



THE AUSTRALIAN WATER BUFFALO MANUAL

Barry Lemcke

Department of Primary Industry and Resources

Northern Territory Government



RURAL INDUSTRIES
Research & Development Corporation



**NORTHERN
TERRITORY**
GOVERNMENT

FOREWORD

The Australian Water Buffalo Manual is a technical manual for the buffalo farming industry in Australia. Its author, Barry Lemcke, is a Northern Australian livestock scientist with over 42 years of experience, including a career focus on buffalo management research.

The Manual reflects the extent of Barry's knowledge and experience gained over his long career and is written in a style that makes the information accessible for all readers. It includes findings from research undertaken at Beatrice Hill Farm, Australia's only buffalo research and development facility as well as from Barry's travels related to the buffalo industry in numerous countries. The success of the dual purpose NT Riverine Buffalo derived from Beatrice Hill Farm, which now have progeny Australia-wide, can be largely attributed to Barry's knowledge, dedication and persistence.

John Harvey
Managing Director
Rural Industries Research and Development Corporation

ACRONYMS AND ABBREVIATIONS USED

AACo	Australian Agricultural Company
ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
AI	Artificial Insemination
AMIEU	Australasian Meat Industry Employees Union
BEF	Bovine Ephemeral Fever
BHF	Beatrice Hill Farm (Northern Territory Government Buffalo Research Facility)
BTEC	National Brucellosis and Tuberculosis Eradication Campaign (Australia)
cv	Cultivar
DM	Dry Matter
EEC	European Economic Community
ESCAS	Exporter Supply Chain Assurance Scheme
EBV	Estimated Breeding Value
FAO	Food and Agriculture Organisation of the United Nations
ha	Hectare
IVF	In-Vitro Fertilisation
MRT	Mean Retention Time
NLIS	National Livestock Identification Scheme
NT	Northern Territory
NTDPIR	Northern Territory Department of Primary Industry and Resources
RIRDC	Rural Industries Research and Development Corporation
TB	Tuberculosis
US or USA	United States of America
USSR	Union of Soviet Socialist Republics

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Chapter 1

INTRODUCTION

INTRODUCTION

WORLD DISTRIBUTION

In 2008 the world Water buffalo population was estimated at around 180.7 million, 96.0% of which were located in Asia (FAOSTAT 2008). In 2013, this had risen to 199.8 million, mainly due to rapid rises in the Indian and Pakistan populations, up by almost 17 million and 4 million respectively (FAOSTAT 2013). There have been some declines in Water buffalo numbers in many South East Asian countries, due to increased slaughtering rates. This compares with the 2013 world cattle population of 1468.0 million head, 495.0 million of which were located in Asia (FAOSTAT 2013).

In 2008 the total world Water buffalo population was distributed as follows (FAOSTAT 2008):

- South Asia 74.8%
- East Asia 12.8%
- South East Asia 8.4%
- Rest of world 4.0%

In 2008 the average annual growth rate in population was estimated to be 1.24 per cent. As can be seen in the population figure increases, this rate was clearly exceeded.

The largest Water buffalo populations are found in the following countries.

Table 1.1 World Buffalo Population in 2013.

Country	Million Heads	Milk, Whole Fresh (tonnes)	Meat (tonnes)
India	109.4	70 000 000	16 100 000
Pakistan	33.70	24 370 000	833 000
China	23.25	3 050 000	336 900
Nepal	5.24	1 188 433	175 132
Egypt	3.92	2 614 500	390 000
Myanmar	3.32	309 000	45 900
Philippines	2.91	-	99 119
Vietnam	2.56	31 000	93 740
Indonesia	1.11	-	40 255
Bangladesh	1.47	39 000	6 470
Brazil	1.33	-	-
Thailand	1.29	-	34 700
Laos	1.19	-	19 580
Cambodia	0.68	-	9 600
Italy	0.40	194 893	11 858

Source: (FAOSTAT 2013); - = data not available.

BREEDS WORLD-WIDE

There are three broad categories of Water buffalo currently in production worldwide:

- **Swamp or Carabao** (48 chromosomes). Mostly found in East and South East Asia; in China, Thailand, Philippines, Myanmar, Laos, Cambodia, Malaysia, Vietnam and Indonesia.
- **Riverine or River** (50 chromosomes). Mostly found in Southern Asia; India, Pakistan, Nepal, Bangladesh and Sri Lanka.

- **Mediterranean** (50 chromosomes). Mostly found in a crescent of countries surrounding the Eastern Mediterranean, from Egypt to Turkey and through to Italy, the Baltic countries, southern ex-USSR and the Middle East.

Despite a slight similarity in name and looks, Water buffalo are only very distantly related to the African Cape buffalo (*Syncerus caffer caffer*), similar to their relationship with cattle (all ruminants of Family Bovidae and Tribe Bovine). Bison also share in the same very distant relationship.

Both the African Cape buffalo and Bison are a much more difficult animal to domesticate compared with the Asian Water Buffalo and this is a near impossible task if the animals are not reared from calves.

Swamp Buffalo

The Swamp Water buffalo is widespread throughout China and South East Asia and has distinct markings on the neck and brisket (chevrons), lighter-coloured socks and wide shaped horns. There are many colours – grey is predominant. However, there are piebald (grey with white patches), pink, albinoid (white) and spotted types.

The Swamp buffalo has basically been the “tractor” of South East Asia, particularly in the rice paddies because they have much larger feet and hooves than cattle, giving stability and traction in muddy conditions. They have gradually been superseded in this task by engine-powered tilling machinery.

The legacy of this history is that in those countries where draught power was their primary use, the only animals that were used for meat were those that were no longer able to achieve the rate of work that was expected of them. Therefore, mainly older animals were used for meat. As they were not usually in good condition, this meat had a higher connective tissue content due to age low solubility (tougher) and was darker in colour, than if the animals had been slaughtered before maturity.



Figure 1.1 Mature Swamp buffalo cows in Victoria.



Figure 1.2 Swamp buffalo bull (3 years of age) at Beatrice Hill Farm (Northern Territory).

The Swamp buffalo appears to be fairly uniform over South East Asia and may only vary in the amount of heterozygosity found in the chromosomes (Barker et al. 1997) in the various country populations.

The carcass composition of the Swamp buffalo was characterised in early work in Australia (Charles and Johnson 1972). While meat yields are satisfactory, the eye muscle in the Swamp buffalo is fairly flat and the hide is relatively heavy, which reduces the dressing percentage and meat yield of the carcass. Both of these attributes can be improved by crossbreeding with the River buffalo. This results in a significant increase in the size and shape of the eye muscle area as well as a reduction in the hide weight, thereby gaining both a higher dressing percentage (up to 4 percentage points higher) and higher carcass meat yields (2 to 4% higher).

Coupled with the big weight-for-age difference exhibited by the crossbreed which affects tenderness, crossbreeding is definitely the more efficient pathway for meat production. The added advantage of the crossbreed is the dairy attributes of the female progeny which increase its marketability. In some other countries, there are reports of infertility in the F1 hybrid (possibly due to 49 chromosomes). In the Northern Territory, this has not been observed in females or in the small number of F1 bulls that were used in early crossbreeding.

River buffalo

Unlike the Swamp Buffalo, there are many recognised breeds of River Buffalo, found mainly in India. There are 17 known breeds in India/Pakistan where the bulk of the world buffalo population exists: Bhandawari, Jerangi, Jafarabadi, Kundi, Kalapandi, Manda, Mehsora, Murrah, Nagpuri, Nili-Ravi, Pandapuri, Surti, Sambalpur, South Kanara, Tharai, Toda, and Godavari (most recent crossbred).

Many of these breeds are regionally based and not widespread. All have 50 chromosomes (25 pairs). There are also many crossbreeds of these breeds e.g. Godavari, but not necessarily named.

There are many and varied horn shapes and configurations from tightly curled, to long and downward or backward sloping.

In India, the principal traditional uses of buffalo are for dairy and draught power, but meat production has also increased dramatically over the last 10 years with 1.56 million tonnes exported during 2013 (valued at USD \$4.49 billion), mainly for export to South East Asia (Vietnam takes approximately 33% of total exports), the Middle East and Africa (Beef Central 2014). This compares with 0.456 million tonnes in 2009. (Cruz 2010). A large amount of the buffalo meat was from surplus males and cull cows from the dairy herd. The recent increases in the Indian buffalo population were due to the much greater number of male calves being reared for meat that were previously culled at birth. (The mortality rate has dropped from about 80% for male calves down to 7-8% since the “Pink Revolution” (Cruz 2010)).

Buffalo account for 30% of the total bovine population in India where there is a ban on the slaughter of cattle for Hindu religious reasons. Buffalo milk accounts for greater than 60% of the total milk production of India. India is now the largest “beef” meat exporter in the world, due to its buffalo meat exports. In 2015, Australia was slightly higher. This meat trade is rapidly expanding through exports as not much meat is consumed in India despite its huge population, due the Hindu majority having a high proportion of vegetarians.

The Nili-Ravi, Murrah and Kundi are the dominant milk-producing breeds, with reputedly the highest milk yields. Individual yields in India are often hampered by lack of nutritional inputs, reducing potential milk yields. There is huge market in India for sweets using milk (buffalo) and sugar as the base ingredients.



Figure 1.3 The four original imported US Riverine cows (1995-97), photographed in 2008 at Beatrice Hill Farm in the Northern Territory.



Figure 1.4 Typical Murrah breed cow in Argentina with tightly curled horns.

Mediterranean Buffalo

This is the third distinct buffalo population grouping that extends from Egypt through the Middle East, Turkey, the Balkans, Italy and into southern ex-USSR countries. There are also small herds spreading into Switzerland, Germany and the United Kingdom. This breed was probably derived from the Indian breeds many centuries ago through movements to the north and west.

Colour and horn shape are the main distinguishing features of the Mediterranean breed. Normally they are very black with only a moderate sweep and length of horn compared with the fuller and spreading horns of the Swamp buffalo. Of passing interest in Italy is the minor presence of Swamp-like markings in the Riverine (Mediterranean) population (chevrons, stockings) suggesting some East Asian origins as well.



Figure 1.5 A Mediterranean buffalo cow in a feedlot dairy in Italy with (not-uncommon) Swamp-type colour patterns.

In Italy, the buffalo dairy industry is well established and mozzarella cheese is a valuable and widespread product, available throughout the country and exported around the world.

The dairy recording genetic program in Italy is arguably the most sophisticated world-wide, as far as dairy buffalo are concerned. It is used widely in the dairy industry for sales of milking/stud animals. The buffalo dairy semen sector in Italy is well provided for by 2 to 3 major suppliers and semen is made available for export at reasonably affordable prices of around 10 to 30 Euros per straw. Some of the index-leading, proven bulls can be much more expensive to purchase at up to 200 Euros per straw.

Many of the Australian dairies have imported and used Italian dairy semen to counteract the likely inbreeding issues posed by the initially small, US-imported population base.

In previous shipments into Australia, semen from 11 different bulls from the same semen supplier was available and certified suitable for export. In the most recent shipment in 2015, 2 different companies supplied semen in 1 shipment and the choice of bulls has now expanded to over 40.

Importation costs can be reduced by sharing space with dairy cattle semen being imported from Italy. The other recent innovation in the Italian industry is the availability of sexed semen from a more limited number of sires. Although the cost was initially up to 7 times the cost of normal imported buffalo semen, it is now down to a factor of 3 to 4 times. There may be advantages for start-up dairy operations in Australia to be able to ensure all females are born. However, in the Northern Territory the first trial usage of sexed semen produced 37 per cent males for 1 of the 2 bulls imported.

The Mediterranean buffalo probably has lower milk yield than some of the Indian breeds but it does represent a good dual-purpose breed for meat production due to its size and growth rate potential. Milk quality (solids components) can be compromised in the genetic pursuit of volume in dairy animals. In the Northern Territory/Queensland, significant hybrid vigour (heterosis) has been found in the US River X Mediterranean crossbred buffalo for both meat and milk production (Lemcke and Suarez 2010).



Figure 1.6 Mediterranean buffalo in an outdoor yard at the "Improsta" Campania Regional Research Farm in Italy.



Figure 1.7 Italian buffalo bull being exhibited at the Third Annual “Mostra Nazionale” Show (Italy) in 2007.

Many years ago when under communist rule, Bulgaria embarked on a national program to increase the milk production of the Mediterranean breed by crossing with the Murrah from India. This evolved into the Bulgarian Murrah which was exported to Australia, Canada and the Philippines for dairy production. The Bulgarian Murrah population has declined in Bulgaria in recent years since the collapse of communism in that country.

The first importation of Bulgarian Murrah and Italian buffalo direct into Australia was into the state of Victoria in 1994-95. The Bulgarian Murrah did not perform as well as the Italian in that region/climate and were gradually bred out of the herd in favour of the Italian genetics.

GROWTH AREAS FOR BUFFALO IN THE WORLD

Apart from India, the main non-traditional continents where buffalo population increases have occurred have been the Americas. South America was the first, mostly within the last 100 years, and is currently expanding numbers at 12.7 % per year (Zava 2010). Brazil has by far the highest numbers (around 85 % of the total of the Americas’ herd) and the most advanced buffalo industry. Then follows Venezuela and Argentina. Columbia has a more recent thriving industry, while the newer players are Chile, Uruguay, Paraguay and Bolivia, all with buffalo projects underway. These countries have selected breeds from many sources around the world. The Brazilian and Argentinian institutions have undertaken very advanced scientific work, especially in areas of reproduction and food science. The Brazilians did much of the pioneering scientific work in the establishment of artificial insemination synchronisation protocols.

Central America also has buffalo in Trinidad and Cuba, with initial steps also being taken in Mexico, Honduras, Guatemala, Belize, Panama and Costa Rica.

Buffalo have been in the USA for many years in small numbers. It is mainly in the last 15 years that dairying has expanded to produce cheeses and yoghurt in several states and also into Canada where three dairies have been established within the last 10 years.



Figure 1.8 A buffalo ranch in Argentina—Riverine buffalo with a mix of Indian and Mediterranean bloodlines.



Chapter 2

HISTORY OF BUFFALO IN AUSTRALIA

HISTORY OF BUFFALO IN AUSTRALIA

EARLY HISTORY OF IMPORTATION

Buffalo farming originated in Australia early in the 1800s, when settlements along the northern coast of Australia were established and provisioned by ships coming from Europe via the Dutch East Indies (now Indonesia).

Three settlements were established and abandoned after various periods of time:

- Melville Island (Fort Dundas) 1825–28.
- Raffles Bay (Fort Wellington) 1827–1829.
- Port Essington (Victoria Settlement) 1836–1849.

Accounts of these settlements can be found in Letts (1962). It appears from reports that livestock newly introduced into these settlements incurred high mortality rates on arrival and the symptoms described would suggest Northern Ironwood (*Erythrophleum chlorostachyum*) leaf ingestion and poisoning.

Most animals would have been familiar with human contact, both during the ships' passage and presumably from being subsequently locked up or tethered after arrival. Some pens would have been erected from local timber and presumably a cut-and-carry, shepherding or tethering system would have been employed. As there were no fences in those early days, escaping would have been relatively simple for animals naturally inclined to explore.

Buffalo were the most successful colonisers of all the domestic species that arrived over that early period. Buffalo escapees from the mainland settlements colonised the Top End of Australia. The exception was Melville Island due to its island isolation and distance from the mainland.

Many other domestic animals were also introduced around the same time, including poultry, pigs, cattle and horses. Remnant populations of Timor ponies, Banteng cattle and Sambar deer still exist on Cobourg Peninsula, but none of these moved as far away from the original settlements as the buffalo.

Over the ensuing 170 years, the Cobourg Peninsula escapees or abandoners kept expanding in numbers, mainly due to the good feed available on the coastal floodplains. These animals became a source of income over that period for the local people, particularly in the hide trade.

The buffalo population peaked in the 1980s at an estimated 360,000 head prior to the national Brucellosis and Tuberculosis Eradication Campaign (BTEC) during which time up to 40,000 head per year were processed through export abattoirs alone.

There are many varied accounts of the history of the buffalo industry. Books include those by Tom Cole ("Hell, West and Crooked"), Terry Baldwin, Syd Parker and other Northern Territory authors. Also of historical interest are various photos in the Northern Territory State Reference Library originating from around the turn of the 20th Century, showing buffalo around the town of Darwin.

Despite verifiable records of only three animals arriving from India in 1886, (two cows and a bull) there are numerous photographs of both Murrah and Jafarabadi breeds, some pulling carts, in old Darwin town. There are suggestions that the verified shipment were the Murrah and that Jafarabadi arrived later (Buranamanas 1963). The inference is that there must have been other unrecorded entries from India at some time. Considering ships would be frequently arriving from the west during the 1800s, this is a likely explanation.



Figure 2.1 Typical Indian origin Jafarabadi breed buffalo pulling a cart in old Darwin town. Thought to be around 1917.



Figure 2.2 Indian Murrah Buffalo in Darwin town. Actual date is unknown, but the most likely is the early 1900s.

Photos for Figures 2.1 and 2.2 (above) were kindly provided by the Northern Territory Library Nos. PH0856-15-0026 from the Bradshaw Collection (Figure 2.1) and PH0111-0030 from the Foelsche Collection (Figure 2.2).

All the early settlements other than old Darwin town had Swamp buffalo brought in from Indonesia and recorded introductions were probably less than 100 head in total. That this number managed to reach a population of nearly 360 000 in 160 years, despite the harvesting of hides over a 60-year period, is testament to the adaptability of the Swamp buffalo to the Top End environment. They thrived and spread to most floodplain areas in the Top End, down the west coast of the Northern Territory and most likely would have also made it across the Queensland border and also into the Alice Springs region.

These incursions were usually bulls that had been forced out of herds by more dominant bulls, in search of a new group of cows to join with. At the peak population count there were instances where big numbers died at the end of the dry season from a combination of starvation due to overstocking of good feed areas and getting bogged in rapidly receding waterholes.

MEAT PRODUCTION IN AUSTRALIA

The 1970s to the 1990s were mainly devoted to meat output through the domestic and export abattoirs in the Northern Territory with the impetus provided by the BTEC campaign destocking. The European Economic Community (EEC) provided very good prices because, unlike beef, there were no barriers to buffalo meat until the end of BTEC in 1997 and the subsequent reduced availability of buffalo. The Point Stuart Abattoir closed in 1986. Mudginberri Abattoir closed in 1995 and the last export abattoir, Meneling (Batchelor) Abattoir closed in 2003, followed by the Litchfield (Darwin) Abattoir (local kill only) in 2007.

The only remaining Top End abattoir that still processes buffalo for local markets is the Gunbalanya Meatworks in Arnhem Land (Oenpelli). This is only accessible by road for 6 months of the year during the dry season (April to October). The AACo Livingstone Abattoir in the Darwin Rural Area opened for business in 2014. In early 2017 it had just commenced some trial buffalo slaughtering and in the same year 2 small-scale private abattoir operations opened for local retail.

Buffalo meat is popular for manufacturing and processing due to its leanness compared with beef, lamb or pork and its good water-holding capacity for production of salamis and corned products.

Industry Representation

The Buffalo Owners and Breeders Association of Australia was formed by NT buffalo owners in 1968 and their first buffalo conference was held in 1970. In 1981, this organisation changed its name to the NT Buffalo Industry Council following a major buffalo industry symposium in Darwin to discuss the upcoming impact of the BTEC campaign.

In 2000, with the support of the Rural Industries Research and Development Corporation (RIRDC), it was instrumental in setting up the Australian Buffalo Industry Council. This is now the national buffalo organisation and is still operating today, representing owners of buffalo in all states. The only other buffalo group is the Victorian Buffalo Industry Council, a group of buffalo owners concentrating on the dairying side of buffalo production in that state. At the time of writing, Victoria was the state with the most buffalo dairies (four) and the largest number of dairy buffalo breeders.

The Live Export Trade

The 1970s saw a new chapter in the buffalo industry with the beginning of the live buffalo export trade which saw Ian Britten-Jones and David George exporting buffalo heifers from Darwin in the Northern Territory to Venezuela and Papua New Guinea in 1974. After initial problems with the Waterside Workers Federation and refusal to load cattle for Hong Kong in Darwin, agreements were eventually made with the meat workers union (AMIEU) allowing lighter weight cattle to be exported and making an opening for the live export trade to expand, including the export of live buffalo.

In 1975 buffalo were exported to Guyana and Nigeria. The discovery of bluetongue virus in the Top End in 1976 (at Beatrice Hill Farm) put a dampener on exports until 1978 when 2000 head were exported to Papua New Guinea over a 2-year period. Indonesia (transmigration programs), Cuba and other countries were also supplied in significant numbers during the 1980s. Brunei eventually became an important market for slaughter buffalo during the 1990s and early 2000s, as did Indonesia from 2005 until the live export ban in 2011.

The only significant post-2011 market for buffalo was the opening of the buffalo slaughter trade with Vietnam, commencing in early 2014. This has continued successfully into 2016 with around 5000 head exported live each year. The Indonesian buffalo slaughter trade has not recommenced due to the difficulties of pre-slaughter stunning of buffalo for Halal slaughter (ESCAS rules), which is not an issue in Vietnam. There are also fewer weight restrictions in the Vietnamese market compared to the Indonesian market.



Figure 2.3 A typical early Northern Territory floodplain buffalo property, Woolner Station (1945).

Establishment of Local Supply

The Federal Government's intention with the newly established floodplain leases post 1920 was to domesticate the buffalo and then set up a dairy to supply cheese and butter to the Darwin market and beyond. There were several issues that didn't allow this to happen which included:

- Swamp buffalo were not productive enough in terms of milk volume to supply milk in sufficient quantity for that type of market
- The only supply route to the Woolner Station was by lugger to Marsh Creek or the Adelaide River or a difficult overland journey and there was no market for the dairy produce or meat because of spoilage/shelf-life issues.

As a result, domesticated buffalo were released and allowed to free-range.

The main income from this time until WWII was the shooting of buffalo for the hide trade. The return from these operations was, at times, marginal. There was never a local hide tannery, so hides had to be shipped to Sydney or overseas for processing.

After the war, the emphasis changed to meat production as demand for hides waned worldwide following the introduction of synthetic alternatives.

Woolner Station – A Pioneer Buffalo Property

Woolner Station is located on the eastern side of the Adelaide River (70 km east of Darwin) and is typical of northern floodplain properties in the Northern Territory. At 647 km², it is smaller than the average size for the Northern Territory, where pastoral properties are mostly held as Perpetual Pastoral Leases. The maximum size of a freehold property is 150 km². Freehold tenure can result from a conversion from Crown lease tenure.

The first Top End lease to run buffalo was Pastoral Lease No. 105 (PL105) at 366 square miles, granted to George Hunter on 1 July 1927 for 42 years. The lease rental was set at 2 shillings per square mile (£36/12/00 per year), for review every seven years. The lease originally ran Shorthorn cattle which didn't compete very well with the free-roaming buffalo.

George Hunter married Thelma Dargie and had five children (Albert, David, William, Lorna and Thelma (Evelyn)). In 1931, PL105 was reduced from 366 to 310 square miles. This allowed a reduction in lease rental to £31 per annum. When George died in 1946, the lease passed to the children (David and Evelyn). Evelyn married Gil Williams in 1946 and they eventually bought out David's stake in 1952. They had three children, Barbara, Lloyd and Glyn.

PL105 was surrendered in 1968 and the new Woolner Pastoral Lease No. 793 (PL793) was registered on 1 July 1973 by Mrs T E Williams and Mr Leonard Stephens at 250 square miles. The new covenants required the establishment within 13 years of 3000 head of branded livestock, 9000 acres of improved pasture and 60 miles of stock-proof fencing.

The lease passed to the Groves family in 1982 and subsequently passed to the current owners, the Walker family in 1991.

In 1993 PL793 was surrendered and Perpetual Pastoral Lease No. 1106 was issued in its place. The current owners are running the lease as a cattle export depot, utilising the vast expanse of Para grass floodplain that has expanded greatly over a long period of time, in the dry season. This Para grass originated from seed brought back from Brisbane where the Hunter children boarded for their education. When conditions were suitable, the runners were then spread around the floodplain, often from horseback, to produce the highly valuable feed resource that it still provides today, generations later.

George's granddaughter Barbara and her brother Glyn still own the small 400 acre separate agricultural lease (No. 371) on Lake Finniss which is situated within the Woolner Station Pastoral Lease. Barbara sadly passed away in 2016.

In 1961 an abattoir was built at Woolner from local paperbark timbers and plain galvanized steel sheeting as per the plans (below).

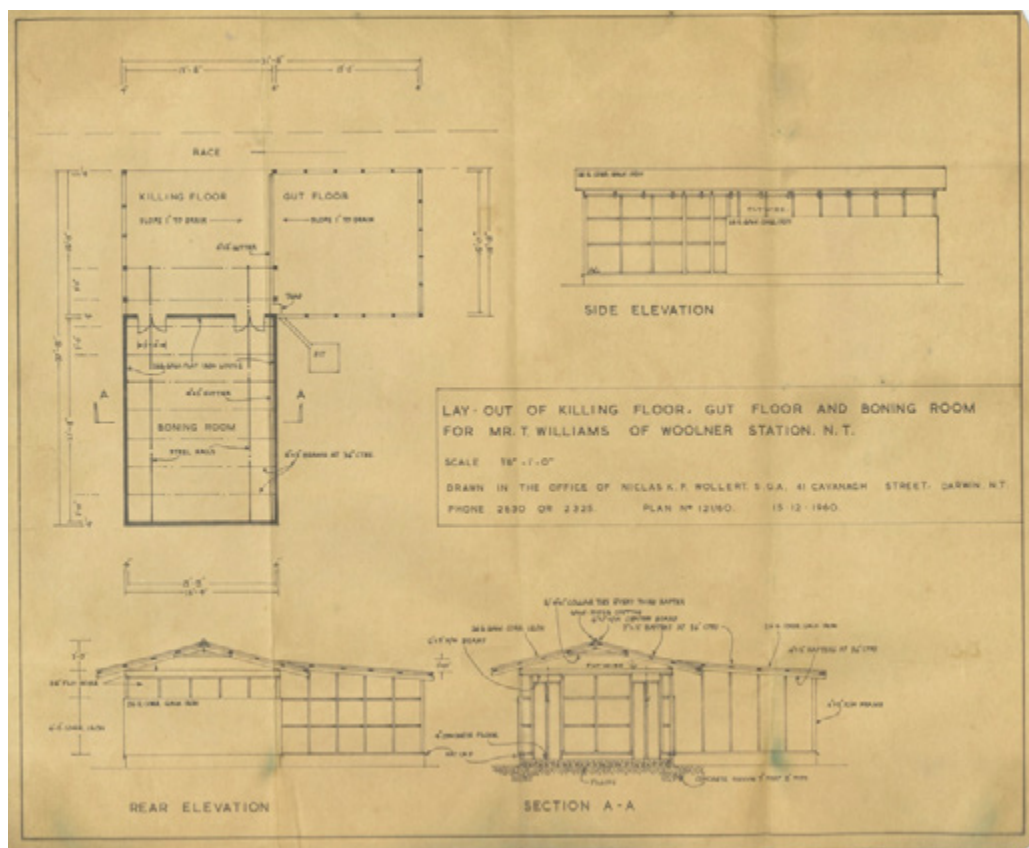


Figure 2.4 Original Plans for the Woolner Abattoir, prepared in 1960.

The abattoir was then leased out to operators who paid royalties to the owner per pound of meat harvested. The abattoir processed both buffalo and cattle meat for the Darwin market.

In 1961 a Mr Lyons was contracted to pay Mrs Williams 3 pence per lb for meat shipped out of Woolner plus £5.00 for each live animal sent off the property. Some records of numbers for July 1962 show a total of 75 head of buffalo and 5 cattle ox producing 24 395 lbs of boneless meat and 4 788 lbs of pet meat in the abattoir. Presumably a government meat inspector graded the meat to human consumption or pet meat according to condition at the time of delivery to the abattoir.

In 1964 a letter of offer was made by a Warren Wilson for a sole entry permit to shoot buffalo on Woolner for the entire period from 15 June 1964 to 31 December 1965, to process them in the Woolner abattoir and to pay 2 pence per lb plus £500 cash payment up front for the sole shooting rights. This contract appears to have been extended into the following year.

Significant numbers were processed at this time with records in 1965 showing that between June and November, 217 790 lbs (99 tonnes) of frozen meat was delivered to the Darwin Cold Stores and in the following year for the same period 127 380 lbs (approximately 58 tonnes). It is presumed that operations were restricted to the dry season, due to inaccessibility in the wet season, to shoot the animals and for transporting product to Darwin. Other product may also have been distributed to other recipients apart from the Cold Stores. The abattoir was not operated for very many years, mainly because some of the operators did not pay their dues to the owners. The abattoir was built in 1961 and power was provided for refrigeration etc. using a diesel powered 32V electrical generator that had survived WWII in Darwin, having powered searchlights during that time.



Figure 2.5 Woolner Abattoir under construction, watched over by Evelyn Williams and son Lloyd.



Figure 2.6 Woolner Abattoir in operation processing cattle, observed by Sue Harmer and Barbara Williams (sitting on the rails).

Other records held by the Williams family indicate that in 1963, product was also sent out during the wet season during January and February, usually in batches of 1500 lbs by aircraft that were used to transport meat to the Commonwealth Cold Stores in the Victualling Yards at Stuart Park in Darwin, reducing markedly both the transport time and the chances of spoilage. There were 24 recorded deliveries over a 6-week period totalling 27,320 lbs of boneless meat to Darwin. The Dragon Rapide aircraft was operated by Neville Bell. It was a 6-8 passenger plane built by de Havilland in the UK for 10 years commencing in 1934. Powered by 2200 HP 6-cylinder engines, it had a freight capability of 2150 lbs including pilot and fuel.

The heaviest load taken was 1750 lbs of meat in 50 lb boxes and several times there were 2 trips per day. The one-way trip would have taken around 20 minutes. The meat inspector did the rounds of 10-12 of these Form 15 abattoirs by aircraft, signing off on certificates for meat for human consumption or pet meat.

Abattoirs were common in the Top End at this time with field shooters operating with trailers and winches behind 4-wheel drive vehicles, shooting the buffalo in the field with high powered rifles and delivering them back to the abattoir for boning within 1 hour of shooting, as required by regulation.

The Form 15 abattoirs operated until the early 1970s in fair numbers (but continued much later in fewer numbers) until the advent of Form 8 abattoirs, (export licenced meatworks) which paid better returns to the producer. Export works were built at Mudginberri and Point Stuart (Opium Creek) in the 1970s and later in 1985 at Batchelor, resulting in an improvement in the technology utilised as the buffalo had to be delivered to the meat works live for ante-mortem inspection by a veterinary inspector and a meat inspector.

The product was available for export and usually was sent to the EEC (Germany and Sweden) where it was classified as game meat, able to bypass the beef quotas which restricted the importation of beef into the lucrative market. The product went mainly into manufacturing meat (salami etc.) where its water-holding capacity (lack of fat) was highly valued and producers were paid higher returns per kg than for beef at the time.

Greater reliance was therefore placed on the use of helicopter mustering, portable trap yards, vehicle mustering, and bull catchers. The 'bionic arm' eventually replaced the bamboo pole/lasso combination as an effective method of live capture and 'mopping-up' single animals that did not respond or were uneconomic to continue to gather using helicopter mustering.

In 1968 domestication of buffalo on Woolner and neighbouring Marrakai Station intensified.

The 1970s beef slump put a dampener on the beef and buffalo markets and domestication schemes until a resurgence in the early 1980s.

In recent years, the live export cattle market has afforded the northern coastal floodplain properties a much better return for their endeavours than was previously possible, except for when the export trade ceased with Indonesia in 2011). The creation of live cattle export depots for putting weight on feeder cattle allowed for a seasonal turn-off when feed from the floodplain was at its most abundant and weight gain harder to achieve in the rest of the Territory during the dry season. A successful northern pastoral enterprise is most likely when a balance of good improved pasture available in the wet season on non-flooded country is complemented with floodplain access during the dry season.



Figure 2.7 Some of the Williams family in the 1950s with a captured young feral Swamp buffalo pet following three weeks in the yards. Left to right; Lloyd, Peter Secrett, Glyn, Barbara, Glenda Hunter, Evelyn Waldock, John Doyle and David Hunter.



Chapter 3

WATER BUFFALO PRODUCTS

WATER BUFFALO PRODUCTS

There are four major uses for Water buffalo worldwide: meat, milk, other by-products and as draught animals. These uses are discussed below. They vary considerably in their relative importance depending on the location in the world.

MEAT

Meat Products in the Top End

Due to the historically large numbers available in the Top End, considerable research work has been undertaken in the Northern Territory focusing on meat production. Free-range animals have supplied meat for almost 100 years, on an ad hoc basis. In the 1950s small abattoirs appeared and these gradually made way for US export-approved works, that during 1980–2000, exported specifically to Europe and Taiwan.

By the 1990s, because of the massive depletion in numbers due to BTEC, the export meatworks killing buffalo had run out of the numbers that they needed to be viable. Up to 40,000 head per year were slaughtered during the peak of the BTEC destocking of properties and bush areas. The higher prices received from the live export of both cattle and buffalo subsequently made it difficult to get a sufficient supply of animals, for abattoirs to survive in the long term.

BTEC required complete eradication of buffalo in known Tuberculosis (TB) endemic areas. Free-range buffalo in some areas, particularly Arnhemland, known to be TB-free historically, were monitored regularly in order to maintain their TB-free status. If a diseased animal was found, that area had to be cleared of the resident buffalo population, as did a buffer zone around it.

While the European Union paid a premium price for buffalo meat compared to that for cattle, and also had access to the EEC that beef didn't have, the writing was on the wall once buffalo numbers began to decline.

TenderBuff®

To remain viable post -BTEC, buffalo farmers needed a better market price than that received from the export abattoirs, which had little control on age, tenderness and quality from predominantly feral-caught stock. Buffalo meat was a bulk product mostly destined for manufacturing, hence the lower price received. It was favoured over beef for this market due to its lower fat content and higher water-holding capacity.

TenderBuff® was then developed by the Northern Territory Department of Primary Industry and Resources and promoted and registered by the NT Buffalo Industry Council to help create a product that would attract an improved market price. To do this the meat would have to be of restaurant quality and the industry able to supply a reasonable number of good quality animals.

Tenderbuff® is a quality-assured product that must comply with five parameters before being branded in such a way that the product could be recognised right up to the end-user (by applying a skin surface brand similar to the lamb brand currently used in Australia). The five criteria are covered in more detail in Chapter 7 Abattoir Operations.



Figure 3.1 Processed Tenderbuff® carcasses waiting to be branded in an abattoir chiller.

TenderBuff® was a very popular product in Darwin and the Northern Territory for over 17 years until the small local Litchfield (Darwin) abattoir closed down in 2007.

In Darwin, most high value Tenderbuff® cuts went to hotels, oil rigs and restaurants, while roasts, corned meats, burgers and sausages were popular at retail butcher outlets around the town.

Buffalo meat is also very popular in the processed meats industry because its low fat qualities give it a high water-holding capacity for smallgoods. In the Darwin area, salamis etc. were very popular when made from buffalo meat and corned silverside and brisket also sold well. Smoking also allows for an increased range of smallgoods.

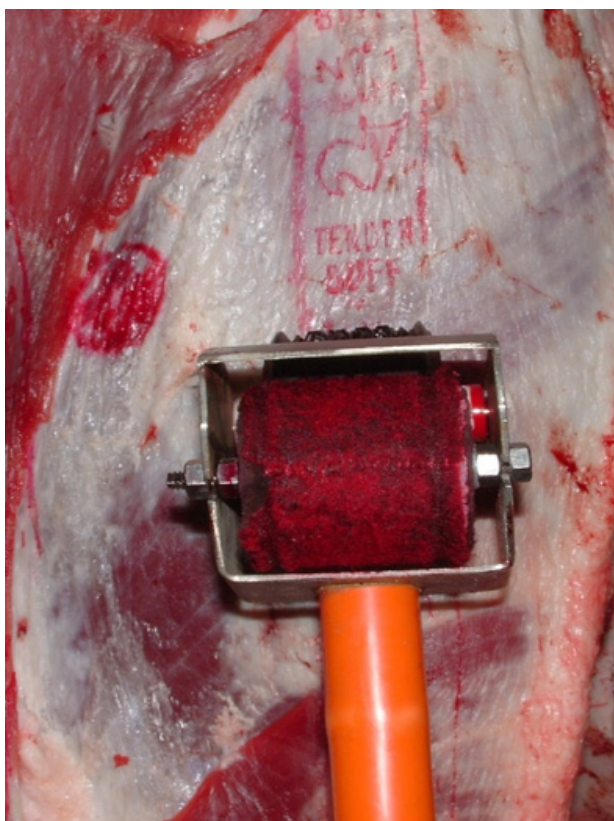


Figure 3.2 The TenderBuff® roller brand being applied to a carcass compliant with TenderBuff® criteria.



Figure 3.3 Typical well-finished Swamp buffalo TenderBuff® forequarter cut showing flatter eye muscle.

Roasts (blade, round and topside) are quality products, popular in restaurants, hotels, cafes and road houses, as are burgers. One smallgoods manufacturer in NSW used to poach buffalo meat many years ago and its taste and texture were difficult to distinguish from ham.

A multitude of quality meat products can be produced from a buffalo providing the right animal is presented.

The main marketing points are that the muscle has a lower fat content than most other meats (kangaroo and deer are probably the only exceptions in readily available products) and lower cholesterol and superior zinc and iron levels when compared with beef. A nutrient analysis comparison between TenderBuff®, beef and chicken is shown below.

Table 3.1 Nutrient comparison between TenderBuff®, beef and chicken (RIRDC 2002) (100 g lean edible portion).

	Energy (kJ)	Protein (g)	Iron (g)	Fat (g)	Saturated fat (g)	Monoun-saturated fat (g)	Polyunsatu-rated fat (g)	Choles-terol (mg)
TenderBuff®	416	20.4	3.3	1.4	0.46	0.42	0.27	46
Beef	502	22.0	2.2	3.7	1.60	1.52	0.24	60
Chicken	506	21.0	1.1	4.2	1.18	1.81	0.47	69

If grown quickly and slaughtered young, buffalo meat (TenderBuff®) is comparable to beef of the same age in terms of its quality and tenderness.

Marbling is rarely seen in buffalo and usually only in very well-conditioned mature animals, mostly cows. One of the downsides with all lean meats is that cooking needs to be carefully carried out otherwise there is a danger of it drying out too much, making it much less palatable.

Meat Preparation and other recipes and instructions for making buffalo products are covered in Appendix A.

Riverine-Cross Versus Swamp Buffalo

The main advantages with the Riverine-cross compared to the Swamp buffalo in the Northern Territory have been:

- 40% average higher growth rates.
- Better carcase characteristics.
- Easier to get into desirable fat range.
- Higher eye muscle area (rounder, fuller eye muscle).
- 2-4% higher dressing percentage.
- 2-4% higher retail meat yields.
- More tender product because of age difference.
- Higher productivity of the property: earlier turn-off of slaughter stock allows more breeders to be run as a proportion of the total herd.
- One year younger to get to breeding age (puberty) allows for a faster build-up of herd numbers in a growing herd and higher turn-off percentage when able to reach a sustainable static herd size.

Riverine-cross buffalo certainly mean the TenderBuff® product is much easier to achieve with their much higher growth rates than the Swamp buffalo (in Australia). The main carcase difference is a higher subcutaneous fat cover at the same age so that because it grows much faster, the Riverine-cross can be slaughtered when younger and its fat levels are lesser.

In many Asian countries the emphasis is usually not primarily on meat production. Animals tend to be slaughtered as a by-product of the dairy industry (cull cows) or if used for draught purposes, are no longer fit for work. The result therefore is a poor quality meat product, as age and condition parameters are usually sacrificed. This is slowly changing as standards of living in these countries rise and they begin to recognise a superior product in terms of taste and tenderness.

DAIRY

Dairy buffalo farming in Australia had a very late genesis; it did not commence until 1995. The industry is likely to grow significantly over coming years as more suitable stock become more readily available and interest increases. The main impediment has been the lack of crossbred and purebred dairy buffalo breeding stock available. A supply of higher Riverine content buffalo has been available for sale in larger numbers in the Northern Territory. However, the demand is in the southern states, with long travel distances and the cost factors involved.

The dairy buffalo industry in Australia commenced in 1994-5 with the importation of 68 head from Italy and Bulgaria (Shaw River Cheese). At the same time, a smaller shipment of eight breeders was imported from the US to the Northern Territory.



Figure 3.4 Herringbone dairy in Italy for milking buffalo.

The US shipment (4 bulls and 4 heifers) was the basis of all the current Riverine dairy buffalo operations, built up from Riverine X Swamp crossbreds except for the Shaw River (Italy/Bulgaria) importation of 68 head. Up to the time of publication, these Italian/Bulgarian genetics and their progeny had not been further distributed in Australia. Progeny had, however, been exported to several countries including Chile, Japan, South Africa, New Zealand and more recently China.

All other dairies in Australia have originated from the US shipment, their progeny and back cross progeny from the Riverine bulls over Swamp cows. These have been more recently infused along the way with Italian dairy buffalo genetics using frozen semen which has become increasingly available through the release of new sires. The fourth shipment to the NT included 11 sires available for importation. The stand-out sire in Italy was originally Malandrino III, who had the best credentials in the Italian genetics analysis system for dairy attributes. The latest

shipment of semen had a choice of over forty sires, many with Malandrino genes.

Malandrino III was the leading sire using this index but his semen is no longer available and was extremely expensive when available. His position has been recently overtaken by one of his sons, Zerbio whose semen was readily available in 2011, but no longer due to his death. Similar bloodlines are currently available, plus a number of others that are not related, to help reduce inbreeding potential in Australia.

Italy has a mozzarella production index known as the PKM:

PKM index value = $\text{Milk (kg)} \times \{[(3.5 \times \% \text{protein}) + (1.23 \times \% \text{fat}) - 0.88] / 100\}$.

The use of Italian semen over the US animals was the most appropriate way of bypassing the inbreeding dilemma raised by the low number of US-imported bulls and cows. At the Northern Territory Department of Primary Industry and Resources' Beatrice Hill Farm, a crossbreeding and backcrossing program was set in place where each of the introduced bulls presided over the one generation for a number of years until enough sires with 50% Italian blood became available to use over each of the backcross lines. Beatrice Hill Farm only runs the higher backcrosses now (7/8 and 15/16); 31/32 is regarded as purebred.

Backcrossed purebred female breeders are building up in number (around 90 calves have been produced since the first four were born in 2008) with numbers increasing each year. The objective of Beatrice Hill Farm was to build up to a 100 head purebred breeder herd to supply dairy heifers, bulls or cows to any producer throughout Australia with objective measurements (Estimated Breeding Values or EBVs) available for selection of suitable stock.

This 100-head figure was achieved by 2014 and thereafter the rate of turn-off can be substantially increased to the Australian or overseas dairy industries. This output could be expected to be around 30 to 40 head of heifers per annum which represents a substantial increase in what was then available to the Australian industry. Considering those already distributed to dairies in Australia, the availability of breeders should improve markedly in the coming years.

Milk yields

Current data from the Beatrice Hill Farm herd's progeny indicates that milk yields are quite variable. A purebred could be expected to produce an average of between 5 and 15 litres/day (with twice daily milking) over the entire lactation. Hybrid vigour has been found between the US and Italian genetics as well as between the US and Swamp breeds both for milk and meat production (Lemcke and Suarez 2010).

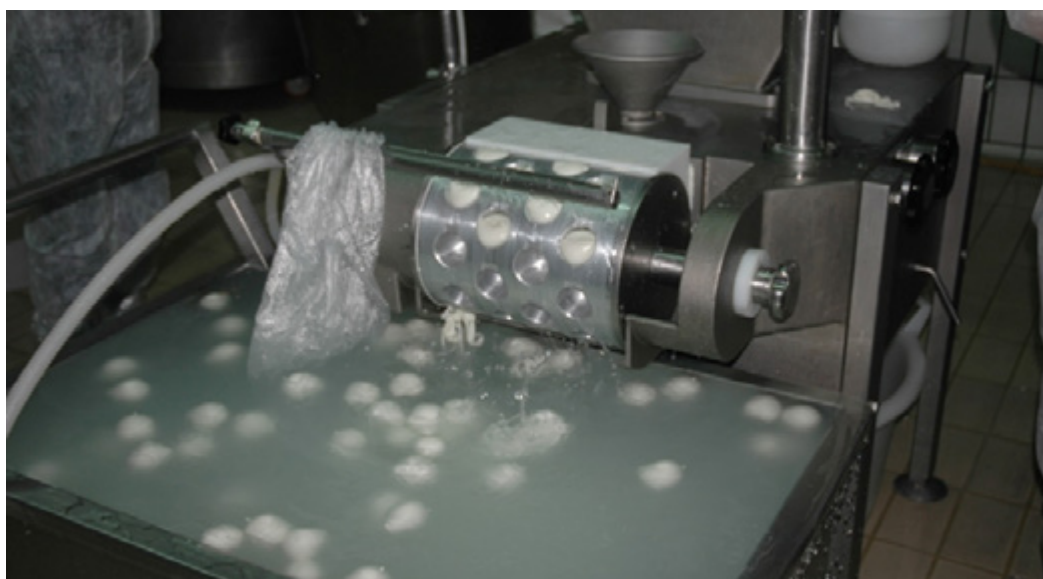


Figure 3.5 The main end product of buffalo milk is mozzarella cheese. The production process can be mechanised as above or be manual for smaller quantities.

Preliminary analysis of NT meat and Queensland milk records can be seen below. The figures shown for milk production for 3/4 bred Riverine cross cows should improve as more yield records become available as most of the original 3/4 heifers produced at Beatrice Hill Farm were by OJ (a Buffalypso type from the US). Buffalypso was a breed developed in Trinidad by Dr Steve Bennett to produce an improved meat animal. Average milk production in OJ's daughters has actually been found to be lower than the F1 females. His influence will dissipate with time as other bulls were used to produce 3/4 crosses.

*Table 3.2 Preliminary Milk Data from Northern Qld; and Meat data from NT (2010), Australia
Breed Codes SP=Swamp; RV= US Riverine; IB = Italian Semen (Riverine)
Millaa Millaa Dairy, Northern Queensland - Least Square Means*

Breed	RV	RV-SP	RV-IB	75%RV-SP
No. of Animals	21	70	8	92
Total Milk (kg)	1530±153	1285±121	1831±215	1081±112
Total Fat (kg)	110±20	74±19	127±27	76±17
Fat (%)	7.2%	5.8%	6.9%	7.0%
Total Protein (kg)	68±8	65±6	82±11	51±6
Protein (%)	4.4%	4.7%	4.5%	4.7%
Total Lactose (kg)	71±8	70±7	100±12	55±6
Lactose (%)	4.6%	5.4%	5.5%	5.1%

MILK PRODUCTS

Whole Milk

Buffalo milk has high solids and fat contents (16-20% and 7-10% respectively, generally double that of Friesian cow's milk); therefore, whole buffalo milk is not likely to be in high demand in fat content-conscious western societies where popular low-fat products abound. In southern Asia (particularly India and Pakistan) buffalo milk is a large percentage of the milk consumed by the population. Due to its attributes, less buffalo milk needs to be consumed in order to get the daily nutritional requirements for various ages of people. Nutritionally, (cattle) cow's milk and buffalo milk are similar, except that buffalo milk has lower concentrations of cholesterol (43-80% that of cow's milk), 58% higher calcium and 40% higher protein, double the fat, slightly higher lactose, higher iron and phosphorus.

Whole milk from buffalo in Australia is therefore more likely to go into further processing and value-adding.

Some people who have cow milk allergies can drink buffalo milk safely. However, that does not include lactose intolerance as buffalo milk has higher lactose content than cow's milk.

The taste of buffalo whole milk is often rated very highly in comparison with other milks for flavour and smoothness due to the higher solids content, particularly fat. As with the meat fat colour, the whiteness of the milk is due 100% of the fat soluble Vitamin A being stored and none as carotene (precursor of Vitamin A). Carotene gives the yellow colouring to beef fat and cow milk fat (cream).

Table 3.3 Comparison of Buffalo and Cow's Milk in Australia (Nguyen et al. 2014)

(Data are the mean $\pm$ the standard deviation of the mean (n=6) for all analyses.

	¹ Buffalo milk	Cow's milk	² Buffalo milk colostrum (individual animal)
pH	6.73 $\pm$ 0.07a	6.56 $\pm$ 0.04b	-
Protein (% (w/v))	4.1 $\pm$ 0.4b	3.1 $\pm$ 0.2c	8.3 $\pm$ 0.2a
Fat (% (w/v))	7.9 $\pm$ 0.2a	3.6 $\pm$ 0.1c	7.3 $\pm$ 0.3b
Lactose (% (w/v))	5.0 $\pm$ 0.2a	4.7 $\pm$ 0.2a	3.2 $\pm$ 0.1c
Total calcium (mM)	45.8 $\pm$ 1.0a	28.5 $\pm$ 0.3b	-
Total solids (% (w/w))	17.1 $\pm$ 0.4a	11.5 $\pm$ 0.1b	-

abc = means in the same row with different subscripts are significantly different ($P < 0.05$) in composition. (P=probability)

¹Buffalo milk was collected from a herd in Victoria, Australia.

²Buffalo milk colostrum was collected from a single buffalo in the Northern Territory (Australia).

Yoghurt

Due to the slightly higher lactose content of buffalo when compared with cow's milk, buffalo plain yoghurt is naturally sweet and quite thick and requires no added sugar. It can be therefore be used in sweet and savoury dishes and flavoured with many different and varied flavourings including honey, maple syrup, liqueurs and fruit purees.

Some people with lactose intolerance can often take yoghurt, as the culture used to turn milk to yoghurt contains the enzyme lactase which reduces the lactose content of the product.

Flavoured and/or frozen yoghurt can also be used as a dessert in lieu of ice cream.

Gelato/Ice Cream

The true gelatis are made from buffalo milk and have a rich creamy texture and flavour. The richness of buffalo milk compared with cow's milk always gives buffalo products the edge for smoothness and flavour. While specialised machines are used for commercial production, there are now many small household appliances that are available for below AU\$100 which are suitable for home manufacturing. Some machines have bowls that need to be pre-frozen, while other more expensive machines have built-in compressors.

Traditional mixing/freezing/remixing requires something like gelatine to keep the ingredients suspended while freezing the second time. The speed of freezing determines the ice crystal size and faster freezing creates smaller crystals and are usually more acceptable. Modern machines work on this principle to reach the right smoothness.

Cheese

Buffalo milk makes a wide range of cheese varieties that differ from cow's milk cheeses in taste, texture and quality. Mozzarella (see below) is the most famous. However, the cheese list, from Italy alone includes:

- **Bocconcini** - same recipe as mozzarella but smaller 20-40 mm ball size.
- **Scamorza** and **Caciocavallo** - mozzarella types, formed into pear-shaped ball and aged.
- **Provolone** - a mozzarella-type, aged and often smoked.
- **Burrata** - uses mozzarella as a casing around a small flavour ball centre.
- **Caciotta** - briefly aged rural cheese with soft rind, soft texture and mild flavour.
- **Stracciatella di Bufala** - a provincial stretched curd fresh cheese which is shredded finely.

Mixed with thick creme to make the centres of burrata.

- **Ricotta** - made from mozzarella whey with whole milk sometimes added to make a smoother texture.

In Australia, the following cheeses have been produced/supplied by current buffalo cheese factories: bocconcini, brie, buffalino, burrata, fetta, haloumi, mozzarella, paneer, quark, ricotta, romano and soft blue.

Home cheese making is covered in Appendix A.

Mozzarella

Traditionally in Italy the most widely made and famous cheese is mozzarella, particularly the famous Mozzarella di Bufala CampanaTM, which has special DOP (Denominazione di Origine Proteta) (English translation; Protected Denomination of Origin) status in the EU which allows for the traditional method of manufacture (often unpasteurised) used in the Campania region of Italy. Mozzarella is one of a group of cheeses known in Italy as 'pasta filata' which translates as 'spun paste' or stretched curd.

Mozzarella processing takes from four to six hours in total. The steps are outlined below:

- Heat milk to 37°C.
- Add starter (specific) and rennet -(starter usually direct but DOP Campana uses whey culture saved from the previous day's batch.)
- Production of curd.
- Separate whey.
- Allow maturation to specific pH range for stretching.
- Addition of heated water to raise curd temp above 60°C.
- Stretch and form into balls.
- Immerse in chilled water to set.
- Store in brine mixture.

While the soft cheeses are popular there is still a number of varieties of hard (matured) and semi-hard cheeses produced but nowhere near the quantity consumed of the mozzarella produced in Italy. Generally, the softer the cheese, the shorter its shelf life. In Italy, mozzarella is eaten the next day, certainly within 2-3 days. For pizza manufacture genuine mozzarella is not used, but rather some of the less moist 'pasta filata' types, such as scamorza.

MILKING PROCEDURES

Buffalo cows generally take longer to milk than cattle cows. Buffalo do not have the cistern milk that dairy cattle produce so there is no "free milk" to be harvested. Cisternal milk is around only 5 per cent of the total milk production in a buffalo udder. The buffalo has to perform a "let-down" or virtually no milk will be released. This is quite variable between cows and udder stimulation is seen to be important. Buffalo also have longer teat canals than cattle and this necessitates hand or machine stripping.

With buffalo in many countries there are a proportion of cows that need to be artificially induced to "let-down" their milk by using an intra-muscular injection of oxytocin (1 mL of 10 iu/mL strength). A small proportion of cows need to be injected at each milking. However, some become habituated and a tap with the hand on the injection site is enough to stimulate the let-down reflex. Manual pre-stimulation of the udder (between 1 and 3 minutes may be beneficial) and feeding while milking have both been shown to enhance let-down. There are milking systems by some manufacturers which vary the vacuum and pulse so that they are gentler at the start and at the

end of milking which can be kinder to a buffalo udder. Some producers provide pre-stimulation to the udder before commencing the milk extraction.

Pecking order is very strong in the buffalo herd and it is best to allow cows to determine their order of milking. An enticement to enter the milking bails is useful. It may be pellets or molasses or something similar. Once a leader has made an entrance, others will usually follow along. Upset cows can be difficult to milk. For example, if they don't want to be milked next to another cow in the bails, it can be difficult to get them to comply. A bail feed lure is considered the best method to fill the line. Establishing a routine is highly beneficial.

DAIRY BAIL DESIGN

Most dairy cattle bail designs will work satisfactorily with time. The most commonly used is the herringbone design, with the main disadvantage being that the line is only as fast as the slowest milker in that side. A walk-through bail, or variations on it, is probably the best for buffalo, in that slow milkers are not holding up the rest of the herd. A rotary design would be useful for a large herd.

A parallel perpendicular system requires more than a single bar in front of the cow especially when new cows are introduced to milking. For hard-to-handle cows not trained to the system it may be easier to milk initially in a crush where there is better restraint until they become more familiar with being machine milked in the bail.

MILKING STRATEGIES

There are several possible milking strategies depending on the size of the enterprise and the value of the milk produced.

- **Once per day milking - with calf removed:** Calf fed colostrum and then milk replacer. This strategy makes dairy farming less demanding on hours but there is a sacrifice in total yield of possibly up to 25%.
- **Twice per day milking - with calf removed:** Calf reared artificially. This system maximises the milk yield from the herd, but at a cost to lifestyle and flexibility.
- **Once per day milking - calves left on mother:** Calves locked up overnight and milking in the morning (or vice versa). Calves should have access to suitable feed and water when separated from their dams for the 12+ hours. This system sacrifices maximum growth rate in the calves, but allows the flexibility of not having to milk at all if milk supplies are surplus to current demand. Using this system there is no necessity to milk daily. Milk yields will be theoretically 40-50% (or less) of the potential yield from twice/day milking.

In South America there are various strategies, including letting the calf suck for the first minute or so to get natural let-down, then taking the rest by machine or hand, or milking out two or three teats and leaving the rest/last for the calf.

This may suit an artisan cheese maker with their own herd and processing carried out on the same property according to local demand for their product.

EQUIPMENT

Milking

Normal dairy milking equipment is used for buffalo and very little change is necessary. Robotic milking can be used in buffalo, but it is expensive and expert maintenance is critical to its operational efficiency.

Vacuum

Vacuum recommendations vary in different countries and are defined by cycles per minute,

pulsation pressures and pulsation ratios, ranging from 50-70 cycles/min, vacuums of 50-60 kPa and ratios of 50:50 to 65:35. Breed may have some bearing on recommendations, so it is probably wise to get local recommendations from people already milking buffalo.

Claws

Total weight and weight distribution are important factors in reducing slippage or riding up the teats. Those which have clear plastic at the end of each cup can be very useful for the management of the dairy while allowing the ability to ascertain whether each quarter is being accessed equally.

Backscratchers/Rubbers

These are self-starting electric motor driven brushes that the cow can use for a back or head rub. They are mounted at a suitable height on a yard rail or post in the yards and start when touched by the buffalo. They appear to be quite soothing for the buffalo and are well-used.

Less expensive, but also less appealing, are single steel posts set in concrete. These could be covered partly with something durable such as a coarse carpet material or stiff-bristled broom heads that could be used as a rubbing post. They could also incorporate an anti-buffalo fly repellent as long as this does not cause residue issues in the milk.



Figure 3.6 Buffalo using the head/body brush in the yards of Vannulo Dairy in Italy.

Fly Removers

There are designs available where the buffalo walks through and the flies vacate the body and are trapped within the confines of the unit. With dairy buffalo this could be incorporated into the system to remove flies before or after milking to avoid annoyance to cows and operators. This removes the need for chemical treatment which is often not an option for a dairy cow.

HIDES

When tanned, buffalo hides make very strong, hardy leather that can be split into many layers and thicknesses. Hides on a heavy bull can weigh as much as 100 kg and be up to 25 mm thick at the neck. This can pose some problems with some tanneries in that the hides can be too heavy for their equipment.

In Australia, demand for hides was behind the first utilisation of the wild buffalo resource in the north. Commencing around 1880, the hide industry continued up until WWII; its demise was hastened by the increasing use of synthetic alternatives. Hides were particularly sought after for use as flat belts for steam-driven machinery.



Figure 3.7 Locally tanned buffalo hide of Swamp Buffalo from the NT. The tanning facility, originally for crocodiles, is no longer operating in the Darwin area.

From 1980 to 2000, most hides were exported. Australian buffalo hides are generally better quality than Indian hides which are in much greater supply. The number of tanneries that can process buffalo and cattle in Australia is dwindling.

Amongst other products, buffalo leather is prized for:

- Car and furniture upholstery.
- Saddlery.
- Bridles etc.

In Asia, hide is cooked and eaten in Indonesia (krupuk in Bahasa), Malaysia, Philippines and Vietnam etc. It is similar in texture to pork crackling when cooked in very hot oil.

HORNS

Buffalo horns are in demand for many and various uses. Some of the many uses (that have been mentioned by purchasers) have included:

- European compound bows (archery)—one of the layers in the bow construction.
- Tatting/crocheting needles.
- Carving.
- For polishing and mounting.
- Burial for bio-organic farming.

Horns are very easily processed and recovered at the meat works. The horn can be severed from the skull with a circular saw, chainsaw or hand saw and then immersed in very hot water. After some minutes soaking, the core easily separates from the outer hard shell of the horn, usually just by tapping it on a hard surface.

The horn can be softened by heating for shaping or straightening.



Figure 3.8 Horns on a Riverine-cross cow of US parentage.

OTHER BY-PRODUCTS

Offal

A full range of buffalo offal by-products can be used e.g. heart, liver, kidneys (Riverine kidneys are markedly different from Swamp), lungs, brain (unless despatched with a rifle), spleen, sweetbreads (from calves), bones (for pet dogs), bile, blood, ears (for dog chews when de-haired).



Figure 3.9 Anatomical differences (lobe structure) between Riverine cross (left) and Swamp buffalo kidneys (middle and right) are quite noticeable.

Manure

Anecdotal evidence and feedback from users suggests that buffalo manure is superior to cow manure. It is sought after for horticultural purposes.

Draught

Some countries still use draught animals for agricultural practices. However, this has been declining over the last 50 years, accounting for the reduction in total buffalo populations in many South East Asian countries, coupled with an increasing desire for red meat in many developing countries' diets. Consumption often outstrips the reproduction rate when draught is no longer a necessity, compounded by poor reproduction rates in livestock when human food production is a greater priority for the available land, rather than for livestock production.

Buffalo were particularly suited to paddy rice production because of their strength, lower centre of gravity when compared to cattle and greater agility in muddy and swampy situations because of their larger hoof footprint. Their work rate is particularly high, provided they are well-fed and regularly watered, which may have not necessarily been the case in many instances in their history.



Chapter 4

FARMING SYSTEMS

FARMING SYSTEMS

SOUTHERN AUSTRALIA

For buffalo, their feral origins and their expansion in the NT from the original English settlements was an inauspicious beginning, hence their reputation as being a pest species. Despite this unfavourable start, buffalo are now found in every state of Australia.

State authorities vary greatly in their approaches to buffalo husbandry. Some are relaxed while others are quite rigid in their rules and levy charges. Ideally, there would be a nationally consistent system to classify buffalo as livestock, particularly in a dairy situation. Regulations in some states make buffalo farming difficult.

The greater numbers of buffalo in southern Australia are now to be found in the dairy industry as that is where the better returns are generally achieved. On the meat side, there are generally difficulties in finding sufficient abattoirs in southern Australia that are willing to provide service kills for producers on a regular basis. This is more than likely due to the small numbers available for slaughter and the unfamiliarity with the species by abattoir staff, a situation which could be easily be resolved with experienced, outside assistance brought in to guide meat industry workers through the first few animals.

Paddock Management

As Water buffalo originated in the tropical or hotter areas of the world, one of the main requirements in the more southern regions of Australia is shelter from the cold. This would be more important in the case of Swamp buffalo as they are less tolerant to cold weather than Riverine buffalo. Riverine buffalo have better cold tolerance due to their heavier coat of hair, which grows with exposure to cold.

Open, exposed country with strong cold winter winds is therefore not recommended, particularly for Swamp buffalo. Good wind protection in the winter, when the chill factor is high, is a necessity. Calving during this time should also be avoided. If not possible and calves are due then, cows must have good shelter belts in which to calve. If introducing buffalo from the north of Australia to colder areas, it is best to do so during the late spring through to summer so that gradual acclimatisation can be achieved as the season progresses through autumn into winter. In Tasmania, trials with Swamp buffalo during snowfalls showed the benefits of horse blankets, which needed to be robust in construction.

Buffalo prefer a roughage-based diet so provision of hay during winter when southern winter pastures are green, short and high in moisture is recommended to help stabilise the rumen.

Buffalo eat coarser materials and have a wider dietary selection than cattle. They will eat some species that cattle won't, so buffalo have been useful for cleaning up reedy channels in irrigation country in southern Australia.

An important message for the southern Australian states is that buffalo should not be mixed with sheep in the same paddock. Sheep are carriers of MCF (Malignant Catarrhal Fever) which is deadly to buffalo as the latter have no resistance to this disease. There is no problem mixing buffalo and cattle in the same paddock. They will tend to stick together in separate species and not interact. Disease management is covered in Chapter 9 Herd Management.



Figure 4.1 Cattle (white) and buffalo (black) are compatible in the same paddock. They will tend to graze in separate groups and not interact.

Aside from the above factors, there would be little point in putting buffalo into arid areas. They are called Water buffalo for a very good reason, so excessively dry country should be avoided. Buffalo are very content in swampy country that is not suited to sheep or cattle. They will happily graze in the water if grass is available there. It is recommended that swampy areas should only be grazed after they have dried out to some extent, if possible, as this will also limit the impacts of pugging disturbance and wallowing.

Wallowing

Wallowing is a defence mechanism against higher temperatures and insect loadings and also helps in a quicker shedding of the winter coat. Wallowing does not appear to be as intense in southern climates as in the wet season in the north, when the biting insect load is heaviest. In the southern parts of Australia, insect loads and rainy weather generally do not coincide. Buffalo do like to have a swim in hot weather so will often be seen in dams, but without the occurrence of surrounding wallows.

If wallowing becomes an issue, then providing a concrete or clay lined “swimming pool” or dam would be a solution in very hot weather. Provision for cleaning out on a regular basis should be considered in the planning process before building. The cleaning frequency would depend on the size of the dam and the number of head likely to frequent the facility. A larger one would probably require less maintenance. Wallows are not a necessity with buffalo and they will only make them if the weather is hot and if there is a water leakage from a pipeline, sufficient rainfall to create suitable conditions or there is a ready-made muddy area to develop further.

Tree Damage

If trees are being damaged by buffalo eating the bark around the base of the trunk, then a solution is usually to provide a source of roughage and a mineral lick block. If the animals are really persistent, then old tyres can be cut radially across the tread and stacked around the trunk of the tree to about 1 metre to protect the trunk from rubbing with horns and chewing if animals are mineral or roughage deficient. The tyres can expand as the tree grows without causing any damage to the tree in the long term.



Figure 4.2 Tree trunk protection provided by split tyres prevents damage from rubbing and chewing.

Dehorning

In southern areas, dehorning buffalo at an early age would eliminate potential bruising, human safety risks and horn-sharpening on trees (part of the tree-rubbing issue). Horns are also used as a digging implement in wallow building.



Figure 4.3 Buffalo thriving on temperate pastures in southern Victoria.

NORTHERN AUSTRALIA

The Northern Territory was the original entry point into Australia for the Swamp and Riverine buffalo from Asia as a food supplier into the new settlements established by the British in the 1800s. The Cobourg Peninsula settlements were all abandoned within 15 years because of unfavourable human conditions (heat, humidity, disease and insects). The buffalo were well suited to the conditions and some escaped or were left behind to form feral populations, particularly along the favourable northern coastal floodplains, where they were able to access green forage all year round, so while numbers were low, they thrived.

Pasture Management

Soils in the Top End are usually low in phosphorus and sulphur and the native pastures in general have very low carrying capacity for ruminants. One head of buffalo per 20 hectares is safe on a year-round basis on many Top End soils, but growth rates of the buffalo will be low. The only native pasture with reasonable carrying capacity in the native state is the coastal floodplain system where there is a satisfactory phosphorus level in the soil and where there are species such as Native Hymenachne (*Hymenachne acutigluma*), which also has very high protein content for a grass. These soils are black cracking clays which are generally not trafficable (and are generally not stocked) in the wet season because they become very sticky.

The best current farming system for buffalo includes a component of coastal floodplain, preferably about 50% of the total area. Ideally, this would be combined with deeper sandy red earth or loams on an adjacent upland system. This upland area will need to be developed with improved pasture species and fertiliser. This will increase the carrying capacity to around 1 head per 1.5 hectare on a year-round basis. Pasture species recommended as suitable for this development include:

Grasses:

- *Digitaria eriantha* (Pangola grass)
- *Digitaria milaniana* (Finger grass cultivars 'Jarra' and 'Strickland')
- *Brachiara decumbens* (Signal grass)
- *Brachiara humidicola* (Tully grass)
- *Andropogon gayanus* (Gamba grass) (a declared weed in some zones of the Northern Territory)
- *Panicum* spp. (Common guinea, Alto panicum, Green panic)
- *Setaria sphacelata* (cv. Kazungula)
- *Urochloa pullulans/mosambicensis* (Sabi grass)

Legumes:

- *Stylosanthes hamata* cv. Verano and other Stylo cultivars
- *Calopogonium mucunoides* (Calopo)
- *Chamaecrista rotundifolia* (cv. Wynn)
- *Centrosema pascuorum* (cvs. Cavalcade/Bundey, particularly for hay)
- *Centrosema brazilianum* (cv. Ooloo)
- *Clitoria ternatea* (Blue pea)
- *Leucaena leucocephala* (Leucaena)

A suitable fertiliser application rate would be at the equivalent of 100 kg/ha of superphosphate per annum until phosphorus levels are sufficient. In the absence of legumes, grasses would also require some nitrogen fertiliser, usually urea, to sustain the pasture over the long term as nitrogen depletion is inevitable.

The floodplain can also be improved with grass plantings such as:

- *Brachiara mutica* (Para grass)
- *Echinochloa polystachya* (Aleman grass)
- *Hymenachne acutigluma/amplexicaulis* (Native hymenachne and cv. Olive).

These species will again improve the carrying capacity of the floodplain, due to the higher amount of dry matter produced by these grasses even under flooded conditions. Ponding (forming levee banks to contain wet season run-off for a longer period into the dry season) increases the productive capacity of the floodplain by increasing the volume of green forage available later in the dry season. Varying depths of flooding can extend the window of green forage availability during the dry season.

If there are no floodplains on the property then improved pastures on elevated country will give satisfactory performance i.e. weight maintenance into the dry season, provided fodder or silage is made to feed to the stock during the later months of the dry season when quality drops off due to dew, humidity and/or rain showers.



Figure 4.4 Improved pastures and fertiliser applications in the Top End allow for significant production improvements, well above that of native pasture.



Figure 4.5 Flooding during the wet season provides ample grass growth for dry season consumption.

In a dairy farming system where no floodplain is available, irrigation would be an advantage to provide green forage in the dry season. This system would incur greater costs with the capital costs, extra fertiliser and water pumping costs, but may be more economical than purchasing supplements such as grain to enhance diet quality. Surface water from a billabong, rivers or dams would be cheaper than pumping from an underground aquifer.

Grain for concentrate rations is currently not readily available locally in the Top End. It is possible to grow maize and sorghum in this region on the better cropping soils of the Douglas Daly region, but bird predation on the grain is intense if only small areas are planted.



Figure 4.6 Huge amounts of green forage available in the dry season on ponded pastures keep the condition on stock throughout the year.

Quality cropping soils in the Top End are not widespread, with large areas of gravelly laterites or stony skeletal soils predominating in upland native pastures and having poor grazing value for most of the year, except in the early wet season when they are actively growing.

Areas further south than Mataranka with drier country are generally less suitable for buffalo as rainfall diminishes, unless there are large areas of swampy country that could be sown to improved pastures. There are some river flood-out areas that may be suitable. Distance to markets then becomes a factor. For the Top End, it is recommended that smaller areas of better land types should be fully developed for intensive pasture improvement and more intensive herd management so that herds are easier to monitor, more accessible and better handled to keep them more tractable. For sales to the dairy industry, which is the more profitable outlet for buffalo breeders, temperament is a very important consideration and open paddocks are more conducive to better handling and control.

Lower rainfall areas are more likely to be for breeding operations only (rather than fattening enterprises) due to a more limited scope for provision of quality forage year-round.

Wild Harvest

There are feral populations (free-ranging herds) in central and eastern Arnhem Land where the best basic usage would be local harvest for feeding local communities. This could be achieved using field shooting and small mobile abattoir operations. While buffalo generally outperform cattle under native pasture conditions, there is little evidence that the costs of fencing, watering and managing native pasture at sustainable stocking rates is economic for buffalo production. Swamp buffalo would operate best under this scenario rather than Riverine.

Demand for buffalo throughout the year for live export should encourage some Arnhem Land communities to become more involved in commercial buffalo harvesting, even to the extent of accumulating suitable stock behind wire to be able to supply stock more regularly or even providing a depoting arrangement with similar aims.



Figure 4.7 Good quality TenderBuff® products can be supplied at any time of the year from Top End floodplain properties.



Chapter 5

HANDLING & TRAINING

HANDLING & TRAINING

HANDLING BUFFALO

Stock handling is an important aspect in managing buffalo. Buffalo appear more intelligent than cattle. However, many of the handling issues are similar.

Low stress stock handling courses are available in Australia and are highly recommended to provide producers with basic knowledge to help them understand the fundamentals in the handling of livestock in general. They are particularly relevant to the correct handling of Water buffalo (see section below).

Work health and safety concerns are paramount in any buffalo management operation. The following characteristics and their associated potential risks should be noted:

- Buffalo are a large animal up to 1000 kg when fully grown at 5-7 years.
- They are well armed with dangerous life-threatening horns.
- If upset or stressed buffalo will engage in either in fight or flight.
- They are fast over a short distance, quite agile and accurate with their horns.
- Depending on temperature they have reasonable stamina and are able to cover long distances at a reasonable pace.

Despite these shortcomings, if handled early and often, buffalo can have incredible affection, patience and loyalty to the people with which they are associated. Instances have been observed where three to four-year-old children in South East Asia can lead a massive Swamp buffalo bull that has been raised by the family, using only a piece of string.

The very popular “Buffalo Girls” in Queensland (four sisters) travelled around the Queensland Show Circuit during the early 2000s with Swamp buffalo trained to be ridden and doing various tricks around the show arena with all sorts of obstacles. This demonstrates that buffalo are highly trainable and intelligent and can adapt to many differing situations easily.



Figure 5.1 The “Buffalo Girls” had many acts that demonstrate the buffalo’s versatility including jumping through ‘rings of fire’.

Quietening Buffalo

Buffalo, even when captured in feral conditions and particularly if young, will calm and tame down more quickly than cattle under the same circumstances. The main objective in quietening buffalo is to establish trust in place of fear, so that all actions committed while in the quietening process should be such that there is no pain or stress associated with the presence of humans.

Food, as with most species, is an excellent taming agent especially when humans are associated with its provision. The quickest way to quieten a group is to move it into a secure yard that has plenty of room i.e. a maximum of 1/3 capacity and feed twice daily. Fresh and clean water should be available 24 hours per day. Usually hay of reasonable quality is enough to maintain weight. If concentrate is also required, then it is best mixed with chaffed hay first to familiarise them with it. A little coarse salt may also help by making it more palatable. Unfortunately, molasses doesn't seem to have the same instant attraction for buffalo as it does with cattle, but they will learn to eat it in a short time. A squeeze bottle can be used to supply buffalo with molasses and with time may provide an effective mustering aid if some individuals are trained to come to it.

If it is a feral-derived group, there will be a large range of responses to training; some will only take a day or so to be very friendly, others may take several weeks and a very small percentage will never calm down. Any that fail to respond positively should probably be disposed of in the short term as they will be a disturbing influence to the rest of the group. There is an economic limit on the time spent to get a single animal to be tractable. This is rare except with older animals, as most will take a lead from the friendly ones to get gradually closer to the "danger". In the early stages there is a need to be cautious, but as body language is the main form of communication with buffalo, a relaxed pose is more likely to impress than one that is very tense.

Techniques that can be employed to help in the domestication process are having:

- a radio turned on so there are human voices even when no one is around. Soothing music (rather than heavy metal) or "talk-back" is preferred. Constant noise is good, but it should also be followed by a significant rest period overnight.
- animals conditioned by calling them to food – "come on" is sufficient to attract attention.
- a calm voice that is not loud. Talk quietly and gently on all occasions.
- a hose attached to tap or pump to provide a steady stream of water. Water is a great pacifier for stressed or overheated buffalo. A stream of water is very useful for the early stages of touching and approaching buffalo in the first instance.

Many of the principles used in horse handling also work well with buffalo. There are many more books on this subject than on buffalo.

In particular, watch your body language acutely, to make sure that you are relaxed and not peering directly at any particular animal.

LOW STRESS HANDLING

One of the best pieces of advice is to invest in one of the Low Stress animal handling schools, run by several organisations in Australia. Even people who have had plenty of stock experience often change their way of operating stock once they have absorbed the theory and practice taught by these schools. Some present the background theory and reasoning first, while others just do the practical applications. Either way, they all teach the concept of a "flight zone".

Flight Zone

The flight zone is the invisible bubble around an animal within which, when someone approaches from any direction, there is a reaction or recognition of the approach. The animal will stop what it was doing and concentrate on the person (predator) approaching or move off in response if the flight zone is breached. It is the recognition of this flight zone that is crucial to low stress handling.

The flight zone can be in centimetres for a dairy cow or 500 metres or more if it is a feral bull buffalo in the wild.

The next principle is that cattle/buffalo are a preyed animal so that all their instincts are related to escaping from a predator and keeping vigilant in case one comes. Their eyes have a very wide field of vision with all but approximately 30° at the rear of the animal visible to the buffalo; due to the shape of the iris which is a long slit. This is different to predators which usually have less than a 180° field of vision, a circular iris and eyes in the front of the head.

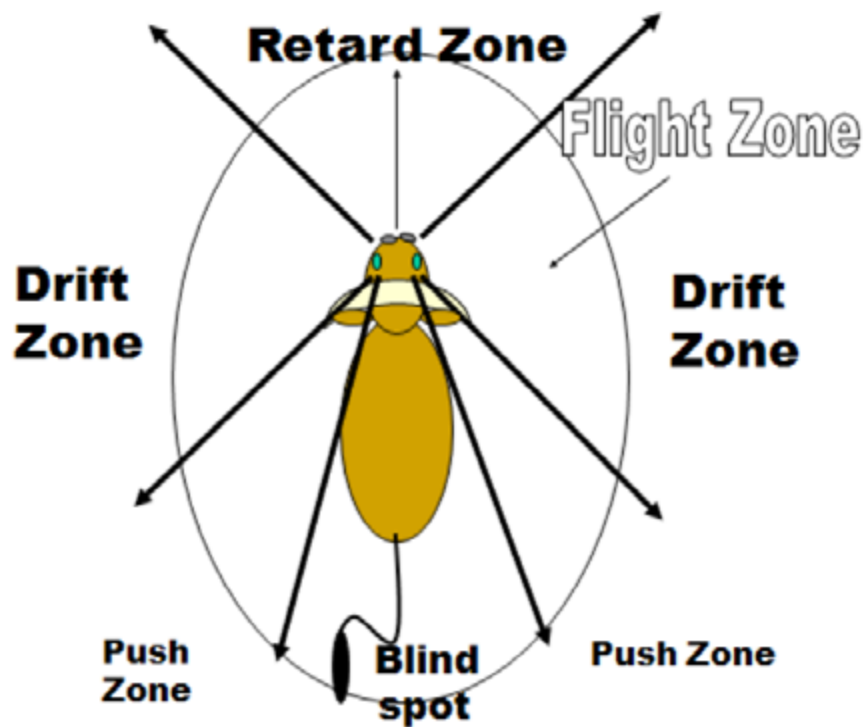


Figure 5.2 Zones of Influence for Low Stress Stock Handling.

Principles of Low Stress Handling

- The flight zone is the distance from an animal which causes it to react to pressure.
- Your position determines the animal's reaction.
- Body language is the strongest form of communication with animals.
- If constant pressure is applied, animals will move into it as they need to face the source of the pressure.
- When pressure is applied it needs to be released.
- Every mob needs a leader and will follow that leader.
- Observation of the animal will tell you where you need to be.
- Remember what you did and where you were to get that movement.

Other basic instincts a buffalo will follow are to:

- Move in the direction that it is facing or heading.
- Want to stay in the mob and follow others in the lead.
- Want to see what is causing pressure.
- Need the pressure to be released – and they have very little patience.

Common Errors in Handling

- Don't try to block an animal's path if it is coming directly towards you. Take the pressure off by retreating backwards, not staring directly at it or by turning quickly and heading in that same direction away from it. If this is done early enough, before the animal is fully committed, it will generally turn back to the mob if not previously heavily stressed. It is too late if the animal has started to run directly at you; you need to observe more closely and to react earlier.
- Don't work in the blind space directly behind, unless moving to the opposite wing of the mob. Animals want to see where you are, so stay in their field of vision. Walking in the blind space usually induces a change of direction in the leaders, as they can't see you.
- Walk in straight lines. Walking in arcs informs the animal that you are a predator and are not to be trusted. If a change in direction is required, make a sharp turn and recommence on a new straight line path.
- Turn a mob's direction of movement by acting from one side to turn them to the opposite side rather than from directly in front.
- Maintain constant movement and do not stand still. Walk from side to side without moving closer to maintain pressure.
- Work in a "Pressure ON" – "Pressure OFF" manner. Constant pressure only causes panic in the animal.
- Don't use any implements such as sticks, rods, pipes etc. and worse still, electric prodders.
- Talk in normal conversation tones and avoid shouting. Again body language is the more potent form of communication. Unfortunately they don't have multi-lingual skills, so don't be upset if they don't understand!.
- Maintain focus. You need to be observing animal movement constantly and be prepared for an instant response. Try to recognise a problem in advance and cover it sooner. Early intervention is usually more effective.
- Don't rush to attempt to close a gate when the mob is starting towards it to exit the yard that they have just been moved into. The most common cause of this exiting is trying to fit too many head into a yard. When pushed into a tight mob they begin to worry more about their hierarchy in the mob than the handler. You need to back off and move from side to side until the animals head back away from the gate opening. Rushing the gate to slam it closed is most likely to remove your teeth or break bones as the gate gets rushed and pushed open by the panicking mob. If the yard is too full then let some back out to the previous yard. In general, only fill a yard to one third of its capacity. If there is not enough space in the yard to accommodate the whole group, then you are putting pressure on the flight zone of the animals closest to the gate. They have nowhere to go other than back out the gate.
- It is better to work from the side of a mob to control its movement. Don't go to the rear of the mob; you have no control of direction in their blind zone. Walking parallel but in the opposite direction will affirm their direction or speed them up. Walking parallel but in the same direction will tend to slow the speed in that direction especially those animals where you are getting into the front of their field of vision. "Pressure ON" can be as much as moving one step closer to the mob and taking "Pressure OFF", maybe one or two steps away.

Zones of Influence

The direction of the handler from the animal has great importance. The blind zone at the rear has already been discussed, but there are three other distinct zones on both sides of the animal where the handler will have differing impacts. Your position within these sectors will determine how the animal will react to your presence. Because of the position of the eyes on the side of their head and not in front, and the shape of their irises, slits instead of circles, their range of vision covers about 320° compared with predators which have eyes in the front of their head and are restricted to less than 180°. The retard zone is directly in front of the head of the animal. Your impact when in this zone is to retard their forward progress – slow them down, provided you are not critically inside the flight zone in which case they will probably stop or veer left or right.

In the drift zone you will tend to have no impact on direction or speed from outside the flight zone and the animal will tend to maintain its direction and speed.

In the push zone there will tend to be reinforcement of the direction of travel leading to an increase in the speed of progress, depending on the distance away.

One of the very basic rules is that the animal will move in the direction it is facing. So if it is not facing in the direction you want it to move, then there is little prospect of it heading in that new direction without facing it first. So you need to move your position to get the head facing the required direction. A buffalo will generally face you if you stand in front of it. If you stand in between where it is and where you want it to go to, then pull back and approach from a 30° to 45° angle from the side, it should move in the right direction.

Always work on the leader. Once she (usually) moves the others will follow. Maintain the position in relation to the rest of the mob, then move parallel to their movement and in the opposite direction to empty the yard. Again, don't walk behind in the blind zone. When following a mob stay to the left or right flank so that they can see you without having to turn.

In the Race

In a race situation, merely walking along the race in the opposite direction to the required movement is generally enough to create good movement. Use following behaviour to best advantage by keeping the race filled, rather than bringing up one at a time.

The main fault is often walking too close to the race, which causes the buffalo to back up because of the excess pressure in the retard zone, so with quiet animals you can walk closer to the race and with more nervous animals you need to walk wider. In some cases, it may be 4–8 metres away if they are really nervous with a wide flight zone.

If the animals are backing up you need to reverse and back off and re-approach from the front, towards their head at a 45° angle until you touch their flight zone then turn and parallel their movement in the opposite direction. It is often better to keep moving in that opposite direction until they stop the movement. If they stop you need to start again from the front. If there is only one animal to move, you can walk in the same direction as it is heading as long as you walk at the same speed of travel as they are doing from the 30° position from their centreline. Don't walk faster or overtake them as that will cause a slowing, stoppage or a reversal of movement direction in the race. This is the usual situation when trying to close a door behind them once they enter the crush. If you start to overtake them they will often stop or reverse their movement in the race or they will falter at the doorway into the crush or scales. You need to re-establish the walk past from the front a second time to initiate the forward progress again.

Moving Groups between Pens in Yards

To transfer animals from one pen to another:

- Enter from the gate from which you wish them to exit. That will most likely see them facing in the right direction.
- Decide where the leaders are and head in straight line to a point perpendicular to the lead animals in the mob. Turn and head for a point at a 45° angle from the middle of the mob. This should make the leaders head towards the gate as you enter their flight zone.
- Parallel their movement in the opposite direction until enough animals have entered the gateway, providing their movement is satisfactory.
- Enter their “push zone” if the leaders have hesitated, to give them a little more impetus (pressure), then retreat one or two steps and reinforce the followers’ movements.
- Ensure the pen you are sending them into will only fill to 30-40% of its total capacity and cut off those that aren’t required. If you fill the pen too full you will not have enough space in that next pen to manoeuvre to again facilitate good movement elsewhere.
- Avoid rushing forward to close the gate as the ones that have turned to face the gateway may rush to get back out. If they hit the gate while you are in front of it, you will more than likely be injured.
- Signify your presence in their possible exit pathway by crossing from side to side without getting any closer to them. This movement will generally get them to turn away from you. Once they are not facing you, you can proceed to close the gate. Side-to-side zig-zag passes are better than heading directly to the gate. This reduces the extra pressure applied by moving in a direct line to the gate. Slamming the gate in front of their noses as they exit is only likely to have the gate returned in the opposite direction at a far greater speed, so best not to be next to it!!
- Close the gate safely. A foot on the bottom rail of the gate when closing it is a good safety precaution.

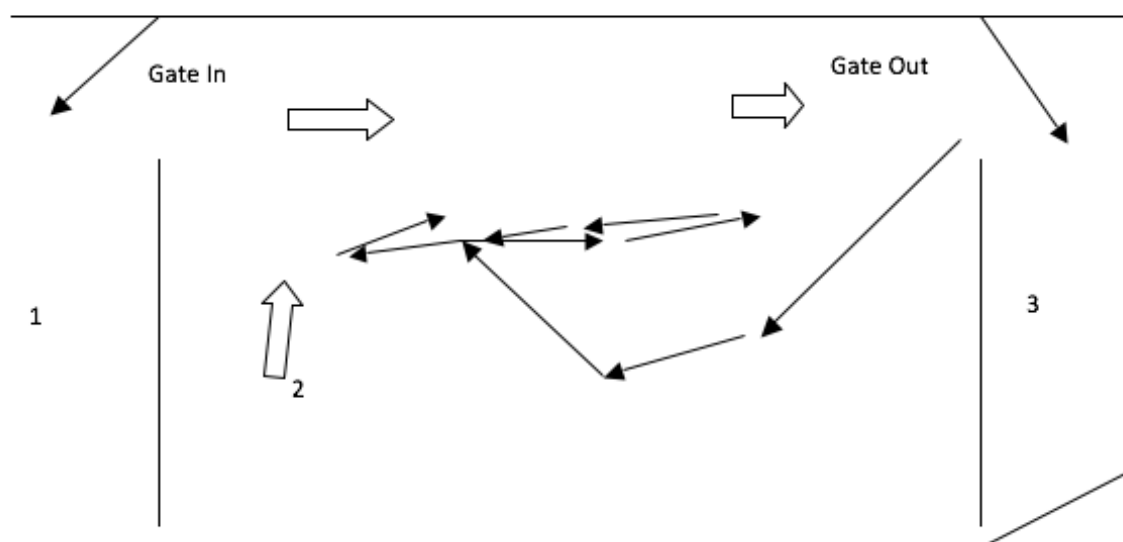


Figure 5.3 General direction of movements to empty a pen through gate (top right) into next door pen.

The main consideration is that each pen should only be loaded to a maximum of around 1/3 of its total capacity. Generally, the next pen is smaller than the last, so 2 to 3 off-loads may be required to have animals from Pen 1 sent to Pen 2 or from Pen 2 to Pen 3.

Final Points

- Always remember to use “Pressure ON–Pressure OFF”
- Keep your body in constant movement
- Be mindful of the Flight Zone
- Learn from previous experience – what did I do last time and what were the outcomes?

More information

There are many online resources available from sources about low stress stock handling techniques. Search for Bud Williams and Temple Grandin for examples. Other useful resources include Smith (1998) and Oxley et al. (2015).



Chapter 6

TRANSPORT

TRANSPORT

Australia has restrictions on long distance transport of livestock and codes of conduct for the transport of livestock are available on the internet. The principal document is the *Australian Animal Welfare Standards and Guidelines for the Land Transport of Livestock* (Animal Health Australia 2012). These standards are uniform for Australian States and Territories.

Responsibilities in the Transport of Livestock

Everyone involved in the transport chain is responsible for the welfare of the animals, from the loading, the transport, spelling and feeding and unloading. All animals should be in good condition, a minimum weight and size and should be treated in such a manner that there is no distress, injury, pain, deprivation or suffering involved in any part of the travelling process. At each step in the transport chain, there is a set of animal welfare responsibilities and people who can be held responsible for breaches.

Consignor: The Owner, Manager and Employees

- Mustering
- Handling
- Preparation
- Feeding and watering
- Holding period

Transporter

- Loading
- Final inspection
- Full journey
- Inspection during journey
- Spelling and feeding during journey
- Unloading

Receiver

- Care after unloading

Transportation of Buffalo Requires Common Sense

There needs to be good consultation for planning between consignor, transporter and receiver to ensure all responsibilities are met.

If buffalo have plenty of space, they will spend a lot of time lying down on a journey which requires much lower densities than if standing only. At maximum densities, the buffalo need to be kept standing and not left recumbent, otherwise they will be trampled by others and injured.

At low densities, young calves can accompany their dams if there is plenty of space to lie down without being trampled. If cows and calves need to be transported, the calves can be kept separate from the cows using a temporary gate panel or normal partitioning while on the truck (preferably up the front for loading and unloading) and reunited in the rest yards en route. However this is not advisable if the journey is longer than 12 hours between rest stops.

Transit Yard Spelling

Buffalo should not stay on a truck for longer than 30 hours, without being unloaded, watered and fed. In the yards, it is recommended that some long hay is available so that the rumen is kept more stable than if just fed small pelleted feed, which will passage and exit the digestive system much more rapidly, because of particle size. This will help maximise the buffalo's resilience on a long journey. Buffalo should have at least a 12 hour rest stop off the truck before being re-loaded for the forward journey. Feed and water should be freely available for the full rest period. In particularly hot weather, shade should also be provided if the rest stop is in full sun, especially in summer.



Figure 6.1 Trucks need to be equipped with sturdy crates for protection of transported stock.

Trucks should have some shielding from cold winds during late autumn, winter and early spring in southern Australia to reduce wind chill factors. Electrolytes in water may benefit thirsty stock.

When transporting animals to meatworks, sending a minimum of two animals on the shipment will help to reduce stress - a single animal in new, unfamiliar surroundings, particularly where slaughtering is taking place will usually undergo some stress from a number of different sources. Unfamiliar staff at the meatworks can be a big part of the problem, so it is best if you be present to unload and see the buffalo safely in their waiting pens. By the same token do not send two strangers in the one shipment, unless they have been paddocked together previously for at least two to three weeks. This is especially important with mature bulls.

If buffalo are at low density in a truck and have plenty of space to lie down, they could also be fed and watered on the truck without off-loading by using racks and troughs that could be attached to the sides of the trailer temporarily when the truck is stationary, but removed for the journey. Some shade would need to be provided in hot weather. Drivers also need to comply with the driver rest requirements under the various State and Territory laws regarding driver fatigue.

LOADING ON SMALL TRAILERS

Experience shows that it is often easier for an animal to jump up into a trailer from the ground up to 500 mm in distance if restricted by panels rather than a horse float type arrangement where there is a ramp that is often noisy when the animal steps on it. The animal tends not to want to enter the confined space and can veer to the side of the ramp instead of entering. An open-sided trailer is often easier to load than a fully sheeted trailer where the inside is dark. A feed lure may help to entice the animal to enter. Panelling to restrict movement in the wrong direction will be required for both situations. Training for these situations is easier when the animal is young, so should be kept in mind for the long-term. This could be achieved by using a trailer as a feeding place on a regular basis, well before the “last ride”.

Strength of Trailer

The design of the trailer should be sufficient to carry the weight of the animal and front/side/rear walls need to be sufficiently strong enough to contain it should the towing vehicle need to swerve or brake hard.

Protrusions

The transporting truck or trailer should not have any fixtures, sharp objects or protrusions that may cause trauma or injury to the animals being moved. The floor and walls up to a height of 1.8 m should be checked for these issues.

Position of Entry Gates/Doors

Most semi-trailers have side loading particularly for road-trains and usually at the front end so that when going in the slope is generally downhill and then uphill to get back out (getting back out is not usually desirable when loading!) A slide gate at the top end of the loading ramp is a very helpful addition to ensure that an animal cannot disrupt the flow in by trying to get back out down the race in the opposite direction. In a small truck or trailer, gate position is probably not an issue. A sliding gate is usually the easiest to manage in practice for quick and efficient operation.



Chapter 7

ABATTOIR OPERATIONS

ABATTOIR OPERATIONS

ENSURING TENDERBUFF® PRODUCT QUALITY

Production of a consistently tender meat product is the collective responsibility of many people along the production pathway and all need to know the responsibilities and consequences of their role. At the end of that pathway is the abattoir.

It is the responsibility of the driver to unload the truck/trailer after arrival at the abattoir. The driver needs to be patient and allow the buffalo to see the exit of the truck quietly and proceed of their own accord. The use of the partitions to restrict the animal's movement usually helps in directing the buffalo to the exit. They need to be facing the exit door to get the most favourable result. If not looking at the exit, there is little likelihood of a useful movement.

The use of electric prodders, shouting, jabbing or hitting with sticks or pipes will generally not get the required results and only generate stress that will result in an elevated pH in the resulting carcass. The person unloading should attract the lead animal's attention from a position that helps align the animal to the exit, then approach from outside its flight zone into a position that causes the animal to move forward. If the animal has become agitated, then a squirt with a hose may help to cool it and calm it.

The more people that try to help by surrounding the truck, the greater the pressure applied to the buffalo. If these extra people have no stock knowledge then they will unknowingly disrupt by getting in the wrong place and distracting the animals, with the result that there is a lesser likelihood that unloading will occur expeditiously without upsetting the animals.

Stock should have ready access to feed and water if there will be more than 12 hours between arrival and slaughter times and access to clean drinking water at all times in the yards while waiting.

Sprinklers to clean dirt and mud from the buffalo's hides are useful, as is a pressure hose directed manually at the affected animals. The bellies of buffalo may need the hose treatment unless there are sprays directed from ground level. There will usually be no objection by buffalo to being hosed down with water and it often has a calming effect and reduces any heat stress.



Figure 7.1 Sprinklers in the pen will calm buffalo considerably and help clean off any accumulated mud and dirt before despatch in the knocking box .

Where possible handlers should apply low stress stock handling techniques in abattoir yards and infrastructure. However, often inadequate separation between handler and animal means that, due to poor design, docile animals usually respond easily but nervous animals will need to be handled carefully so as not to elevate stress levels.

As previously mentioned in Chapter 6 “Transport”, single animals can be more difficult to work with when out of their normal surroundings. It is advisable when transporting animals to the abattoir, to take at least two so that they are not left alone for too long which may cause heightened tension and anxiety. Animals from other properties should not be put in the same pen due to the likelihood of incompatibility and possible fighting, particularly with bulls or young and old buffalo mixed together. Stress levels will definitely increase if there is chasing in the pens and it will use up vital glycogen reserves. Lack of muscle glycogen reserves causes an elevation of final pH and increasing toughness and dark colouration in the meat as a result of stress.

TENDERBUFF® BRANDING - FIVE CRITERIA

1. Carcase weight – over 150 kg and below 300 kg (the top weight was increased once Riverine crosses became available as they were far heavier within the age parameter).
2. Carcase fat - in the range of 3-12 mm on the P8 (rump site). It was found through experience that P8 and 11-12 rib fat thickness are closely equivalent in the Swamp buffalo, provided carcase dressing has been done carefully.
3. Dentition – The animal has to have no permanent incisor teeth. This can be easily identified in the live animal or the dead animal before the head is removed. Permanent incisor teeth are much broader (over 20mm+) compared with calf temporary incisors, which are generally well worn down and narrow by 2.5 years of age. The mean age of eruption of the first pair of permanent incisors is 2.7 years and they are about twice the size (in width). Incisor teeth usually erupt in pairs but they may emerge up to 1 month apart with roughly 8 to 9 months between the 2nd, 3rd and 4th pairs.
4. Electrical stimulation of the carcase. - A requirement because fat cover on water buffalo is usually low, often resulting in cold shortening of muscles in modern efficient chillers and a toughening of the meat due to a larger number of muscle fibres contracting into a smaller space. A thick subcutaneous fat layer can insulate the carcase somewhat from this cooling issue. However, buffalo carcasses have a much lighter and uneven distribution of outer carcase fat compared with beef. Electrical stimulation causes a more rapid onset of rigor mortis (down to 2 hours) which in turn stops any further cold shortening. The normal onset of rigor mortis in a non-stimulated carcase is 12-14 hours. Electrical stimulation is achieved using a cheaper low voltage unit with nose and anal probes or alternatively, for faster throughput, a high voltage unit which normally operates via the hanging rail and can treat multiple carcasses at the one time. It is applied soon after slaughter. It should not be confused with electrical stunning prior to bleeding.
5. Measurement of final muscle pH. - Acidity of the muscle is closely related to tenderness; higher acidity (lower pH) is best, pH of 5.3 is usually the lowest figure achieved. Up to 5.8 is acceptable for TenderBuff®. Over 5.8, price discounts are applied. Around 6.4 is the worst possible reading and the meat will be very dark. In a freshly killed carcase, pH starts at around 6.7 and acidity increases (pH lowers) over a period of 18-24 hours to final pH. The drop in pH is totally related to the amount of glycogen stored in the muscle at slaughter. Glycogen is converted to lactic acid by enzyme action in the muscle. Tenderness increases as pH drops and protein bonding is broken down. (See Figure 7.2, below).

When pH is at 6.0 or higher, the product is generally frozen immediately after boning as it has a too short a shelf life at refrigeration temperatures; the lower the pH, the lighter the colour and the greater the acceptability to the customer.

A reduction in pH is related to the stress level of the animal. If an animal is stressed before slaughter, then muscle glycogen levels are depleted and they may take up to 48 hours of no stress to fully recover. If lactic acid is not present, then natural enzymes in the muscle are not inhibited and muscle fibres are broken down and the meat quickly develops “off-colours” (brown to green to purple) and “off-flavours” as sulphur is released from the breaking of protein bonds.

If all criteria are met, the quality assurance person can apply a TenderBuff® strip brand to the outer surface of the carcass, so that all important externally exposed muscles will have been branded.

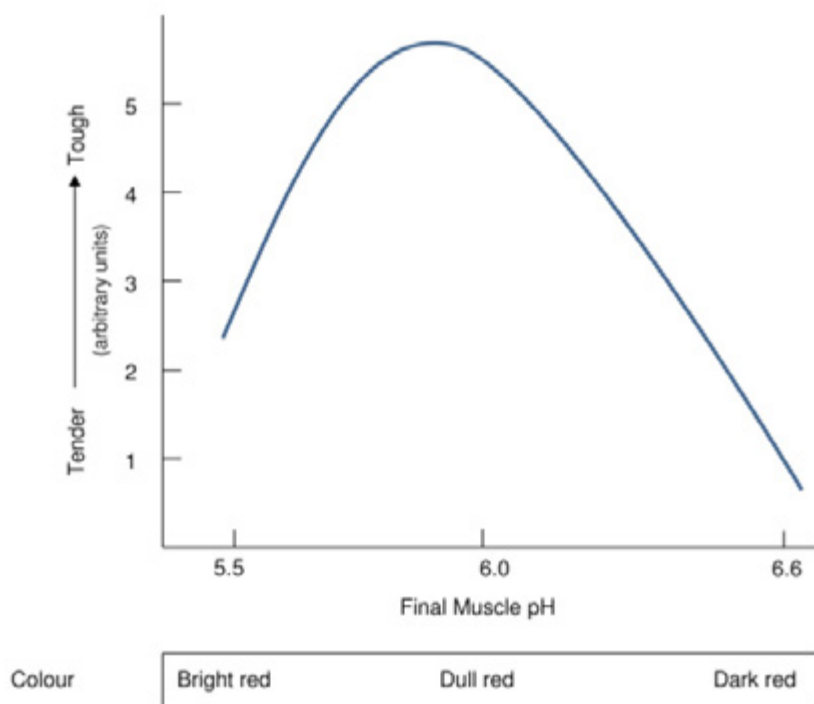


Figure 7.2 The relationship between tenderness, muscle pH and colour.

STRESS AND MEAT TENDERNESS

Stress and meat tenderness are directly related. Muscles at rest contain the normal amount of glycogen for muscle energy and work. If a buffalo over-exerts or gets stressed, it uses up some or all of the muscle glycogen (energy reserve) and this then takes some time before it is replaced back to normal rested levels (refer Chapter 6 Transport).

In the carcass after slaughter, glycogen in the muscle is converted by enzyme action into lactic acid which causes the muscle pH level to drop. A muscle with a full dose of glycogen will have an ultimate pH that will drop over a period of 24+ hours from around 6.8 down to around 5.4, when all has been converted to lactic acid. If most glycogen has depleted prior to slaughter, the pH will stay high at up to 6.4. All levels in between are possible according to the level of glycogen reduction prior to slaughter. High pH also causes a colour difference. High pH meats are dark and low pH muscles are a much lighter and brighter red. High pH animals (beef and buffalo) are referred to as ‘dark cutters’ in the butcher trade.

For TenderBuff®, meat pH levels from 5.4 to 5.8 are acceptable for TenderBuff® branding while above pH 5.8 the prices paid per kg are discounted based on a grid system, in stages according to the level above 5.8.

Apart from decreasing tenderness at higher pH, there is also a decrease in keeping quality of the meat (shelf life). This loss of meat quality is not corrected by vacuum packaging, and spoilage can only be halted by freezing as soon as possible after boning. Hanging for a longer period (aging) will also not help.

Loss of shelf life is due to the naturally occurring enzymes in the meat actively breaking down muscle protein components and linkages. The acidity of muscles in an unstressed hung carcass has an inhibiting effect on this enzyme activity.

High pH meat needs to be eaten immediately or frozen. If placed in vacuum packaging, off-flavours and colours develop within days. Shades of green/purple/brown develop in the vacuum bag making the meat quite unappealing to the eye and unappetising and sulphur is also released with protein breakdown, causing an unappealing smell.

SUMMARY OF STANDARD OPERATING PROCEDURES IN ABATTOIR RECEPTION

- All animals should be moved at a walking pace – anything faster is stress inducing/related.
- Driver quietly unloads animal/s.
- Buffalo walks quietly to holding pen where sprinklers provide heat relief and wash off dirt etc.
- When ready for slaughter animal is quietly and gently moved up races to knocking box.
- In an abattoir situation the tool of choice is the “cattle talker” -a plastic or timber pole up to 2 metres in length with strips of plastic or similar material attached to the end which are distracting to the animal when shaken and allows the handler to maintain adequate separation. An electric cattle prod should only be used on the rare occasion when all else fails.

KNOCKING

The knocking box is where the animal is stunned or despatched and should be well lit and not a dark hole that the animal will be hesitant to enter. There should be a perceived escape route for the buffalo, a “light at the end of the tunnel”, so that force is not required to enter the box facing a blank wall. It is usually easier to move a buffalo forward if there is one in front to follow. The buffalo should not be held in the knocking box for any more than one minute before despatch.

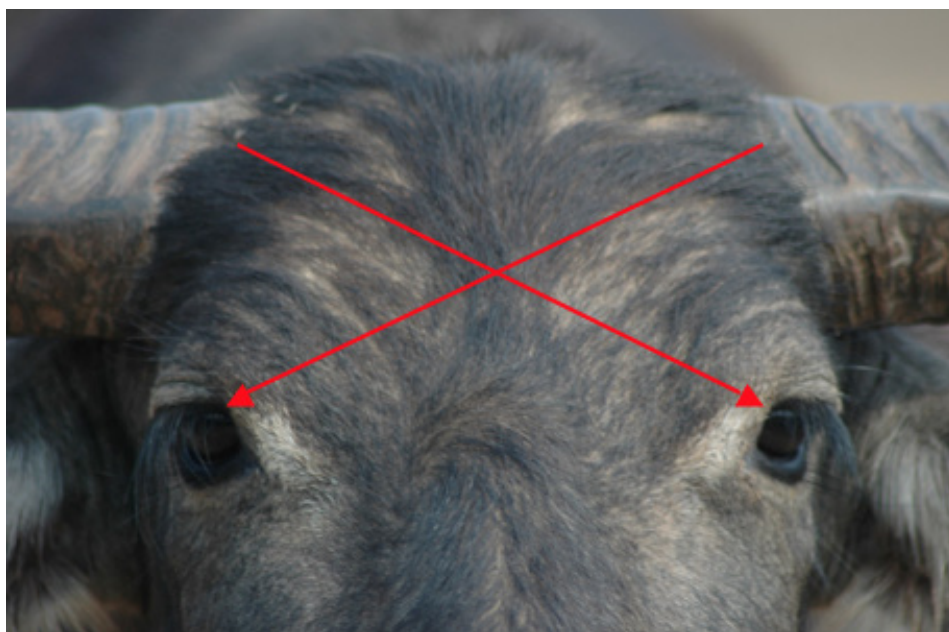


Figure 7.3 Aiming position for rifle for a clean despatch. A penetrating bolt stunner is more likely to be effective in the poll position (behind the skull).

Knocking is most often carried out with a rifle as a captive bolt pistol requires a much heavier charge than for an equally aged or sized cattle cow. The skull structure is much heavier than cattle and skin thickness much greater. The captive bolt pistol is less effective the larger the animal. Percussion stunners are also not effective in larger buffalo without using very heavy loads. There is currently work being done by CSIRO to study stunning in buffalo to develop an effective Halal method, particularly for overseas exports. The current theory is that poll stunning is more likely to be an effective method than frontal stunning. In the Northern Territory experience over many years, it has been found that a .22 magnum calibre rifle using solid projectiles is adequate for most animals up to 450 kg liveweight in the frontal position. For older cows and particularly big bulls, a bigger calibre and power projectile is necessary and a .223 was found to be effective in all cases.

The aiming point is similar to cattle and is the bisection of two diagonal lines from the eye sockets to the base of the opposite horn.

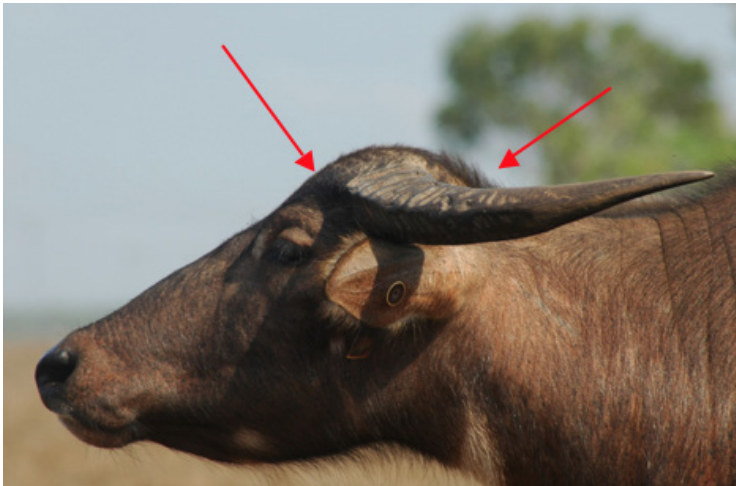


Figure 7.4 Angle of penetration for frontal rifle projectile or alternative poll shot.



Figure 7.5 TenderBuff® processing. Removal of hide and internal organs prior to carcass splitting.

- The aiming trajectory should be perpendicular to the angle of the skull at that point. (The brain cannot be utilised for human consumption if a buffalo is head shot.)
- For Tenderbuff® or leaner carcasses, electrical stimulation is then recommended and that should occur immediately after bleeding has commenced in the hanging position but must be completed within 10 minutes of death.
- The hide thickness of buffalo is two to four times that of cattle. Due to the wallowing habit, mud, manure and sand on the skin should be washed off completely or it will take the edge off the knife quite rapidly. There are also hygiene/health considerations in cleaning all mud and manure off the hide to reduce external contamination of the carcass when butchering.
- Electrical stunning is a viable alternative to percussion/penetrating bolt stunning or rifle use.

PROCESSING

Normal abattoir procedures for cattle are then followed. The main differences are in hide weight. In buffalo it will generally be between 50 and 70 kg depending on age and weight of the animal at slaughter. The carcass should be processed and in the chiller within 1 hour of bleeding.

The speed of processing affects cleanliness of operations and the quicker the animal is processed and placed into the chiller with proper cleaning and wash down, the less contamination is picked up from the environment. All splitting saw bone dust should be thoroughly cleaned from the spine and sternum and anywhere that it is found on the carcass surface. Excess blood should also be removed from all surfaces.

SUMMARY

The production of TenderBuff® relies on good management of stock that are processed in an abattoir. Poor handling at the abattoir destination can result in elevated stress levels that increase the final pH of the carcass and therefore eating quality of the final product.



Figure 7.6 TenderBuff® specifies no permanent incisors. Permanent incisors are readily recognised as they have around double the width compared to the temporary ones in the above picture.



Figure 7.7 For smaller abattoirs, cradles are convenient for processing. Note the hide thickness of this Riverine cross steer.



Chapter 8

CALF REARING & WEANING

CALF REARING & WEANING

CALF REARING

Calf rearing for buffalo is not as easy as with cattle calves. The sucking reflex in a new-born buffalo calf is not as strong and the calf is more likely to fret the loss of the dam and be less interested in food from other sources. This is particularly so if the calf and dam have been together for more than a month.

Generally, if more than 100-120 kg liveweight, buffalo calves can survive an early weaning and more so if they have company of another buffalo or group of calves and preferably one that is older and able to pass on eating and drinking education.

It is recommended that all calves are fed colostrum for the first feeds or for longer if it is readily available. Suitable milk replacer can then be substituted gradually over a period of 3-4 days. Difficult feeders could be fed buffalo milk for longer until a routine is firmly established with gradual substitution with milk replacer over the next week until it reaches 100%.



Figure 8.1 First drink from a bottle for new calf. The first feeds should be buffalo colostrum. The sucking reflex for buffalo is not as strong as cattle and it can take longer to get the calf to suckle strongly.

Most buffalo calf-rearers leave the calf with the cow for up to 4 days to ensure that the full quota of colostrum is properly consumed by the calf and it is drinking strongly.

When the calf is removed from the dam it is best to allow it to get a little hungry and thirsty before attempting to try and get it to suck from a bottle or bucket for the first time. Warm the milk to body temperature until the feeding regime is fully established.

The calf should be milk-reared for at least 1 month and then given access to concentrate twice daily. The concentrate could be up to 0.5 kg made up of different mixtures of lucerne chaff, copra meal, or other protein meal, grains and mineral mixed in with milk powder.

Starting Concentrate

Concentrate can be gradually introduced at four to five weeks with free access to good quality hay at all times. Calves should start at 150 g/day of concentrate mix or calf pellets built up to 250 g/day between 3 and 6 months of age. Concentrate is best fed twice per day rather than once to reduce the possibility of stomach upsets. Barley, wheat, sorghum, oats, rye and maize are all suitable energy sources, while protein sources can be copra meal, brans, cottonseed meal, fishmeal, canola and other legume seeds.

Lucerne chaff is a great starter component or additive for concentrate mixes. Leucaena leaf meal is useful in the tropics.

As concentrate consumption rises it can slowly be substituted for milk and by 3 to 4 months, the whole milk can be completely stopped over a period of a week or two.

The benefit of calf rearing is mainly in the dairy industry so that the full quota of milk from the cow can be harvested to achieve the maximum milk production for sale.

The other option is to allow the calf to remain on the cow and milk her once daily or at whatever schedule is convenient. Calves need to be locked up overnight and released again with the cow after the morning milking or vice versa. Once a routine is achieved the process operates easily. A high-producing cow is prone to mastitis if the calf is left with her for too long a period and is not able to consume enough of the milk she produces.

Good hay and water needs to be available overnight so the calves are not overly hungry next day. This helps a heifer calf to get used to hand feeding for later training to milking; eating some feed in the bales is a good diversion and relaxant for the cow being milked.

A further option is the use of multiple suckling of a high milk fat percentage dairy cow breed such as a Jersey or a Guernsey. The Jersey is more suited to hotter climates. A herd of foster cows with up to three to four calves per cow could be used.

Milk Replacers

Buffalo or goat's milk should be used on the first attempt once colostrum is finished rather than a powdered preparation for maximum acceptance. Substitutes should be introduced gradually once they are sucking strongly. A preparation that mimics the fat and solids content of buffalo milk should be created by increasing the amount of powder in the water.

Some milk replacers designed for cattle calves can be toxic to buffalo particularly those fortified with copper. Brands used by farmers currently rearing calves vary widely according to suppliers, but some attempt should be made to duplicate the composition of buffalo milk. Feeds per day (2) at 10% of body weight daily to 30 kg and then 5% for extra kilograms up to 100 kg liveweight. i.e. 3 litres/day for 30 kg calf, up to 6.5 litres/day for a 100 kg calf. There is no substitute for fresh buffalo milk to get the calf to suck strongly from the start and gradually substitute with the milk replacer.

Getting a stubborn calf to suckle

Bottle rearing is usually the best first option and once established, then changes can be considered such as 'calfeteria' feeding. Bucket or bowl feeding is an option if bottle feeding is refused.

It is thought that with bucket feeding, the calf ends up with less saliva entering the stomach than with sucking, hence less of the essential enzymes found in the saliva. This is believed to make it more prone to stomach upsets.

Swamp calves are more difficult to rear when they are removed from their mothers after several months together. They tend to fret and lack appetite and more often than not they will refuse a bottle or bucket.

Some suggested lures in this situation include:

- Soft ripe banana flesh
- Some honey on teat and in milk
- Buffalo milk
- Goat's milk.

Calves that are hand reared are often isolated individually in cages as they have a tendency to want to suck on the navels or scrotums of their companions which can cause hernias or fertility problems in bull calves later used for breeding.

It is easiest to rear calves in cages off the floor with mesh or timber slats on the cage bottom and keep the area clean of faeces to reduce the spread of internal parasites and diseases. It is also easier to monitor feed consumption and drinking patterns when calves are housed individually.

Calf Health

It is recommended that 7-in-1 vaccinations are given to buffalo calves starting at 4 weeks with a booster at 10 weeks.

Access to green pasture is always good if available, but be vigilant for worm or Coccidia infection. Faeces can be monitored for eggs and oocysts, especially if slightly loose. To break infection cycles, rotation of pasture is good practice.

Factors impacting on calf health are also included in Chapter 9 Herd Management.



Figure 8.2 A typical calf rearing set up that separates individual calves. Water and feed receptacles are placed within reach of the front of the cage.

WEANER TRAINING

The Beef CRC in Australia has completed extensive testing on cattle and has concluded that weaner yard training has benefits and advantages that persist through to the feedlot, to the point of slaughter or throughout a lifetime if kept for breeding (Pettiford 2004). Between 5 to 7 days of yard time is recommended. Low stress trainers often argue that less time is sufficient given the specific training.

The benefits of yard weaning for the feedlot industry are:

- Lower sickness rates due to lower stress levels.
- Fewer deaths or respiratory disease.
- Improved weight gain in the feedlot.
- More likelihood of reaching a higher priced target market.
- Higher growth rates resulting in savings in feed costs due to reduced times to finishing and greater throughput for the feedlot per annum.
- Possibility of a negotiated premium for supplying superior feeder stock to the feedlot.
- Less stress at the abattoir resulting in better meat quality outcomes.

Minimum requirements for yard weaning compared with paddock weaning:

- Well-built weaner proof yards with good quality water supplied.
- Stocking density at a minimum of 4 m²/head for 180 to 260 kg calves.
- Good quality hay or silage provided daily to appetite.
- 5 to 7 days duration.
- Human presence every day and multiple times per day.
- Reasonably sloped, non-bogging surface.

The above results are derived from research work carried out on cattle and there is no reason that they are not readily transferable to buffalo. It is highly recommended that buffalo weaners will also be yard trained. This will initially involve controlling the speed and direction of movement, controlling and stopping the 'rush' and the navigation of the yard system, putting them through the race/crush/scales multiple times to get them used to human handling and procedures. This all should be done very gently and quietly so that there is no rush or quick movements and at a walking pace (e.g. Oxley et al. 2015).

There should be no restrictions to passage through the yards and race, known as "a free walk". Later, after calves have passed through a number of times, they can then be stopped at slide gates, weigh scales and crushes and then be allowed to move on.

The first training for weaners should be in the biggest secure yard available to maintain a good distance from them to control their movement. This will totally depend on the size of the mob that will be routinely weaned and processed. You need to walk parallel with their direction from corner to corner, until they no longer run and they do everything at a relaxed walk. Controlling direction and speed of the weaner group is crucial, as is being able to stop their movement and hold them as a relaxed group.

It is also important that weaners be taught to handle stress e.g. an exaggerated rush towards the mob will apply sudden pressure, but the overlying principle is to relieve the pressure quickly. This should be done multiple times at intervals so that the weaner group learns to absorb pressure and there are no consequences arising from the increased pressure.

WEANING OPTIONS

Four alternative weaning strategies are possible:

- No weaning – leave as single herd.
- Separate cows and calves and keep apart (paddock weaning).
- Yard weaning (as explained above).
- Yard weaning and training.

No Weaning

Running buffalo as a single herd is the simplest option, but causes problems in the long-term. Whenever there is turn-off (stock departing the property) the entire herd needs to be mustered, monitored and processed through the yards. Turned-off animals need to be drafted off, so there is a lot of processing required to produce an even, marketable line of stock. Poor temperament animals pass on bad habits, particularly to their progeny. Bad habits are easiest to learn and pass on and are more difficult to fix. There is no mating control over younger heifers. Classes of animals with greater nutritional requirements at specific times cannot be given preferential treatment with a better paddock, supplementary feeding, routine injections, etc. without all animals being involved.

Separate Cows and Calves (Paddock Weaning)

Paddock weaning is preferable to no weaning. Segregation of males and females should also be carried out, if possible, to prevent early mating. With the known growth rates of Riverine and Riverine Cross calves, maturity is reached not long after normal weaning age at less than 12 months of age.

This method keeps animals with similar nutritional-needs in groups for better management. Calves are not trained, so are less easy to handle long term.

Yard Weaning

Yard weaning allows the weaner group to have time to socialise in a confined situation and teaches the individuals to cope with stressful situations such as separation from the mother, close contact and mixing with its contemporaries. Segregation enables better and easier management of turn-off, e.g. separate sexes and separate weight classes for staged turn-off to particular markets. This also allows for processing of smaller groups. Extra yard training practice can achieve better preparation for the abattoir and other steps in the production process.

Yard Weaning and Training

The best outcomes from yard weaning and training are achieved for the long term if procedures are learned early, before maturity. As in all species, learning is easier when young and is designed to expose weaners to mustering, vehicles, motor bikes and/or horses, yard work and handling so that learnt behaviour is retained for their lifetime. Weaners are taught how to take pressure (stress) and that it will always be quickly removed. ("Pressure On-Pressure Off" is the key to low stress stock handling). Early training pays big dividends for many years with easier mustering, faster processing and less stress in all operations, particularly in yards.

The advantages of a stress-free animal are that it is more likely to comply with directions, while a stressed animal does not behave rationally and can be unpredictable. This also removes stress and frustration for the handlers. Quiet, easily managed buffalo are distinctly preferable when considering work health and safety issues.

A lot of learned behaviour is passed onto progeny. A bad-mannered cow will often produce bad-mannered and/or flighty progeny.

The principles of weaning are to sever the mother-calf bond and teach the calf to operate independently of the dam and how to socialise with its cohorts, working cohesively together. This is basically to learn how to operate in a herd situation, in which the basic mustering parameters are to walk leisurely as a herd in a straight line until required to change direction.

Weaning Schedule

The factors to consider in determining a weaning schedule include the following:

- Nutritional status of the pasture.
- Condition of the dam.
- Availability of suitable feeding materials for weaners' in-yard training period.
- Mating schedule for the herd.

Pasture Nutrition

Reasonable quality pasture should be available post-weaning to ensure that there are no nutritional impediments at this critical stage. If pasture is not an option, then fodder and concentrate should be available. Weaning is a good time to give exposure to feedstuffs that are likely to be available and used later in life, e.g. pellets or molasses that may be used to feed milking cows in the dairy in later years.

Green forage is the best option for post-weaning and this can be achieved through irrigation if not a seasonal option, or by having a saved leguminous pasture on standby from the wet season for the Top End of the Northern Territory. Good quality hay, particularly legume, or silage is also an option for maintaining or increasing weight as weaners. This can be supplemented with protein and/or energy meals/feeds if there are limitations in fodder roughage quality.

Dam Body Condition Status - Lactation Stress

If the dam is losing body condition rapidly due to lack of suitable feed, then providing weaners are 120 kg minimum, they can be safely weaned and put on full-feed rations. This reduces the nutritional need of the dam by 30% and if feed is marginal, then the dam is more likely to survive. There is no economic value in losing a breeder under lactation stress, as the calf is also likely to die as a result, if too light. A poorly conditioned cow is also likely to be producing less milk for its calf. It is cheaper to wean the calf and feed it separately, as extra feed to the cow will most likely only increase the milk supply for the calf, but not be enough to increase her own condition unless unlimited good feed is available. Lactation stress is most likely in a late northern dry season, a dry southern late summer or during a drought. All are good reasons for early weaning and feeding of the weaners. See Appendix C for Body Condition Scoring.



Figure 8.3 It is not difficult to determine which cow is likely to get pregnant first during the next mating season.

Suitable Feedstuffs for Weaners

The heavier the weaners, the easier they are to feed and the lower the quality of material necessary for continued growth. Often a good quality hay is sufficient for heavier weaners, particularly if leguminous, but if lighter ones are weaned then the quality of the feed offered must be improved. With very small calves it is often advantageous to put them with a very quiet older or adult steer or dry cow to mother and protect the orphans. They are then less likely to fret over the loss of the dam.

Mating Schedule

Breeders will need a rest period from lactation during the last trimester of pregnancy, particularly if it is the time of the year for feed stress e.g. September to November in the Top End of the Northern Territory. The double stressors of lactation and late pregnancy should be specifically avoided at all costs particularly if during a low feed availability period as above.

As the buffalo gestation period is 310 ± 10 days (Riverine) to 330 ± 10 days (Swamp), the weaning day should be carried out at least 60 to 90 days before calving is due; that is, a September weaning at the latest for a December calving start.

In the Northern Territory Top End, a controlled mating period is recommended to start from December or early January. The mating period could be 3 to 4 months, with calving coinciding with the start of the wet season. Some properties may have better pasture nutrition available in the dry season from floodplain pastures, so a different mating season would be advantageous.

In colder areas in southern Australia, it may be wise to try to avoid peak winter calving. Calving may be more seasonal the further south the location, so there may be periods when cows will not be cycling, usually in early to mid-summer. Experience in southern Australia will need to be shared to determine the best mating times for different latitudes/climates, depending on outcomes found over time. Dairy owners will probably also need to balance out their milk supply according to seasonal demand, which may differ from the optimum breeding season for cows. Buffalo cows breed best under shortening daylight conditions i.e. from February to July in more southern conditions. The further north in Australia, the lesser the effects of seasonal breeding.

Suggested Weaning Schedule

Separate weaners and dams in the yards and remove the cows as far away as practically possible from the yards, preferably out of earshot, but with several fence barriers in between to help prevent their return. There is usually not as much pressure with buffalo as experienced with cattle at separation. Buffalo cows are usually quite content once moved away and do not appear to fret the loss of the grown calf in the ensuing few days after weaning. It is quite rare for the buffalo cow to be found back at the yards the next day, attempting to re-unite with her calf.

Feed and water must be carefully monitored to ensure they are always available. Water should be clean and potable. Troughs with algae should be thoroughly cleaned before weaning commences. Good quality hay should be the main feed ingredient (good silage is also suitable); however, protein and energy supplements should be added for lighter weaners to ensure they suffer no setbacks.

If it is a very mixed weight weaner group, smaller weaners may need to be segregated to ensure they have unimpeded access to feed. Smaller calves usually end up with the left-overs if adequate trough space is not available, as they are out-muscled by the larger ones and often hang back.

Allow for hay to be fed in racks and grain/silage to be fed in troughs that are cleaned twice daily if contaminated with faeces. Elevated troughs reduce the risk of faecal contamination. Trough space needs to be able to accommodate all stock in the yards at the one time, that is 300 mm of trough per head if concentrate is not fed freely or constantly available. Feeding on the ground increases wastage and heightens the risk of worm infestation building up more quickly.

Treat weaners at introduction to weaning with a pour-on treatment to kill all internal and external parasites and with vaccines for 5 in 1 or 7 in 1 and Botulism, if locally recommended.

If lice are seen treat initially and then a follow-up lousicide at 16 to 18 days is required to kill the eggs and emerging larvae. All parasites (internal and external) need to be controlled so no unnecessary weight losses are incurred.

Weaners should be fed twice daily and exposed to friendly human contact for an hour or two daily. Walking around the yard while weaners are feeding is a good way of introducing them to humans with minimal disturbance. Sitting on a fence and moving every now and again to a different position is a good start, also providing an opportunity to observe the most nervous weaners, as they may need to be singled out for extra training later.

Use the biggest yard available and when fully fed, begin working the weaners to get them to understand movement control: stopping-starting and moving in a certain direction. This can be initially commenced by working them along the longest side of a rectangular yard from corner to corner just by paralleling their movement. You need to be far enough to the side to not create bad movement ie. on the edge or outside their collective flight zone.

If you go faster than their pace, they will get slower and stop as you pass into their retard zone. Just repeat this action from end to end, until they stop running and learn that they can do it without a rush. Once movement is controlled you can start on the yard training, race training, and with free runs through all yard facilities to learn the layout.

If there is a suitable laneway next to the yards where there is good feed, after two to three days the weaner group can be taken from yards and then brought back, firstly on foot and then on horseback or motorbike, to start mustering training. The weaner group can be left in the laneway overnight and brought back to the yards daily or nightly as a training exercise.



Figure 8.4 Weaners need to be taught to maintain straight lines and to stop, with everything done at a walking pace.

After about a week of intensive work, when the weaner group has completed all yard training exercises well and without running, they can be moved to their paddock. Some operators consider this period too long, but it is a good guide for inexperienced producers, until they learn the ropes and can then manage it more quickly.

Reinforcement of learning should occur on a regular basis while in the paddock. This may consist of just random movements of the herd within the paddock, when passing through with the motorbike or horse. Move them around, block them up and then move off away from them. Gradually longer intervals between lessons can be instituted. When doing inspections, it is good training to just spend 10 minutes with the group in the paddock, talking to them and getting them more used to human company, possibly by taking a few biscuits of hay to attract them or a squeeze bottle of molasses to hand out a few rewards for coming up close. Once a few are trained, others will learn as well. The more frequent the exposure, the quieter the herd will become over time, with the building up of mutual respect between the handler and the herd.



Chapter 9

HERD MANAGEMENT

HERD MANAGEMENT

Herd management encompasses any operation carried out on the herd which affects productivity, therefore including many and varied subjects/actions of a husbandry or disease control nature.

SEGREGATION

Segregation involves dividing the herd into separate groups that have common needs. There are many benefits to segregation. There are the nutritional requirements of particular groups that are critical at different times of the year e.g. cows in late pregnancy or during lactation compared with dry cows. Newly weaned calves are also a group that require better nutrition. Turn-off animals should also be getting some of the best feed available to hasten their turn-off. Dry, non-pregnant cows and unmated bulls have the lowest quality nutritional requirements.

The advantages of segregation include needing to process fewer animals through the yards on the one occasion. It reduces the amount of drafting required and all animals generally get the same treatment which helps streamline operations. For example, if steers are being sent to the market, then the whole herd does not need to be yarded – only those in that particular age or weight group. This makes the task simpler and easier. It becomes a matter of just using a two-way draft to draft off those that meet the market specifications and sending the balance back to the paddock.

After mating duties, bulls will rarely run together unless you have very big paddocks with multiple watering points so that they are able to maintain adequate separation. There have been a few occasions where it has been possible to multiple sire mate using two bulls in small mating groups of around 30-40 head when the bulls have been compatible. Generally, they will have grown up together and are put in to the mating group of heifers before full maturity.

When fully matured, bulls need to be separated by two or more fences. Large bull groups can be run together in some circumstances; however, some dominant bulls may need to be separated if they are constantly harassing others. It helps if there is a wide range of ages where the younger bulls automatically know their place in the herd. Older single bull additions are usually the most problematic. In a single herd situation, bull numbers will need to be carefully managed or there will be a lot of fence repairs being attended to on a regular basis!



Figure 9.1 Keeping the herd in segregated groups makes management much simpler than having to muster the whole herd to sort out for a specific job.

CONTROLLED MATING

Controlled mating is a technique which controls when bulls go in and out of breeder groups. All year-round mating is generally not desirable except in a dairy herd where a good spread of calving is an advantage or in a climate/environment that does not have much seasonal variation, e.g. the wet humid tropics. In the dairy herd you may still need to manage the mating period if there is some clumping of calving at particular times of the year, or an AI program is deemed advisable.

Controlled mating is useful in tailoring the calving period to align it with peak pasture production so that the cow is not lactating during nutritional stress periods. Some argue that year-round calving allows for turn-off to be spread evenly through the year, but there is usually enough between-animal variation not to have a rush of animals that need to be turned off at the one time when confining to a controlled period of mating. It does help in producing more even lines of a particular product for a particular market e.g. milking heifers for sale that are only 3-4 months of age apart, can be mated as a group to control the first calving. An example would be assembling a line of heifers for the export market where the pregnancy cannot be past 7 months of gestation for travel.

If controlled mating is practised, then calves can be weaned at the one time. Yard training can also be achieved as a bigger group on an annual basis, rather than a number of smaller groups throughout the year.

Controlled mating implies that you have sufficient control of the herd to be able to pull the bulls out of the herd on a particular date. The research herd at Beatrice Hill Farm is mated more or less from 1 January to 30 April in all years, with weaning carried out in August/September. This allows for a training and feeding period using just hay and is usually followed quite soon with the green forage from the opening rains of the wet season around October. Buffalo are unlike cattle in that they are better able to withstand the dry season lactation stress and can therefore be weaned later in the year.

Calves are born from late November to mid-February, except those in AI programs which are run throughout the year. This gives all cows a non-lactation period of approximately 90 days to pick up weight during the late dry-early wet season before they are due to calve for the next season. This is difficult to achieve with an unrestricted mating period without a lot of extra work mustering the herd at regular intervals.

Controlled mating allows every year for a specific single time of 3 months after mating finishes where cows can be assessed for fertility, and culling can be safely carried out.

If carrying out a selection program on a herd, then the maximum period of mating over which calves can be satisfactorily compared is roughly 3 months.

WEANING

Calves that have had proper weaner training (refer Chapter 8 Calf Rearing and Weaning) will generally be able to be turned off sooner and are therefore more profitable. It is a work health and safety issue, as a buffalo that has been subject to human exposure will be much quieter later in life than one that has not been through the process. Weaning is the critical time for yard training. This is one of the most important issues on any buffalo farm.



Figure 9.2 A consistent group of well-grown weaners. Note the light colouration of a number of these purebred Riverine weaners. Some of the Italian semen bulls are prone to throw these lighter colour patterns in progeny. The white tail tip is common as well.

The aim of weaner yard training is that it should be a stress-free period during which the weaner is taught how to handle stress (pressure). Any stress (pressure) applied needs to be removed quickly. They can be taught to take an increased level of stress by removing that stress as quickly as possible. With habituation, the stress applied can be increased as long as they know there will be a release each time. The long-term temperament of the animal can be essentially determined at weaning age.

Bulls can change in temperament over time with maturity or to stress applied when older, but essentially if the animal isn't friendly at weaning then more intensive work may be needed to make the animal tractable after the regular training is carried out. The time spent should be commensurate with the possible value of the animal in the future. It may be more economical to cull the animal and sell in the short term.

Early weaning of Swamp buffalo in particular, can be quite detrimental if the mother-calf bond is established too strongly. Weaning under 120 kg in calf liveweight is not recommended except under extreme conditions such as drought stress. The calf tends to get quite stressed at the dam's removal and will start pining, become listless and not feed adequately for survival, especially if it is alone and unaccompanied by other buffalo. If the newborn calf is to be removed, it should receive two or three days of colostrum before being removed permanently for complete artificial feeding.

Water buffalo calves can be particularly difficult to get to suck strongly on an artificial teat and buffalo milk is the best milk to use until sucking strongly. Milk replacer can then be substituted slowly for the buffalo milk at twice daily feedings. Buffalo are not as strong in the sucking reflex as cattle calves. Weaning in buffalo can be safely carried out when they reach at least 200 kg, but can be done earlier if there are drought stresses or similar. Lower weight calves will require better quality feeding to maintain their growth rates. Weaning under 100 kg is not recommended unless calves are already well trained to a creep feeding (access to supplemental feed) regime while still with the mother. There are several online resources related to creep feeding strategies.

HEIFER SEGREGATION

Experience at Beatrice Hill Farm has found that if heifers are kept segregated from the main breeder herd for their first and second calves, their calving survival outcomes are considerably improved. In the Northern Territory in larger holdings, it is assumed that the heifer will possibly abandon the calf if the herd moves away from her, especially if it is weak. The heifer will not want to be left alone away from the main herd. A lone heifer is particularly vulnerable to dingo attack if she has a new calf, especially if it is not very strong from a prolonged birth.

Heifers should be put in an area that is more routinely inspected and more open and accessible and possibly better fenced, to reduce the chances of dingo/wild dog attack. Multi-wire electric fences with seven to eight wires are very effective in repelling dingoes. This may not be necessary in smaller, more intensive production areas. However, the practice makes good sense anyway, as the nutritional requirements of a lactating first calf heifer are greater than for a mature cow, so the heifers can be offered better quality feed and better-monitored paddocks.

DISEASES

Globally there are many diseases associated with buffalo, particularly where nutrition is sub-optimal, but few are found in Australia. Buffalo are generally a very hardy animal when in good condition and have not had a great deal of selection pressure placed on them for productivity increases. Therefore, there tend to be fewer problems than are encountered with cattle in the same environment. Calving problems (dystocia) and udder problems are not encountered very often in the Northern Territory. The main disease of buffalo in the Northern Territory was once Bovine Tuberculosis (TB).

Tuberculosis

Bovine Tuberculosis is a bacterial disease caused by *Mycobacterium bovis*. This disease was well-established in the Top End of the Northern Territory prior to the National Brucellosis and Tuberculosis Eradication Campaign (BTEC) and to be of a particularly high incidence in the more densely populated coastal floodplain areas.

Destocking, or testing and destruction of reactors (animals which tested positive) were the main management methods, with restocking from known TB-free areas.

The testing procedures using Bovine Tuberculin were not entirely effective because of cross-reactions with avian strains of TB giving both false positive and false negative results. Sometimes comparative tests were done with avian and bovine strains, but they usually only increased the number of reactors. On occasions the reaction site was measured with callipers and those with higher values were destroyed, but still many showed no TB lesions on post-mortem examination. In areas that were very densely populated with buffalo in the 1970s and 1980s, some groups of buffalo had up to a 30% incidence of TB infection.

Australia was declared TB-free in 1997 and there have been no detections of TB in the last five to ten years.

Brucellosis

Brucellosis is a bacterial disease caused by the organism *Brucella abortus*. This disease was also a component of the 1970 BTEC campaign in Australia and although buffalo are susceptible, there were never any known cases detected in buffalo in the Northern Territory at any time in its history. Eradication was achieved by blood testing all cattle and all reactors were slaughtered. Australia was pronounced free of Brucellosis in 1992.

OTHER BACTERIAL DISEASES

Bovine Johne's Disease

Bovine Johne's Disease caused by *Mycobacterium paratuberculosis* has never been detected in buffalo in the Northern Territory and the Top End is a declared-free area. Caution needs to be taken when bringing stock into the Northern Territory from interstate areas which are not free of the disease and biosecurity requirements may apply.

Leptospirosis

Buffalo and humans are both susceptible to Leptospirosis. The organisms responsible are *Leptospira interrogans* serovars Hardjo and Pomona which can be vaccinated against using 7-in-1 vaccine (Ultravac 7in1™). The bacteria infect the kidneys and genital tract and can shed Leptospirosis in the urine of infected bovines. The people most likely to contract the disease are those associated with buffalo and cattle on a regular basis especially when working yards and dairies. Buffalo and cattle are vaccinated from 6 weeks of age with a booster at 5-6 weeks after the first vaccination and thereafter at annual intervals.

Human symptoms of Leptospirosis are strong headaches, high fever, muscular aches and pains, nausea, vomiting and profound fatigue. Elimination of the disease from the herd is the best way of avoiding the human disease form, which is usually contracted by urine splash on infected skin / sores or mucous membranes.

The 7-in-1 vaccine also protects against the five common clostridia-caused diseases found in 5-in-1 vaccines (including Tetanus, Pulpy Kidney, Blackleg, Black Disease and Malignant Oedema).

Botulism

Botulism is a clostridial disease which is not covered by the above vaccines. It is caused by the bacterium *Clostridium botulinum*, which produces an incredibly powerful toxin that is fatal. In extensive phosphorus-deficient grazing areas in northern Australia, cattle and buffalo with nutrient deficiencies and those that chew on bones are the most likely to be affected by the disease. Thus the incidence of the disease is often correlated with phosphorus deficiency.

The growth of the bacteria requires warm, moist and slightly anaerobic conditions such as rotting carcasses or rotting plant material such as feed, hay or silage. The bacteria growing under such conditions will produce the toxin which, when ingested, will cause paralysis which progresses to death, usually within 10 days. There are various types of Botulism designated by letters. Type C and D vaccines are available to cover the types found in most geographical areas. Bivalent C&D vaccine is most commonly used in northern Australia.

Yersiniosis (Flood Mud Scours)

In the early days when Swamp buffalo were transported interstate, there were some deaths attributed to this bacterial disease caused by *Yersinia pseudo tuberculosis* or *Yersinia enterocolitica*. The various symptoms include diarrhoea, enterocolitis, scours, mortality, placentitis, abortion, perinatal mortality, pneumonia and mastitis.

It is commonly contracted in winter after floods, usually with copious scours or death. Commonly observed symptoms are dehydration, refusal to eat, recumbency, lethargy and copious scouring. Antibiotic treatment early on in the course of the disease can be effective.

Haemorrhagic Septicaemia

Haemorrhagic septicaemia is not found in Australia, although it is found in South East Asia. Vaccination, may be practised in quarantine to guard against outbreaks when buffalo and cattle are exported. The disease, caused by the bacterium *Pasteurella multocida*, results in an acute and highly fatal septicaemia, probably more so in Water buffalo than cattle. Death occurs within eight to 24 hours.

VIRAL DISEASES

There are many viral diseases that can affect buffalo; fortunately most are not present in Australia. These include Foot and Mouth Disease, Rinderpest, Rabies and many others.

Bluetongue

In the Northern Territory, bluetongue antibodies are regularly found in buffalo and cattle, but the disease is only short-lived with a mild fever for a few days and then immunity follows. It does, however, reduce the potential for export destinations such as China because of its import restrictions on animals with bluetongue antibodies. Some other export destinations require a three-month sojourn in a zone free of the biting midge insect vector and the buffalo can be shipped after that period of quarantine. This means that the virus is no longer active in the herd to be shipped overseas, due to the absence of the vector.

Bovine Ephemeral Fever or 3-day Sickness

Buffalo do not seem to be as affected by Bovine Ephemeral Fever (BEF) as cattle, with a much lower frequency of occurrence than that of cattle in the Top End of the Northern Territory. BEF can occur throughout the year but most outbreaks are seen during the wet season. A vaccine is now available. Affected stock can lie down for up to two weeks and are unable to stand up, but most get up within a few days as the name suggests. The main treatment is the provision of feed, water and shade, if necessary. If prolonged, there are often mortalities.

Bovine Pestivirus

Pestivirus causes two main diseases: Mucosal Disease and Bovine Viral Diarrhoea.

The effects of the virus depend on when the animal was first infected. Once infected, the animal succumbs to the disease or becomes resistant by producing antibodies which can protect it against further infections. If a heifer or cow is infected for the first time while they are pregnant, then the impact on the foetus will be determined by the stage of pregnancy. In the first four months, the calf can be seriously infected resulting in a life expectancy of up to 24 months, but death is usually much sooner, in utero (abortion), at or after birth (post-natal) or around weaning, when it has to fend for itself. Once infected as a foetus, the calf becomes a permanent carrier of the virus as they never produce antibodies to it.

The virus is spread by carrier animal to other animals via all body secretions. The disease is active through early infected calves that are less than four months in utero.

If the dam is infected after four months of gestation, the foetus is able to produce its own antibodies to fight the disease and does not become a carrier, but may still show abnormalities. The main symptoms are ill-thrift, severe reproductive losses, diarrhoea, respiratory disease and suppression of immune system leading to other disease risks.

Many animals contract the virus and produce antibodies and are then unaffected by the disease and carry lifelong immunity as long as they are not pregnant at the time of infection.

A vaccine is available and once started must be ongoing as there will be no natural immunity in the whole herd if vaccination is discontinued. The whole herd then has to be managed carefully to ensure no outside contact with carriers.

Malignant Catarrhal Fever

Malignant Catarrhal Fever (MCF) is probably caused by a number of strains of the herpes virus that are carried by sheep (without symptoms), for which buffalo have no immunity. The symptoms are severe mucous nasal discharge and eye infection, possible mouth lesions and occasionally diarrhoea. With the lack of sheep in the Northern Territory, MCF is not an issue. However, in other states of Australia where sheep are prevalent, the obvious management tool is not to mix

buffalo and sheep in the same or adjoining paddocks, particularly during winter. If contracted by buffalo, the disease is usually 100% fatal with no treatment available.

PARASITIC DISEASES

Buffalo can be affected by parasitic worms which are usually the same ones that affect cattle. It is rarely seen as a problem in the NT but that may be due to moderate to low stocking rates and a long dry season to break the worm life cycle, as well as change of pasture in free-ranging herds. Those that may be found include:

- *Ostertagia ostertagi*. The small brown stomach worm has caused some problems in the southern Australian states and buffalo appear to have little resistance to it, as the worm is not normally found in the Top End of the Northern Territory.
- *Haemonchus placei*, Barber's pole worm.
- *Strongyloides papillosus*, Threadworm, most common in calves.
- *Cooperia spp.*, Small intestinal worms.
- *Skrjabinagia bovei*, Abomasal worm.
- *Oesophagostom umradium*, Nodule worm.
- *Moniezia bendini*, Tapeworm.
- *Calicophoron calicophorum*, Stomach flukes.

Toxocariasis

At Beatrice Hill Farm (NT) there have been two outbreaks of worm infection in successive years in purebred Riverine calves caused by a large roundworm called *Toxocara (Neoascaris) vitulorum*. This condition is called Toxocariasis. The worm larvae are passed to the calf by the cow in the milk and the worm lodges in the small intestine. Larval stages can migrate to the various tissues such as the lungs and liver and can cause death; the younger the calf, the more serious the effects. Death is often via pneumonia. The earlier that the worm infection is treated the better the outcome. Eggs in the faeces indicate infection. Drenches are effective against the worm as long as tissue migration has not caused further complications. This worm is common in tropical and subtropical areas and owners need to be vigilant in observing calves that are not thriving.

After 6 months of age, the calf is resistant as are most adult buffalo. Calves shed eggs in their faeces which infect the pastures for several months. They are ingested and lodge in the small intestine. And migration occurs from there. The worm is up to 40 cm long and looks like cooked soft spaghetti and may be mistaken for a ball or string of mucus in the dung of an adult. Producers should be vigilant when pregnancy testing breeders.

In South East Asia where the worm is endemic, treatment of the calf is necessary within the first month of life to ensure survival. Treatment of the dam in late pregnancy using the "white drenches" is effective in reducing the numbers of infected calves.

Treatments

Worm infestation can be easily treated with many pour-on materials that are readily available or by the use of drenches (anthelmintics) which are available in 3 broad-spectrum categories, mostly by oral dosage. It is advisable not to use the same category of drench on a constant basis as resistance can be established in the herd.

The three broad-spectrum categories are:

1. Benzimidazole drenches ('BZ' or 'white' drenches)—Oral drenches.
2. Levamisole/Morantel drenches ('LEV', 'LV' or 'clear' drenches)—Mostly Oral.
3. Macrocyclic Lactone drenches ('ML' or 'mectin' drenches)—Some oral, many pour-on types.

Others include Spiroindolones and amino-acetonitrile derivatives (AAD) and other mid and narrow-spectrum drenches. Some are used in combinations to increase effectiveness and to reduce the chances of resistance. The best strategy is to rotate amongst the broad groupings depending on the worm species being targeted. Producers need to carefully read the labels to determine whether the drench is appropriate for the purpose. eg when producing milk for human consumption. More information can be found in other state government Fact Sheets available on the internet e.g. NSW DPI Primefact 419 (June 2007) "Cattle worm control—the basics".

Coccidiosis

Coccidiosis (*Eimeria spp.*) can usually be found only in calves that are scouring. Dirty tail and anal areas and/or a calf in poor general condition are signs to be on the lookout for. Scouring can be profuse and runny.

The usual conditions for worms and Coccidiosis are heavy stocking rates in paddocks, large groups held in yards, short grass and damp conditions. Coccidiosis is diagnosed by counting the oocytes in calf faecal material under a microscope at the same time as looking for worm eggs. If the oocyte count is very high, then it can be treated by injection (Tribactrim®, under veterinary supervision) for immediate relief or by using Rumensin® which can be delivered in mineral blocks, loose mixes or pelleted concentrates. Some caution needs to be taken with Rumensin® in buffalo as their tolerance is much less than cattle and it can be toxic if too much is ingested.

Adults are generally not affected at all except when in very poor body condition and/or under stress. Poor body condition makes the animal more susceptible to many different diseases and conditions, because of the animal's general lack of immunity.

Liver Fluke

While Liver Fluke caused by *Fasciola hepatica* can be a problem in buffalo overseas, it has never been found in the Northern Territory. It is also endemic in some areas of southern Australia. The lesions on the liver make it easy to recognise on post-mortem examination. If Liver Fluke is an issue, a veterinarian can recommend appropriate treatment for the local district.

EXTERNAL PARASITES

Buffalo Fly

Buffalo fly (*Siphona exigua*) is common in the Northern Territory but does not cause the same degree of nuisance in buffalo as is experienced with cattle in the same conditions. Buffalo rarely develop the same skin lesions that cattle do, probably due to their much thicker skin.

Several methods can be used to control Buffalo fly:

- Insecticidal ear tags with up to three months of protection.
- Various pour-on preparations usually lasting up to one month.
- Sprays with varying lengths of protection – from one day to two weeks.
- Non-chemical physical structures that trap flies when the animal enters.
- Back rubber systems – oil plus chemical in a container with a drip-feed into the matting and situated in the paddock for 24-hour usage.

The effectiveness of measures depends on how well the fly numbers are controlled in a given

area, the distance from untreated herds and the season. The largest numbers of flies are usually found in the wet season or early dry season, when moist breeding sites are still readily available, usually in dung pats. Isolated herds are more easily protected, particularly if all animals on the property are treated at the same time.

Buffalo Louse

This louse (*Haematopinus tuberculatus*) is well-established in the Northern Territory in most herds; its effects are most noticeable when animals are underfed.

The eggs are most often noticed first. Eggs are creamy in colour, about the size of a pin-head and are found attached to hairs in many locations on the body. Rubbing on tree trunks, as distinct from horn rubbing is also an indicator of infection. The adult lice are a mid-grey colour, the body is about 3 mm across and usually visible on pink or lighter skinned areas under the tail or between the legs or the underbelly.

Buffalo in poor condition are more severely affected, particularly young calves. Buffalo travelling interstate should always be treated for lice before shipping to ensure that it is not spread to new areas interstate. There are a number of preparations, but for most chemicals the registration only covers cattle.

There are sprays and pour-ons available. To be absolutely sure, a second dose 16 days after the first is recommended to kill any larvae emerging from eggs attached to the skin hairs on the buffalo. Some preparations are not capable of killing the eggs of the louse.

It would appear from experience on Beatrice Hill Farm that eradication of Buffalo Lice is possible. Two pour-on applications (e.g. Easydose®) 16 days apart appear to be necessary to achieve this. Treatment of all animals on the property at the same time is needed and groups should be kept separated. Incursions of feral animals can cause breakdowns and all new arrivals should be quarantined from contact until double-treated with the pour-on.



Figure 9.3 These calves are not showing adverse effects despite a large number of buffalo flies.

Cattle Tick

Buffalo appear to be quite resistant to cattle tick (*Boophilus microplus*) and have not been known to contract tick fever. Ticks are only found on buffalo when they are mixed in the same paddock as tick-infested cattle. This may be due to their thicker skin, but even when mixed with heavily tick-infested cattle, buffalo only carry small numbers and full engorgement of ticks is rarely seen. Buffalo in poor condition are most likely to be affected by ticks.

Cattle ticks are becoming resistant to chemical treatments, but can probably be eradicated by pasture spelling over a long period of time (greater than 12 months), if stock are chemically treated when moving to a new paddock. In tropical climates, the dry season is valuable in helping to break the cattle tick life cycle.



Chapter 10

PASTURE & FEED MANAGEMENT

PASTURE & FEED MANAGEMENT

BUFFALO PHYSIOLOGY AND FEED REQUIREMENTS

Kennedy et al. (1992a and b) found that two factors contribute to the advantages that buffalo have over cattle:

- Buffalo are able to more efficiently recycle nitrogen from their diet by shunting nitrogen to a higher concentration in the kidneys and extracting a larger amount for recycling, i.e. they lose less nitrogen in the urine. This means that buffalo may need less supplementary nitrogen in the diet compared with cattle.
- Buffalo are able to produce a smaller particle size in the rumen so that there is faster and more efficient passage through the digestive system. Buffalo have lower MRTs (mean retention times) of digesta in the rumen. This means that the turnover of bacteria is more rapid.

Kennedy et al. (1987) found that voluntary intake of a low quality roughage diet was higher in buffalo than in cattle of the same weight. Buffalo had consistently higher blood urea nitrogen levels on high roughage, low quality diets. With buffalo, blood urea levels dropped on the higher grain diet, while the reverse occurred with cattle.

This work suggested that there is no benefit in feeding more than 30% of the buffalo diet as concentrate. Concentrate is usually the most expensive component of the diet. While feed efficiency (kg weight of feed/kg of liveweight gain) may improve slightly, the costs increase significantly.

For growing buffalo at around 250 kg liveweight, 2 kg grain and 0.75 kg of a protein meal/head/day (copra meal, cottonseed meal or similar) can be used as rule of thumb with freely and constantly available roughage. Some mineral deficiencies may need to be corrected, depending on the source and the type of grain used. Maize and sorghum are the main grains used in the Top End of the Northern Territory. This would be a buffalo “feedlot” ration if fed as a block supplement (preferably with a block of around 8% phosphorus); that is, good quality hay, grain, protein supplement and phosphorus block.

The main attribute of dairy buffalo compared to cattle is the ability to produce milk from a pasture grass system. In Australia, most current dairies are pasture-based and the only concentrates used are some pellets or molasses to lure them into the bails and keep them occupied while milking and aiding milk let-down. In countries such as Italy they are generally fed full-balanced rations which consist of grain (maize), maize silage, hay, protein meals and minerals in order to maximise productivity. These rations are fed in a feedlot, not in the milking bails and pasture access is rare, particularly in the winter.

PASTURES IN THE TOP END OF THE NORTHERN TERRITORY

The stocking rate is the key to successful pasture production in the Top End, or anywhere in the tropics. Consideration needs to be given to the distinct ‘wet’ and protracted ‘dry’ seasons. Feed budgeting must be undertaken to ensure there is sufficient standing or conserved feed at the end of each wet season to maintain the herd through the entire following dry season.

Wet Season

There is usually no problem in pasture feeding livestock in the ‘wet’ season, as there is abundant rainfall and good pasture growth during this period. The main requirement is the use of fertiliser and improved pasture species. Native pastures are generally of much lower feed quality and have much lower carrying capacity. Grasses and legumes both have an integral place. The main fertiliser requirements are for phosphorus and sulphur. Both are very low in most Top End native soils, with the exception of black soil plains where some phosphorus is usually present. Potassium is also usually in need of top-up several years after establishment, especially if harvesting hay from the area and there is no manure recycling occurring. Soil testing would be beneficial in the long-

term. Nitrogen draw-down will also be experienced after long-term grass grazing, if no legumes are in the system. This is usually satisfied using urea.

Copper and zinc are usually the only trace minerals that may need boosting every four to five years, as well as boron in some soils, for good legume growth. Lime or dolomite may be needed to increase pH after many years of pasture production.

All improved pastures benefit from 8–10 kg per annum of phosphorus and equivalent amounts of sulphur are usually recommended. This can be provided by ‘Super’ or sulphur-fortified Triple Super. There are a large number of suitable grasses and legumes to choose from in the Top End that are productive over a wide range of land types. Some are better suited to specific land units or regions.

Table 10.1 Suitable grasses and legumes for Top End pastures.

GRASSES	LEGUMES
Pangola	Verano
Jarra grass	Wynn cassia
Strickland	Blue pea
<i>Setaria sphacelata</i> cv. Kazungula	Ooloo
Tully (Koronivia grass)	Leucaena (some soils do not need dry season irrigation – many will).
Gamba grass	Phasey bean (flooded)
Guinea grasses—several varieties	Other perennial Stylos including <i>S. scabra</i> , <i>S. guianensis</i>
Signal grass	Cavalcade/Bundey Centro (best hay species)
Mekong brizantha	Calopo for northern poorer soil areas
Buffel on sandier soils	
Sabi grass—further south	
Para grass	
Aleman grass for flooded areas	
Hymenache	
Elephant grass (Napier)—mainly for cut-and-carry under irrigation	

Dry season

Methods to ensure sufficient standing feed

- Destock floodplains in the wet season and feed off in the dry season. Ponded pastures are a particularly efficient method of providing bulk green forage for the dry season through ponding at different levels on the floodplain or by using higher banks to deepen the flooded levels in various areas. The deeper areas take longer to dry out and are capable of producing green forage late into the dry season – almost all year round if around 1.0–1.5 metres of depth can be achieved.
- Save standing pasture as fodder “banks”; legumes are particularly useful in this regard. Leaving them ungrazed for the later part of the wet season allows for maximum growth and dry matter production, to enable feeding off in the dry season.
- Produce high quality hay or silage using local improved pastures, or maize/forage sorghums for silage only.
- Irrigate in the dry season. Napier grass is the most useful here, or it can be replaced by forage sorghums, with the disadvantage of being of lower in quality and having to be re-seeded each

year. Some millets are also productive (e.g. Bullrush Millet or Katherine Pearl). Some other millet varieties have problems in that they are day-length sensitive and go to seed at a very early stage. Again, fertiliser is a necessary input to ensure the efficiency of the water that is applied.

- Place mineral blocks particularly containing salt, nitrogen and sulphur in the dry season to make more efficient use of low quality dry standing forage.
- Use supplements to make up for nutritional deficiencies in the dry standing forages.



Figure 10.1 Elephant Grass.

This is excellent forage for use under irrigation in the tropics where irrigation is available in dry periods and forage harvesting is preferred to direct grazing. It has a good combination of quantity and quality attributes.

Pasture Utilisation

The key to any grazing enterprise is management of the pasture resource. In the Top End this is about maximising the amount of forage from a given area of land and managing grazing or harvesting, as much as possible from that forage. The stocking rate is the crucial factor and management of animals to ensure that the forage resource is maximised. In order to understand the process, it is necessary to understand the growth cycle of a perennial pasture sward.

Typical Perennial Tropical Pasture Grass Growth Curve

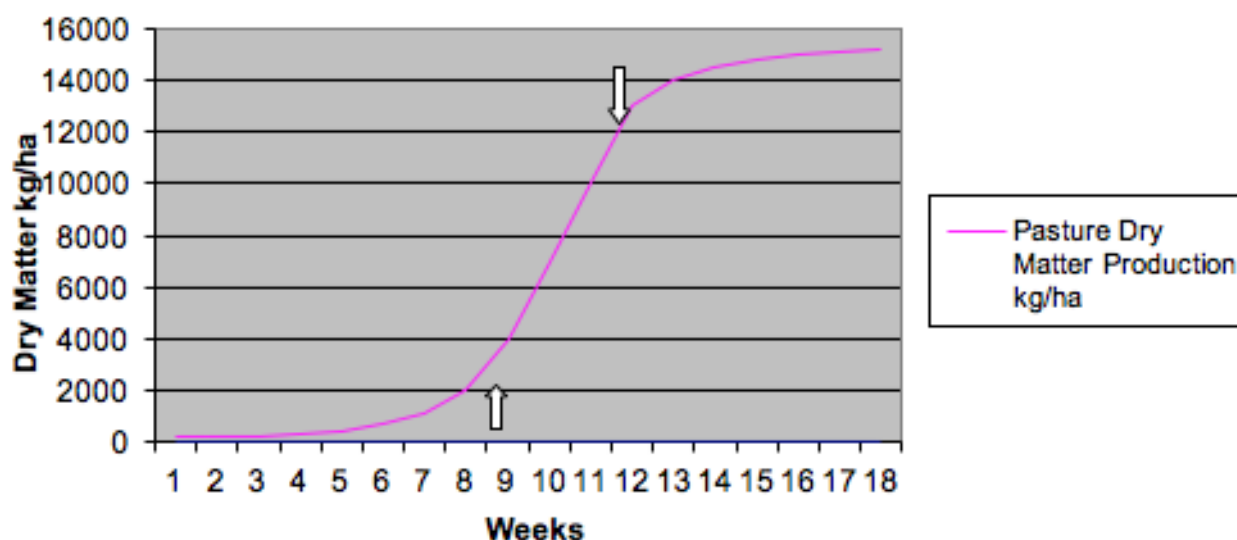


Figure 10.2 The typical growth pattern of a high-producing fertilised pasture grass. The aim should be to maintain the sward in the maximum growth phase (between the arrows)

When pasture height or dry matter (DM) per hectare is grazed too heavily, it takes a long time to build up the leaf area to ensure maximum growth occurs. This is because growth depends on leaves intercepting sunlight and storing energy to produce more leaf. After that crucial point, DM production is exponential until the leaf canopy closes over. This means that the upper leaves start to overshadow lower leaves, so a plateau is reached such that although growth continues, the death of leaves below without sunlight begins to cancel out the benefit of the active growth on top. Therefore, the total DM available remains fairly static during this phase. The amount varies for each individual species and the quantity of fertilizer applied.

The aim of management of the grazing animal should be to exploit this phase of rapid growth by removing the animals before the sward is completely eaten out. If taken down too low and leaf area is diminished during the lag phase, the time of low growth rate is lengthened.

With Top End tropical prostrate grasses, the goal is to leave around 150 mm of height in the sward when animals are removed. For tall grasses, such as Guinea or Gamba, this height should be increased to 300-400 mm of growth at cessation of grazing (destocking).

If destocking is practised correctly, then re-grazing can occur within 3 to 4 weeks, in comparison to severely grazed areas which may take three to four times longer to build up the same amount of DM. There are a few other factors which may reduce the productivity of regrowth, such as the presence of an active monsoon trough for a prolonged period, a dry season when there is no rain, low overnight temperatures in the dry season and use of irrigation. Temperatures below 15°C cause a drop in growth rates of many tropical forage species. The presence or absence of essential plant nutrients can also affect the DM accumulation. Adequate fencing to keep out wallabies and other herbivores is also an issue that needs to be addressed, otherwise destocking grazing animals can be in vain.

During heavy monsoon or cyclonic conditions, the soil can become waterlogged. In these conditions, coupled with a lack of sunshine, plants will shut down or severely limit their production.

It is recommended that grazing management is practised so that the “rapid growth” window is utilised to maximum advantage.

RECOMMENDATIONS FOR TOP END IMPROVED PASTURE GRAZING MANAGEMENT

ROTATIONAL GRAZING

- Maximum pasture growth should be achieved.
- Grazing at a level of around 6 head/ha until the pasture has 150-200 mm of growth remaining (higher for bunch grasses).
- Removal of stock.
- Rotate to next paddock and repeat grazing.
- The total area required will be around 1 to 2 ha per head of the total herd of dry cow equivalents depending on the level of fertiliser used and the balance of upland versus floodplain pasture.
- When the period of grazing has been determined, the number of paddocks required can be determined, to allow a 5 to 6 week rotation before getting back to the starting paddock i.e. if 1 paddock lasts 1 week, then there will be a need for 6 to 7 paddocks in total.
- Paddocks may vary in size; just leave stock on until the required level of consumption has been achieved, then destock by moving to the next paddock.

If there is some uncontrolled grazing e.g. large numbers of wallabies, then allowances will need to be made accordingly.

Other systems such as set stocking, cell grazing and others are available and each will have their advocates. Some will also espouse the benefits of using less fertiliser or better weed control capabilities. Every producer will need to make up their own mind about what is best for their production system.

WEED CONTROL

One of the biggest threats to pasture management, particularly of improved/fertilised pastures, is broadleaf weeds. Weeds can gradually (or quickly) increase and start to dominate the landscape over time, due mainly to the fact that the edible fodders are being constantly reduced and weeds are generally untouched, with the possible exception of some minor trampling damage. Weeds can then gain ascendancy and shade out usable pasture plants, produce copious amounts of seed and spread wider until they completely dominate.

Good Weed Control Practices

- If possible start with weed-free country. It is far easier to keep land weed-free than start off with a weedy area.
- Ensure all vehicles, equipment and machinery are cleaned of all weed seed before they enter the paddock/property.
- Immediately hand-pull any weeds that appear as soon as they are seen before they seed. Make this a firm habit. If quantities are too large for hand pulling, then spot spray regularly; again before weeds have a chance to go to seed.
- In grasses, broad leaf weeds can be selectively removed in most cases using a mixture of herbicides containing 2,4-D and Metsulfuron. It is usually more effective when the plants are younger and actively growing. Spot spraying or boom spraying are suitable application methods in a grass pasture. If useful legumes are present in the pasture, then these sprays will also remove the legume component. If adequate seeding has occurred previously they will eventually re-establish but possibly not until the next wet season. In general, a legume component in a grass pasture is worth around an extra 20-30 kg of buffalo or cattle liveweight

gain per year, so it is well worthwhile retaining legumes for the nitrogen they add to the system. Spot spraying is the only option in a mixed grass/legume pasture so it will depend on the weed density as to whether it is a practical proposition.

- Do not allow weeds to set seed. If flowering and seed formation have commenced, then the weeds should be wholly removed to a dump site that can be regularly monitored and sprayed out if seeds manage to survive.
- It is necessary to observe strict quarantine principles on all paddocks to prevent weed outbreaks. Particularly check for weeds under shade trees as birds are not very good at observing quarantine rules!
- Only purchase pasture seed with a seed test (germination and purity) and ensure there are no weed seeds present that are a problem in the Top End. Be sure to check carefully the “impurities” “weed seed present” section of the report which should have been completed by an independent assessor. Certified seed may not be necessarily available for all varieties of pasture seed.

Do not accept/purchase seed with any of the following weed contaminants:

- *Sida acuta*, Spiny-headed sida.
- *Sida rhombifolia*, Paddy’s lucerne.
- *Sida cordifolia*, Flannel weed.
- *Senna obtusifolia*, Sickle pod senna.
- *Senna occidentalis*, Coffee senna.
- *Crotalaria spp.*, Rattlepods.
- *Hyptis suaveolens*, Hyptis.
- *Sporobolus spp.*, Giant rat’s tail grass (*S. pyramidalis* and *S. natalensis*) is becoming a rapidly spreading menace in Top End pastures and it is proving expensive and difficult to eradicate.
- *Themeda quadrivalvis*, Grader grass.
- *Mimosa spp.*, Various mimosas such as creeping and floodplain or giant mimosa.
- *Cleome spp.*, Spider flowers.

Buy tested seed with good germination and sow at rates that will give good coverage in a short time. Use fertiliser for best establishment and development, choose those fertilisers with phosphorus and sulphur in roughly equal proportions. Monitor pastures on a regular basis to check on condition, fertiliser needs (colour of grass), deficiency symptoms and presence of weeds.

It is necessary to do a weed check virtually every month throughout the wet season and 1 month into the dry season. Remember a lot of weeds have bi-annual or constant seeding. For example, *Sida* can seed on established plants from mid-November to January, with another flowering from February onwards, until the dry sets in fully, Giant rat’s tail grass can seed constantly and some Sennas will seed as soon as plants are mature enough, regardless of the time of the year.

Keep a small sample of the seed planted in a sealed container in the fridge for later checking if establishment expectations are not met upon germination; it is too late to wonder once it has all been planted and has failed to emerge.



Figure 10.3 Four of the Top End's worst broadleaf pasture weeds, left to right: *Senna obtusifolia*, *Hyptis suaveolens*, *Sida acuta* and *Sida rhombifolia*.

Pasture Monitoring

- Pasture progress and health should be monitored and recorded, as follows:
- Keep a paddock book with a section for each paddock. List the initial planted species, rates of application and fertiliser applied.
- Record maintenance fertiliser.
- Record weed control measures (time taken, herbicide type/rate and species controlled).
- Set up photo points in each paddock and take yearly photos of the same spot (a picket is a suitable marker). These photo points should be representative of the paddock and show a good expanse of pasture. Stand around 10 metres away and use the same zoom lens setting at the same time/s each year to get a sequential record over time of pasture condition. This will show whether there is deterioration in pasture quality over the years. Do not rely on memory!
- Record livestock movements in and out of the paddock with dates/numbers and classes of stock.
- Record rainfall and duration of season for the property (for multiple sites if a large property).

Over time this information allows for good estimation of the carrying capacity of the paddock and the property, if a good record system is kept. There are computer-based software programs for properties which cater for this type of recording as well as the livestock components of the farm.

SOUTHERN AUSTRALIA

As the author has no southern pasture experience it would be best to canvass the district for the best cattle pastures that can grow there and contact the local advisory government agencies e.g. Departments of Agriculture/Primary Industries to obtain their recommendations for cattle in local areas. It should be kept in mind that buffalo will readily consume a wider range of forage species and may appreciate coarser, higher roughage content, lower quality grasses and especially during winter when moisture levels in grasses and forages are high.

Buffalo can also help clean out reeds from dams and irrigation channels. Wallowing behaviour appears to be much reduced in southern climates, possibly because high temperatures and high insect loadings do not coincide as they do in the tropics.

Droughts can be a very disruptive for buffalo production in southern areas and provision should be made for a conserved fodder reserve during the good years to help cope during the bad years. A greater emphasis should be placed on roughage supply and this can be cereal straws, grass and legume hays or silage.



Figure 10.4 Southern pasture differences. These are very different to tropical pastures in quantity and quality and will generally generate better weight gains in good seasons than their northern counterparts. The main difference in tropical pastures is usually that while the total dry matter content can be higher, the digestibility values are usually much lower.



Chapter 11

INFRASTRUCTURE & FACILITIES

INFRASTRUCTURE AND FACILITIES

FENCING

Most fencing designed for cattle is suitable for buffalo. As they are a very strong animal and have an impressive horn structure for tackling sub-standard fences, designs need to be well thought out and maintained.

High Tensile Barbed Wire, 1.6 mm

4 to 5 equally spaced wires with the top wire at 1.2 m and 5-6 metre spacing between steel pickets or timber posts is suitable for buffalo. If it is a boundary fence, then an electrified outrigger stand-off wire would be recommended on the inside of the fence to keep buffalo in, or on the outside to prevent intruders, or both, whichever is the priority.

The electrified wire would be placed at around 750-900 mm above ground level and around 200-300 mm away from the fence to act as a deterrent to touching the fence. It will need to be run through insulators if the supports are not made of insulating material. The rest of the fence should be set up to act as the earthing system for the stand-off electrified wire.

Some Swamp buffalo have been observed to hook a horn around a strand of barbed wire and stretch it till the wire is slack and they can walk through.

Plain Wire Electrified Fencing

Buffalo are very sensitive to electric fencing and it is highly recommended as the most effective available fence type to use for buffalo control. There are many suitable designs depending on the class of buffalo, their temperament and training, and the geography, land types and location of the property. A single insulated tape or wire with posts at 10 m is sufficient for rotational grazing control with trained buffalo.

A three-strand wire electrified fence is suitable for paddock subdivision using 2.5 mm high tensile heavy galvanized plain wire. Place the top positive (live) wire at 1200 mm, the middle earth wire at 800 mm and the bottom positive (live) wire at 400 mm above ground level with posts at 18 m centres (hardwood timber or insulated steel pickets) with 2 or 3 insulated droppers in between. Self-insulating, black polythene droppers are adequate for this purpose.

Use “Read-Lift” gates for any gateways or openings, unless very high machinery or equipment is required to have regular access. The usual lift height is 3000 mm at the pivot point with a 30 m span to each adjoining fence post and 3-4 droppers on each span. Construct from 40 mm galvanised pipe or 40 mm Square Hollow Section (2.5 mm wall thickness). Don’t use too high a tension on the wires otherwise the lift gate will need to be pinned down to stop it rising of its own accord. The lift pivot point is in line with the fence, so when viewed from above, the gate is a Vee.



Figure 11.1 A “Read-Lift” gate in shut (down) (L) and open (up) (R) positions.

The design shown in Figure 11.1 gives a wide opening for stock to gain access to the next paddock. The bottom hinge is a 20 mm steel rod threaded through a hole in the end of the pipe, the bottom of the post and another short post 100 mm away.

For boundary fencing, a 5-strand electric fence is sufficient for good security. However, this depends on what other pressures may be encountered in the specific location. If wallabies or kangaroos need to be excluded as well, then an 8-wire design with a further 2 offset wires on the outside is suggested (see Figure 11.2, below).

Wallabies tend to burrow under the lowest wires, so this is where 2 offset wires outside the fence will help impede their progress. Even so, you will need to patrol the fence on a regular basis to fill in any ingress sites (burrowing under) with something heavy like a rock, concrete block pieces, or hardwood logs to impede progress at that spot. If land is well-graded before erection of the fence, there are fewer problems later on with uneven terrain and wallabies finding lower spots to burrow under. It may help to have the lowest wire as a pulsed wire to reduce burrowing under. However, if the soil is dry then this may have lesser impact. The bottom wire should be no more than 100 mm from the ground surface, and if live, then the fenceline will need to be very well-graded prior to construction to reduce the chances of shorting to ground.

All electric fences need the grass to be totally controlled underneath the fences to allow maximum power retention in the fence.

Chemical Controls for Under-fence Vegetation

The following are suggested:

- Velpar® liquid or granular preparations or current equivalents are effective if sprayed in a 2-metre band under the fence on a yearly basis. Do this early in the wet season to be fully effective.
- Round-Up®, which may need up to 3 applications per season, depending on the seed or grass load from the neighbouring pasture.

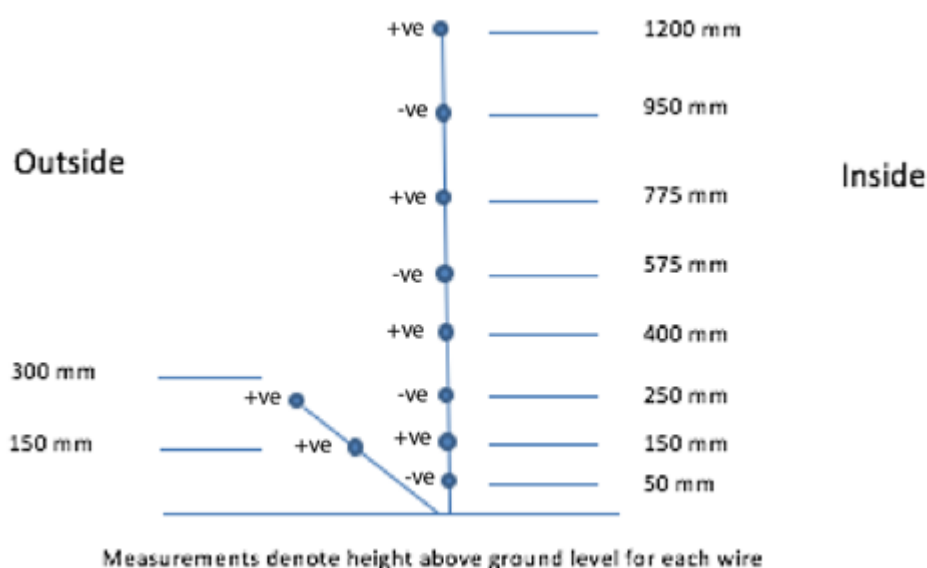


Figure 11.2 Anti-wallaby electric fence design (Top End, NT).

Electric Fence Energiser Units

It will depend on the size of property and kilometres of electric fence as to which power model is selected. Some have different test features that identify faults in the system and possibly their location as well.

Mains power models are recommended if mains power is available as they have more power per km and are cheaper. Their power usage costs are not significant in comparison to the cost of the battery and solar panels. Most manufacturers specify a kilometre of fence rating for each model. Solar set-ups or battery powered energisers are more expensive per joule of output and less powerful. However, there is no option if mains power is not available in a remote area. A back-up battery is a necessity in a solar set-up.

In the Northern Territory, lightning protection is advisable but is not 100% effective if a fence gets a nearby strike. The lightning protection is required on both the fence side and power input side of each energiser.

Mains surge protection with equipment insurance is advised on the power input side and a coil/diverter system with earth stake system on the fence side close to the energiser. The bigger models can cost several thousand dollars, so are a significant investment. It pays to have a spare circuit module on hand to maintain continuity of power in the fence once there is a fault.

The lightning earth needs to be separate and distinct from the energiser earth system. An energiser return earth system is an absolute necessity in the Northern Territory dry season or summer in southern Australia when the soil is dry and can't act as the system earth.

A back-up energiser is a good idea, as repairs can take a considerable time, or the energiser may explode, shatter into many pieces and be unrecoverable. If a bad storm is approaching then the power should be turned off and the plug removed from the socket and the fence terminal positive and negative wires removed from the unit as the best prevention, even if covered by warranty or insurance.

Lightning in the Top End is a regular wet season occurrence; nevertheless, the effectiveness of electric fencing with buffalo outweighs the lightning problems.

Planning an Electric Fencing System

When devising an electric fencing system, the primary consideration should be how well it can be monitored. One of few downsides of electric fencing is that a single fault can affect the entire system. Some of the higher level energiser models feature fault-locating systems and alarms to notify when and where a fault exists. If this is not an option, there are methods that allow for easy monitoring of the system.

By designing the fence layout so that the end of the system is close to the energiser, it is just a matter of testing the voltage at the start and end of the fence. If the voltage recorded is normal at both locations, then there is no need to inspect the rest of the fence. If there is full voltage at the end of the system, then you can assume that the fence is intact and there are no shorts. In a non-electric fence, the integrity of the whole system needs to be physically checked to ensure there are no breakages.

The idea is that the system may be 60–70 km in length, but if the connectivity is arranged to have the last panel of fencing close to the origin, but not connected up to the origin, then a simple voltage check at the end of the system guarantees the integrity of the whole system. Within the system, there needs to be separation into sectors, so that when a fault is indicated, it is not necessary to inspect every metre of the system. Therefore, in large systems, the sectors would be less than perhaps 1.5 km in length.

The testing regime would be to travel to the end of sector 1 and disconnect from the rest of the outgoing sectors. If the voltage is normal, then re-connect and go to the end of sector 2 and isolate the rest of the system and retest the voltage.



Figure 11.3 Permanent connector (left) and curl-on or (pig tail) connector (right). The alternative to the curl-on is a more expensive on-off switch. The high tensile spring gives a good connection for current, particularly when the fence wire is not rusty!

The use of the curl-on spring connectors (pig tails) (see figure above) is the simplest to operate and isolate each sector. If there is a fault farther out along the fence, then when taken off the positive wire, the voltage in the unaffected fence so far checked will rise and when reconnected to the bad sector, the pig tail connector will spark again when reapplied to the faulty fence sector wire. If the fence has 4 live wires, there will be 4 curly connectors at the end of each sector, connecting to the corresponding wire of the next sector. All earth wires need to be interconnected and an earth stake used at 1 km intervals along the whole fence.

The wire that causes sparks when reconnecting the pig tail indicates which wire has the fault. The lighter the spring is applied, the stronger the spark indicating the short. The spark sound will become muted when the spring is properly (fully) applied but there the fault will still be indicated by a drop in voltage upon re-application of the connection. In fault finding always start at the energiser and work outwards along the fence from there.

Where there is a dead short between live and earth wires, there will be no voltage in the live wire on the non-energiser side of the problem area and the voltage will drop quickly before the fault, thus helping to locate the origin of the fault, by working progressively from the energiser to the end of the fence. Therefore, if the voltage on the final sector of the fence is read first, it is safe to assume that everything in between is intact.

YARDS

Design

Most cattle yard designs are suitable for buffalo. Design depends on how quiet the buffalo are on the particular property. Quieter, fence-trained buffalo that can be more easily and safely moved, can be handled in the same standard yards that are used for cattle.

The advent of the Riverine/Riverine cross in Australia with liveweight records in excess of 900 kg in some Italian buffalo in good condition has necessitated the expansion in the width of races, crushes and head bails, as individual animals can be very broad across the back, abdomen and hips. At Beatrice Hill Farm in the Northern Territory, races have had to be widened to accommodate these bigger cows and bulls.

Race width should be at least 750 mm internal spacing to cater for the bigger Riverine or Riverine-cross animal. In southern Australia, on better pastures, weights could be even heavier.

At Beatrice Hill Farm, the race panels are vee'd and hinged and can be changed to suit larger and smaller stock with minimal changeover time. Vee panels can also be hinged vertically on the sides to open out or at the top/bottom to open up or down. If an animal ends up upside down in the race it can be difficult to extricate because of its size and weight. This can occur when animals in front back up quickly. The one behind rears up and puts their front legs over the rump of the animal backing up and the backer persists in moving backwards. The second animal ends up being upside down and facing rearwards and invariably tightly jammed in a vee race. As it attempts to right itself, it usually gets its spine tightly wedged between rails. If the race panel can be opened out, then it is much easier to turn the animal upright than when it is wedged in a race with permanent panel sides.

If the race is vee'd, then the bottom rail needs to be high enough to clear the ground when swung outwards. The locking system can be large padbolts on the bottom of the panels locking into holes cut into the upright posts. A crowbar may also be required to take the pressure of the animal's weight on the panel, to be able to operate the sliding bolts to open up. Keep clear when releasing the slide bolt.

With the variable vee-panels, one or both sides of the race can be hinged on the bottom to the floor, but to incorporate a release gate, this needs to be side-hinged within the panel frame.

At Beatrice Hill Farm, while the bottom of the vee is fixed to the concrete, the tops of both panels have two counter-acting chains and locking cleats which can be used to narrow and stabilize the vee for processing smaller buffalo or cattle groups. This can help to minimise turning around in the race when weaners and calves are being processed.



Figure 11.4 Example of a Vee race suitable for adult buffalo bulls and cows. This view shows the panels in their widest position. Vertical posts are fixed in position. The RHS panels are side-hinged to open outwards in the event an animal goes down in the race. The left hand panels are bottom-hinged to come in to position determined by the restraining chains. For example, shortening one while lengthening the other will close up the left hand panel.



Figure 11.5 Vee race restraining chains. These chains determine the position of the front bottom-hinged panel. To close up the panel for smaller stock, the left hand chain is lengthened and the higher, longer chain at the top is shortened.

Another valuable installation in yards, particularly where it is not possible to enter the yard due to an irritable animal, is the 90° to 360° swinging gate arrangement, where a group of animals can be progressively reduced to single file race width before they enter the race. This can be in the form of two 360° revolving gates in a circular system, which reduce the available space leading to the race entrance, or a revolving longer 90° gate in a square yard with an outer rounded circumference yard panel on the free swinging end of the gate panel. Locking options can be evenly spaced on this outer radius. This is similar to what is often used in dairies to keep cows coming into the dairy shed to reduce handling time.



Figure 11.6 Swinging Gate Arrangement. The panel arrowed is hinged at the far end and is supported on two car tyres to hold its weight and keep it vertical. It opens out to 90° to accept the stock. The panels are set to the outside of the arc and the uprights provide a locking mechanism for a sliding pipe latch on the end of the gate to hold the moving gate every 2.2 m along the arc.

This set-up allows handlers to be completely safe from bad-tempered animals at the critical point where animals are usually put under the most pressure to line up in a race. These are an alternative to the standard forcing pen which is where most incidents occur in the yard system with irritable animals.

Some producers prefer circular yard designs so that stock are not trapped in corners and which allow better flow. Low-stress practitioners are not in favour of these designs, considering them unnecessary, as competency in low stress stock handling techniques enable handlers to direct stock in any direction. Circular yard designs may be more useful for operations where personnel are not as well-trained or when regularly operated by a single person.



Figure 11.7 A well-designed and built set of yards for one person. This allows for single operator handling of a herd or group of up to 50 head. It has a revolving gate for filling the race and shade over the recording area.

Shade

When constructing yards, allow for shade trees or shade cloth roofs to be erected. Shade can make a big difference in temperament between those animals processed first and last on a long, hot day. For trees, fast growing-trees that spread widely with dense leaf growth are required. For the Northern Territory, Raintrees, Albizias and Enterolobiums are suitable shade providers which need protection from browsing animals when first planted, but when well grown, can be lopped to provide emergency fodder.

Crush and race width

A minimum width of 700 mm (28 inches) is necessary, but should preferably be 750 mm (30 inches). These sizes should be checked before purchasing, as a special order may be necessary for a non-standard size in a particular brand. Do not buy a crush that is too light in weight as its longevity will be compromised.

Always design yards so that there is a good-sized rectangular yard for training weaners. The size of this yard will depend on the number of weaners to be processed. The yard should be big enough to house all weaners at about 15 to 20% capacity with about 2-3 times the width for the long side so that there is plenty of length for moving the stock around. Also allow for drafting after processing and at least a three or four way draft. All yards do not need to be the same size.

If buffalo are behaving very erratically, allow for the least a 3-metre wide personnel access way along the full length of the race and crush to allow enough separation between nervous animals and handlers. A baulk fence should be erected for safety separation, if stock will be occupying the same yard area as people recording.

Baulk Gates

Baulk gates are usually necessary when head bailing buffalo. The minimum gap between the head bail and baulk gate should be around 800 mm, for all the horns to be fully past the head bail.

Unfortunately, some buffalo with long horns are very difficult to head bail as the tips of their horns are past the point of the shoulders. Once the shoulders are caught by the head bail, the animal is very difficult to restrain from moving forward due to their strength. Head bailing requires skilful reflexes as the operator needs to be precise enough to allow the horns to be fully through before closing up.

A buffalo will often pull back quickly if the horns are touched in error, as it thinks the opening is too narrow and it will be reluctant to make a second attempt to move. Either that or its head is forced higher and rearward, making it even more difficult to catch before shoulders are engaged.



Figure 11.8 A sturdy baulk gate with a locking catch. The gate is hinged on the working side of the race/crush and opens away from the crush exit. There should be no section where the animal can get its head under or through and/or be able to get a horn locked in place.



Figure 11.9 Close-up of locking latch which engages automatically when the gate is swung closed.

Loading Races/Ramps

A single file race is suitable for smaller farms for both loading and unloading trucks. A wider unloading race can be used when off-loading large groups. However, operators need to be mindful of the National Livestock Identification Scheme (NLIS) requirements for reading electronic tags on arrival on a property, so single file is probably the safest option unless a good multiple-animal electronic reader is in place.

Ramps should not be too steep. Height will depend upon the tailgate height of trucks that are routinely used and the configuration of their gates.

A level area of at least two buffalo lengths (3 to 3.5 m) should be available at the top of the ramp for buffalo to enter trucks and preferably be close to the truck entrance with a sliding gate, to deter any stock turning around in the truck. Buffalo coming back down the race and disrupting the steady flow in, is not particularly gratifying to the operator when trying to load a mob.

Two swing gates are required to be swung on the outside of the sliding door frame, with chains to be able to secure the sides between the end of the ramp and the truck sides during loading.

Another sliding gate at the bottom of the loading ramp would also be useful.

People access on one side (usually the offside) of the race of at least two metres width is also needed to expedite efficient loading and to enable the person to select the correct distance from the race at which to walk in the opposite direction to the loading direction of the stock.

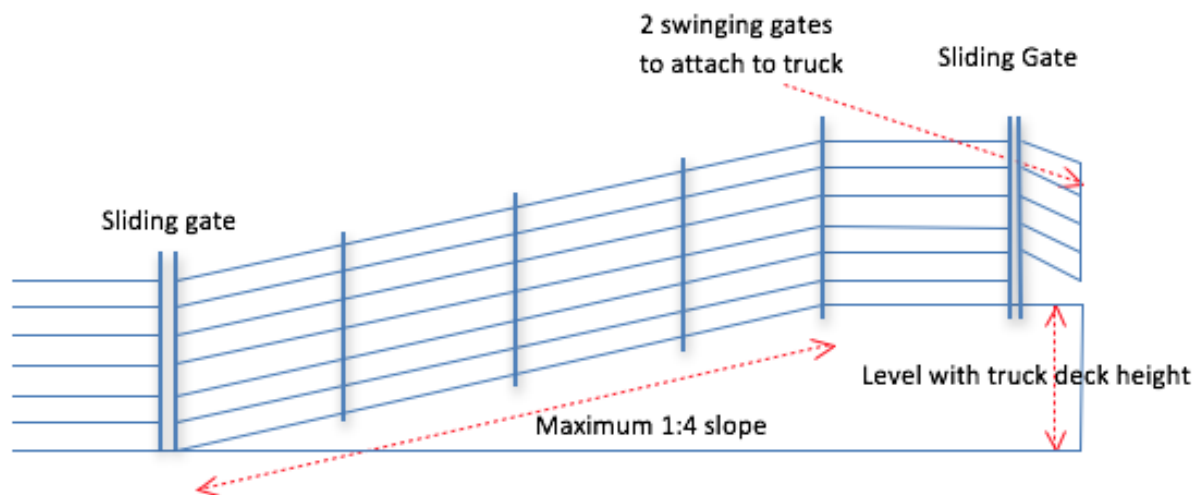


Figure 11.10 Loading race for buffalo. Allow for personnel access on each slope and top of at least 1-2 m wide, preferably on the working side where sliding gates are located.

Gate Latches

Spring-loaded gate latches are excellent for a safer positive gate closure, as many people have been injured or lost teeth trying to shut a gate in front of a running animal, attempting to close-off an escapee in a hurry. In such designs, the handle is spring-loaded and the latching bolt or tongue has a 45° bevel to hit the striker plate on the gate post to enable entry. A hole a little larger than the diameter of the latch is drilled in the striker plate. The handle needs to be lifted to almost 90° against the spring loading to disengage and have a diagonal facing enabling it to be turned back to the origin when released, using the spring pressure to make it automatic.



Figure 11.11 Spring-loaded gate handle. The gate will lock instantly and safely when slammed shut, not requiring the operator to be close by.

Portable Panels

Portable panels can be used to build yards. These have the advantage of being movable if a certain design doesn't prove to be satisfactory. Portable yard systems include race bows and gate frames that link to the panels generally using steel pins or rods in bracket holes to latch together. They are generally suitable for circular designs due to the flexibility of the pin joining systems. Tees and cross corners are no problem, with single panel tees being used to brace a long length of joined panels in a straight line.

Otherwise, star pickets can be used to brace every three or so panels with a Cobb & Co wire hitch (ensuring that the twist tie is on the outside so as not to injure the cattle/buffalo on the inside).

Heavy-duty yard panels would need to be used with wild or feral-caught buffalo, if used for initial capture or domestication training. Lighter panels are suitable for trained buffalo.

All yard systems need to be checked before use, to remove all projections that may injure stock when they move within the yards. Trip hazards or collision items must be removed.

Sliding Gates

In races, loading ramps and similar pressure areas, sliding gates are usually the best option and are simple to fabricate in a workshop. There are many and varied designs.



Figure 11.12 Sliding gates can be made quite simply. On the left is the upper slider, two of which are needed. On the right is a swinging gate that does a similar job to a slider for smaller applications such as on this calf cradle.

Head Lifters

There are many head lifters available today that come standard or extra with cattle crushes. A simple one that can be constructed easily is to use two double yacht pulleys that have a locking pawl on the top pulley block. This usually requires at least a double pulley system and 16 mm marine rope (usually nylon is very strong and easier on the hands) long enough to allow the lower pulley block to extend to the floor and enough to reach the floor on the free end. A fixture up on the yard roof or an arm welded above the crush frame provides an anchor point for the top pulley.

The bottom pulley will have a D-shackle which has a nose loop attached. The nose loop is made of seat belt webbing or heavy leather about 40 mm in width, doubled-up and stitched together with a 50 mm brass or steel ring to allow the noose to tighten around the jaw.

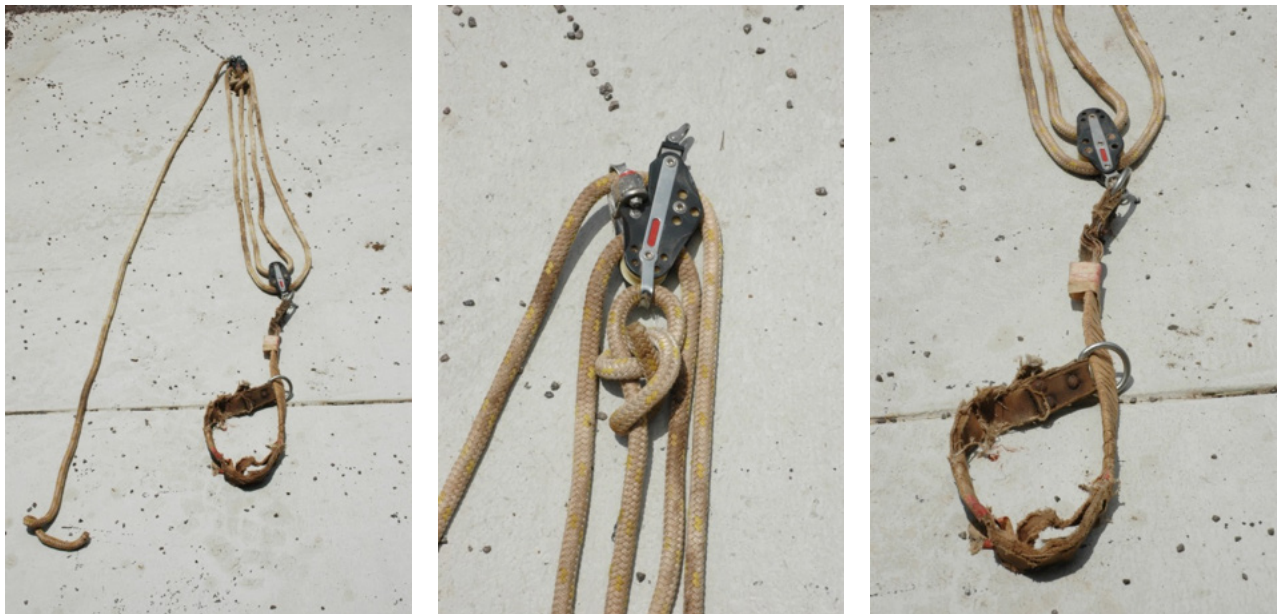


Figure 11.13 Head lifter. (L) in total, (C) top pulley arrangement and (R) bottom pulley and head noose (well used).

The loop is thrown over the nose; sometimes this can be difficult, as buffalo tend to drop their nose to the floor when a loop appears. The loop must be rapidly pulled tight to apply tension to avoid it being flicked off. This equipment is useful for checking dentition or for jugular bleeding (for veterinary or quarantine testing).

For blood sampling, if it is easier to loop a rope around the horns, a half hitch over the nose enables the head to be pulled to the right hand side and the head-rope locked to pipe lugs welded on the side of the crush frame.



Figure 11.14 A station gate latch made from readily available materials. Arrowed is one of three pipe lugs of heavy-walled 25 mm galvanized pipe, 100 to 150 mm in length fixed about 200 to 250 mm apart in parallel, fillet-welded to the stationary crush framing or roof support post next to the head bail for attaching ropes used for restraining the buffalo's head for horn tipping, blood sampling etc.

Yard Sprinklers

If working buffalo in the yards in hot weather, it is good practice to have a permanent misting/sprinkler system to keep the buffalo cool, particularly if the yards are not shaded. It can be achieved just by using tree irrigation mini sprinklers and polythene tubing suspended above the yards on wires and attached to a small water pressure pump. The water delivery rate should be monitored so that it does not make the yards muddy and slippery.



Figure 11.15 A simple pressure pump. This can supply water to troughs, washing facilities and run a sprinkler system for keeping dust levels down and buffalo cool. Small systems could use a 12 Volt pressure pump similar to those used in spray packs.

In the dry season, sprinklers should be operated for an hour or two (enough to settle any dust in yards) prior to recording, to make the job much more pleasant for both stock and handlers, who will be able to see and not be blinded by or breathing in faeces-infected dust particles for a prolonged period.

An alternative is to first soak the soil with water from a fire cart and as required during the day to keep buffalo calm and cool. Overheating causes temperament problems in the animals in the yards.

Overheating is more pronounced in buffalo than in cattle due to fewer sweat glands in the skin. Panting and a protruding tongue are sure signs of an overheated buffalo; in this situation, a cooling water spray from a hose is required immediately until symptoms disappear.

Dams (Swimming Pools)

Buffalo appreciate the cooling effects of a swim, hence the 'water buffalo' name tag. They wallow instinctively to cool off and escape biting insects. In southern Mediterranean-type climates when it is hottest in the summer, it is also dry, so wallowing appears to be much less of a habit there.

If wallowing gets too intense, resulting in muddy and putrid water, then it may be advisable to pour a concrete base in the swimming pool/small dam so that the water stays cleaner and can be periodically cleaned out. Allow for a reasonably sized, level apron above the level to which the pool is filled and also leave a sump in the lowest point to be able to pump out if it becomes too dirty. Allow 2 m² of surface area of the pond per head for adults and a depth of no more than 900 mm. Be mindful of very young calves drowning in the "pool" when mixed with a large number of adult cows. It is best to keep calving cows away till the calves are at least one month old and sturdier.

Water Troughs

Water troughs need to have a frame around them to prevent them being used as swimming pools. A welded steel frame needs to be manufactured from reasonably robust heavy steel pipe (50 mm, medium wall minimum). For a long semicircular trough, a central frame consisting of 2 pipes at 800 mm and 1200 mm above ground level is a suitable deterrent to buffalo submerging.



Figure 11.16 The simplest arrangement to deter buffalo from trough swimming. A second or third rail could be added to act as an in-line strainer if the trough serves two paddocks and straddles the fence. In this case, upright posts would be earth embedded, outside the trough frame.

For a round concrete trough, a triangular frame is sufficient to keep buffalo out and not impede animals drinking. The frame fits snugly inside the trough with legs in water or on steel plates ‘dyna-bolted’ to the top wall or outside wall of the concrete trough, if the trough is sufficiently strong. The frame should be constructed from 25 mm galvanized heavy wall pipe or of bigger diameter pipe with thinner walls.

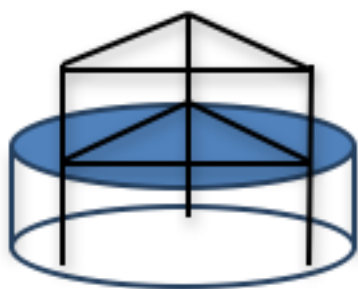


Figure 11.17 Diagram showing a design for a triangular frame construction inside a round concrete trough.

Hay Feeders

It is best not to feed hay on the ground as it is likely to be trampled or fouled with manure and wasted. There are many different designs suitable for hay feeders depending on the size and shape of the hay bales being made or purchased.



Chapter 12

ARTIFICIAL INSEMINATION & EMBRYO TRANSFER

ARTIFICIAL INSEMINATION AND EMBRYO TRANSFER

ARTIFICIAL INSEMINATION: WHY IT IS NEEDED IN AUSTRALIA

Artificial insemination (AI) is needed in Australia, because the genetic base of the Australian buffalo industry is small. The Swamp buffalo herd originated from probably less than 100 recorded head (Letts 1962) brought in from Indonesia (Dutch East Indies).

The Riverine herd in Australia introduced in 1994 has been derived from less than 80 head. AI is the only way to introduce new genetics and counteract the inbreeding potential of both these populations. Unfortunately, no Swamp Buffalo semen is importable into Australia to improve the breed and genetic diversity within the herd is low.

Dairy Industry

A small number Riverine buffalo from India in 1880s flourished in Darwin for around 30–40 years (Letts 1962) but their effect, if any, in the wild population was probably diluted over time. Imports of Riverine genetics in the mid-1990s of around 80 head from US, Italy and Bulgaria gave rise to the current dairy herds in Australia, but the Italian and Bulgarian importations were not distributed to other producers.

Therefore, all the current buffalo dairy cows in Australia apart from the Shaw River operation in southern Victoria are descended from the four heifers and four bulls imported from the US from 1994 to 1997 into the Northern Territory. Firstly the bulls were crossed with Swamp buffalo cows in the Northern Territory and then those progeny were backcrossed to the US bulls to produce the subsequent backcross generations with increasing Riverine content.

A 31/32 Riverine cross progeny (5th generation backcross) is regarded as purebred. The four original heifers and their subsequent female progeny have produced nearly 200 live female calves (July 2016) at Beatrice Hill Farm since 1996 and a reasonable number sold to various other NT and interstate producers over that period would have also added to the score. All four original heifer imports are still alive and producing calves, the oldest at 22 years of age, illustrating their longevity. Ninety purebred females have also been produced via backcrossing by 2017.

The only available variation in genetics to keep the industry from severe inbreeding has been the importation of dairy semen from Italy since 2000. There were no other possible sources of readily available milking buffalo semen world-wide. Early Italian shipments were of poor quality, but have improved greatly in semen quality and conception rates since 2009. There are now 3 or 4 Italian semen suppliers and since 2011, sexed semen has also been available from several of them.

There is a lot of regulatory red tape and cost involved in the importation of semen but the usual procedure is to try to piggy-back with Italian dairy cow semen shipments to make it more affordable for small quantities with fixed shipping canister and freight costs. Various producers around Australia have coordinated their needs in a single shipment with the NT Government. Testing and other numerous requirements must be met by the Italian exporters to comply with Australian import rules. Costs are made up of the Italian export price per straw and the Australian importer's costs of freight, GST, quarantine charges and agent fees.

In 2011, from the one exporter alone, there were 11 sires available that were allowable for Australian importation. The sire lists are increasing in number every year. Malandrino III was the stand-out sire in the Italian industry and his semen when available was very expensive. He has only recently been superseded on the Italian Index leaders' lists by one of his progeny, "Zerbio", whose semen is also now no longer available. By 2016, the selection of bulls had expanded four-fold.

Timing

Buffalo calving history records for the local district will give the best indication of when cows are most fertile. AI should be timed to coincide with the period of highest calving frequency. Conversely, try to avoid those periods where calving frequency is historically low. Out-of-season protocols are available for synchronising oestrus if a more even calving pattern is desirable e.g. to even out milk production over seasons.

Buffalo are seasonal breeders which means they respond to daylength. They are most fertile when daylength is shortening and they are therefore referred to as “short-season breeders”; that is, autumn is the most productive conception time. This effect is more marked at higher latitudes and less so in the tropics. In tropical areas they are more likely to be influenced by the availability of feed and its quality and ambient temperatures. In the Northern Territory at the end of a dry season, when feed is scarce and temperatures are high, cows are less likely to be cycling. The seasonality effect becomes stronger and more important with increasing latitude.

In the Top End of the NT where mating is continuous, there is a marked surge of calving in the December-April period, due to the effect of green forage availability in November-December with the start of the wet season. If the property has extensive floodplain country and better dry season nutrition, then calving tends to be in the June-August period. Therefore, the major influence on buffalo breeding in the tropics is nutrition rather than daylength. Research in Brazil (Baruselli et al. 2001) has demonstrated that successful breeding outcomes are heavily influenced by body condition in buffalo; the better the body condition, the higher the conception rates and also the greater influence of seasonality the further south in Brazil that the buffalo herds are found. Body Condition Score at calving also heavily influences post-calving conception rates; that is, better body condition at birth reduces the time taken to conceive the following calf.

Requirements for a successful AI program

- Cows must be easily managed and quiet. They must not get stressed with yard work.
- Cows should be in good Body Condition Score.
- 50-60 days has elapsed post-calving for lactating cows.
- Cows are not pregnant. They all need to be pregnancy tested prior to drug treatment, otherwise the prostaglandin given will cause an abortion and a nil response to the drug protocol, with the resulting waste of the drug cost and the loss of a prospective calf. Buffalo are difficult to pregnancy test by palpation under eight weeks of gestation without an ultrasound machine to locate the foetus, as the genital tract is much less developed than cattle at the same stage of pregnancy.

Requirements for a successful fixed-time synchronising program

Because of the short day breeding attributes of buffalo there are two successful drug protocols available. In the Northern Territory this equates to:

- Period 1: Jan-July use ‘Ovsynch’, the “In-Season” protocol
- Period 2: Aug-Dec use the “Out-of-Season” protocol

Injection times are critical, particularly the timing between prostaglandin and the fixed-time AI.

Table 12.1 Drug Protocols for Fixed-time Synchronising in Buffalo.

IN SEASON (OVSYNCH)			
1mL Gonabreed® (GnRH) or (Fertagyl®, Receptal® 5mL)	(Prostaglandin) EstroPLAN®, Juramate® Estromil® 2mL	1mL Gonabreed® (GnRH)	Fixed Time AI
Day 0 4 pm	Day 7 4 pm	Day 9 4 pm	Day 10 8 am
4 pm			
OUT OF SEASON			
2mL Ciderol® or Bomerol® (Oestradiol Benzoate) Insert Cue-mate®/CIDR®	Remove Cuemate®/CIDR 2mL EstroPLAN® plus 400iu eCG (e.g. Pregne- col® or Folligon®).	1mL Gonabreed® (GnRH)	Fixed Time AI
Day 0 6pm	Day 9 6 pm	Day 11 6pm	Day 12 8 am

eCG = Equine Chorionic Gonadotropin, GnRH = Gonadotropin-Releasing Hormone

DO'S AND DON'TS

- Treat cows very quietly and gently. After a time, some may become a bit needle shy or a bit hesitant to go up a race or through the head bail. Unrestricted runs through the yards with no gates closed in the length of the race/crush with the whole group will free them up.
- Do not use any other chemical products during the drug protocol e.g. lice treatments, fly sprays, vaccinations etc. Get parasite controls finished before the drug regime is commenced; eg, bad buffalo fly should be controlled well before day 0 of the drug protocol with pour-ons, fly tags or similar products.
- Keep the cows near to the yards so they can be brought in for injections with as little as possible energy usage in mustering. Do not run them into the yards; mustering should always be at a relaxed walking pace. Similarly when being let out they should not be allowed to run out the yards. Put a lead out in front to take them back to the paddock at a gentle walking pace. Any adrenalin will conflict and override the effects of the synchronising drugs.
- Provide good nutrition throughout the protocol. Some grain feeding could be instituted 2-3 weeks before to put them in a "spike-feeding" strategy. Never leave off-feed overnight in the yards and always have hay available if good pasture is not available, especially the night before the AI.
- Use good quality semen. The semen must have good motility to be effective.
- Leave the cows on feed and water in the yards for an hour to settle them down after the drug injections and semen insemination. Calves of lactating cows can be left in the group for the duration of the synchronisation program. If calves are old enough to wean prior to the synchronising program, weaning prior to commencement of protocol may increase conception rates.

Equipment Needed

- Semen canister and semen straws.
- Liquid nitrogen.
- Thawing flask (polystyrene foam).
- Thermometer (0–50°C with 0.1° accuracy).
- Curved-nose forceps for retrieving straw from liquid nitrogen canister.
- Paper towelling for wiping/cleaning vaginal area of the cow and for drying the AI straw.
- Sharp fine scissors for cutting the top off the semen straw.
- 0.5 or 0.25 mL AI pistollette (AI gun) or universal size that takes both size straws. New model pistollettes that take both size straws and have dedicated sheaths, are preferred as they are thinner and stronger).
- Universal sheaths to suit the pistollette being used.
- Plastic covers for sheaths if the cows have particularly copious and runny manure and are re-contaminating the pistollette sheath regularly upon insertion.
- Electric jug to heat water in thawing flask to a constant 35–36°C and to maintain temperature throughout the session. In the tropics where water and ambient temperature are hotter than in cooler southern climates, this is not so critical. Care needs to be taken to ensure 36°C is not exceeded, otherwise the sperm will be damaged or killed on thawing.

Italian Semen Suppliers

There are currently four Italian semen exporters and there is some sharing of bulls between suppliers. These exporters are:

CoFA - www.cofa-it.com Centro Tori Chiacchierini - www.chiacchierini.it

Cipab - www.cipab.com SemenZoo - www.semenzoo.it.

Three exporters can supply sexed semen from selected bulls. Initial trials of the sexed semen in the Northern Territory indicated that the rates of conception are similar to the normal semen from one of the suppliers so far tested in the NT. This supplier also supplies sexed semen for a limited number of the bulls in its charge. The cost of the sexed semen was originally around 6–7 times the cost of normal semen, but this has reduced to 3–4 times. Cost needs to be factored in when assessing the benefits which are claimed to be:

- Reduction in the time required for genetic improvement (around half the time), because more female replacements are available in the 1 year.
- Removal of the cost problems of male calves, whose value is only for meat when they are fully reared. However, the option remains of producing a bull calf for future use in the herd from the best cow, using male sexed semen.
- Herd build-up, renewal or replacement is much quicker with more females available and reduces the need to bring in females from other herds. In a new dairy herd that is trying to build up numbers as rapidly as possible, this option is probably well worthwhile, when considering the cost of purchase of heifers for replacements. This would be more so with a smaller herd.

MULTIPLE OVULATION EMBRYO TRANSFER (MOET)

In the US, there have been successful transfers of embryos in buffalo as far back as 1983 (Drost et al. 1983), followed by Bulgaria, India and Thailand. Calves were produced. However, the technology has yet to develop to commercial viability. An attempt using RIRDC funds in 1998 in

the NT yielded only five embryos, two from 1st cross buffalo cows, from a joint project with the Victorian Department of Agriculture. These embryos were frozen and have not been implanted to date.

Recent work in Egypt (Kandil et al. 2012) produced 13 good quality embryos from 10 cows (nothing from heifers despite better ovulation rates) that were super-ovulated and 8 were flushed to give 1.62 embryos per cow. A 60% success rate for the transfer was recorded using fresh embryos (three of five cows) and five cows came on heat at the correct time out of the 10 cows injected. Again heifers did not successfully produce calves. Heifers often have small tracts and cervixes that are difficult to get into with the cannulas used to access the uterus for implantation.

Fresh embryos often have better success rates for implantation compared with frozen.

Until a lot of new work is done, Multiple Ovulation Embryo Transfer is not a viable technology to use commercially in buffalo, as the recovery rates are still too low.

IN-VITRO FERTILISATION

In-Vitro Fertilisation (IVF) may have future application, but plenty of work in developing the technology is still required. The technology dodges the main stumbling block of Multiple Ovulation Embryo Transfer, which is in the multiple ovulation phase. More specialised equipment is necessary in sucking eggs from the ovaries, but the advantages are that a greater number of eggs can be harvested at shorter intervals from a particular cow without having to subject the cow to multiple drug injections which may be reproductively damaging in the long term to a valuable breeder.

Once eggs are harvested, they go through the laboratory process of in-vitro fertilisation. Once an embryo is produced the transfer process is virtually identical to Multiple Ovulation Embryo Transfer using synchronising drugs. A recipient cow is synchronised, observed on heat and a similar period of incubation of the egg is observed after which the embryo is implanted in the uterus of the recipient cow, usually 5 to 7 days post-oestrus.

The Philippine Carabao Centres spent a lot of resources on this work, but found the success rate to be too low. They achieved an overall success rate from oocyte collection to birth of only 2.47% due to the 10% conception rate from a thawed IVF embryo (L. Cruz, personal communication, 2014).

There is a drop in conception success between thawed and fresh embryos even in cattle, where the technology is better developed. More research work will be required before this technology is adopted on any scale in buffalo.



Figure 12.1 Semen collection from US-imported bull "Bill". This was successfully frozen in 1998 and remains in storage. Multiple ovulation was also attempted in Darwin at that time, in collaboration with the Victorian Department of Agriculture, as described above under 'Multiple Ovulation and Embryo Transfer'.



Chapter 13

BREEDING & GENETICS

BREEDING & GENETICS

BREEDS

There are two distinct subspecies of Water buffalo, *Bubalus bubalis* subsp. *bubalis* (River buffalo) and *Bubalus bubalis* subsp. *kerabau* (Swamp buffalo) which have 50 and 48 chromosomes respectively. The River type originates from the Indian subcontinent and west to Egypt, the Balkans and Italy, whereas the Swamp is from Assam and Nepal in the east of the Asian subcontinent through to eastern China and south down through the Indonesian archipelago.

The two subspecies of Water buffalo, the River buffalo *Bubalus bubalis* subsp. *bubalis* and the Swamp buffalo *Bubalus bubalis* subsp. *kerabau*, were successfully crossbred in Australia and no evidence has been found of any infertility problems in the F1 male or female lines during their first 15 years at Beatrice Hill Farm in the Northern Territory. There may have been some 49 chromosome buffalo produced but there was no way of recognising them. Of the small number of F1 bulls used initially for breeding duties on private properties, none were recorded as infertile. Any heifer not conceiving by 3 years of age would have been culled for lack of breeding and so a long-term history was not built up to identify non-breeders or any observation of chromosome number.

Barker et al. (1997) sampled the known population of Australian Swamp buffalo from as many possible locations in the Northern Territory as was feasible and found the genetic variation (heterozygosity) was the lowest of many countries. Many overseas visitors comment on the small size of Australian Swamp buffalo and there may be some genetic and some environmental factors that account for this.

The population base for the Swamp buffalo in the NT was estimated to be less than 100 head introduced, according to Letts (1962), who summarised the available information relating to the first settlements in the NT. The buffalo population had increased to 360 000 head over the previous 160 years of colonisation of the Top End.

For over 60 years, the flourishing hide industry, plus some meat harvesting for the local population, may have contributed to the smaller-sized animal that evolved over time, as the best prices were received for the biggest bulls, so they were constantly under pressure. Size, however, is very responsive to feeding. At the Coastal Plains Research Station (now BHF) near Middle Point in the Darwin region, Swamp buffalo, particularly the breeder cows, grew to much greater weights than those achieved on stations relying on native pastures. This was most likely due to the better nutritive value of fertilised improved pastures and conservative stocking rates.

Only three recorded Riverine buffalo came directly from India in 1886, but old photos of early Darwin showed significant numbers of at least 2 specific Indian breeds being used in old Darwin town; namely Murrah and Jaffarabadi. The inbreeding from such a small base would have been very intense but archival photos from the NT State Library collection show quite a number existing until at least the 1920s. Other suspected importations from India weren't tracked down or recorded officially in ship logs.



Figure 13.1 Murrah buffalo tethered in the Police paddock in Darwin.



Figure 13.2 Good examples of the Jafarabadi breed typically seen pulling carts in Darwin around the early 1900s.

The two photos above were kindly provided by the Northern Territory Library. Figure 13.1 is No. PH0002-0135 from the Bradshaw Collection and Figure 13.2 is No. PH0238-0704 from the Peter Spillett Collection.

There are 17 distinct breeds in India/Pakistan of the River buffalo, the Swamp and the Mediterranean breeds. The “Buffalypso” from Trinidad resulted from a crossbreeding program of four Indian breeds, mainly bred for meat and draft. A Buffalypso bull imported into Australia from the US was a good beef type, but not a good milk producer, according to the milk production records of the daughters he sired in Australia.

GENETICS

The Australian milking buffalo is derived from a number of sources. The original Riverine genetics in Australia were sourced from Italy, Bulgaria and the US. The Italian and Bulgarian lines went to Victoria, but were not released/sold to any other producers in Australia. The Bulgarian line was discontinued by the producer as they were not as well suited to the local environment as the Italian line. The location, on the southern Victorian coast, west of Melbourne, is comparatively cold in winter. Some crossbreeding between the two was carried out, with temperament and hardiness the important differences. Around 40 and 28 head were imported from Italy and Bulgaria respectively.

The US imports were four heifers and four bulls and are the basis of the rest of the Australian River buffalo population that is currently being milked. The US imports did not have any dairy history in the US at the time of importation. Dairy herds have since been established in the US with the same basic animals. They have also used semen from Italy. There has been found to be good hybrid vigour (heterosis) between the Italian and US Riverine animals for both meat and milk (Lemcke and Suarez 2010), as well as with the Swamp buffalo for meat production. Some of the US dairy stock was taken to Canada and some Bulgarian imports destined originally for the Victorian dairy operation were diverted to Vancouver Island in British Columbia, Canada.

It is very early days for the dairy buffalo industry in Australia because of the low population base, which has allowed tracking of the genetics that have mostly come from the one source. This tracking relies on producers keeping good records of births and bull matings. The use of Italian semen also helps in comparing production in different Australian environments by providing reference sires for genetic analysis. The analysis is provided by the Agricultural Business Research Institute of the University of New England and the industry has been fortunate to be able to tap into the BreedPLAN objective-based genetic system that services most of the cattle breeds in Australia, as well as overseas. They have been able to access data also from buffalo in Thailand and the Philippines.

The accuracy of the genetic parameters will be low for some time due to the lack of data and numbers of recorded stock in the database. However, with time and increasing numbers participating, the accuracy of Estimated Breeding Values (EBVs) will be improved. This system will provide a valuable tool for selection of suitable animals for taking the industry forward. It will also quickly identify those Italian sires which work well under Australian conditions.

A necessary part of this process is the use of milk testing services. These services measure the individual yields of the entire herd for both milkings in a day by taking samples from each cow and shipping them to the laboratory, which carries out the following tests.

- Total solids.
- Fat.
- Protein.
- Lactose.
- Cell counts.
- Acidosis and Ketosis tests.

BREEDPLAN

BreedPLAN is a modern genetic evaluation system which has evolved since the 1980s and is now widely used around the world. It has been developed by the Agricultural Business Research Institute of the University of New England and services 22 cattle breed societies in Australia alone.

BreedPLAN was originally designed for use with herds but Group BreedPLAN now can cover all herds within a breed as long as some common reference bulls are used within each herd to be able to compare between herds. AI is a useful method to distribute reference sires between herds.

The system uses a Best Linear Unbiased Predictor (BLUP) technology to estimate EBVs for a wide variety of important production traits. It quantifies the EBV in the units by which it is measured and estimates the trait advantage above the mean value of the whole population.

The system is a national scheme which offers the potential to accelerate genetic progress within the breed, evaluate animals objectively, improve breed productivity and offer a greater opportunity for changing the genetics of a herd so as to increase the value of cattle sold for breeding or for slaughter.

The model is able to separate genetic and environmental effects on productive parameters. The parameters are shown in Table 13.1, below.

Table 13.1 BreedPlan Parameters

WEIGHT	FERTILITY/CALVING	CARCASE	OTHER
Birth weight	Scrotal size	Eye muscle area	Docility
Milk	Days to calving	Fat depth	Net feed intake
200-day weight	Gestation length	Retail beef yield	Structural soundness
400-day weight	Calving ease	Intra-muscular fat	Flight time
600-day weight		Carcase weight	
Mature cow weight		Shear force ¹	

¹On trial, not yet available. Not all traits are available for all breeds unless specifically recorded.

The BreedPLAN dairy buffalo system has yet to be fully developed, using the yields and component measures but it is hoped also to include such things as likeability, milkability and temperament assessments that are currently in use in the dairy cattle industry in Australia.

BREEDPLAN BASICS

BreedPLAN objectively measures animal performance traits in 3 categories:

- Production (Growth).
- Reproduction (Fertility.)
- Carcase attributes.

Production or Growth traits

Production traits include Birth weight, 200-day weight, 400-day weight, 600-day weight, up to 1200-day weight and Mature weight.

Reproduction or Fertility traits

Reproduction or fertility traits include scrotal circumference, days to calving and calving interval.

Carcase traits

Carcase traits include Rib fat, P8 fat, Eye muscle area, Carcase weight, Saleable meat yield and Marbling score.

BREEDPLAN RECORDS

Stock need to be weighed and recorded at various stages: at birth, weaning, post-weaning, mating details, 5 years for mature weight, progeny and relevant traits at slaughter. Stock are recorded in 'management groups, so only stock that have run in the same paddock, fed the same rations and the same supplements can be compared. The system provides BreedPLAN measures on a full herd basis. If there are common sires used in two different herds then the two herds can be compared.

The trait average was established near the start of the system for a particular breed, once enough data was available. The current breed EBVs can indicate the breed progress since that base figure was established. Current breed averages are always available when looking up a particular individual's genetic merit (EBVs).

Water buffalo have been incorporated into the BreedPLAN system, but it can only function effectively if recording data is submitted on a regular basis (at least yearly) for all new progeny, to increase the accuracy of estimates.

Accuracy is described in percentage terms, <50-74% = medium, 75-90% = med-high, >90% = High. Individual producers are then able to select bulls or cows that will improve herd productivity for any measurable trait by using the stock with the best EBVs for that trait. This particularly applies to herds that are deficient in a particular aspect of production.

If producers are focused on a particular market, they can select and tailor those traits that the market requires. If there are multiple traits then they can be weighted to suit that particular market, which has led to the establishment of selected breed indexes that apportion weights to a large number of traits and come up with a single value for a market expressed in dollar values. This index displays the economic value that will be added from that particular bull or cow to its progeny. Indexes are created using Breed Object.

EBVs between different breeds are not comparable. However, that does not apply to buffalo in Australia at this stage. Buffalo of Swamp, US Riverine, Italian and Bulgarian origins are currently tracked in the Buffalo Database, plus any crossbreeds between them.

Points to remember when using BreedPLAN:

- All stock need to be individually distinguishable i.e. Ear tags, EIDs (e-identifications)/ plus back-up/ tattoos, brands etc. (Remember that ear tags can disappear, especially in breeders, so consider rumen capsule electronic identification for longer-term retention.)
- Single-sire mating is necessary, or alternatively, DNA testing for parentage.
- Breeder groups should be as large as practical.
- The mating period should be restricted for good comparisons (three months is desirable).
- As few management groups as possible should be run.
- Birth dates and weights should be recorded
- Calves should be mothered-up and records kept of bull mating dates and cows running with them.
- Weights of calves and cows should be recorded at weaning, and at roughly 200-day intervals post weaning; that is at 200 days, 400 days and 600 days. (These intervals need not be rigidly adhered to, but need to reflect the production system milestones.)
- Carcase weights should be recorded and data supplied retained, when slaughter is carried out.
- Scrotal circumference of bulls should be recorded at 400-days or 600-days.

ESTIMATED BREEDING VALUES (EBVS)

When the whole breed is compared, it is called Group BreedPLAN and the genetic merit of any animal can be compared with any other recorded animal within that breed. Group BreedPLAN then allows a buyer to select a bull or cow on its merit for each trait. Sometimes all traits can be combined according to their economic importance into a specific index, for example the Japanese Ox Index or Northern Export Index in Brahman. These indexes use a formula to translate Estimated Breeding Values (EBVs) into a single monetary value that attempts to quantify in dollar terms the extra genetic merit that a particular animal can bring to the average productivity of its progeny in the herd. Each EBV is weighted according to its economic value for producing a particular end product.

Animal Performance

Any animal performance in its lifetime or over a particular period is controlled by two factors:

- Genetics (the arrangement of genes).
- Environment (available feed quality and quantity, climate).

The proportion of the effect caused by genetics is known as the heritability of a particular trait. The greater the effect of the environment on the outcome, the lower the heritability of that particular trait.

The contribution of genes to the overall performance of a particular animal is calculated by comparing it with other animals that have been treated the same in every respect. If the performance of a single animal in the herd is higher than the mean of the whole herd, this can be attributed to its genetic make-up, provided that it has been treated the same as all its compatriots.

An animal's performance over and above the population mean value is calculated as an EBV. It directly measures the impact of genes in terms of the difference in weight (or whatever trait is recorded) compared with the mean of the herd.

An EBV estimates a particular animal's probable genetic performance as a parent and the contribution that it will pass on to its progeny. It also takes into account not only the animal's own performance, but also the performance of any relatives (parents, grandparents, uncles, cousins, siblings).

EBVs can change over time depending on the number of relatives that can be added, additional production data available, either from parents, descendants or from itself. Younger sires or dams with fewer observations can change EBVs more dramatically than older animals with many more progeny. The accuracy of the estimate increases over time with the number of extra records that can be recruited to a particular animal.

Mating Groups

It is advantageous to be able to identify the sire and dam of all progeny. This requires the use of single-sire mating groups or DNA testing, which is currently unavailable or very expensive compared with cattle (around \$60 per sample for buffalo). Multiple-sire groups are difficult practically with buffalo, except for very young bulls grown up together and never separated, because of their propensity to try to keep all their cows for themselves (fighting other bulls). A second bull usually ends up by itself or in the next door paddock with damaged fences, if paddocks are not large.

At least two fences between single-sire mating groups are needed to reduce the fighting along the fence line or at the gate (a favourite place if not protected electrically). It is best to have a cow group size of more than 30 head and a maximum of 40 head and keep the mating period down to a maximum of around three months. Calves should be run together for as long as possible and bull calves kept entire, at least until after weaning. Treatments should be the same

for all animals in the management group; (that is, the same feeds, paddocks, supplements, vet treatments, vaccinations), so the performance of the progeny of this animal can be predicted to be a combination of the EBVs from both parents, i.e. the average value.

PROGENY PERFORMANCE EXAMPLE USING EBVS

This example uses 400-day weight data:

If the EBV for a bull is +22 kg and EBV for the cow is +14 kg, then the prediction of the EBV for the progeny of that combination is going to be the addition of half of the EBV value of each parent.

So the expected progeny EBV = $+11 + 7 = +18$ kg

The higher the EBV for a particular animal, the higher the contribution to the offspring.

Unfortunately, biology is not an exact mathematical model, because when the chromosomes from the bull and dam segregate and recombine they will do so randomly, resulting in a random combination of the individual genes. The performance of the progeny will therefore also be affected by the sequence and random selection of the available genes from each parent.

The average of all the progeny performance of these parents should have a mean of 18 kg; there will be a normal bell shaped population curve if all the progeny are measured. Some will perform above the average and just as many below the average of the two parents.

Trait Enhancement

Different breeders will be looking at different traits to enhance in their herds. Some breeders place a lot of emphasis on “looks” but the real emphasis should be on those traits that matter in the marketplace.

The first thought is usually growth rate – “the bigger, the better” - but often this is not necessarily the case. While it is good to have an animal that grows quickly to get to its market weight, with obvious benefits in tenderness of the meat product, there can be downsides, particularly if that selection tends towards an animal with a high mature weight in a less favourable environment.

For example, in the tropics where the feed supply is dramatically affected by the amount of rainfall in the dry season, a higher mature weight animal will require a larger maintenance ration compared with a lower liveweight animal. Therefore, a better feed supply will be required for maintaining weight and an even larger one to have weight gain or fat gain when pasture quality is poorer. So growth traits need to reflect the environment in which the production is occurring. It may be more profitable to produce three calves from three medium mature weight cows than two calves from two heavy mature weight cows utilizing the same amount of feed.

Fertility traits are often a more important consideration. The frequency of calving is very important in economic terms for both meat and milk producers in keeping the herd maintenance costs down per calf produced.

The fertility traits of great importance are scrotal size for bulls (the larger, the better) and days to calving (as low as possible) or calving interval (lowest is best). ‘Days to calving’ is the number of days from the start of mating (bull going into the herd) to the birth of the calf. Females with a lower ‘days to calving’ measure would be expected to conceive earlier in the mating period, return to oestrus earlier after calving and have an earlier onset of puberty as heifers.

Bulls with a larger scrotal size are expected to produce bull progeny with a greater testicle circumference and heifers that reach earlier puberty.

Other Parameters

Other selection criteria for Water buffalo, including temperament, udder, feet, horn shape and milk production are described in Appendix B: Australian Buffalo Standards. These are criteria which can be applied by the producer in progeny selection.

THE BUFFALO REGISTER/DATABASE

The Buffalo Register/Database/BreedPLAN is maintained by the Agricultural Business Research Institute (ABRI) in Armidale NSW at the University of New England. ABRI runs the same set-ups for most of the breed societies in Australia and also in many other countries around the world. The database can be accessed online by the public or Breed Society members who want to look at what buffalo are registered and check their pedigree, progeny and/or performance records. The web address is <http://breedplan.une.edu.au/>. The layout is similar to other Breed societies where a number of enquiries can be made according to herds or to individual animals. There are annual fees and charges per calf for registration and BreedPLAN analysis.

Submitting Calf Records

Below is a version of the calf record form and the instructions for filling in. There is also an electronic version which can save double handling. These forms are available electronically from buffalo.register@nt.gov.au.

Australian Water Buffalo Register										Animal Recording Form														
					HERD IDENT : _____ NLIS PIC : _____ BREEDER : _____					***** Circle Option ***** [Birth Weights in lbs / kgs] STUD PREFIX: _____										Return this completed form to: Australian Water Buffalo Register GPO Box 3000 Darwin NT 0801 Email: buffalo.register@nt.gov.au FAX: 08 8999 2043				
DAM OF CALF			SIRE OF CALF			MATING DETAILS		CALF IDENTIFICATION			CALF BREED		BIRTH DETAILS			Color			Horn		ET			
Herd	Year	Tag	Herd	Year	Tag	Date	Male	Herd	Year	Tag	NAME (optional)	(not req'd if both parents known)	Date of Birth	Sex	Twin	Calf	Calv	Calv	Birth	Color	Horn	ET		
Ident			Ident			dd / mm / yy	Code	Ident					dd / mm / yy	(MF)	(2)	Fate	Ease	Grp	Wt			(Y=yes)		
e.g. AUS 96 123			AUS 98 021			07/08/01	A	AUS 02 134			ANDES		14/05/02	M		1	A	35		B	H			
1						/ /							/ /											
2						/ /							/ /											
3						/ /							/ /											
4						/ /							/ /											
5						/ /							/ /											
6						/ /							/ /											
7						/ /							/ /											
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11						/ /							/ /											
12						/ /							/ /											
13						/ /							/ /											
14						/ /							/ /											
15						/ /							/ /											
I hereby certify that the information submitted on this form is correct.						Mate Code P = Natural Paddock A = AI - Synchronised B = Non-synchronised AI H = Hand Mating		Calf Breed Four x 2 character breed codes eg RV RV SP SP for River x Swamp (See Breed-Code sheet for codes)		Twin BLANK = Single 2 = Twin		Calv Grp Mob of Dam when calf born		Calv Fate BLANK = Calf Born Alive A = Calf Aborted D = Calf died within 48 hrs Supply date, sex, CE & Bwt if possible		Calv Ease Blank = Not Recorded 1 = Unassisted 2 = Assisted Easy Pull 3 = Assisted Hard Pull 4 = Assisted Surgical 5 = Abnormal Presentation								
Signed _____ Date _____						 Denotes Mandatory Details.																		
(Authorised Signatory)																								

Figure 13.4. Australian Water Buffalo Register - Calf Recording Form.

Instructions for completing and submitting the Animal Pedigree and Birth Recording details	
	<i>Last Updated: 7-Feb-08</i>
There are three other sheets in this Excel file:	
If you want to hand write the animal details onto forms and send the completed forms, use:	
Calf-Form	- Use this form to record the pedigree and birth details of your animals (whether new calves or new parents not previously recorded in your herd). - Print this sheet on A4 size paper and hand write the details for your animals onto the printed sheet.
	Post the completed hand written sheets to the address printed at the top of the sheet.
	You may fax these sheets to the number printed at the top of the sheet. However, if the fax received is not of good enough quality to read the data correctly, you may be asked to send the original forms by mail.
If you want to submit the information electronically in a basic layout, use:	
PC-format	- Use this as an Excel template to complete the pedigree details for your animals (both calves and base animals) and submit this sheet ELECTRONICALLY either by email or on floppy diskette. - Do not delete columns from this sheet. If the column does not apply to you, leave the column blank. - It is up to you to ensure that the information entered is accurate and complete.
	Note that this is a subset of information that can be submitted and there is no automatic data checking. To submit a more complete set of data which has been pre-checked against your database, you should consider using an integrated software package like Herd Master (Tel: 02 6773 5247 or via the web: http://saltbush.une.edu.au/)
	To use this format to enter and submit data for either calves or base animals:
	- copy the PC-format sheet to another Excel workbook (using edit - move or copy sheet, make sure the "create a copy" box is flagged).
	- Enter the data into the new workbook. Note that the 3 heading lines will remain fixed at the top of the page and the data rows will scroll to the visible screen size.
	- save the sheet in the new workbook as a comma delimited (CSV) file:
	* use File - Save as
	* in the pop up box, type in a File name (no extension), and highlight CSV in the Save as type area.
	* you can continue to edit and look at the data in columns, but the data will be saved in a text format with each field automatically separated by a comma. Do not delete or hide unwanted columns.
	* Excel will ask a number of questions when you close the file, including "only the current active sheet will be saved" [select "OK"] and "do you want to save the changes" even if you haven't made any.
	While this is confusing and annoying, it is a function of Excel. If you choose "Yes" to save changes, ensure that the "CSV" file type is selected.
	Send the file(s) by either:
	- email as an attachment to buffalo.register@nt.gov.au OR
	- copy it on to Compact Disc and post the CD to the address listed on the forms .
	- Please include a note explaining what is included in the file (eg 2007 drop pedigrees for 102 calves).
Disclaimer	AWBR takes no responsibility for data entered via this PC-format spreadsheet other than to try and load the information as supplied. Problems in the data will be returned to you for correction.
Breed-Codes	This is a list of valid buffalo breed codes used in the Buffalo register.
Description of fields:	
The following descriptions relate to both the Electronic (PC-format) and written form (Calf-Form) unless specified otherwise.	
These fields MUST be completed. Other fields are optional.	
Note:	- The order of the columns are slightly different between the electronic and paper formats. The columns relating to the PC-format are shown at the left of these descriptions. - Some fields are not included in the paper format.
A Herd Ident	This is the three character Herd Ident allocated to your herd

column in PC-Format



	Optional Traits	Only available for electronic PC-Format.			
Z	- Trait 1 code	Code for optional birth trait (see table below for codes)			
AA	- Trait 1 value	Value for optional birth trait (see table for units and ranges of values for trait)			
AB	- Trait 2 code	Code for optional birth trait (see table below for codes)			
AC	- Trait 2 value	Value for optional birth trait (see table for units and ranges of values for trait)			
AD	- Trait 3 code	Code for optional birth trait (see table below for codes)			
AE	- Trait 3 value	Value for optional birth trait (see table for units and ranges of values for trait)			
AF	- Trait 4 code	Code for optional birth trait (see table below for codes)			
AG	- Trait 4 value	Value for optional birth trait (see table for units and ranges of values for trait)			
AH	Grade of Calf	Not used in Buffalo - Electronic PC-Format only			
AI	Rego Flag	Not used in Buffalo - Electronic PC-Format only (Register,Not-register,Commercial)			
Recording NEW PARENTS on the database					
Complete the following mandatory fields to add new parents:					
Calf Ident (herd/year/tag)	Record the animal ident. Preferred format is herd/year/tag but may be herd/tag if this is unique across all years of recording.				
Sex					
Date of Birth	record the birth date if known. Otherwise, estimate the year of birth and either write this in the birth date column on the Calf-Form or in the Calf Year (column X) field.				
Calf Breed	Record the breed of the animal using the 4 x 2 character breed codes.				
NLIS Id	Record the NLIS animal Ident if known				
Other fields can be optionally recorded if the information is known.					
Include new parent records in a separate file to their calves (ie ensure the parent does not occur in the same file as its progeny).					
OPTIONAL TRAITS					
Code	Description & Range				
HG	Heart Girth of calf at birth	(cm)			
SL	Shoulder to Pin length of calf at birth	(cm)			
HH	Hip Height of calf at birth	(cm)			
HD	Hock to Dew Claw length of calf at birth	(cm)			
CW	Cow Weight at calf birth	(kg)			
BS	Birth Size	(score)	H/L/M/S/V		
DNA	DNA case number				
STANDARD BREED CODES					
		<i>last update:</i> 7-Feb-08			
* new code		Note: Breed codes should be displayed as 4 x 2 character breeds where each breed part represents 25% of the breed composition. (eg SP SP SP SP for pure Swamp; RV RV SP SP for Riverine x Swamp cross)			
Alternative name for breed					
Flag	Code	Breed Name	Composite Breed / Blood% (notional)	Add Date	Person
	SP	Swamp Buffalo			
	RV	Riverine Buffalo (US)			
	BU	Bulgarian Buffalo (Murray)			
	IB	Italian / Mediterranean Buffalo			



Appendix A

HOME PREPARATION

MAKING BUFFALO CHEESE

Making your own cheese at home is not too difficult, but is generally time consuming. However, a reasonable amount of preparation and equipment is required when first starting. The best method is to buy a starter kit from a cheesemaker's supply retailer, a supplies catalogue and a cheese recipe book (for example, the Australian book, *Home Cheesemaking: The secrets of how to make your own cheese and cheese products* (1995) by Neil and Carole Willman (Agmedia) is comprehensive. There are also online sites dedicated to cheese making.

In terms of equipment, the home cheese maker needs stainless steel containers, bowls and trays, thermometers, starter cultures, rennet and milk. Cheese making books will explain the theory and practice required to produce good outcomes. The degree of difficulty and time taken differs with the particular cheese variety and more equipment is needed for semi and matured varieties. Sanitation of rooms and equipment is a key consideration in producing a great tasting and safe product.

As well as cheese, other products such as ice cream and yoghurt, are simpler to make. Ice cream and yoghurt machines make these processes quite simple for home production.

MEAT COOKING TECHNIQUES

The ideal cooking stage ('doneness') for buffalo steak or roasts is rare to medium, i.e. the steak is removed from the grill as soon as the reddish bubbles of moisture appear on the upper cooked surface. A low-cost meat temperature probe is the most efficient method of gauging the right stage for the removal of a buffalo roast from cooking and information regarding the relationship between temperature and doneness is available online, for example at www.beefandlamb.com.au / 'How to use a meat thermometer'.

Roasts and steak both benefit from being soaked in vegetable oil in the refrigerator for up to 12 hours prior to cooking to increase the moisture content and prevent drying out.

TenderBuff® is the obvious choice for dry cooking methods, as the animal is young and therefore meat products should be tenderer than those from older, mature stock. For wet cooking methods, a much wider range of cuts is available that will still cook well and taste good.

Buffalo products fit in well with many cooking styles such as Chinese, Asian, Mediterranean and Australian. They work well for many and varied recipes such as stir fry, Thai buffalo salad, rendangs, roasts and BBQ and virtually anywhere that beef is used, buffalo will be able to be substituted. Corned buffalo is superb and is used for making pastrami.

Its low fat content makes buffalo meat perfect for many smallgoods, because of its high water-holding capacity; salamis, sausages with many flavours and buff burgers are very popular.



Figure A.1 Buffalo steaks - raw and barbecued.

Steaks

- Soak buffalo steak cuts in cooking oil at least two hours before cooking.
- Ensure the cooking plate or grill is sizzling hot before starting the first side, when cooking buffalo steak. The surface should seal quickly in order to retain moisture. If there is bubbling around the edges of the steak while cooking, then the plate is too cool and much moisture will be lost.
- Avoid adding salt or seasonings (usually contain salt) until the steak surface has sealed, as the salt will draw out moisture from the meat.
- Only cook to rare to medium 'doneness'.
- Rest the cooked meat prior to serving (three minutes).

Roasts

- Soak the roast whole in water with a tablespoon of vinegar per kg of meat for a minimum of 4 hours before placing in the oven to counteract the roast's low fat content and lack of moisture.
- Use an oven bag on a slower heat for a longer time than for beef e.g. 150-160°C (check centre with meat thermometer according to preference) and then finish with a high burst of heat for a short time at 220°C to brown off the roast with the bag removed, or>>>>>
- Seal the surface first under high heat and then slow cook after transferring into the oven bag. The oven can be turned off and the roast left to finish cooking inside the bag in the oven in the slowly reducing heat.
- Retain the bag juices for making gravy.
- Consider 'pot roasting' as an alternative cooking process, if the roast is sourced from an older buffalo. It is slower and is a 'wet cooking' method that leads to better tenderness than would be achieved by oven roasting. This can be achieved in a pressure cooker on slow, or in a heavy pot with a lid on slow heat after sealing/browning initially in a frying pan on all sides quickly at high heat with a small amount of cooking oil.
- Always rest the roast before carving

TENDERBUFF®

Table A.1 Suggested Cooking Methods - Preparation and Processing Ideas For Tenderbuff®. From RIRDC (2002) Australian Water Buffalo; Selected Meat Cuts and Information.

PRODUCTS	FOOD SERVICES DESCRIPTION	PAN FRY	BBQ/ GRILL	ROAST	CASSE-ROLE/ CURRY	CURE	BRAISE	MINCE	RAW	PIES	DRIED
Tenderloin	Eye Fillet	✓	✓	✓					✓		
Striploin	Porterhouse	✓	✓	✓					✓		
Rump	Rump	✓	✓	✓							
Topside	Topside			✓	✓		✓	✓			✓
Knuckle	Round		✓	✓	✓	✓	✓	✓			✓
Outside	Silverside				✓	✓	✓	✓		✓	✓
Tritip	Tritip				✓			✓		✓	
Flank Steak	Flank Steak				✓		✓				
Blade	Blade/Oyster			✓	✓	✓	✓		✓		
Chuck Tender	Oyster	✓			✓		✓				
Chuck Roll	Chuck			✓	✓		✓	✓		✓	
Spencer Roll	Rib Roll	✓	✓	✓							
Cube Roll	Rib Eye Roll	✓	✓	✓					✓		
Brisket	Brisket					✓		✓			
Strips	Stir Fry	✓			✓						
Dice	Cubes				✓					✓	
Mince	Mince	✓	✓					✓			
Sausage	Sausage	✓	✓		✓						
Burger Patties	Patties	✓	✓								

RECIPES

TENDERBUFF® PASTRAMI

Made from the eye of the silverside – the meat is corned then baked in a slow oven on a rack above a tray of water. It is covered with cracked pepper, French mustard and herbs prior to baking. Test with meat thermometer in the centre to medium beef temperature (65–70°C).

Some recipe suggestions from Klemens Hedenig (Charles Darwin University) appear below.

TENDERBUFF® STROGANOFF

Ingredients – four main course portions

800 g TenderBuff® rump
150 g plain flour
50 mL oil
100 g onions
3 peppercorns
1 bay leaf
100 g pickled gherkins, chopped
200 g button mushrooms, sliced
200 mL sour cream
250 mL buffalo stock (or beef stock)
10 g chopped parsley
salt and pepper to taste

Method

Trim meat of fat and sinews, cut into thin strips (approximately 2.5 cm by 1 cm) and dust with around half of the flour. Heat oil in a stew pot, add buffalo strips and cook until golden brown. Add onions and stir fry for about five minutes. Add buffalo stock, peppercorns, bay leaf, gherkins and button mushrooms. Bring to boil and simmer for about one hour or until tender.

Blend 150 g of sour cream with the rest of the flour and add to the pot, stirring constantly to avoid a lumpy appearance. Simmer for another 10 minutes and adjust seasoning with salt and pepper. Transfer Stroganoff into a serving dish; place the remaining sour cream in the centre and sprinkle with chopped parsley.

MARINATED BUFFALO FILLETS

Ingredients –four main course portions

1 kg buffalo fillets, fat and sinew removed and cut into 80–100 g pieces
100 g peanut butter
100 mL light soy sauce
flour for coating
oil for shallow frying

Method

Mix light soy sauce and peanut butter into a paste, pour over buffalo fillets, mix again then let the meat marinate in a fridge for a day. Before cooking coat meat on both sides with flour and shallow-fry in a hot frying pan until done to your liking. The cooking method “shallow-frying” implies that

more oil is used in the cooking process than in sauteeing. This allows a rather crisp finish. The cooking time is around two to four minutes. Serve with steamed or braised rice and vegetables.

LEMON GRASS AND CHILLI BUFFALO PARCELS ON SWEET AND SOUR SAUCE

Ingredients – four entrée portions

300 g TenderBuff® rump, chopped
40 g butter
20 g lemon grass, finely chopped
2 red chillies, finely sliced
50 g onions, finely chopped
100 g tomato paste
12 cabbage leaves, blanched in salt water
100 g castor sugar
100 mL white wine vinegar
20 mL tomato sauce
10 g corn flour
water as required
Salt and pepper to taste
12 tooth picks

Method

Heat the butter in a frying pan, add chopped buffalo meat and cook until nicely browned. Add chillies, onions, lemon grass and sauté until onions are soft. Add 50 g of tomato paste and a small amount of water. Bring to the boil then remove from heat and let cool.

Cut the stalks off the cabbage leaves. Spoon buffalo mixture onto leaves, fold into parcels and secure with toothpicks. Heat parcels by steaming in a double boiler for about three minutes.

Prepare the sweet and sour sauce by combining sugar, vinegar, tomato sauce, remaining tomato paste and 200 ml of water in a saucepan. Bring to the boil. Mix corn flour with a small quantity of cold water and add to the saucepan, stirring to avoid lumps. Simmer for about two minutes. Set aside and keep warm.

To serve, pour spoonfuls of sweet and sour sauce onto a heated plate, place buffalo parcel in the middle and garnish with red and green capsicum strips.

BUFFALO STICKS WITH CORIANDER PLUM SAUCE

Ingredients – four entrée portions

300 g lean buffalo mince
100 g onion, finely diced
20 g garlic, crushed
20 g curry powder
5 g mint, chopped
30 g parsley, chopped
20 mL red wine (e.g. claret)

100 mL spicy plum sauce
5 g coriander leaves, chopped
salt and pepper to taste
12 bamboo skewers, soaked

Method

Place buffalo mince, onions, garlic, curry powder, mint, parsley and red wine in a mixing bowl. Season with salt and pepper and mix well. Put equal amounts of mince around one end of each skewer in a sausage shape. Cook the buffalo sticks on a griller or BBQ until browned on all sides. To make the sauce, combine plum sauce, soy sauce and coriander in a bowl. Serve buffalo sticks with sauce on the side. Garnish with sprigs of fresh herbs.

CLEAR BUFFALO SOUP

Ingredients - ten portions

2 kg buffalo shoulder (blade)
2 kg buffalo neck bones, or bones with some meat on them
3 large carrots, washed but not peeled
3 parsnips, washed but not peeled
4 stalks of celery
4 bay leaves
1 bulb of garlic
2 onions cut in half
5 cloves
10 peppercorns
4 beef stock cubes
20 mL light soy sauce
150 g parmesan cheese, grated
salt and pepper to taste

Method

Place 2 kg of buffalo bones and 2 kg of buffalo shoulder in a large pot and cover with 4-5 litres of water. Add carrots, parsnips, celery, onions and all other ingredients and bring to the boil. Gently simmer for about an hour. Remove the scum as it floats to the surface. Do not boil vigorously as this will make the broth cloudy and give an unappetising appearance.

Remove carrots, celery, parsnips and onions and set aside. Continue to simmer the rest of the broth until the meat becomes soft, which could be another two hours or so.

Peel cooked vegetables and cut into bite-sized chunks.

Remove meat from the pot and strain broth. Cut meat into similar chunks as the vegetables and return cut meat and vegetables to the strained clear broth. Bring to boil again, and then serve in large soup bowls sprinkled with parmesan cheese.

The Country Women's Association of the Northern Territory's Buffalo Cook Book (1980) also contains many recipe suggestions. Copies can be purchased online from resellers.



Appendix B

AUSTRALIAN BUFFALO STANDARDS

AUSTRALIAN BUFFALO STANDARDS

by Roger Haldane and Barry Lemcke

Description and drawings by Roger Haldane of Shaw River Buffalo Cheese Pty Ltd, Yambuk Vic.

Selection criteria

- Temperament.
- Udder.
- Feet.
- Horn Shape.
- Milk Production.

TEMPERAMENT

This is a very important part of selection in Water Buffalo. They have probably been selected for this trait for thousands of years by the various peoples who domesticated them. So this is an ongoing commitment for buffalo breeders.

Buffalo are a powerful and courageous animal and should be treated accordingly. Therefore, the utmost care should be taken to select only breeding bulls that come from parents that have proven docility.

If young animals show traits of nervous and/or aggressive behaviour, they should not be considered in the advancement of the breeding program. The selection for docility should go hand-in-hand with good animal handling techniques, to bring out the best in the animal's nature.

Low stress stock handling techniques (e.g. Smith 1998) have been found to be extremely useful in training stock handlers, where it has been recognised that the handler is the cause of many of the bad temperament problems that may develop. However, temperament appears to be strongly inherited so the use of quiet bulls and docile cows will be the best combination for buffalo breed advancement.

This also becomes a very important safety issue with human injury or death a very real possibility if the wrong choices are made, considering the size of the animal.

UDDER CONFORMATION

It is only after lactation commences for the first time that udder selection is possible, other than culling calves at birth with teat numbers other than 4.



Figure B.1 Udder conformation (key next page).

Udder Selection - Conformation (Shape and Placement)

1. Desirable conformation

This is a well-attached udder with balanced quarters where both back and front quarters are of similar size. Teats should be cylindrical, rather than bottle shaped or conical and preferably no longer than 50-60 mm and no more than 25 mm in diameter.

2. Undesirable

This udder has larger capacity in the back quarters with uneven teats, with larger teats at the rear and smaller teats at the front.

3. Undesirable

This udder is long and pendulous with large long teats. There is poor attachment of the udder to the body.

4. Multiple teats

This causes a significant problem in a mechanical milking situation when a cow has other than 4 teats.

Calves can be born with only 2, 3, 5 or 6 functional teats. Non-functional teats of various sizes can also be part of the mix. Calves should be checked at birth for the number and spacing of teats in order to cull those that do not have four teats. You also need to check that they are well-spaced and not fused or close together. You need to be particularly vigilant with crossbreds produced through upgrades with the Swamp breed, as there are a significant proportion of swamp breeders with 2 and 3 teats. This may have no adverse implications in a meat herd, but should be culled out in the dairy situation. In bovine milking herds the practice has been to cut off extra teats so that the cow has a normal 4-teat udder. This practice has led to the persistence of the gene for these extra teats. It is recommended that in dairy buffalo, all calves with non-conforming udders be culled. This culling is also applicable to breeding bulls.

FEET

As with the selection of cattle for feet characteristics, care must be taken when selecting animals, that they are not down on their pasterns (see Figure B.2, below).

Buffalo are naturally a little more slanted than cattle because of the more flexible nature of their foot structure. It is recommended that buffalo with extreme and obviously poor foot structure should be culled as breeders.

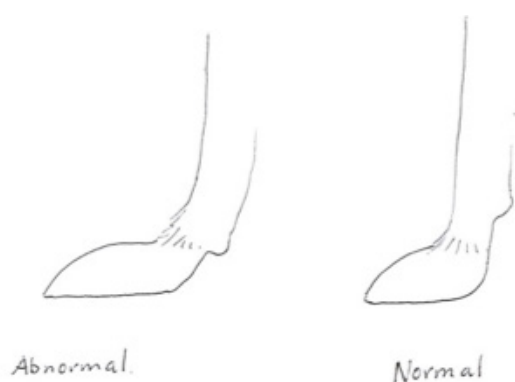


Figure B.2 Foot structure.

HORN SHAPE

Various buffalo breeds have variety of horn shapes, but in modern animal handling facilities, there can be problems with some of these configurations.

It would therefore be beneficial to select animals which had horn shapes that caused the least amount of difficulty when handling animals in raceways etc.

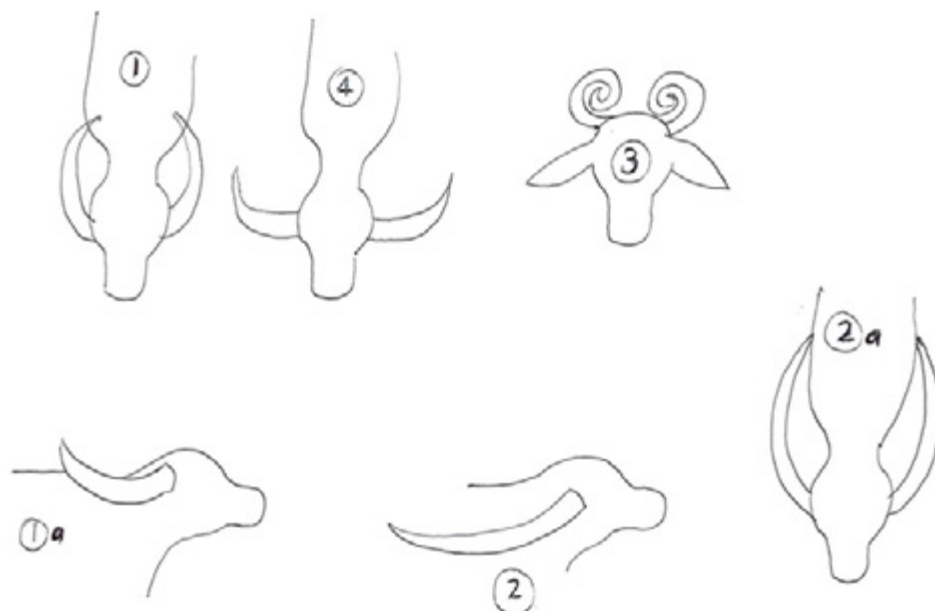
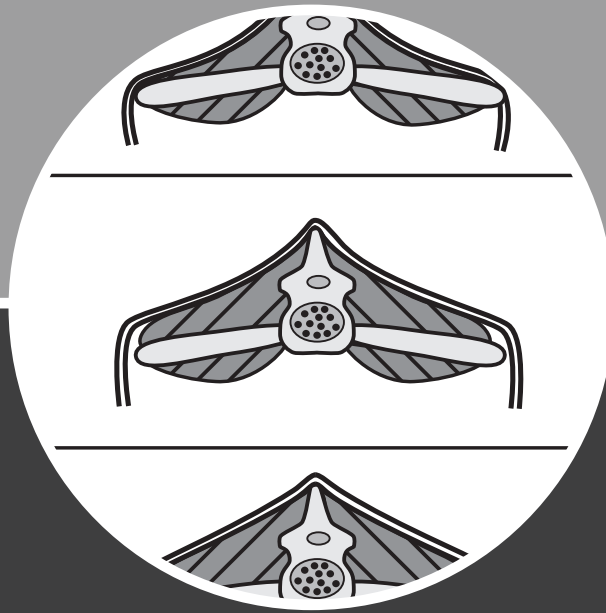


Figure B.3 Horn shape (key below).

1. This illustrates an ideal horn shape. The horns are not widespread and sweep back and up to allow the animal to proceed into confined areas with ease.
2. This illustration shows how the horns sweep back and up. The importance of the horns curving up is demonstrated in illustration no. 2 and 2(a) where the animal has no curling up of the horns and the horn tips are interfering with the turning movement of the animal.
3. This illustration is of the extreme Murrah-type horn. This horn shape is excellent for working through raceways, but has a drawback in the event that the buffalo can catch a wire of a fence. In this situation the wire becomes trapped and locked in the curl of the horn and the animal has difficulty in easily regaining its freedom. This can be even more problematical if the wire is electrified.
4. This shape is a typical Swamp Buffalo shape that particularly causes problems in negotiating races particularly as age increases. First cross River/Swamp can generate large spread horns with age that also have trouble in races and the only solution with both is to carry out a partial dehorning if the cow doesn't learn to tilt her head sideways to move along the crush. Clashing with the vertical posts of the race is the main problem.

MILK PRODUCTION

Large volume cows may tend towards udder problems in the long term if milk volume is heavily selected for above all other traits. Milk volume should not be the only basis of selection as the solids content is a major consideration particularly when whole milk is not the end product in the manufacturing. Constituents such as protein and fat are as much as important as volume particularly for cheese production. Buffalo milk can be drunk safely by many people that are able to drink sheep or goat milk but are unable to drink cow's milk. There may also be important constituents of the milk solids that, may be known or unknown, that give buffalo milk quality advantages over other species.



Appendix C

BODY CONDITION SCORES FOR WATER BUFFALO

BUFFALO

Body condition scores for Water Buffalo

Score (1-5) Export (Suggested)	Optional Score [1-9] (Production/ Research)	Description	P8 Fat mm thickness (1-5) [1-9]	Loin Surface	Illustration of vertical section of the loin region between spinous and transverse processes
1	1	Emaciated ; very weak – extreme muscle wastage. All bones highly visible. Skin 'draped' over skeleton. Unsteady gait.	0	Severely concave	
	2	Very lean ; becoming quite angular, concave around most muscle groups including legs with muscle depletion evident.	0	Very concave	
2	3	Lean ; short ribs visible, hook and pin bones still prominent. Can easily count all ribs. Some muscle depletion. No subcutaneous fat visible or palpable.	0	Moderately concave	
	4	Backward store ; tail head still prominent with hollows to pins. Ribs visible only at top and rear.	[1-2]	Slightly concave	
3	5	Store ; (Average) good muscle definition, with fat starting to be deposited, rib outlines disappearing, hook and pin bones still defined.	(1-4) [3-4]	Level, even slope	
	6	Forward Store ; hook and pin bones becoming more rounded. Pin to stifle leg straight to slightly convex.	[5-7]	Slightly convex	
4	7	Prime ; quite even and smooth over whole backline. Muscling becoming more convex due to fat deposition.	(5-35) [8-14]	Moderately convex	
	8	Fat ; well-rounded all over all bone. Some unevenness of fat deposits appearing around rump area.	[15-35]	Very convex	
5	9	Overfat ; usually only mature cows can achieve this condition. Bulbous fat deposits both sides of tail head. Pin and hook bones not discernable.	(>36) [>36]	Severely convex crease / dip along spine	

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