



# Swan's Lagoon Celebrating 50 years

#### *Acknowledgement*

*The information in this booklet was compiled by Geoffry Fordyce and sourced from the vast number of Swan's Lagoon publications, particularly annual reports and scientific journal papers. A more complete companion publication includes all known references. Colour photographs were taken by Geoffry Fordyce, Stephen O'Connor and Wayne Hall. I gratefully acknowledge the guidance of Russ Tyler, Lyle Winks, Peter Smith, Dave Smith, Bob Shepherd and Ruth Kerr in preparing this booklet.*

*On 26 March 2009, the Department of Primary Industries and Fisheries was amalgamated with other government departments to form the Department of Employment, Economic Development and Innovation.*

## Introduction

Swan's Lagoon, which is 125 km south-south-west of Townsville, was purchased by the Queensland Government as a beef cattle research station in 1961. It is situated within the seasonally-dry tropical spear grass region of North Queensland. The station was expanded from 80 km<sup>2</sup> to 340 km<sup>2</sup> by purchase of the adjoining Expedition block in 1978. The first advisory committee formed and initiated research in 1961.

The median annual rainfall of 708 mm (28 inches) is highly variable, with over 80% usually falling in December–April. Annual evaporation is 2.03 metres. The 60% of useable area is mostly flat with low-fertility duplex soils, of which more than 50% is phosphorus deficient. Natural spear grass-based pastures predominate over the station.

Swan's Lagoon research has contributed to understanding the biology of many aspects of beef production for northern Australia. Research outcomes have provided options to deal with the region's primary challenges of weaning rates averaging less than 60%, annual growth rates averaging as little as 100 kg, high mortality rates and high management costs. All these relate to the region's variable and highly seasonal rainfall—challenges that add to insect-borne viruses, ticks, buffalo fly and internal parasites.

As well as the vast amount of practical beef production science produced at Swan's Lagoon, generations of staff have been trained there to support beef producers throughout Queensland and northern Australia to increase their business efficiency.

The Queensland Government has provided most of the funds for staffing and operations. Strong beef industry support is reflected in project funding from meat industry levies, managed by Meat and Livestock Australia (MLA) and its predecessors. MLA has consistently provided the majority of operational research funding since the first grant for 'Studies of management practices, adaption of different breeds and strains to tropical environments, and studies on tick survival and resistance' in 1962–63. A large number of other agencies and commercial companies have also supported research.



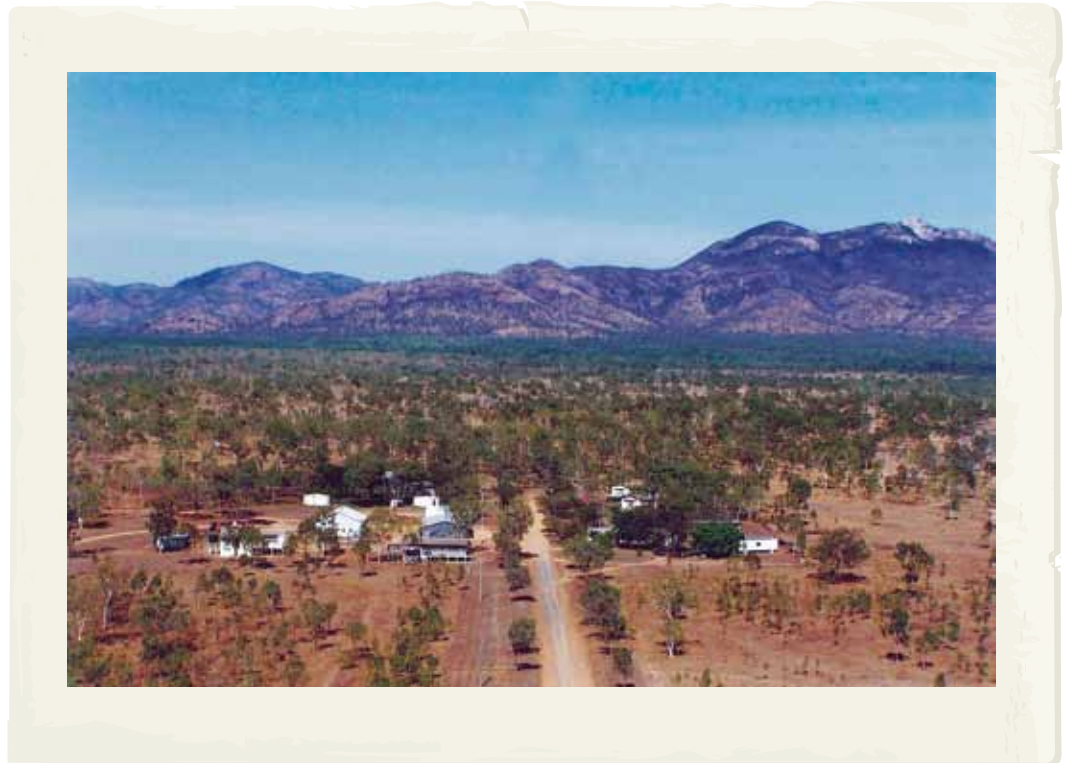
*Swan's Lagoon, September 2004 – the name was reportedly taken from a postman whose surname was Swan. He used it frequently to camp on his run.*

## The resource

### The station

To enable practical operation of research, Swan's Lagoon has more than 150 paddocks ranging in size from a few hectares to several thousand hectares. Each paddock is watered from an extensive, integrated system using water pumped from the main lagoon, three dams and seven bores. Two major sets of cattle yards and three smaller yards service the station. A large pen complex adjacent to the main yards has serviced nutrition research since 1974. All infrastructure is serviced by an extensive road network.

Swan's Lagoon has two small office buildings plus four houses for station families, and single accommodation for eight staff. Two large sheds complement the hub of the station, and they house motorbikes, 4-wheel-drive vehicles, a truck and some heavy machinery necessary for station operations.



*The Swan's Lagoon office area looking east to west towards McGregor's Bonnet at the centre of the station*

### Livestock

Typically, Swan's Lagoon carries at least 3000 cattle and up to 50 horses for mustering. The cattle have been used for on-station research as well as providing animals for research at other sites across Queensland.

After stocking initially with typical industry Shorthorn-Devon cattle, Brahman crossbreds were introduced and bred from 1963. High-grade and crossbred Africander and Sahiwal herds have existed, but only Brahman and Brahman-cross cattle have been maintained in the past 25 years.

*Two-year-old Beefmaster heifers on the main lagoon, December 1994*





## Management

The busiest period is the April–May muster which entails mustering most station cattle, foetal ageing, selection and culling, regrouping cattle, branding, weaning, weaner training and cattle vaccinations. During this period, waters have to be kept operational and experimental measurements continued.

In the early years, first round mustering in the Expedition area, which was acquired in 1978, was a great challenge. To achieve an 80% muster after a full day in the saddle of a single, large, heavily-forested paddock populated with brumbies was quite an achievement. Fortunately, infrastructure development left those days in the 1980s.

One of the most stressful periods of the year for both livestock and staff is the late dry season, with the concurrence of survival management and calving. The break in the season is always very welcome. Supplementation using molasses-urea in roller drums dominated research for many years, with a shift to fortified molasses supplements in the 1970s and 1980s.

Disease control has been effective through breeding tick-resistant cattle, combined with strategic health care including vaccination against vibriosis, tick fever, botulism and other clostridial diseases.



*Swan's Lagoon station hands, June 2005*



*Cattle on M8U at Teddy's Mill, November 1994*



*Smoko time, Expedition yards shed, May 2002*

## Research outcomes

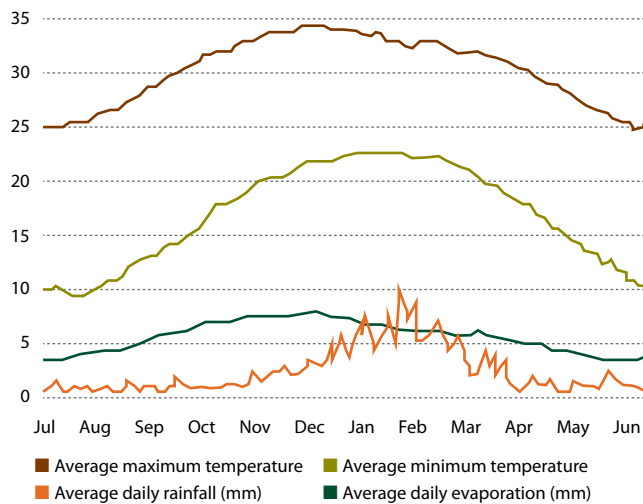
### Urea-sulphur supplements

As dry season supplementary feeding based on urea to overcome protein deficiency became established within the Queensland beef industry, Swan's Lagoon trials developed the principles for its use. Many studies demonstrated that urea needed balanced sulphur to be effective. The main effect of urea-sulphur supplements was shown to be increased energy intake by cattle, with dry season pasture intake typically increasing by 30–50%.

These supplements were shown to increase feed intake in weaners when faecal protein levels fell below 8%, which in the dry tropics usually occurred during April. Dry season weight loss was reduced and mortalities prevented. Weight benefits are usually lost in the following wet season, but they can improve lactating cow pregnancy rates by about 10–15% for each body condition score preserved into mating.

Urea by itself is unpalatable and quite toxic if eaten to excess. Many forms of urea-sulphur supplementation were tested at Swan's such as molasses-urea in roller drums, 'home brew' (grain, molasses, urea, salt, phosphorus), salt-based licks, and dispensing into drinking water. Mixing urea-sulphur with salt and some protein meal achieved higher and less variable intakes and is now standard beef industry practice, e.g. mixes such as 30% urea, 6% ammonium sulphate, 12% calcium phosphate, 5% protein meal and 47% salt.

Shifting supplements in a paddock had no effect on the areas grazed, but significantly reduced intake if sited 2 km or more from waters.



*Average daily temperature extremes, evaporation and rainfall at Swan's Lagoon – derived from Bureau of Meteorology SILO interpolation since 1889*



*Pens used for nutrition research, September 2004*

## Fortified molasses

Early experiments with straight molasses showed it to be ineffective as a supplement despite it being energy-dense. Initial studies with molasses-urea feeding of weaners during the dry season on Swan's Lagoon were the first to document weight gains in supplemented weaners when un-supplemented weaners were losing weight. This led to development of fortified molasses, in which various combinations of additives such as urea, protein meals, phosphorus and salt, balance its deficiencies and meet the objectives of feeding it to cattle. Experiments at Swan's Lagoon over several dry seasons concluded in 1979 that 6–8% urea in molasses was a good percentage to control supplement intakes to suitable levels—the basics of the now ubiquitous M8U (Molasses with 8% urea).

The huge benefits of feeding fortified molasses were demonstrated on a vast scale in the 1982 drought, when M8U and other mixes with protein meals saved countless cattle lives in Queensland, including Swan's Lagoon.

The next phase was the development of mixes of molasses to increase growth and reduce sale age. From many component and systems studies, MUP was developed—typically molasses with 3% urea, 10% protein meal, 1% dicalcium phosphate (DCP), 1% salt plus monensin. Various mixes can achieve growth ranging from 0.3 to over 1 kg/day on dry pasture. MUP is a valuable commodity for managing small weaners. MUP systems have been shown to achieve a net annual weight gain of at least 30 kg, and have been quite profitable when used for production feeding of weaner steers.

A recent systems study showed that targeted use of M8U and MUP for cows and steers increased weaner weights and annual growth, with almost all steers reaching 500 kg by 2.5 years of age. Very few steers produced under strategic low-input management achieved this target.

*A steer weighing 550 kg at 2.5 years of age after receiving MUP in his first two dry seasons, May 2006*



## Stylos in tropical pastures

Swan's Lagoon research has contributed significantly to the introduction of Stylosanthes-based pastures to Australia's dry tropics. This began with Townsville stylo which was decimated by the fungus Anthracnose in 1974. Research attention then shifted to introductions from Central and South America and achieving stability of stylos with other pasture species on poor quality soils.



Seca stylo was shown to increase annual cattle growth by up to 20 kg. Other stylos had less effect if used alone. The Swan's Lagoon work showed that phosphorus-fertilised stylo pastures consistently increased annual cattle growth per ha by at least 50 kg. The fertiliser effect persisted for more than 20 years after it was discontinued. Feeding phosphorus to steers on unfertilised Townsville stylo during the growing season significantly increased steer growth rates.

*First station manager, Rod Strachan, (kneeling!) in a Townsville stylo pasture in 1965*



### HGP use in steers

Studies with hormonal growth promotant (HGP) began in the late 1970s. HGP is administered as a small implant under the skin of the ear. Initial research at Swan's Lagoon and elsewhere established that most HGPs increase growth by 5–25% during their active period. None has been found to affect dry season growth, even when energy-rich supplements such as protein meal are fed. HGP is now widely used in the beef industry.



*Brahman steers nearing slaughter weight in the Growth Pathways Optimisation project, March 2010*

### Heifer fertility management

Heifer pregnancy rates are mainly a consequence of the proportion reaching puberty by mating. Swan's Lagoon research has shown that Brahman females reach puberty on average at two-thirds of mature body weight. The average for crossbreds is slightly lower. For typical beef cattle today, average weight at puberty is near 330 kg. However, the variation is very large, with some reaching puberty 100 kg lighter, and some 100 kg heavier than the average. Overall, the basic recommendation from Swan's Lagoon and related work is that, to achieve high pregnancy rates, heifer groups need to average at least 380 kg during the ideal mating period.

The consequences of yearling pregnancies, whether controlled or through lack of bull control, have been well researched at Swan's Lagoon. Pregnant yearlings need to maintain their body condition through pregnancy to prevent calving difficulties. Controlled yearling mating is a good option when high growth rates and pregnancy rates are achievable.

*Year-old Beefmaster heifers supplemented with fortified molasses and about to be mated, December 1995*





### **Cycling, conception and weaning rates**

Swan's Lagoon research has demonstrated the challenges in achieving a calf every year from every cow. Initially, females have to reach puberty or start cycling again after calving. Time of puberty is mainly controlled by weight. A body condition score of 3–4 (moderate-good) is needed for lactating cows to achieve adequate pregnancy rates. Once cycling and free of reproductive diseases, only two-thirds achieve pregnancy each cycle (which averages 21 days). In 1995, four of five heifer groups on Swan's Lagoon achieved a 100% pregnancy rate after three months mating.

At Swan's Lagoon, the benchmark in continuously-mated cows for loss between confirmed pregnancy and weaning was 8%, with the largest period of loss being within a week of birth. The reasons for higher calf loss under extensive conditions are quite difficult to research, but contributors such as poor cow body condition, poor teat and udder structure, predators and low weight and vigour at birth have been identified.



*Beef CRC Brahman cow and calf*

## Efficient breeding systems

High breeding herd production efficiency can be achieved with astute management, even on phosphorus-deficient soils. Over 15 years at Swan's Lagoon, the continuously-mated Brahman cross herd achieved a weaning rate of 83%, that is, 83 calves weaned per 100 cows mated in the previous year. The average weaner weight was about 165 kg with approximately 70% being over 150 kg. This was achieved by management that focused on maintaining cow body condition; the major strategies were safe stocking rates, adapted cattle, weaning all calves 100 kg or heavier at the two annual musters in early May and late August, and strategic supplementation.

Three-month annual mating of Brahman crossbreds achieved a long-term average weaning rate of 73% with an average weaner weight of 170 kg. Analyses of 12 years of data showed that 68–84% of the variation in annual pregnancy rates could be explained by weather events between July and November the previous year, thus confirming the importance of maintaining cow body condition.

Weaning management was critical in cow production efficiency. Delaying weaning of calves to the second round typically costs cows 30–40 kg live weight and 30% pregnancy rate the following year; the effects accrue on a daily basis and timing of weaning is critical. Calves weaned later are heavier at that time, but by 2–3 years of age, the difference has mostly gone; for example, no pregnancy rate advantages occurred for heifers. The conclusion was that it is much cheaper to wean the small calf at the first round muster and feed it a supplement than to leave it suckle till second round. Though weaning triggers non-pregnant cows to cycle, the biggest advantage is the preservation of condition through its effect on reduced management costs and increased pregnancy rates the following year, more calves the year after, and ultimately more steer sales, which is the major profit centre.



*One of the foundation bulls (880015) for the nucleus bull-breeding herd, March 1995 – with low-input management, this herd achieved an average weaning rate of 88% and mature cow weights exceeding 500 kg*



*Geoffry Fordyce foetal ageing, September 1989*



*A Brahman calf nursery, December 2008*

### **High-input breeding systems**

In collaboration with James Cook University scientists, detailed studies between 1986 and 1994 of nutrition effects on ovarian function in lactating cows led to the development of spike feeding, a strategy now widely used in the North Australian beef industry. First-pregnancy females are supplemented with the energy equivalent of free access M8U for 50 days late in the dry season prior to calving. This strategy increases pregnancy rates during their first lactation by an average of 20%. It is a consequence of supporting healthy egg development during the 5 months it takes before ovulation and pregnancy; that is, a cow is preparing for her next pregnancy during her current pregnancy. Spike feeding simulates the effects of early storms.

Spike feeding has been incorporated into systems studies where it has been demonstrated to be profitable, but only when other systems management is well advanced.



*The late Ian Kendall during spike feeding research with M8U, October 1990*



### Reducing cow mortalities

Poor nutrition is an annual challenge facing cattle during the dry season. Cows are particularly susceptible if they are in late pregnancy or are suckling a calf because of the high energy demand. Swan's Lagoon research clearly shows that reproductive status is as much a consideration in survival management of cows as body condition. If both criteria are used when drafting cows for feeding, 1–2 months of expensive supplementation under drought conditions can be saved.

Adapted cattle, safe stocking rates, and good weaning management have all been demonstrated at Swan's Lagoon to preserve cow body condition and increase survival. A secondary benefit of these strategies is that cows tend to synchronise their reproduction with the seasons, thus further reducing their risk and requirement for expensive survival management.



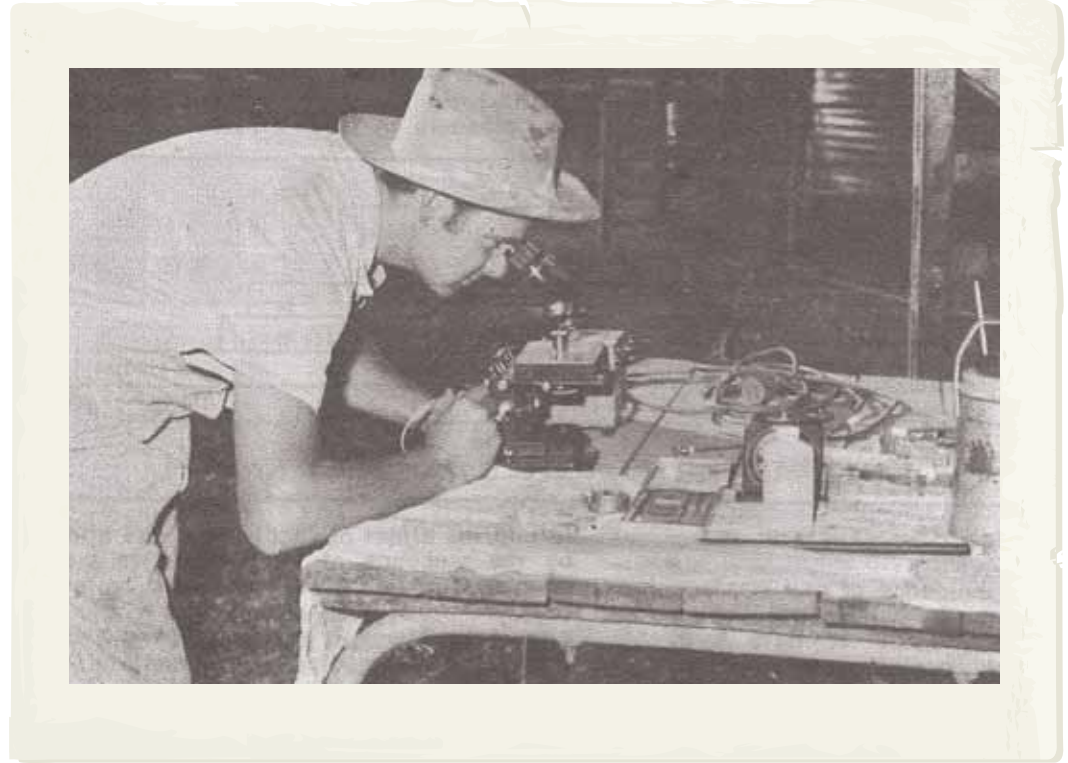
*Neil Cooper leading the 2001 Beef CRC  
Brahman weaner heifers, January 2002*

*Trevor Morrison mixing molasses and protein  
meal at Teddy's Mill for drought-stricken  
cows, December 1982*

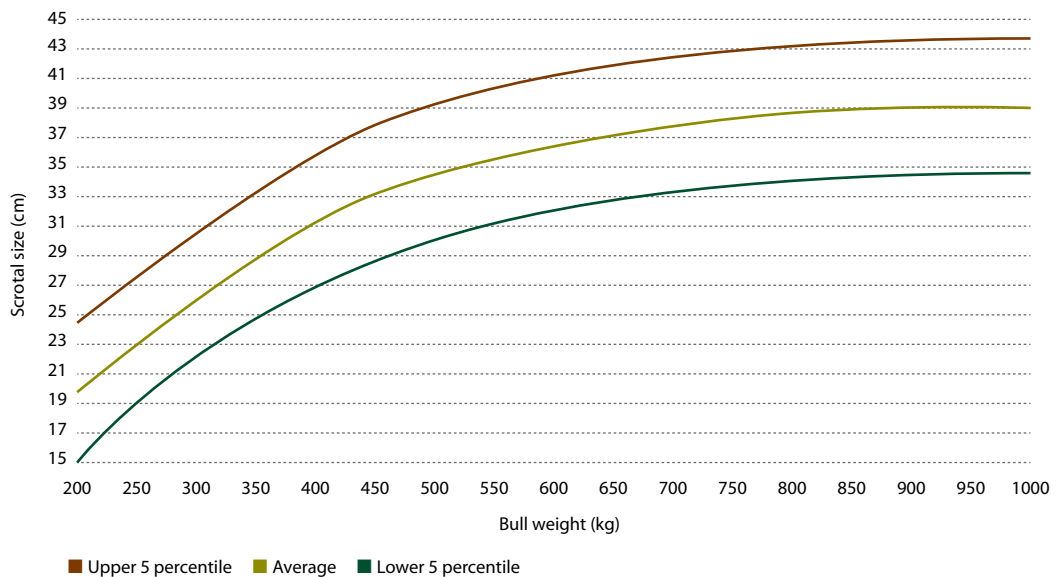
## Selecting fertile bulls

Swan's Lagoon research over many years has made a significant contribution to the Australian standards for bull reproductive soundness. Sperm morphology is a standardised assessment using powerful microscopes to determine the percentage of normal shape sperm. Single sire mating studies demonstrated that bulls with less than 50% normal sperm are subfertile.

Studies of serving assessment by bulls over many years have failed to demonstrate its ability to predict calf getting ability, other than to identify bull defects.



*Dick Holroyd assessing bull semen, 1975*



*Swan's Lagoon and other data showed that tropical bull weight is a good predictor of scrotal size, irrespective of breed. This graph can be used in breeding soundness evaluations and when selecting bulls to breed more fertile female offspring.*



### **Bull management**

North Australian beef producers are slowly starting to reduce bull to female mating ratios after Swan's Lagoon and allied research showed that no matter how many bulls there are, 2% achieve most of the pregnancies. This is hardly surprising given that a typical fertile bull produces at least one million normal sperm per minute and enough for a fertile ejaculate every 5 minutes. As few as 1.5% bulls were shown to be adequate even in large paddocks, as long as they remain fertile. This work underpins the recommendation that 2.5% of reproductively-sound bulls is adequate under North Australian conditions.

Swan's Lagoon studies showed bulls to be highly territorial and there appears to be a threshold at about 3.5% bulls, above which their fighting causes reduced body condition as well as significant injury.

*A Swan's Lagoon Brahman-cross bull in Burns paddock, March 2006*

### **Tropical cattle growth genetics**

Early Swan's Lagoon studies showed the growth and survival advantages of adapted *Bos indicus* cattle and their crosses. As *Bos indicus* options, Brahmans were a larger breed with higher growth than Sahiwals.

Swan's Lagoon performance recording of pedigreed cattle showed that weight and growth rates are moderately heritable. Selection of calves with high growth during suckling was found to indirectly select for slower-growing, smaller cattle.

Recent Beef CRC research on Brahman heifers found heritability of about 40% for weight and fatness measures, 60% for hip height and 25% for eye muscle area. Blood level of a liver hormone called IGF1 (a metabolism regulator) at 18 months of age is 40% heritable in heifers, and higher levels are genetically related to both heifers and steers being heavier and fatter.



*Two-year-old Sahiwal bulls in the Millaroo yards, 1985 (Bulls surplus to research were sold to beef producers)*



## Tropical cattle reproduction genetics

Breed differences in weaner production have not been shown to be substantial at Swan's Lagoon. Within breed, the importance of adaptation and growth was demonstrated by a high genetic correlation between ability of cows to hold condition in the dry season, and their lifetime calf output.

Internationally-significant Beef CRC research in recent years at Swan's Lagoon and other Queensland sites has shown that half the large variation in heifer weight and age at puberty is due to genetics; for example, the average weight at puberty for the progeny of some bulls is more than 100 kg lighter than the average for others. The genetic relationships of both scrotal circumference and 18-month IGF1 blood levels with weight at puberty offer potential methods to breed for this trait.

A more exciting find is that the ability of Brahman cows to cycle during lactation, especially in their first lactation, is highly heritable. Further, female progeny of bulls with a high percentage of normal sperm cycle conceive more readily during lactation.

Selection on these reproductive traits may significantly improve tropical breeder herd efficiency. Current research shows promise for gene markers which will enhance this opportunity.

*Two-year-old Beef CRC Brahman heifer on Swan's Lagoon*



## Coccidiosis

Post-weaning diarrhoea is commonly seen in North Australia and often attributed to 'worms'. Swan's Lagoon research has shown that it is more often due to coccidiosis. This disease causes acute loss of 10 to 30 kg live weight. The protozoan parasite is a normal gut inhabitant, but causes clinical disease about a month after calves suffer immune depression brought on by the stress of weaning; a major stress is thought to be failure to start weaner feeding immediately after separation from their dams.

Adequate yard and pasture nutrition with supplementation to at least maintain weight is the best method to prevent stress in weaners, and thereby reduce the incidence of coccidiosis. The disease can also be prevented by low-dose monensin in supplements.



*Small weaners with coccidiosis being offered medicated fortified molasses for treatment, July 2008*



### Cattle trapping

A short-arm spear trap was developed at Swan’s Lagoon as an alternative to the traditional large timber traps. The design is now widely used across the beef industry.

This work progressed to a novel animal-powered device for separating calves from their dams on waters with trapping enclosures. The separator was demonstrated to achieve near 100% calf separation under commercial conditions. It was used in creep feeding research on Swan’s Lagoon. Despite its potential for low-stress calf separation, its use requires training and retraining of cattle and complementary infrastructure such as a transportable cattle handling module. This research has provided a base for substantial research that has followed in North Australia.

*A Hirst spear trap operating in the Charters Towers area*

### Station managers

Many hundreds of people have been employed at Swan’s Lagoon in its 50 years as a research station. Their work has been integrated by the station manager. These people have to be good cattle managers, people managers, and business managers, as well as being able to understand and support research within the administrative framework of the department—quite a challenge!

The first manager was Rod Strachan, appointed on 12 March 1962. In all there have been 15 managers at Swan’s Lagoon. Each has added his personal mark to the development and maintenance of Swan’s Lagoon as a beef cattle research station. Two have had paddocks named after them: Strachan and (Russ) Tyler. Many were young men as managers, and have gone on to distinguished careers in the beef industry, many within Queensland Government beef advisory and support services.



*Historical versions of former managers, Peter Smith (1969–1970) and Alan Laing (1985–1988)*

## Science leaders

Swan's Lagoon-based scientists are the people who have built its reputation. The science leaders have tended to have the longest tenures at the station with people such as Lyle Winks, Dick Holroyd, Stu McLennan, Geoffry Fordyce, John Lindsay and Rob Dixon each stationed there for over 10 years.

Applied science has been the strength of Swan's Lagoon and collaborating scientists have played a vital role. In this regard, the relationship between Swan's Lagoon and James Cook University's Department of Tropical Veterinary Science was very strong for over 20 years.

Biometrics is a vital element of successful research. Swan's Lagoon scientists have had a long association with many outstanding biometricians including Peter O'Rourke, Vivienne Doogan, Tony Swain, Pat Pepper, Bob Mayer, David Reid, Angela Reid and Kerri Dawson.



*Lyle Winks, Scientist, Swan's Lagoon 1965-1976*

## Getting and selling the message

A major strength of Swan's Lagoon operations was the advisory committee which operated for 40 years. The committee comprised beef industry representatives and departmental stakeholders. The annual reports to this committee provided a very strong avenue for extension of research outcomes to industry. At the same time, industry issues coming through this committee were vigorously debated in formulating research projects that then had strong industry and government support.

Arthur Clay, Director of the Department of Primary Industry's Division of Animal Industry led the purchase and development of Swan's Lagoon, and initiated the advisory committee as its Chair till 1968. The early committee had the services of Max Burns and Don Stapleton, who were Townsville-based beef advisers, and two very capable beef producers in the region, Dr Jock Allingham and Humphrey Heatley who served the committee with distinction for 19 and 16 years, respectively. Humphrey's son Don (MLA chair 2005–2011) also gained some early career experience on the committee.

In excess of 300 publications have been generated from Swan's Lagoon research. This is a valuable contribution to beef industry science, especially when combined with countless other delivery processes including six large field days that have previously been held on the station.



*Rebecca Hall and Geoffry Fordyce presenting to the NBRUC field day, March 2007*



## Rudi Wyburg

Any operation that has been a success owes it to outstanding people. Swan's Lagoon owes its success to many outstanding people based there. One special person was Rudi Wyburg who was employed by Rod Strachan in 1963. She was still there 47 years later in 2010 when she passed away.

Rudi was everyone's personal assistant, and with a staff complement usually of 10–20, that is a huge task. She conducted it with grace and skill. Prior to computers, all neatly presented output from the station was joyfully tapped through Rudi's manual typewriter. As well as the mountain of routine administrative requirements of a government department, she had many secondary duties peculiar to rural locations. In her earlier years, helping with station livestock work was par for the course. Managing station and family purchases on the weekly 'bun run' to town (Ayr) was also her task.

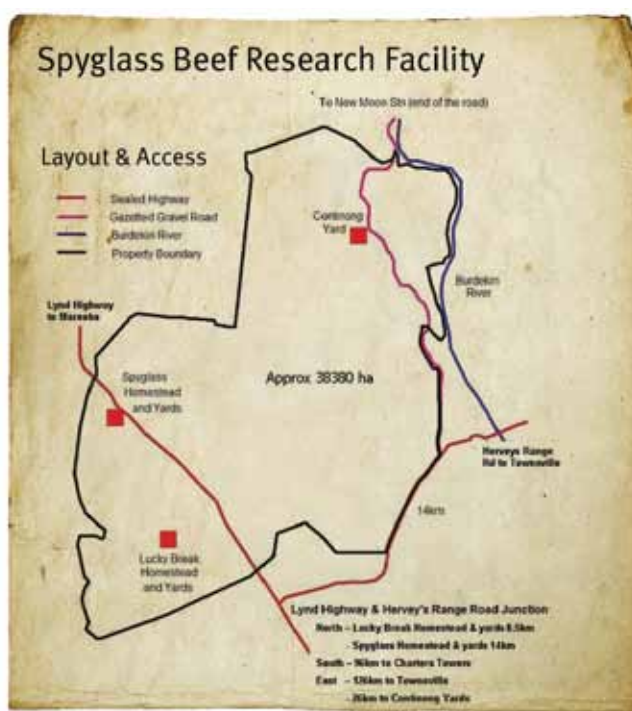
She will always be missed by the Swan's Lagoon 'family'.

*Rudi Wyburg at her 65th birthday party,  
18 October 2006*



## Spyglass – a fresh approach

Producers in the northern beef industry have made great strides over the last 50 years to improve cattle production efficiency using the results of work from Swans Lagoon. However the research, development and extension (RD&E) effort to support the northern industry for the next half century will now move to the new beef research facility at Spyglass in the upper Burdekin area.



Consisting of two previously family-owned properties, Spyglass and Lucky Break, which were balloted off Hillgrove in the 1950s, the 38 500 ha Spyglass Beef Research Facility has a diverse range of land types, including Narrow-leaf Ironbark, Box and alluvial country, that are representative of the wider region. The property can carry over 4000 cattle. Managing and improving savannah pastures, cattle genetic improvement strategies to improve beef production efficiency, and managing nutrition will be major research themes.

Research outcomes with direct application to beef business will be a major focus of Spyglass activities. As an example, the links between the abundance of better grass species, cattle performance and economics is understood at small scales, but needs quantifying at the herd level. A

systems approach to RD&E will help increase the rate of adoption by graziers of practices that not only improve land condition and water quality, but lift animal performance and increase financial viability. The location of Spyglass on the Burdekin River will create opportunities to evaluate diversified land uses such as high-return, intensive agriculture on small areas that might attract other industries into the region.

Collaboration with scientists and beef industry advisers from other agencies to increase RD&E efficiency will be a feature of Spyglass. Partnerships with multiple state government departments, Australian and overseas universities, agribusiness, AgForce and North Australia Beef Research Council (NABRC), MLA, CSIRO and other RD&E agencies will provide a breadth of research expertise and capability for the activities conducted on Spyglass. This expertise will create training opportunities for many including graziers and university post-graduates.

Whatever is done on the property, primary producers will have the opportunity to see the future of their industry by looking through the Spyglass.

