the spear below this flap in place. The door on the cow-side is held fully open by the adjusting chain at the bottom of the door. This arrangement provides a block to the animals on the calf-side and an easy passage through the separator on the cow-side. Over a number of weeks the chain is gradually let out, thus reducing the size of the opening, until the door closes fully against the upright post and the animals have learned to push against the door to open it. At this stage the chain can be completely removed, the rubber flap raised fully (by hooking it in place, with the adjusting chains as short as possible) and the spear removed. The separator is now in its normal operating mode; **the cow-door should always be fully closed after the initial training period** (the only exception being with stranger cattle - see below).

Once trained, **an animal will remember how to operate the door at least 12 months after it has last used it, so there should be no necessity to retrain breeder animals.**

**(b) Calves**

Calves born in the dry season will begin to follow their mothers to and from water through the separator; **the door on the cow-side closes behind the cow forming a barrier to the calf, but the open calf-side provides an easy passage for it**. Repeated use ensures the calf becomes accustomed to taking this route. Calves born during the wet season may be several months old before first encountering the separator, but they will also choose to go through the calf-side, as it provides a clear passage.

**(c) New Breeders**

**Young animals that will be retained in the herd for breeding will require some re-training**; as calves and weaners they will have learned to pass through the calf-side of the separator, but as adults will need to go through the cow-side. This re-training is carried out exactly as for the initial training of breeding stock. Adult breeding animals brought on to the property from elsewhere will probably be unfamiliar with spears and separators and will, therefore, require training, as described above.

## *Trapping*

**The spears should be put in place on the calf-side 2 to 3 weeks prior to trapping, so that the animals get accustomed to pushing through them**. Initially the spears should be put in place at their wide, training setting and then, a week or so later, changed to the narrow, trapping setting. This is achieved by simply changing the spears from one side of the frame to the other, which alters the gap between the spear tips.

**Trapping simply involves setting up a calf yard, using portable panels, around the calf-side**. If the separator is placed at the entrance to water then the main mob can also be trapped by closing the out-spear. The setting of the trap is done in the late afternoon, after the cattle have moved out of the water enclosure, and is left for approximately 36 hours to catch maximum numbers of animals. Portable equipment can then be used to brand calves and load weaners on to trucks for transport to the cattle yards.

Alternatively, calves, weaners and strangers can be trapped straight in to a permanent yard complex, if this is available, where they can be processed in the usual way.

## *Stranger Animals*

**When using separators all reasonable measures should be taken to prevent cattle unfamiliar with the separator system from entering the paddock** (e.g. from neighbouring properties or paddocks with unfenced water). These "strangers" create problems as, being unfamiliar with spear gates and the separator, they may refuse to enter the water enclosure and, if not found in time, will perish. There is evidence that strangers will pass through a spear gate more readily then through a separator, although some will, with time, pass through separators. These animals are, in general, the younger, smaller animals and, because they have had no experience of operating the cow-door, will go through the calf-side. Thus, at the time of trap-mustering, these strangers will be caught in the calf yard, can then be separated out and returned to their own paddock. Larger strangers may not pass through the separator due to the physical difficulty they experience attempting to go through the calf-side, and because they have not learned to push open the cow-door.

**If strangers are found outside water enclosures the best option is to remove them**. If this is impossible and the separator is on the entrance to water, then it may be possible to encourage them to enter by fully opening the cow-door, leaving it in this position for a week or so, before fully closing it. However, it must be pointed out that it is possible that drafting efficiency will be reduced at the time of trapping, as calves and weaners may have learned that there is an alternative way through the separator, and may challenge the closed cow-door.

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## APPENDIX II. Operation of the Lapweigh Scale

Installation

The cable connection between the weigh platform and the display unit should be installed so as not to be susceptible to damage from moisture or cable severance.

The dynamic cattle weigher display unit should preferably be mounted under cover to give the unit some form of protection from weather extremes and interference from animals even through the unit is housed in an extremely robust case (ASA specification IP65) and generally can tolerate most conditions except immersion in fluids.

The dynamic cattle weigher requires only 12 V DC with 70 mA current which can be provided by a 12 V car or tractor battery. This ideally should be used in conjunction with a solar panel battery charger.

If it is intended to use an EID scanner in conjunction with the scales, the scanner should be placed immediately prior to the scales. The scanner requires an additional pwer source independent from the scale.

When the display unit is in position and the weigh platform on a firm foundation, ensure that there is no weight on the platform and then connect the electronic interface between the weight platform and the display unit before connecting the battery. It is very important to ensure that correct polarity is used when connecting the battery to the display unit, although a safeguard against error has been installed.

Display screen

When switched on the four lines of the display screen should illuminate. The second line will show the date the software was produced (day/month/year and day number) and then the unit will start its initialisation process which should take about 25 seconds. This display should then show the correct time, date (day/month/year), day number and 0KG on the right hand side of the top line. This real time clock is updated every two seconds. At this point, the second line which is reserved for weights and error codes should show 0KG. The third line which is reserved for EID should read IDENTIFICATION CODE - IDENTIFICATION CODE. The fourth line displays the weight range limits.

Checking the calibration of the unit

The calibration may now be checked by stepping on and off the weigh platform. The weight just recorded, a quality code, and the time of weighing will be displayed on the right hand side of the second line. If the weight is on the platform for less than 0.5 seconds, this weight will not be displayed or stored in memory as it is assumed to be invalid. The quality codes (rating) which are displayed and retained with the weights in memory are as follows:

Code 0. The weights has passed all internal checks. The 0 code is displayed on the screen but not stored so that a valid weight has no flag in the printout.

Code 1. Weighing was asymmetric i.e., the weight taken for the first and second halves of the weighing period are compared and if the disparity is greater than 20% this error flag is set and the mean of the two halves is displayed.

Code 2. The weight fluctuation over the weighing period was above 50% of the net weight indicating the animal was moving very quickly.

Code 3. See below.

Code 4. The weight was steady for at least 0.25 second.

Codes 3,5-7 Combinations of the error codes 1, 2, 4 will give 3, 5, 6, 7 showing that the weighing has failed more than one test. Weights with an error code of 3 to 7 should be discarded (not used) as the weight displayed is unreliable.

When a second weighing has occurred, the previous weight is shifted to the left hand side of the second line and the new weight is displayed in its place.

Connection with an EID system

If an EID system is used in conjunction with the scales, the EID scanner should be initialised prior to connection with the display unit.

When the display unit has been calibrated and the EID scanner has been initialised (tuned), then and only then, should this unit be connected to the RS232 socket on the display unit. The ID scanner in front of the scales then records the ID on the third line below the weight immediately after the animal has been recorded.

Retrieving data and communicating with a PC or laptop computer

Whenever an animal is weighed the contents of the second and third line are stored in memory. To retrieve the data from memory, you may connect a PC or laptop computer which has installed a communication program such as TELIX or PROCOM. The communication parameters should be set as 1200 baud, 8 data bits, 1 stop bit, no parity. Connect the supplied computer cable to the computer and the RS 232 socket of the display and then initialise your communication program.

Press (CR) to clear buffer, then using uppercase characters only, type ? T (CR) and the display unit will respond with current time + (CR). When shown, this means press return or enter key only and date.

To retrieve data, open a file or set capture on your communication program, then type ?D(CR) and the display unit will respond by dumping all available data which will be displayed concurrently on the PC screen and the display unit. The file is terminated by using a CTRL/Z, exit capture mode or close file, whatever is required by your communications program. The file just dumped is in the form of an ASCII file and may be readily printed.

When the data has been successfully transmitted, data should be cleared from the display unit memory. To do this while still connected, type RESET (CR). With this command all data will be cleared and memory buffer pointers will be returned zero.

Adjustment of machine and troubleshooting

1. To correct time using the communications program, type in, for example, T14:30:00 (CR) which should reset the time to 2.30 pm..
2. To correct date, type in, for example, D23/10/94 which would reset the date to 23 October 1994.
3. If the recorded test weights appear doubtful, a recalibration is required.
4. ZERO.

Clear the platform of all debris to re-establish zero. This is done by typing in ZERO (CR) while communicating with the computer. Then, place on the platform a known weight which should be at least 50% - 60% of the expected maximum weight.

If this calibration weight is, for example, 400 kg, type in CAL 400 (CR). The display should now show 400 kg in the top right hand display of the screen. When the weights are removed from the weight platform the display should reset this weight to zero. It is advisable to reset the memory buffer after a calibration. This is done by typing RESET (CR). The dynamic cattle weigher should once again be ready for use.

Algorithms used for the scale

Sample weights are read from the platform 32 times per second. Each sample is a 31 millisecond average weight and these samples are stored in a 256 record circular buffer, giving a maximum weighing period of 256/32 = 8 seconds.

The tare (or zero) is set dynamically when the system is first switched on and compensates for any slow zero drifts which occur subsequently. This allows a threshold to be set (nominally 20 kg) which can be used to define a weighing cycle. When the time for which the incoming samples are greater than the set threshold (exceeds 8 seconds), the scales enter 'static weight' mode and weights are calculated by averaging over the 8 second period. Only the first weight in a sequence of static weights is stored to minimise memory usage.

A 'dynamic weight' cycle begins when an incoming sample first exceeds the preset threshold. The cycle is complete when an incoming sample falls below the preset threshold. On completion of a cycle, incoming samples are ignored until the dynamic weight has been calculated and stored. A time buffer of at least 0.25 seconds is required to discriminate between consecutive valid weights.

The pattern of a valid dynamic weight cycle consists of a flat topped mound with a front and back 'porch' of about half the height of the flat top as shown below. The front and back porches are due to samples taken with the animal having only two legs on the platform. The flat top occurs for the time the animal has four legs on the platform. In practice, the lengths of the flat portions of the curve vary enormously with animal behaviour, and the flat portions deviate from true flatness due to kinetic effects of animal movement (see Figures I and II).

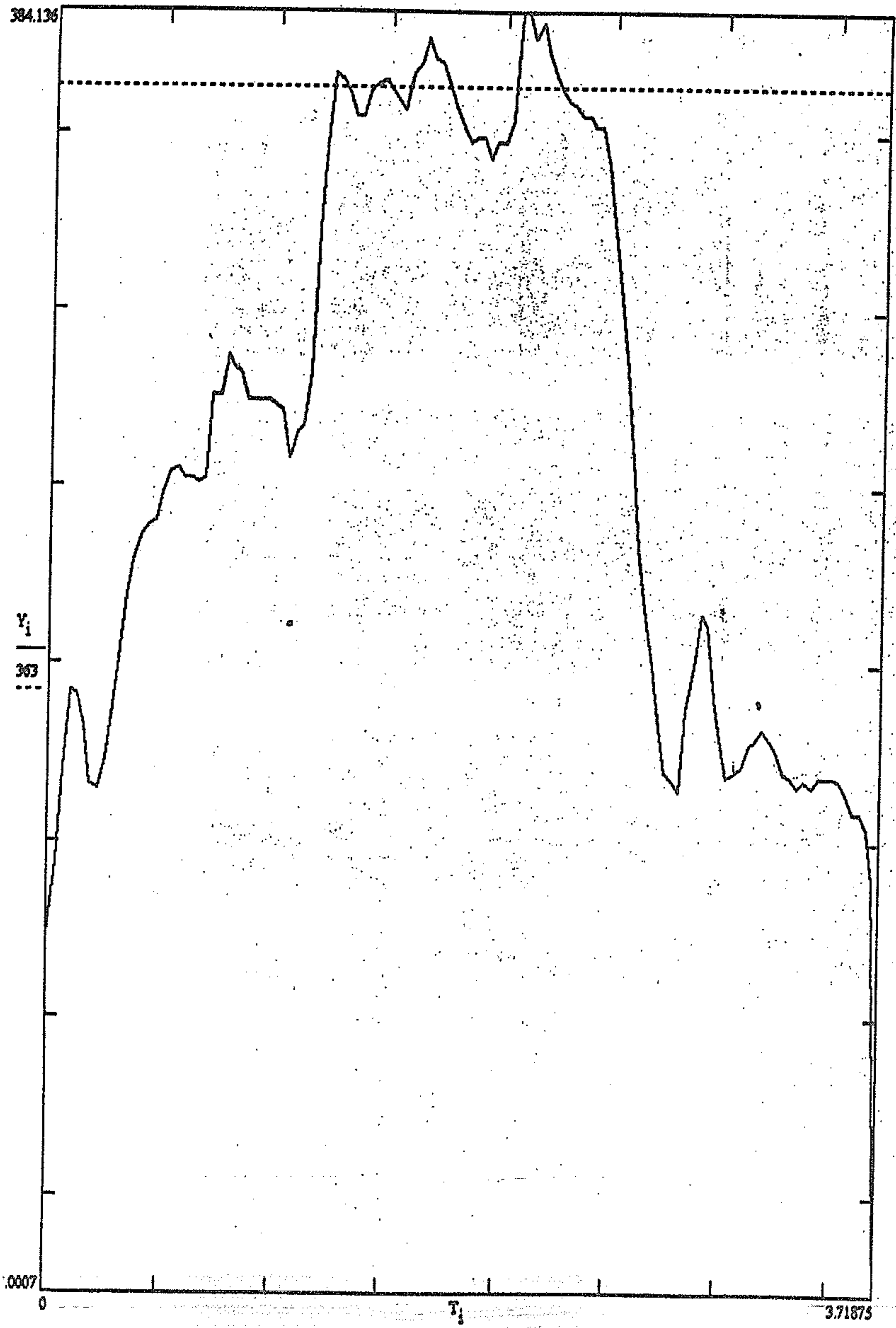
High frequency components of noise (around 13 Hz) occur due to impact of hooves on the platform and can be damped partially by using rubber mats on the platform surface (Figure III). Electronically, averaging of samples is used to minimise errors from this source. By making the readings a true average of the samples and by making the samples a true average of the sample time window, harmonics of the high frequency noise contribute negligable errors.

$x := \mathrm{READPRN}(b984)$ $\quad N := \mathrm{length}(x)$ $\quad i := 0 .. N - 1$

$Y_i := (x_i \cdot 256 - 6635) \cdot \left(\frac{460}{10040.8}\right) + 60$ $\quad T_i := \frac{i}{32}$

FIGURE I

Scale output demonstrating a 'good plateau' resulting in an accurate weight




KILOGRAMS vs TIME IN SECONDS

$x := \mathrm{READPRN}(bph\_4)$ $\quad N := \mathrm{length}(x)$ $\quad i := 0..N-1$

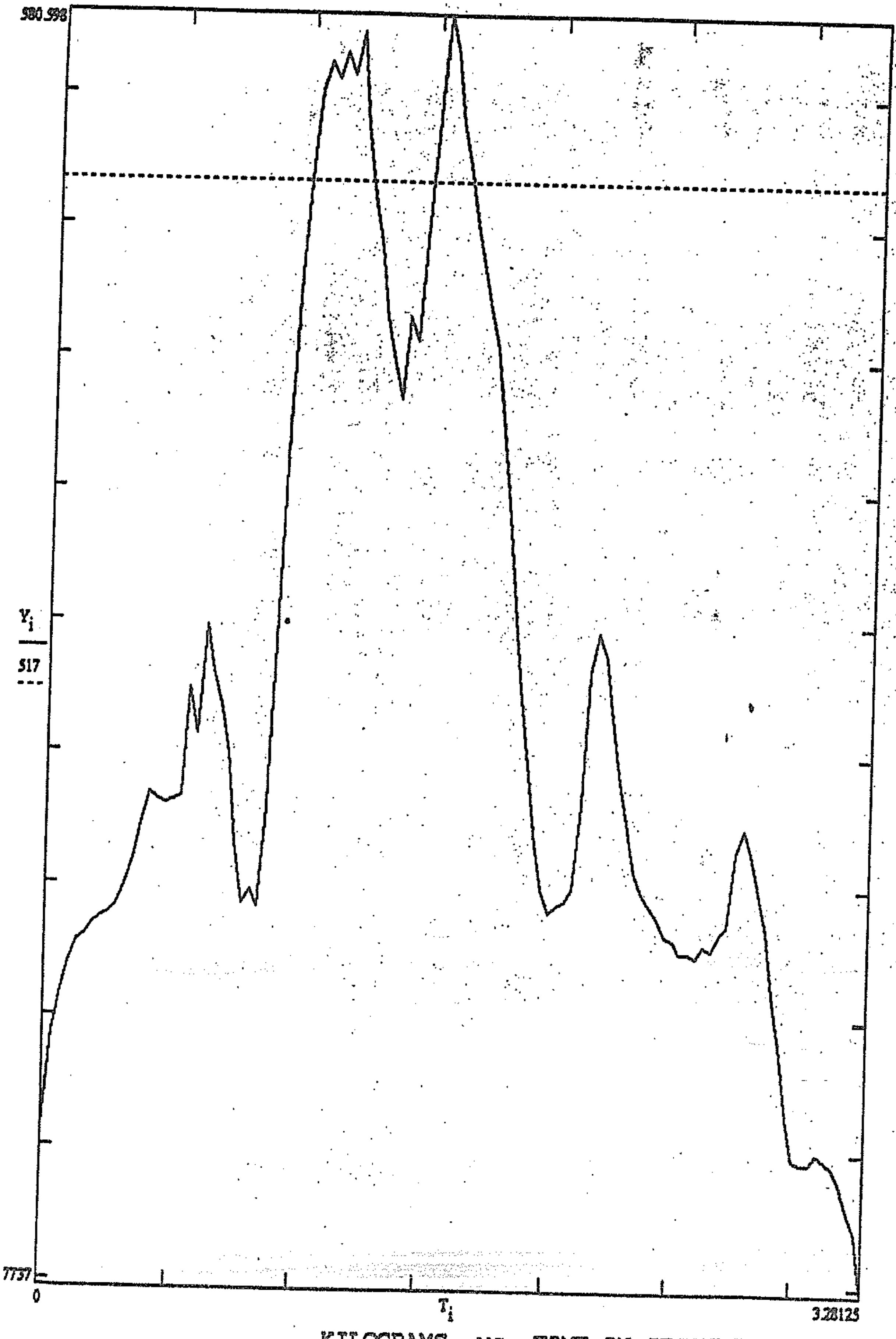
$Y_i := (x_i \cdot 256 - 6635)\cdot\left(\frac{460}{10040.8}\right) + 60$ $\quad T_i := \frac{i}{32}$

[redacted]

UNBALANCED

FIGURE II

Scale output demonstrating a 'poor plateau' resulting in an inaccurate weight




KILOGRAMS vs TIME IN SECONDS

A low frequency resonance gives a slower oscillation in the flat portions of the standard curve, and this is due to the basic "spring/mass/damping" system of the animal/platform combination. This resonant frequency and damping will vary with the animal weight and is most troublesome with heavier animals (lowest frequency, least damping). The amplitude of this error will be dependent on the walking style of the animal, as will the phase. The effect will cancel when the measurement period is chosen to be an integer number of cycles of the oscillation, but this is not always possible. When cancellation of this oscillation is not possible, the weight is flagged as suspect.

In instances where the animal travels too quickly across the platform, an accurate weight estimate is not possible (Figure IV). When the total time that the samples are above the threshold is less than 0.5 seconds, the weight is discarded as invalid. When the flat portion of the curve is less than 0.25 seconds, the weight is flagged as suspect.

The algorithm used to calculate the animal weight depends on extracting the appropriate data from the upper flat portion of the curve. As a first approximation a centred window of half the total time is used to calculate a mean weight. The highest individual sample in this window is saved for later error testing. The window width is then progressively reduced until the mean value ceases to increase. This is then the final value of the animal weight.

The final window is then halved and the weights calculated from both halves are compared. Differences greater than 10% cause the stored weight to be flagged as suspect because of poor cancellation of low frequency oscillation. A maximum sample value more than double the animal weight suggests a high kinetic energy input from the animal, and the weight is again flagged as suspect. A final window width less than 0.25 seconds also causes the animal weight to be flagged as suspect.

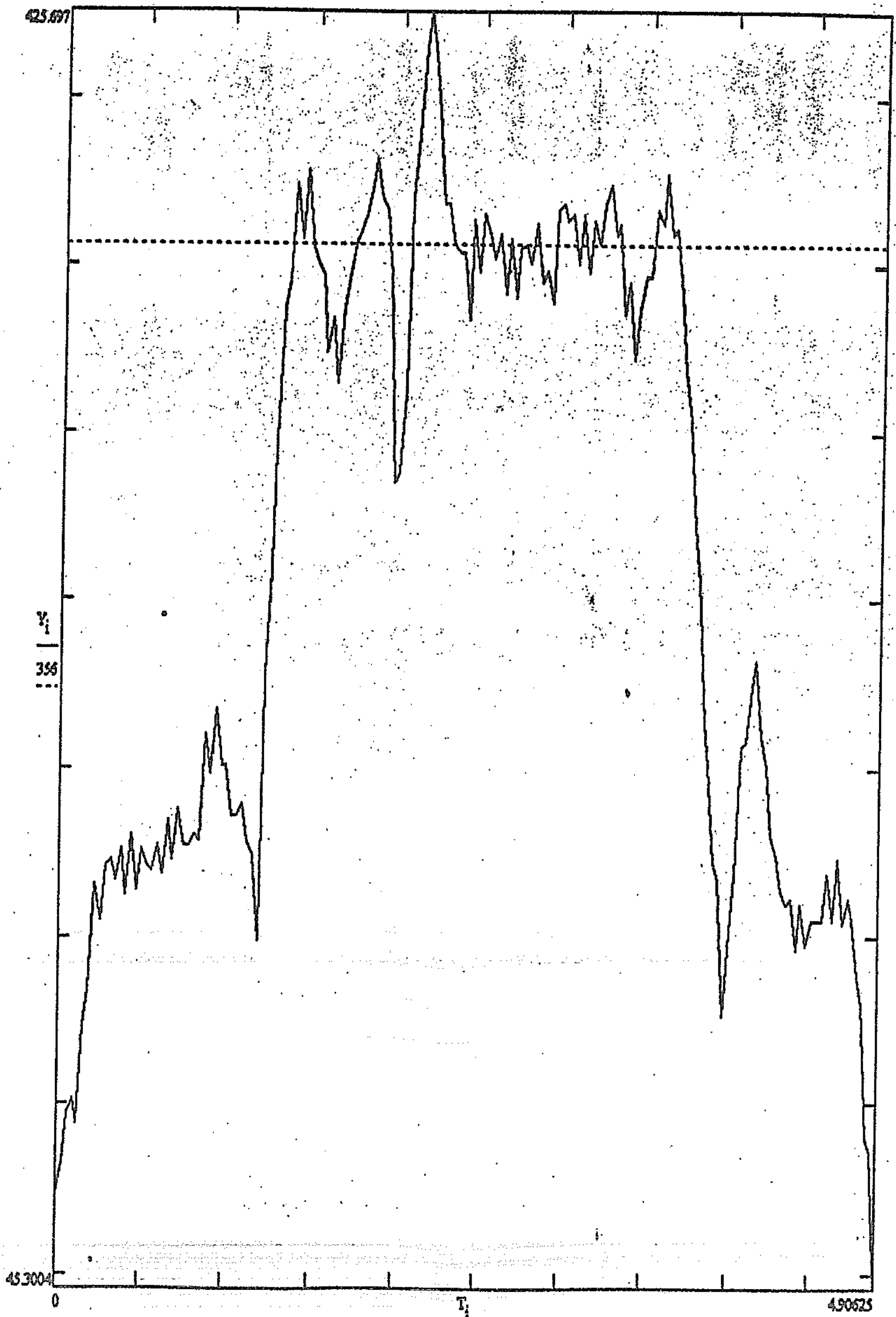
All animal weights are stored with a date and time annotation to allow correlation with animal identification codes. The animal identification codes are also stored with data and time annotation, and are sequentially interleaved with the animal weight records.

$x := READPRN(A984\_3) \qquad N := length(x) \qquad i := 0..N-1$

$$Y_i := (x_i \cdot 256 - 12901) \cdot \frac{460}{9945 \cdot 8} \qquad T_i := \frac{i}{32}$$

FIGURE III

Scale output showing resonance and the need to dampen the signal




KILOGRAMS vs TIME IN SECONDS

FAST

[redacted]

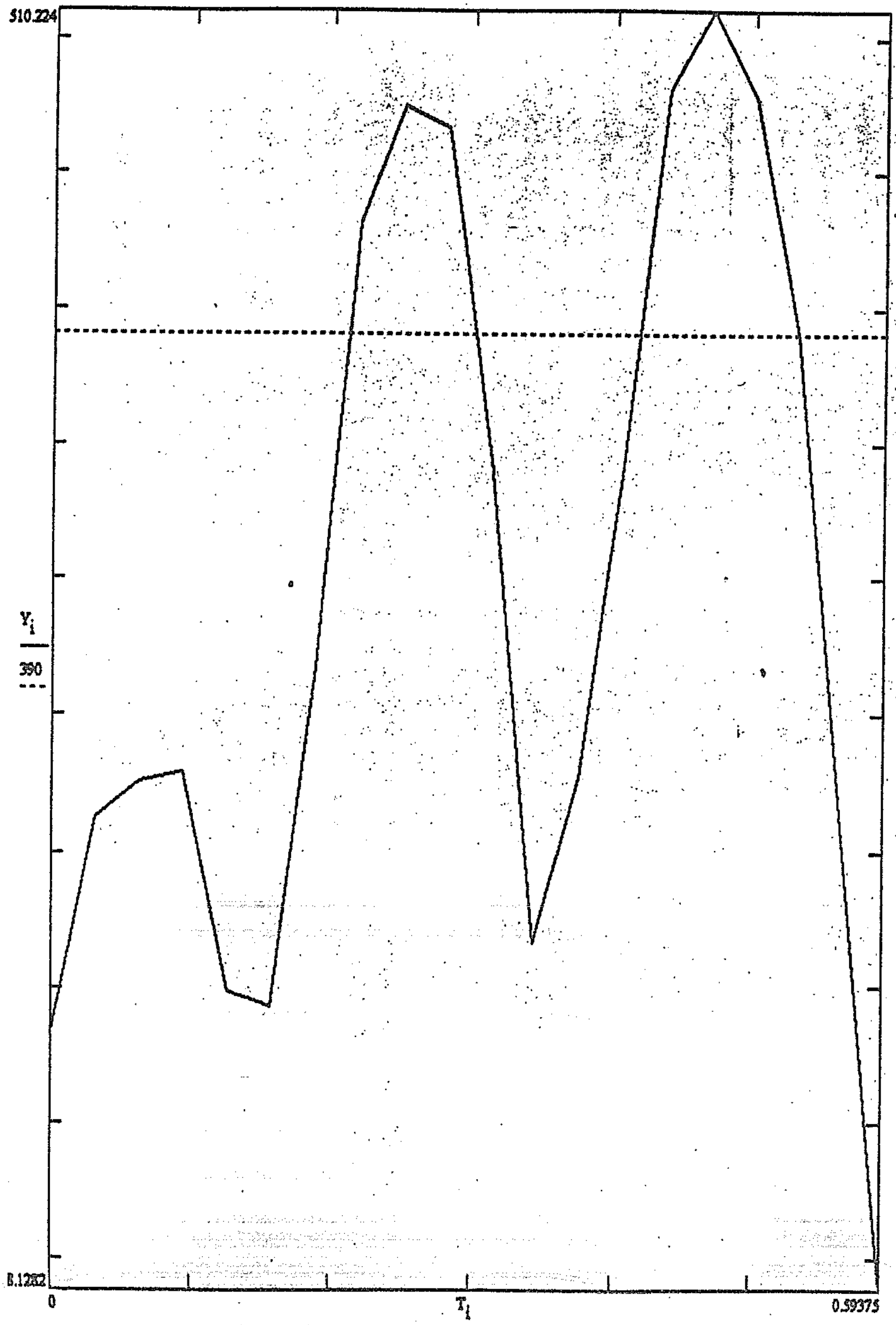
HIGH PEAK

$x := \mathrm{READPRN}(b776) \qquad N := \mathrm{length}(x) \qquad i := 0..N-1$

$$Y_i := (x_i \cdot 256 - 6635) \cdot \left(\frac{460}{10040.8}\right) + 60 \qquad T_i := \frac{i}{32}$$

FIGURE IV

Scale output showing the result of an animal moving over the platform too fast



## APPENDIX III. Raw data collected during testing of Lapweigh scale at Swan's Lagoon

MARCH

Day Number (with letters in parentheses denoting multiple recordings within a day)

| EID | 1 (a) | 1 (b) | 2 | 3 (a) | 3 (b) | 3 (c) | 4 (a) | 4 (b) | 5 (a) | 5 (b) | 5 (c) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | | | | 454 | | | 457 | | | | |
| 11 | | | | 458 | 455 | | 454 | | 423 | | |
| 40 | 438 | | 444 | 439 | | | 443 | | | | 468 |
| 53 | | | | 444 | 459 | | 456 | 465 | 452 | 463 | |
| 55 | 432 | | 478 | 475 | 475 | | 478 | | | 438 | |
| 66 | 485 | | | 483 | | | 501 | | 502 | 469 | |
| 67 | 462 | 482 | 481 | 473 | 483 | | 479 | | | 385 | |
| 73 | 405 | | | 407 | | | 413 | | 411 | 420 | |
| 75 | 413 | | | 422 | | | 420 | | | | |
| 76 | 460 | | 464 | 463 | 446 | | 473 | 418 | | | |
| 78 | 432 | 442 | 439 | 438 | | | 440 | 494 | 444 | | |
| 80 | 354 | | | 359 | | | 362 | | 364 | 483 | |
| 82 | 477 | | | | | | 468 | | | | |
| 86 | 429 | | | 439 | | | 436 | | 443 | | |
| 94 | 446 | | | 460 | 453 | | 450 | | 404 | | |
| 96 | 408 | 413 | | 404 | | | 405 | | 463 | | |
| 99 | 440 | | 452 | 450 | | | 445 | | 460 | 460 | 364 |
| 100 | 397 | | 399 | 400 | 408 | | 405 | | 475 | 429 | |
| 103 | 397 | 401 | | 400 | 404 | | 403 | 441 | 404 | 458 | |
| 134 | | | 402 | 405 | | | 395 | | | | |
| 150 | | | | 497 | 499 | | 507 | | 493 | 501 | |
| 151 | | 485 | | 482 | | | 491 | 503 | 430 | | |
| 160 | | | 435 | 433 | | | 448 | 468 | 459 | | |
| 165 | 466 | | 477 | 478 | | | 481 | | 476 | | |
| 166 | 456 | 460 | | 454 | 425 | 465 | 488 | | 453 | 477 | |
| 167 | 434 | | | | 440 | | 442 | 442 | 453 | | |
| 174 | | | | 427 | | | 428 | | | 434 | 435 |

APRIL

| EID | 6 (a) | 6 (b) | 6 (c) | 7 (a) | 7 (b) | 7 (c) | 8 |
|---|---|---|---|---|---|---|---|
| 10 | 498 | | | 483 | | | |
| 11 | | 492 | | 479 | | | |
| 40 | | | | 476 | | | |
| 53 | 482 | | 495 | 484 | 485 | | |
| 55 | 512 | 525 | | 500 | 528 | | |
| 66 | 527 | | | 215 | | | |
| 67 | 505 | 503 | | 501 | 510 | | |
| 73 | 427 | | | 422 | | | |
| 75 | 458 | | | 452 | | | |
| 76 | 463 | 494 | | 487 | 499 | 503 | |
| 78 | | 478 | | 476 | 478 | | |
| 80 | 377 | 384 | | 387 | 395 | | |
| 82 | 494 | 507 | | 500 | 504 | | |
| 86 | 471 | 482 | | 465 | 483 | | |
| 94 | 481 | 491 | | 473 | | | |
| 96 | 428 | 449 | | 438 | 471 | 438 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 99 | 481 | 487 | | 483 | | 488 | 481 |
| 100 | | 433 | | 429 | 438 | | |
| 103 | | | | 425 | 425 | 438 | |
| 134 | | | | 421 | 435 | 431 | |
| 150 | 527 | | | 519 | 531 | | |
| 151 | 524 | 507 | 524 | 513 | 533 | 526 | |
| 160 | 468 | 451 | | 469 | | | |
| 165 | 502 | 511 | | | | 515 | |
| 166 | 487 | | | 486 | 500 | 510 | |
| 167 | 461 | 465 | | 464 | | | |
| 174 | 447 | | | 443 | | | 436 |

MAY

| EID | 9 | 10 (a) | 10(b) | 11 (a) | 11 (b) | 11 (c) | 12 | 13 (a) | 13 (b) | 14 | 15 (a) | 15 (b) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | | | | 524 | 527 | | | 496 | | | | |
| 11 | | 521 | | 502 | | | | | | | 520 | 547 |
| 40 | 518 | 504 | | 504 | 520 | 521 | 507 | 514 | 510 | | 501 | |
| 53 | 554 | | 524 | 511 | | | | 520 | | | 497 | 524 |
| 55 | 557 | 542 | 548 | 539 | 550 | | 543 | 551 | | | 534 | |
| 66 | | 574 | | 559 | 573 | 600 | | 576 | | | 565 | |
| 67 | | 527 | 547 | 541 | 541 | | 536 | | | | | |
| 73 | | 459 | | 472 | | | | 477 | | | 462 | |
| 75 | | 473 | | 485 | | | | 488 | | | 475 | |
| 76 | | | | 528 | | | 527 | 538 | | | 534 | |
| 78 | | 513 | | 515 | 498 | 507 | | 520 | | | 486 | |
| 80 | | 390 | | 395 | | 410 | | 410 | | | 401 | 406 |
| 82 | 535 | 523 | 551 | | | | 540 | 552 | | | 546 | |
| 86 | | 509 | | 509 | | | | 522 | | | 510 | |
| 94 | 510 | 521 | | | 516 | | | 506 | | | 508 | |
| 96 | | 468 | | 458 | 471 | 471 | 462 | 472 | | 462 | 466 | |
| 99 | | 518 | | | 521 | 526 | 522 | 520 | | | 334 | |
| 100 | | 473 | | | 467 | 469 | 463 | 472 | | 461 | 450 | 474 |
| 103 | | 437 | 435 | 467 | 480 | 468 | 459 | 466 | | | 454 | |
| 134 | | | | 440 | 465 | | 463 | 460 | | 445 | 447 | 462 |
| 150 | | | | 245 | 563 | | | 558 | | | 259 | |
| 151 | 562 | 545 | | 548 | 557 | | | 558 | | | 551 | |
| 160 | 542 | 503 | | 340 | 515 | 510 | 508 | 491 | | | 509 | |
| 165 | 466 | | 555 | 547 | 543 | | 543 | | | 536 | 546 | |
| 166 | | 535 | | | 529 | | 520 | | | | 524 | 524 |
| 167 | | 488 | | 539 | | | 475 | | 543 | | 528 | 482 |
| 174 | | | | | 486 | | 477 | 477 | | | 472 | |

# APPENDIX IV. Raw data collected on steers at Swan's Lagoon

| | 1ST DAY PART DAY 17/8/95 | PART DAY 18/8/95 | 19/8/95 | PART DAY 20/8/95 | 21/8/95 | PART DAY 22/8/95 | 23/8/95 | 24/8/95 | PART DAY 7/9/95 |
|---|---|---|---|---|---|---|---|---|---|
| 10 | 328 | | ✓ | ✓ | 313 | | ✓ 308 | 325 ✓ | 357 |
| 1 | 278 | | 279 | | 339 | 313 | | 424 | |
| 5 | ✓ | 359 | ✓ | ✓ | ✓ | | ✓ | 372 | |
| 6 | 285 | ✓ | 327 | | 325 | | ✓ | 334 ✓ | |
| 7 | ✓ | | 324 | | ✓ | | | 332 | |
| ) | | | ✓ | | ✓ | | | | |
| ( | | | ✓ | 318 | 319 | | | 324 | |
| ! | ✓ | 298 | 290 | | ✓ | | 299 | 296 | |
| ) | | | | 332 | 311 | 314 | 285 | 459 | 328 |
| . | ✓ | 352 | ✓ | | 354 | | ✓ | 358 | |
| ) | ✓ | | ✓ | | ✓ | ✓ | ✓ | 338 | 260 |
| | ✓ | | ✓ | | | | | 252 | |
| 2 | ✓ | | 263 | | ✓ | | 335 | 398 | 289 |
| ; | | | | 344 | ✓ | | 330 | ✓ | |
| | 266 | | ✓ | | 392 | 272 | 297 | ✓ | [redacted] |
| | ✓ | 309 | 330 | 362 | ✓ | | ✓ | ✓ | 323 |
| - | 289 | | | | 294 | | | 283 355 | |
| | ✓ | | | | ✓ | | | 121 | 304 |
| - | ✓ | | 302 | | ✓ | | 317 | ✓ | |
| | 263 | | ✓ | | ✓ | | ✓ | 287 | |
| | ✓ | | 419 ✓ | ✓ | | | ✓ | [redacted] | |
| | [redacted] + | | 361 | | ✓ | | 305 | 299 ✓ | |
| | | 238 | 307 | 308 | ✓ | ✓ | 308 | 322 | ✓ |
| | | | 398 | | | | 310 | ✓ | |
| | [redacted] + | | 202 | | 320 | 332 | 321 | ✓ | |
| | [redacted] + | | ✓ | | ✓ | | | ✓ | |
| | | | ✓ | | 310 | 290 | 153 | | |
| | 306 | 292 + | 294 + | | 365 + | 301 | 353 + ✓ | ✓ | |
| | ✓ | | 241 | | ✓ | | | ✓ | ✓ |
| | ✓ | | ✓ | | 330 | ✓ | ✓ | ✓ ✓ | |
| - | | | 159 | | 141 | | | | |
| | ✓ | | 318 | | 313 | | | 332 | |

✓ DENOTE animal was read by EID reader but we were unable to link it to a weight

Part Day

| | 14/9/95 | 15/9/95 | 29/9/95 | 30/9/95 | 1/10/95 | 2/10/95 |
|---|---|---|---|---|---|---|
| 00 | 345 | ✓ | 362 ✓ | 360 | 356 | 361 |
| 01 | 297 | 304 | ✓ | 312 | 311 | 313 |
| 05 | 392 ✓ | 389 | (392 ~~[illegible]~~) | 394 407 | 398 407 | 401 406 |
| 06 | 359 | 356 | ✓✓ | 356 | 358 368 | ✓✓ |
| 07 | 359 368 | ✓ | ✓ | 375 390 | 379 | ✓ |
| 08 | 316 | ✓ | 330 | 338 ✓ | 333 | ✓ |
| 11 | 358 ✓ | | 351 (371?) | 356 | 352 | 357 374 |
| 12 | 283 ✓ | 342 | ✓ | 343 | 349 ✓ | ✓ |
| 13 | 339 ✓ | 314 | 356 | 349 | 351 358 | ✓ |
| 14 | 388 ✓ | | 392 | 404 401 | 399 | ✓ |
| 20 | ✓ | 375 | 369 387 | 388 | 381 | 353 |
| 21 | 285 | 289 | 296 | 299 | 295 | 297 |
| 22 | (275?) 292 | 292 | ~~281~~ 124 319 | 304 | 305 | 307 312 |
| 23 | 342 ✓ | 343 | 341 | 345 357 | 347 361 | 346 |
| 26 | ✓✓ | 297 | 385 ✓ | 305 315 | 307 ✓ | ✓ |
| 31 | ✓ 333 | (345?) | (356?) ✓ | 345 353 | 359 350 | 342 350 |
| 32 | 319 ✓ | 315 | 331 ✓ | 328 | 324 ✓ | 338 ✓ |
| 34 | 302 ✓ | ✓ | 316 319 | 302 320 | 316 | 311 |
| 35 | 336 ✓ | (337?) | ✓ 350 | 343 | ✓ | ✓ |
| 38 | 312 ✓ | 260 | 328 ✓ | 312 ✓ | 319 | 314 |
| 42 | 367 376 | ✓ | 382 387 | 386 390 | 380 | 387 ✓ |
| 55 | 326 326 | (354?) | 348 ✓ | 338 ✓ | 333 | 354 ✓ |
| 56 | ✓ | ✓ | 355 393 | 357 ✓ | 348 355 | ✓ |
| 98 | 337 ✓ | 336 | 348 ✓ | 352 ✓ | 344 | 348 ✓ |
| 57 | 315 ✓ | | (347?) ✓ | 336 345 | 339 343 | 336 |
| 63 | 326 351 | 353 | 356 370 | 367 370 | 375 | 365 |
| 67 | 380 330 | 332 | 349 ✓ | 343 | 337 | 345 152 |
| 69 | 314 323 | | 319 | 331 120 | 329 | ✓ |
| 70 | 320 ✓ | | (339?) ✓ | 329 338 | 332 | ✓ |
| 77 | 268 ✓ | ✓ | ✓✓ | 269 | 267 | ✓ |
| 78 | 355 | 354 | 374 ✓ | 371 ✓ 380 | 362 (376?) | 366 |

~~[illegible]~~



| | PART DAY. 4/10/95 | 5/10/95 | 6/10/95 | 7/10/95 | Part Day only 8/10/95 | 13/10/95 | 14/10/95 | 15/10/95 PART DAY. | |
|---|---|---|---|---|---|---|---|---|---|
| 00 | 364 | ✓306 359 | ✓ | 362✓ | 348 | 371 | ✓ | | |
| 01 | | ✓ | 318 | 311 | 315 | ✓ | 320 | | |
| 05 | 407 | ✓✓ | 400 | ✓410 | 410 406 | 404 420 | 408 418 | ✓ | |
| 06 | ✓ | ✓368 | 378 | 367✓ | ✓ | ✓ | 368 | 364 | |
| 07 | | 380✓ | ✓ | 383 392 | 381 | 380✓ | ✓ | 384 | |
| 10 | ✓ | 330 343 | 336 | 335 336 | 336 | 331 347 | 340 | | |
| 11 | ✓ | 343 369 | 358 | ✓359 | ✓ | ✓✓ | 356 | 359 | |
| 12 | | 348 355 | | 345✓ | | ✓ | 357 | 350 | |
| 13 | ✓ | ✓✓ | ✓ | ✓✓ | ✓ | ✓ | ✓360 | ✓ | |
| 14 | ✓ | 402 413 | ✓ | ✓✓ | 400 | 408 420 | ✓ | | |
| 20 | | ✓✓ | 370 | ✓✓ | 361 | 379 | ✓✓ | 384 | |
| 21 | | ✓✓ | ✓ | 298✓ | 300 | 306 | | ✓ | |
| 22 | | 307 309 | ✓ | 306 ✓✓ | 306 | ✓ | ✓✓ | 312 | |
| 23 | ✓ | 350 354 | 352 | ✓✓ | ✓✓ | 356 | 355 | 361 | |
| 26 | ✓ | 305 317 | ✓ | 314 | 319 | ✓ | ✓ | 313 | |
| 1 | | ✓✓ | ✓ | ✓✓ | ✓359 | ✓354 | 366 | ✓ | |
| 2 | ✓ | ✓✓ | ✓ | ✓334 | ✓ | ✓ | ✓ | ✓ | |
| 4 | | ✓319 | 324 | 317 322 | 322 | ✓✓ | 323 | 318 | |
| 5 | | ✓347 | ✓ | ✓353 | 345 | 359 | ✓ | ✓ | |
| 8 | | ✓✓ | 319 | ✓324 | 302 | ✓ | ✓ | 322 | |
| 2 | ✓ | ✓✓ | ✓ | ✓385 | ✓✓ | ✓ | ✓ | 392 | |
| 5 | | ✓ | ✓ | 339✓ | ✓ | 355 | 344 | | |
| 6 | | ✓360 | ✓ | ✓ | ✓✓ | ✓ | ✓✓ | 359 | |
| 7 | ✓ | 337 348 | ✓ | ✓✓ | ✓ | ✓ | ✓ | 351 | |
| 3 | | ✓364 | ✓ | ✓✓ | ✓ | ✓ | 372 | ✓ | |
| [illegible] | | ✓✓ | 344 | ✓350 | | ✓ | 357 | ✓ | |
| 7 | ✓ | 325 339 | 330 | 331 388 | ✓ | ✓✓ | 339 | | |
| 9 | ✓ | ✓337 | ✓ | ✓✓ | 342 | ✓ | ✓✓ | ✓ | |
| 7 | | 272 | ✓ | 270 | ✓ | ✓283 | 272 | | |
| [illegible] | | ✓380 | ✓ | ✓✓384 | 375 | ✓ | 379 380 | 376 | |
| [illegible] | | ✓ | ✓ | 317 340 | ✓ | ✓ | ✓ | | |

| | 25/10/95 | 26/10/95 PART DAY. | 27/10/95 | 28/10/95 | 29/10/95 | 30/10/95 stopped recording | 9/11/95 | 10/11/95 PART DAY. | |
|---|---|---|---|---|---|---|---|---|---|
| )0 | 358 | | ✓ | ✓ | 346 342 | | 378 363 | 379 | |
| 1 | ✓ | | ✓ | | ✓✓ | | ✓340 | 334 | |
| 5 | ✓ | | ✓ | ✓ | 378 399 | 376 | 422 429 | ✓ | |
| 6 | 368 | ✓ | 365 | ✓ | 343✓ | | 377 | | |
| 7 | ✓ | | ✓ | 382 | 352✓ | | 407 414 ✓ | 402 | |
| ) | ✓ | | ✓ | | 310 | | | 353 | |
| 1 | ✓ | | 364 | ✓ | 338 | | ✓395 | ✓ | |
| 2 | 352 | | 359 | ✓ | 339 343 | | 375 | 367 | |
| 3 | ✓ | ✓ | 351 | ✓ | 319✓ | | 365 370 | 360 | |
| 4 | ✓ | ✓ | 404 | ✓ | 389 | 375 | 429 433 | 423 | |
| 0 | ✓ | | ✓ | 368 | 341 | 342 | | | |
| 1 | ✓ | | 298 | | 270✓ | | ✓ | ✓ | |
| 2 | 312 | | | ✓ | 287 298 | 288 | 337 | 334 | |
| 3 | | | ✓ | 354 | 331 345 | 325 | 382 | 365 | |
| 5 | [illegible] | | ✓ | 316✓✓ | 290 295 | | 326✓ | ✓323 | |
| 1 | ✓ | | ✓ | ✓ | 318 | 317 | ✓366 | ✓ | |
| 2 | ✓ | | ✓ | ✓ | ✓334 | | ✓ | ✓ | |
| 4 | 312 | | 322 | 311✓ | 299✓ | | 331 | 342 338 | |
| 5 | 362 | | 340 | ✓ | | | ✓ | 362 | |
| 8 | 312✓ | ✓ | ✓ | | 254✓ | | 332 | ✓ | |
| 2 | 385✓ | ✓ | 394 | 387 | 370 376 | 360 | 296 417 | 410 413 | |
| 5 | 346 | | ✓ | | 317 | | | ✓ | |
| 6 | ✓ | | 366 | ✓ | ✓ | 327 | 375 380 387 | 375 | |
| 7 | ✓✓ | | 343 | ✓ | ✓ | | ✓ | 356 | |
| 3 | ✓ | 355 | 357 | ✓ | 327 | | 371✓✓ 375 | 372 | |
| 2 | ✓ | | 349 | ✓ | 320 | | 300 361 | ✓ | |
| 7 | 330 | | 333 | ✓ | 313 | 296 | 346 343 | 353 | |
| ) | 463 | ✓ | ✓ | 350✓ | 317 | | 358 369 | 362 | |
| ) | 339 | | ✓ | ✓ | 258 255 | | 287 295 | 288 | |
| 8 | 172 | | 379 | | 343 | 345 | 396 | 383 | |
| 2 | ✓ | | ✓ | ✓ | 309 | | 353 ✓ | 354 | |

| | 17/11/95 | 18/11/95 | 19/11/95 | 20/11/95 |
|---|---|---|---|---|
| 00 | | 390 401 | 395 403 | ✓ 403 |
| 01 | | 335 ✓ | 344 343 | 325 |
| 05 | | 428 440 | ✓ 442 | ✓ 435 |
| 06 | | 391 398 | 388 | ✓ |
| 07 | | 407 ✓ | ✓ | 393 |
| 10 | | 363 373 | 368 | 353 372 |
| 11 | 397 | 384 396 | 391 400 | ✓ 398 |
| 2 | | 381 176 | ✓ | ✓ |
| 3 | ✓ | ✓ 390 | ✓ | ✓ 388 |
| 4 | | 429 ✓ | 437 | ✓ |
| 0 | | ✓✓ | 301 | 394 |
| 21 | | 321 329 | ✓ | |
| 2 | 352 | 348 ✓ | 346 | ✓ 355 |
| 3 | 388 | 389 389 | ✓ | ✓ 393 |
| 6 | | 333 346 | 335 | ✓ |
| 1 | | 371 388 | ✓ | ✓ 386 |
| 2 | | 347 ✓ | 352 | ✓✓ |
| 4 | | 345 354 | 346 | ✓ 305 |
| 5 | | 372 386 | 388 | ✓✓✓ |
| 8 | 156 | 348 ✓ | 355 ✓ | ✓ |
| 2 | | 416 435 ✓ | ✓ | ✓✓ |
| 5 | | 363 ✓ | ✓ | ✓ |
| 6 | ✓ | 384 389 ✓ | ✓ | ✓ 372 ✓ |
| 7 | | 359 ✓ | 368 | ✓ 385 |
| 3 | 383 | ✓ 386 | ✓✓ | 372 ✓ |
| 7 | 372 | 375 383 | ✓ | ✓✓ |
| 9 | | 357 372 | 366 | ✓ |
| [illegible] | | 371 ✓ | 374 | ✓ 380 |
| [illegible] | | 297 306 | ✓ | ✓✓ |
| 8 | 410 | 397 ✓ | ✓ 415 | ✓✓ |
| 2 | | 386 ✓ | 364 | ✓ |

## APPENDIX V. Summary of number and percentage of incorrect weights obtained in steer data

# Automatic Cattle Weighing 17/8 – 20/11/95

| Recording date | No. of individual ID * WT values recorded x | No. of 'spurious' wts. | % spurious | No. of ID's recorded: Once | Twice | ≥Thrice | at all | y TOTAL | [illegible] |
|---|---|---|---|---|---|---|---|---|---|
| 17/8/95 | 10 | 4 | 40 | 24 | 0 | 0 | 24 | 24 | 4 |
| 18/8 | 6 | 1 | — * | 7 | 0 | 0 | 7 | 7 | — |
| 19/8 | 16 | 5 | 31 | 28 | 0 | 0 | 28 | 28 | 5 |
| 20/8 | 5 | 0 | — | 8 | 0 | 0 | 8 | 8 | — |
| 21/8 | 14 | 4 | 29 | 29 | 0 | 0 | 29 | 29 | 40 |
| 22/8 (PART) | 6 | 0 | — | 9 | 0 | 0 | 9 | 9 | — |
| 23/8 | 13 | 3 | 23 | 19 | 2 | 0 | 21 | 23 | 5 |
| 24/8 | 20 | 6 | 30 | 23 | 6 | 0 | 29 | 35 | 57 |
| 7/9 (PART) | 7 | 1 | — | 9 | 0 | 0 | 9 | 9 | — |
| 14/9 | 35 | 2 | 6 | 8 | 24 | 0 | 32 | 56 | 62 |
| 15/9 (PART) | 19 | 1 | 5 | 26 | 0 | 0 | 26 | 26 | 73 |
| 29/9 | 34 | 2 | 6 | 10 | 22 | 0 | 32 | 54 | 63 |
| 30/9 | 45 | 2 | 4 | 14 | 17 | 1 | 32 | 51 | 88 |
| 1/10 | 39 | 0 | 0 | 20 | 12 | 0 | 32 | 44 | 89 |
| 2/10 | 24 | 1 | 4 | 22 | 10 | 0 | 32 | 42 | 57 |
| 4/10 | 2 | 0 | — | 14 | 0 | 0 | 14 | 14 | 14 |
| 5/10 | 29 | 1 | 3 | 4 | 27 | 1 | 32 | 61 | 48 |
| 6/10 | 11 | 0 | 0 | 31 | 0 | 0 | 31 | 31 | 35 |
| 7/10 | 27 | 1 | 4 | 4 | 26 | 2 | 32 | 62 | 44 |
| 8/10 | 17 | 0 | 0 | 24 | 6 | 0 | 30 | 36 | 47 |
| 13/10 | 15 | 0 | 0 | 23 | 9 | 0 | 32 | 41 | 37 |
| 14/10 | 18 | 0 | 0 | 24 | 7 | 0 | 31 | 38 | 47 |
| 15/10 (PART) | 15 | 0 | 0 | 24 | 0 | 0 | 24 | 24 | 62 |
| 25/10 | 15 | 4 | 27 | 28 | 3 | 0 | 31 | 34 | 44 |
| 26/10 (PART) | 1 | 0 | — | 8 | 0 | 0 | 8 | 8 | — |
| 27/10 | 15 | 0 | 0 | 31 | 0 | 0 | 31 | 31 | 48 |
| 28/10 | 7 | 1 | — | 23 | 3 | 0 | 26 | 29 | 24 |
| 29/10 | 36 | 2 | 6 | 14 | 17 | 0 | 31 | 48 | 75 |
| 30/10 (STOPPED) | 10 | 1 | 10 | 10 | 0 | 0 | 10 | 10 | 100 |

(CONT) ↓

* Insufficient no. (<10) on which to estimate a real percentage

| ANIMAL ID | No. of [redacted] values recorded (X) | No. of 'spurious' ID*WT | % Spurious wts | Once | Twice | > Twice | At All | Total (Y) | X/Y % |
|---|---|---|---|---|---|---|---|---|---|
| | | | | ← No. of [redacted] recorded → | | | | | |
| 00 | 27 | 1 | 4 | 19 | 9 | 1 (3) | 29 | 40 | 67 |
| 01 | 20 | 2 | 10 | 21 | 4 | 0 | 25 | 29 | 69 |
| 05 | 29 | 0 | 0 | 17 | 14 | 0 | 31 | 45 | 64 |
| 06 | 21 | 1 | 5 | 21 | 8 | 0 | 29 | 37 | 57 |
| 07 | 20 | 0 | 0 | 18 | 8 | 0 | 26 | 34 | 59 |
| 10 | 20 | 0 | 0 | 17 | 6 | 0 | 23 | 29 | 69 |
| 11 | 25 | 0 | 0 | 17 | 10 | 0 | 27 | 37 | 68 |
| 12 | 21 | 2 | 10 | 20 | 6 | 0 | 26 | 32 | 66 |
| 13 | 20 | 1 | 5 | 22 | 9 | 0 | 31 | 40 | 50 |
| 14 | 21 | 0 | 0 | 22 | 7 | 0 | 29 | 36 | 58 |
| 20 | 17 | 1 | 6 | 23 | 5 | 0 | 28 | 33 | 52 |
| 21 | 14 | 0 | 0 | 18 | 4 | 0 | 22 | 26 | 54 |
| 22 | 28 | 3 | 11 | 20 | 8 | 1 (3) | 29 | 39 | 72 |
| 23 | 26 | 0 | 0 | 19 | 9 | 0 | 28 | 37 | 70 |
| 26 | 24 | 4 | 17 | 19 | 11 | 0 | 30 | 41 | 59 |
| 31 | 22 | 0 | 0 | 19 | 12 | 0 | 31 | 43 | 51 |
| 32 | 14 | 1 | 7 | 16 | 10 | 0 | 26 | 36 | 39 |
| 34 | 27 | 1 | 4 | 15 | 11 | 0 | 26 | 37 | 73 |
| 35 | 16 | 0 | 0 | 20 | 5 | 1 (3) | 26 | 33 | 48 |
| 38 | 18 | 3 | 17 | 19 | 9 | 0 | 28 | 37 | 49 |
| 42 | 24 | 3 | 12 | 16 | 13 | 1 (3) | 30 | 45 | 53 |
| 55 | 17 | 2 | 12 | 17 | 7 | 0 | 24 | 31 | 55 |
| 56 | 21 | 3 | 14 | 23 | 6 | 3 (3) | 32 | 44 | 48 |
| 57 | 17 | 1 | 6 | 16 | 9 | 0 | 25 | 34 | 50 |
| 63 | 25 | 2 | 8 | 21 | 8 | 1 (4) | 30 | 41 | 62 |
| 67 | 19 | 4 | 21 | 18 | 8 | 0 | 26 | 34 | 56 |
| 69 | 25 | 3 | 12 | 19 | 7 | 0 | 26 | 33 | 76 |
| 70 | 22 | 4 | 18 | 19 | 11 | 0 | 30 | 41 | 54 |
| 77 | 16 | 1 | 6 | 19 | 7 | 0 | 26 | 33 | 48 |
| 78 | 24 | 1 | 4 | 19 | 8 | 2 (3) | 29 | 41 | 59 |
| 82 | 12 | 3 | 25 | 16 | 6 | 0 | 22 | 28 | 43 |
| 98 | 17 | 1 | 6 | 16 | 11 | 0 | 27 | 38 | 45 |
| TOTAL | 669 | 48 | | 601 | 266 | 10 | 877 | 1164 | |

| Recording date | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 9/11 | 39 | 2 | 5 | 12 | 16 | 2 | 30 | 58 | 7 |
| 10/11 (PART) | 24 | 0 | 0 | 27 | 3 | 0 | 30 | 33 | 7 |
| 17/11 | 7 | 1 | — | 9 | 0 | 0 | 9 | 9 | - |
| 18/11 | 47 | 1 | 2 | 0 | 30 | 2 | 32 | 66 | 7 |
| 19/11 | 23 | 1 | 4 | 24 | 8 | 0 | 32 | 40 | 5 |
| 20/11 | 18 | 1 | 6 | 11 | 18 | 2 | 31 | 53 | 3 |
| TOTAL | 669 | 48 | | 601 | 266 | 10 | 877 | 1163 | |

| TIME PERIODS AGGREGATED | | | % |
|---|---|---|---|
| 17 – 24/8 total | 90 | 23 | 26 |
| 7 – 15/9 | 61 | 4 | 7 |
| 29/9 – 8/10 | 228 | 7 | 3 |
| 13 – 15/10 | 48 | 0 | 0 |
| 25 – 30/10 | 84 | 8 | 10 |
| 9, 10/11 | 63 | 2 | 3 |
| 17 – 20/11 | 95 | 4 | 4 |

# APPENDIX VI. Extract from Allflex FX Series operators manual

# 4. WEIGH MODES

The following functions are described in this section.



## 4.1 Selecting the Appropriate WEIGH MODE

A choice of two WEIGH MODES is available via the WEIGH MODE key. Each press of the WEIGH MODE key moves the operating mode between HOLD and CONTINUOUS.

At switch on, the indicator automatically goes in to the HOLD mode.

The HOLD WEIGH MODE should be used for weighing live animals. A unique software routine averages the weight of moving animals to produce accurate repeatable live weight results.

The CONTINUOUS WEIGH MODE is suitable for weighing static loads. The averaging routine is operating continuously giving regular updates of the weight applied to the scale.

## 4.2 Using the HOLD WEIGH MODE

Having loaded the animal into the crate or onto the weighing platform a press of the WEIGH KEY begins the following sequence:

(a) multiple samples of the weight reading are stored and averaged out.
(b) the result of this calculation is displayed and 'held frozen' on the BOTTOM DISPLAY SCREEN of the indicator.
(c) the result is 'held frozen' on the top line of the TOP DISPLAY SCREEN.
(d) the 'held frozen' weight is stored in memory in the currently selected MOB FILE.

Removal of the animal from the scale causes the BOTTOM DISPLAY SCREEN to default to live displaying of the true zero position of the scale.

The TOP DISPLAY SCREEN holds the animal weight until the next press of the WEIGH button.

## 4.3 Using the CONTINUOUS WEIGH MODE

During operation in this mode the bottom display is continuously held 'live'. As the weight is applied the display increments upwards. Once the weight is removed the display decrements back to the zero position.

A press of the WEIGH key will average and store the weight on the scale, as in the HOLD mode. The resulting weight is 'held frozen' on the TOP DISPLAY SCREEN whilst the BOTTOM DISPLAY SCREEN remains unlocked and continues to display the weight on the scale.

# 7. DRAFTING

The following functions are described in this section

7.1 Checking settings of DRAFT LIMITS.
7.2 Selecting new DRAFT LIMITS.
7.3 Using the DRAFT display mode.
7.4 Analysing DRAFT statistics .
7.5 Automatic drafting using the FX31.

## 7.1 Checking DRAFT LIMIT settings

A press of the DRAFT LIMIT key displays the setting of LIMIT 1.

**Example:**

```
LIMIT 1=38kg
NEW #, (ENTER),  ↑ or ↓
```

A press of the DRAFT LIMIT or ↑ keys will display LIMIT 2.

**Example:**

```
LIMIT 2=42.5kg
NEW #, (ENTER), ↑ or ↓
```

The two DRAFT LIMITS can be scrolled through with the ↑ and ↓ arrow keys.

## 7.2 Setting new DRAFT LIMITS

Having accessed the DRAFT LIMIT function with a press of the DRAFT LIMIT key, a new DRAFT LIMIT can be keyed directly in from the keypad. After confirming that the correct DRAFT LIMIT has been keyed a press of the ENTER key stores the DRAFT LIMIT in memory.

Scrolling with the ↑ arrow displays the second DRAFT LIMIT ready for keying a new value.

## 7.3 Using the DRAFT display mode

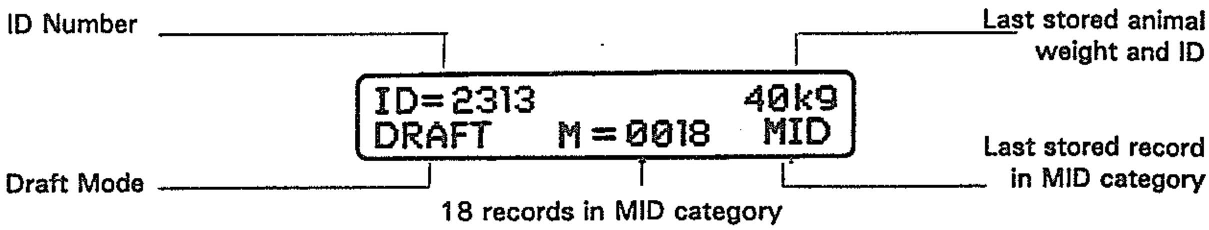
A press of the DISPLAY MODE key takes the TOP DISPLAY SCREEN from STD (Default Mode at switch ON) to DRAFT.

Having preset the DRAFT LIMITS to the required changeover points, as the weighing session proceeds, the TOP DISPLAY SCREEN indicates which draft category the last stored weight record has fallen into (HIGH, MID, LOW) and how many stored weights in the current MOB FILE also fall into that category.

**Example:** DRAFT LIMIT 1 = 38 kg
DRAFT LIMIT 2 = 42 kg

Weigh animal at 40 kg (Press WEIGH key).

Top display reads:




## 7.4 Analysing DRAFT statistics

When operating the FX31 indicator in the DRAFT display mode, a press of the STATS key presents statistical information based on the DRAFT LIMIT set points.

**Example:**

```
MOB=12      AV=38.25kg
H=0026 M=0045  L=0132
```

This screen display details the following information:

- The records are stored in MOB 12.
- The average animal weight is 38.25 kg
- 26 animals are in the high category (HIGH)
- 45 animals are in the middle category (MID)
- 132 animals are in the low category (LOW)

**Note:** ☞ The STATS display times out automatically after five seconds. Holding the STATS key down retain the STATS on the TOP DISPLAY SCREEN.

A press of the STATS key displays the mob average and number of animals in each category as shown above.

Having pressed the STATS key, a press of the ↑ scroll key displays the average weight in each draft category.

**Example:**

```
H=39.36kg       (AVG)
M=37.82       L=38.16
```

## 7.5 Automatic DRAFTING Using The FX31

The addition of a REMOTE DRAFTING CONTROLLER to the FX31 indicator allows the user to set up automatic drafting facilities.

Clean relay contacts in the REMOTE DRAFTING CONTROLLER can be used to control switching equipment on electrically driven two or three way drafting gates.

# 8. EID / AUTO DRAFTING FUNCTIONS

The following functions are described in this section.

8.1 Communications between the FX31 indicator and a TIRIS Electronic Identification Reader.

8.2 Communication between the FX31 indicator and an Allflex "Remote Drafting Controller".

8.3 Setting functions and times via SET-UP-menu's.

8.4 Flow chart of EID / Weighing / Drafting relationships.

## 8.1 Communications between the FX31 Indicator and a Tiris Electronic Identification Reader

Having set EID ON in the EID / OPTIONS SET-UP menu (refer Section 2.4) the FX31 indicator initialises communications with a Tiris EID reader attached to the RS232 Serial Port. (Refer to manufacturer for details).

Application of a weight to the scale above a preset lower limit (see below) results in the FX31 triggering transmit cycles in the TIRIS reader at approximately one second intervals. The transmit phase begins when weight on the scale reaches the following lower limits :

Weight > 5 kg for scale capacity of 1000 kg up.
Weight > 1 kg for scale capacity of 100 - 1000 kg.
Weight > 0.2 kg for scale capacity less than 100 kg.

Operation of the weigh routines depends on the setting of a number of options available in SET-UP as follows.

AUTO WEIGH MODE ON/OFF

ON - the weigh cycle proceeds automatically.

OFF - a press of the WEIGH key initiates the weigh cycle.

WEIGHT INITIATED / EID INITIATED

WEIGHT - the weigh cycle proceeds independently of receipt of an ID number once the weight on the scale is greater than 50% of the lower draft limit.

EID - the weigh cycle is initiated on receipt of a valid ID number from the TIRIS reader.

## 8.2 Communication between the FX31 indicator and an Allflex "Remote Drafting Controller"

Having set AUTO DRAFT ON in the EID / OPTIONS SET-UP menu (refer section 2.4) the FX31 indicator communicates with the ALLFLEX AUTO DRAFTING CONTROLLER.

Once AUTO DRAFT ON/OFF has been set to ON in the EID / OPTIONS SET-UP menu, two-way communications take place via the RS232 serial port on the FX31 indicator (refer to manufacturer for details).

HIGH, MID and LOW drafting relay contacts provide the interface between the FX31 indicator and external devices (drafting crates, feed bin augers, etc).

Should AUTO DRAFTING and EID be a requirement, the TIRIS reader is coupled to the ALLFLEX AUTO DRAFTING CONTROLLER to allow simultaneous communication with both devices.

## 8.3 Setting Functions and Times via SET-UP Menu's

Having scrolled through the SET-UP menus to the following option choices :

OFF-LINE
EID / OPTIONS ON-LINE
PRINTER ON-LINE
COMPUTER ON-LINE

Selecting EID / OPTIONS ON-LINE accesses the following options in order :

EID / OPTIONS ON-LINE

↓

EID / OPTIONS SET-UP

↓

EID = ON/OFF

↓

AUTO DRAFT = ON/OFF

↓

AUTO WEIGH MODE / MANUAL WEIGH MODE

↓

WEIGHT INITIATED / EID INITIATED

↓

WEIGH DELAY (0 - 25.5 seconds)

↓

[IN] CLOSE (0 - 25.5 seconds)

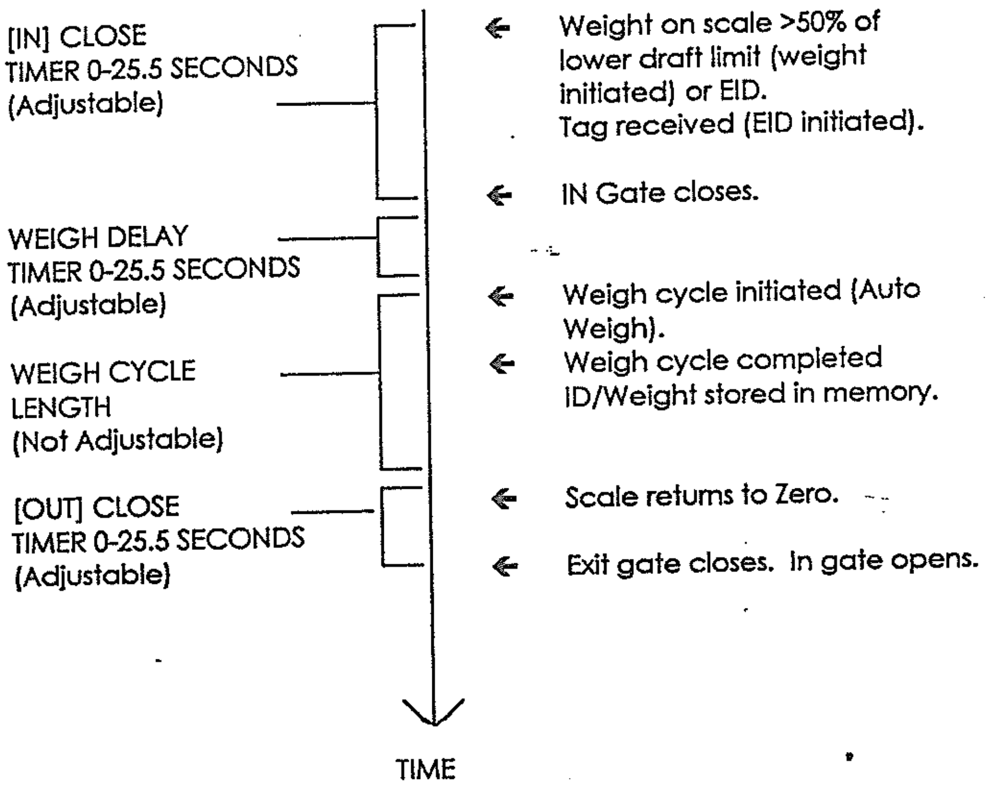
↓

[OUT] CLOSE (0 - 25.5 seconds)

↓

AUTO DOSE = ON/OFF

# 8.4 Flow chart of EID / Weighing / Drafting relationships




The timers can be operational or invalidated by setting the time period to 0.0 seconds.

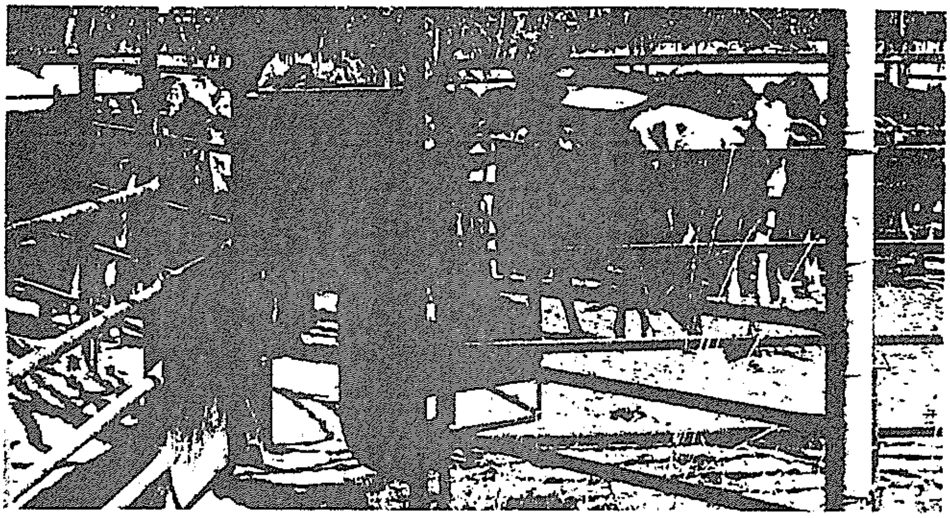
A single IN door and up to three OUT doors can be controlled from the ALLFLEX AUTO DRAFTING CONTROLLER.

The AUTO DRAFTING CONTROLLER relay contacts are clean 24 Volt, 1 Amp rating.

# APPENDIX VII. Media articles relating to project

# Cutting the costs of cattle handling

by CAROL PETHERICK,
QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES



*Cows which learn to use the cow-calf separator usually remember how it works, even if they have not used the device for 12 months.*

EQUIPMENT designed to hasten and simplify cattle mustering and drafting is undergoing tests in northern Queensland.

The devices being developed may benefit other areas of the cattle industry. Cattle which come to water during the dry season can be drafted and trapped at holding enclosures using equipment which operates in conjunction with spear gates.

The devices enable different classes of animals to be separated and trapped, so some can be processed on site and only selected animals need to be taken to yards for further processing.

## The cow-calf separator

The cow-calf separator consists of a door, which the cows are trained to push open, and an opening to the other side of the door, through which the calves and weaners pass. Ideally, cows should be trained to use the door before they calve.

Training involves partially blocking the calf-opening and holding the door fully open for several days with a length of chain which fits into a notch. During the following weeks the chain length can be increased a little at a time so the gap the cattle have to pass through decreases.

The cattle become used to feeling the door touch them as it 'gives' when they pass through. By the time the chain is fully lengthened the cows know they can push the closed door open.

Once fully trained, the calf-opening can be opened up completely. The breeders will continue pushing open the door, hardly giving the calf-opening a second glance.

## The calf-opening

When a young calf follows its mother to water the cow pushes open the door, passes through and the door slams shut in front of the calf who has not learned how to push open the door. The calf looks for an alternative way and discovers the opening.

Over weeks or months, cow and calf become used to going different ways through this device.

During this period the out-spears from the calf-opening (so that calves cannot exit back through the separator) can gradually be put in place and a panel or two fitted between the cow door and the calf exit - so that the animals become used to this arrangement.

When it is time to wean calves the panels are added to and a temporary calf-yard is erected around the calf-opening. The calves and weaners will be trapped as they come through. Depending on animal numbers, it may be possible to process the calves on site and return them to their mothers while the weaners are trucked to yards.

The cow-calf seperator could be used at either the entry to or the exit from a water enclosure. The advantage of drafting as the cattle come in to water is that it is also possible to trap the cows in the enclosure by blocking the out-spear.

After the calves have been processed they can be released to their mothers in the water enclosure.

Studies with small groups of animals show that once trained, a breeding cow remembers how to use the separator even if she has not used it for 12 months.

Heifers which had used the calf-opening as calves continued to squeeze through the calf-opening a year later. This means that animals being retained for breeding require 're-programming' and must be trained to use the cow door.

In order to simulate the situation of calves born away from controlled waters, a small mob of trained cows (about 30) and their naive calves was moved into a paddock containing a separator at the water when the calves were about 6 months old. They were allowed to use the separator for two weeks before being trapped when a 100% correct draft was attained.

A transportable device which incorporates branding, drafting and loading facilities has been developed and this further reduces the costs by enabling animals to be processed at water points.

## Weighing devices

Devices which will weigh cattle in the paddock and draft on the basis of weight are being developed. Cattle working a water will pass over scales and provide producers with regular information on weight changes so they can predict when cattle will reach target market weights.

Tests have started on a prototype of the North Queensland (NQ) weight-draft system. The system uses a commercial scale which allows draft limits to be set and data to be stored and printed.

Animals within a certain weight range can be drafted in one direction while all others are drafted another way. Instead of a producer having to muster the entire mob to yards, selected animals can be drafted and trapped in a temporary yard in much the same way as the cow-calf separator.

Another prototype device in the early phase of testing is the Lapweigh walk-over scale. The major advantage of this scale is that it is able to weigh an animal as it walks over the scale, so there is no need for the animal to be stationary.

Regularly provided information on animal weights can be used to make better informed management decisions, such as when to start feeding supplements or for predicting calving dates.

While these devices are mainly applicable to the arid areas of northern Australia there may be potential for some of the concepts and technology to be transferred to other areas of the cattle industry.

The devices should not replace the traditional first-round muster, because it is good management practice to take all animals to yards at least once a year for animal counts, vaccinations, and culling.

**CATTLE YARDS**

The Kondinin Group has launched a national

# BEEF & LIVESTOCK

# Finishing option at Gleeson

Gleeson overseer, Peter Scott, inspects heifers running in a single sire paddock with a Romagnola sire.

By DUNCAN BROWN

**Gleeson**

- Tom Keats runs 3500 head.
- Brahman/Beef-master infused.
- Replacement females selected on growth.

THE RECENT sale of 600 steers and 800 cows to the live export market has left Cloncurry cattleman, Tom Keats in two minds about pursuing his ambition of purchasing a finishing block.

Gleeson is a major breeder operation encompassing 145,000ha, including the recent acquisition of adjoining property White Hills.

The entire aggregation comprises a mix of spinafex, red desert and red soil country extending through to prime blacksoil flats.

A string of adverse seasons in the north west has forced Mr Keats to wind back breeder numbers by 50pc to around 3500 head.

The lead of the steers are normally sent to agistment around the Diamantina as 300kg young steers from where they will continue as Jap Ox to the southern processors.

The strength of the live export market which recently accepted 600 Gleeson steers weighing around 367kg liveweight and 600-800 poor condition cows purchased with White Hills has forced Mr Keats to reconsider his long term marketing strategy.

The cows went on to return $350/head, while the calves were trucked south to be sold onto a strong Casino calf market currently paying up to 300¢/kg dressed.

"It ensures a good quick return for calves and it only costs around $40/had to get them there.

"I can't see them filling ships with cull type cows but with the money they are paying for steers at present it certainly must help to bring their overall rate down.

"The live exporters seem to be chasing poorer conditioned cows so they can put the kilograms on them offshore. They are also avoiding cows with excessive milk after dropping their calves to avoid problems with mastitis.

"But the signs are encouraging. We intend to keep drafting the lead of our steers for the Jap Ox market until the exporters start offering premiums for quality - which might not be too far off."

Mr Keats' multi-sire herd is largely made up of 88pc Brahman content females and Beefmasters, a composite breed derived in the United States on a conformation not color basis.

Birthdates are recorded and all calves are weighed as weaners and yearlings and replacement females selected on a growth rate and fertility basis.

"The most important factor determining our program is kilos not color," he said.

## Taiwan growing export market

TAIWAN'S rising affluent society and "westernised" culture is taking its consumption of beef, sheep and goat meats to new levels, furthering marketing opportunities for Australian meat exports.

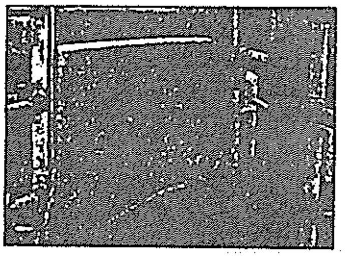
Australia's fifth-biggest export market for beef and sheepmeat, Taiwan actually takes $125.6 million of our beef exports, and sheepmeats worth $21.2 million (1993 figures). It is the largest export market for Australian goat meat, with nearly 33pc all exported Australian goat meat consumed by Taiwan.

A study commissioned by the Meat Research Corporation (MRC) found several crucial factors, including Taiwan's anticipated entry into GATT by the end of this year, provided an optimistic outlook for Australia's red meat industries.

The Taiwan Meat Marketing Strategy, prepared by the Centre for International Economics and Asia Market Intelligence, expects Taiwan's traditional meat consumption of poultry, pig meat and seafood to extend into red meat products as its agricultural technology advanced, incomes grew and lifestyles changed.

As Taiwan moves closer to entering GATT the strategy predicts a reduction in tariffs on general quality and special quality beef.

## Separator reduces farm costs



LIKE many Queensland cattlemen, Tom Keats, Gleeson, Cloncurry is now intent on reducing farm costs - starting with labor.

He has gone a long way to achieving this over the last three years through the trialling of the MRC-funded cow/calf separator unit, developed by the Queensland Department of Primary Industries at Swans Lagoon, Burdekin.

According to Mr Keats, the separator has weaned up to 500 cows and calves in one hit with a 98pc success rate and has ensured the entire weaning process requires far less manpower.

The cow calf separator works in conjunction with holding enclosures built around fixed watering points.

The cow enters through a steel gate just below eye height and shielded with steel plate and veers to the left with the gate swinging shut behind. The calf then walks through a small opening to the right and is separated from the cow by steel yard panels.

Mr Keats said the separator should only be used after the first round muster which is still essential for any vaccinations.

"The cows should be conditioned to the separator as maiden heifers because the calves learn very quickly. It can take up to 12 months for cattle to be drafting smoothly."