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# DEVELOPMENT OF A WELFARE INDEX FOR THOROUGHBRED RACEHORSES

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**Abstract**

A uniform method capable of measuring animal welfare within the Thoroughbred Racing Industry (TBRI) does not exist. The aims of this study were to first investigate the importance of different welfare issues for Thoroughbred Racehorses (TBR) in Australia and then to incorporate them into a TBR welfare index (TRWI) that could be utilised in the industry. The second aim was assisted by the first, which utilised the expert opinion of stakeholders with in the TRWI, highlighting those aspects of husbandry requiring most improvement, and validated with behavioural measures. National and State Associations linked to racing were invited to send two delegates (experts) to a stakeholder meeting to determine key welfare issues, which they considered may have negative equine welfare implications. Following this a survey was created which posed vignettes of different combinations of welfare issues, which was subsequently presented to stakeholders around Australia. Fourteen key welfare issues were identified, each with two to four levels that were related to common husbandry practices. The 224 respondents identified the following welfare issues in declining order of importance: horsemanship > health and disease > education of the horse > track design and surface > ventilation > stabling > weaning > transport > nutrition > wastage > heat and humidity > whips > environment > gear. Further analysis of data tested the statistical significance of demographic factors, which determined that the respondents were relatively uniform in their answers. The TRWI which emerged from the responses could potentially be used to identify and improve welfare in training establishments.

The TRWI was validated by an assessment of Thoroughbred racehorse welfare through behavioural observation measures in 13 Thoroughbred racehorse training establishments and by an Australia wide survey of TBR trainers. This determined how key welfare issues relate to the behaviour of TBR's. By highlighting the most critical aspects of TBR welfare issues the TRWI has the potential to improve TBR practices, lower wastage within the industry, improve TBRI's profitability, improve the safety of riders and workers, and improve the public's perception of the industry.

**Declaration by author**

This thesis is composed of my original work, and contains no material previously published or written by another person except where due reference has been made in the text. I have clearly stated the contribution by others to jointly-authored works that I have included in my thesis.

I have clearly stated the contribution of others to my thesis as a whole, including statistical assistance, survey design, data analysis, significant technical procedures, professional editorial advice, and any other original research work used or reported in my thesis. The content of my thesis is the result of work I have carried out since the commencement of my research higher degree candidature and does not include a substantial part of work that has been submitted to qualify for the award of any other degree or diploma in any university or other tertiary institution. I have clearly stated which parts of my thesis, if any, have been submitted to qualify for another award.

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## Publications during candidature

"No publications"

Articles in Conference Proceedings

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## Contributions by others to the thesis

The design and concept of this research project was achieved through discussions and consultations with my principal advisor, Professor Clive Phillips, who also assisted with the analysis and interpretation of research data. Miss Amy Denyer contributed to the data collection by assisting in the continuous recording of the behaviour of stabled Thoroughbred racehorses.

## Statement of parts of the thesis submitted to qualify for the award of another degree

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**Keywords**

thoroughbred, racehorse, husbandry, index, welfare, training

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“ and God took a handful of the Southerly
wind and blew his breath over it, and
created the horse”- *Bedouin Legend*

# TABLE OF CONTENTS

## LIST OF FIGURES

# LIST OF TABLES

## Abbreviations

| | |
|---|---|
| **ACA** | Adaptive Conjoint Analysis |
| **ACPC** | Australian Conference of Principal Racing Clubs |
| **AHIC** | Australian Horse Industry Council |
| **AJC** | Australian Jockey Club |
| **ANI** | Animal Needs Index |
| **ARB** | Australian Racing Board |
| **ARBL** | Australian Racing Board Ltd. |
| **ARI** | Australian Racing Industry |
| **ATRI** | Australian Thoroughbred Racing Industry |
| **BCS** | Body Condition Score |
| **DQAC** | Dairy Quality Assurance Centre |
| **EFA** | Equestrian Federation of Australia |
| **EW** | Equine Welfare |
| **FAWC** | Farm Animal Welfare Council |
| **GFC** | Global Financial Crisis |
| **HFAC** | Humane Farm Animal Care |
| **LIV** | Level Importance Values |
| **M** | Men |
| **NIH** | National Institute of Health |
| **NOAR** | National Office of Australian Racing |
| **REM** | Rapid Eye Movement |
| **RIRDC** | Rural and Industrial Research Development Council |
| **RQAWP** | Racing Queensland's Animal Welfare Policy |
| **RSPCA** | Royal Society for the Prevention of Cruelty to Animals |
| **SCARM** | Standing Committee on Agriculture and Resource Management |
| **SIA** | Stress-Induced Analgesia |
| **TAFE** | Technical and Further Education |
| **TBR** | Thoroughbred Racehorse |
| **TBRs** | Thoroughbred Racehorses |
| **TBRI** | Thoroughbred Racing Industry |
| **TBRIs** | Thoroughbred Racing Industries |
| **TGI** | Tier-Gerechtheits-Index |
| **TRI** | Thoroughbred Racing Industry |
| **TRWI** | Thoroughbred Racehorse Welfare Index |
| **TRWS** | Thoroughbred Racehorse Welfare Survey |
| **UCD** | University Of California |

| | |
|---|---|
| **UK** | United Kingdom |
| **USA** | United States of America |
| **W** | Women |
| **WBGT** | Wet-Bulb Globe Temperature |

## Definition of Terms within the Thesis

| | | |
|---|---|---|
| Stable | = | stall, stalls, box stall, boxes, stable boxes |
| Yard | = | paddock or run out, contains one horse |
| Horse trailer | = | transport, float, trailer |
| Transport | = | movement by truck. |

## Description of Barns, Stables, and Yard

1 Barn type has a corridor down the middle of the building. All stables face inward on both sides of the corridor. Stables have solid walls to approximately 1.2m with heavy duty 'K' wire above, thus allowing visual and physical contact between TBRs.

1b Back to back stables situated in the middle of the barn and parallel to the single rows, on both sides of the corridor, thus allowing greater visual and physical contact.

1c. Yards can be attached to a stable, sometimes with free access for the TBR.

2 Stables situated side by side, and forming a long narrow building e.g. one stable deep. They have solid walls which do not allow physical or visual contact between TBRs, but all stables open out on to an opened grassed area and TBRs have visual contact over these stable doors, and in some cases physical contact over these doors.

2b. Yards are attached to each stable, or a larger yard with two stables opening into it. One horse only is allowed in the yard at any time.

3. Yards with a roofed area, enclosed on one or more sides with a solid wall but still allowing physical and visual contact between the TBRs in the open area of the yard that is not roofed.

# CHAPTER 1

## 1.1 Introduction

The management and husbandry of the Thoroughbred racehorse has developed over many hundreds of years, originating from humans' earliest efforts to domesticate the wild horses of Eurasia. Archaeological sites dating back to 3500 BC (Outram *et al.,* 2009) have yielded important indications of domestication (Outram *et al.,* 2009) either through changes in skeletons and teeth (Benecke and Driesch, 2003) and changes in human behaviour connected in some way to horses such as yards, bits, chariots and drawings of horses being ridden or driven (Anthony, 2007).

The domestication process was inhibited by the difficulty of restraint and captive breeding so that most horses were probably tamed captives (Levine, 2002). The difficulty of keeping horses captive was a limiting factor in their use and could be the reason why horse handling skills do not appear to influence human culture until the Neolithic and early Bronze ages (Levine, 2002). Foremost of the horse dominated cultures were the Scythians who were empowered by their ability as mounted warriors. For these people the horse was highly valued and almost deified. Burial mounds reveal horses buried with their masters, their bridles and saddles mounted in gold.

We know little of their welfare and it is not until Xenophon, 2445-2369 BP that the first references to early husbandry and management appear. Xenophon advocated kindness and patience and consideration of the horse at all times. He considered the horse as a partner rather than an object (Xenophon, 1962). This co-operative approach is based on understanding the behaviour of the horse (Wynmalen, 1947; Xenophon, 1962; Ensminger, 1963; Braider, 1976; Mayes and Duncan, 1986; Roberts, 1996; McGreevy, 2004; McLean and McLean, 2008). Unfortunately there is an alternate approach to the horse-human relationship based on human dominance and submission (Wynmalen, 1947; Roberts, 1996; McLean and McLean, 2008; McGreevy and McLean, 2010b). It is this approach which so often ends in a state of learned helplessness by the horse (Roberts, 1996; Roughan and Flecknell, 2004; McDonnell, 2003; McLean and McLean, 2008; McGreevy and McLean, 2010b). The cultural differences in the human-horse relationship, evident in

classical and ancient history, are still evident today (Wynmalen, 1947; Ensminger, 1963; Roberts, 1996; McLean and McLean, 2008; McGreevy and McLean, 2010b).

Historically the days of horse transport provided people with some understanding of horse behaviour and psychological needs (Huntington *et al*., 2004). Three generations into the mechanised transport era have resulted in a loss of equine knowledge, especially management skills, which were frequently acquired during childhood (Phillips, 2007). Modern training methods and racing events differ in intensity throughout Australia and the world, and are continually challenged on welfare issues (Rollin, 2000; Waran *et al.,* 2007b) Despite domestication equines retain the basic behavioural repertoire of feral or free ranging horses (Wilson, 2000; Goodwin, 2007). They are prey animals who have evolved as trickle feeders, with a complex social life and a home range grazing system. Equine behaviour is predicated by these factors (Molvar and Bowyer 1994; Pusey and Packer, 1997; McGreevy, 2004; Ransom and Cade, 2009).

The study of feral horse behaviour has provided a greater understanding of the horse (McDonnell, 2003; Ransom & Cade, 2009; Houpt, 2011). Recent research suggests that husbandry and handling practices are not independent of one another (Wilson, 2000; Sondergaard and Halekoh, 2003; Hall *et al.,* 2008) and must be considered together with evolutionary needs (Tyler, 1972; McGreevy, 1996; Sjaastad *et al*.,2003).

Although Thoroughbred racehorses (TBRs) might have excellent care in training establishments, many suffer from health issues, physiological behavioural abnormalities and physiological disturbances (Bailey, 1998a and 1998b; Colville and Bassert, 2002; Sjaastad *et al*., 2003; Hall *et al.,* 2008) not seen in feral or free ranging horses. Such physical and psychological abnormalities are assumed to be caused by the management and handling to which they are subjected.

When training TBRs It is not possible to replicate the way feral horses live in the wild (Wilson, 2000), but it is possible to improve management, stabling facilities and racetrack surface and design by implementing continuous evaluation procedures for on-going improvement using various assessment methods (Wilson, 2000), focusing on welfare issues that go beyond the prescribed standards and protocols of general management procedures.

## 1.2 Aim and objectives of thesis

### *1.2.1 Aim*

To develop an objective method of quantifying the welfare of the thoroughbred racehorse in Australia

### *1.2.2 Objectives*

To:

- Identify issues that are important to the husbandry and welfare of Thoroughbred racehorses through expert opinion and an on-line survey of Thoroughbred racehorses.
- Create a Thoroughbred racehorse welfare index (TRWI) based on the importance of issues identified from a stakeholder survey.
- Conduct non-invasive studies of Thoroughbred racehorse behaviour in racehorse training establishments and correlate the findings with the welfare index scores to identify relationships indicative of welfare concerns.
- Validate the usefulness of the Thoroughbred racehorse welfare index through an Australian wide survey of Thoroughbred racehorse trainers.

## 1.3 Synopsis of remaining chapters

Chapter 2

a) Briefly discusses the evolution of the horse, the behavioural ecology of feral and free ranging horses, the social structure and social behaviour of the horse as well as reproduction, behavioural development, activity budgets and finally, domestication. The impact of early domestication on the physical and psychological wellbeing of the Thoroughbred racehorse (TBR) provides an insight into the development of abnormal behaviours as the TBR attempts to cope with its environment.
b) Gives an historical overview of the development of the Thoroughbred breed, the selling and racing of Thoroughbred racehorses (TBRs) in England, early racing in Australia and subsequent importation of TBRs to Australia. The Australian Racing Industry (ARI), breeding and sales of Thoroughbred racehorses in Australia is also discussed together with the importance of the Australian Racing Industry (ARI) to the Australian economy.
c) Identifies welfare indicators for Thoroughbred racehorses

d) Discusses the measuring of welfare.
e) Development of questionnaires.
f) Sampling methods and the construction of an ethogram.
g) The use of the Thoroughbred Racehorse Welfare Index (TRWI)

Chapter 3

a) Identifies issues important to the husbandry and welfare of the Thoroughbred racehorse through expert opinion, and with administration of an online survey to stakeholders in the Thoroughbred racehorse industry.
b) Development of the Thoroughbred Racehorse Welfare Index (TRWI) based on the importance of issues identified from the stakeholder survey.

Chapter 4 is a non-invasive assessment, by continuous recording, of Thoroughbred racehorse behaviour in Thoroughbred racehorse training establishments and a correlation of the findings with the TRWI.

Chapter 5 validates the usefulness of the TRWI using an Australian wide survey of Thoroughbred racehorse trainers throughout Australia.

Chapter 6 discusses the usefulness of the TRWI, and those welfare issues most in need of improvement as well as the cost of implementing these improvements and the possibility of enforcing the findings of the TRWI. Thoroughbred racehorse welfare indicators are also discussed together with wastage in the TRI. The thesis describes the research and methodology of the development and use of the Thoroughbred racehorse welfare index (TRWI), the measurement of equine welfare using non-invasive methods, and finally discusses if a different technique or research method could have been employed for this study.

# CHAPTER 2

# LITERATURE REVIEW

## TABLE OF CONTENTS



## LIST OF FIGURES



## LIST OF TABLES

## 2.1 Origin

The Thoroughbred horse is the result of a selective breeding program initiated by the British Government during the 16th and 17th centuries in response to a change in war tactics. The introduction of gun powder and the increasing use of firearms made the large heavy armour-carrying horse of previous centuries redundant. Thus to develop lighter, swifter more agile horses, suitable for cavalry, stallions of Arabian breeding were imported from North Africa and the Middle East (Wentworth, 1944; Ensminger, 1963; Braider, 1976).

The Arab horse, which had been increasingly developed in middle eastern countries over the centuries as a cavalry mount (Fitzpatrick, 2005), was the major contributor to the development of the Thoroughbred breed (Wentworth, 1944, Ensminger, 1963, Braider, 1976, Fitzpatrick, 2005).

The Arab horse is most likely descended from the finer boned and probably the swifter of the two distinct equine types whose remains have been found in the Siberian permafrost (Braider, 1976, McGreevy, 2004). This horse is believed to be the forebear of “our modern hot-blooded” Arabians and Thoroughbreds (McGreevy, 2004, Fitzpatrick, 2005). The term “hot blooded” refers to their adapted suitability to hot climates (McGreevy, 2004).

## 2.2 Evolution

All equines are descended from *Equus caballus* who evolved over a long period of evolution, estimated by geologists to be 58 million years (Ensminger, 1963, Braider, 1976, Macfadden, 1988a, Macfadden and Hulbert, 1988). The ancestors of *Equus caballus* can be traced back to the Eocene period in North America, when its earliest ancestors, five toed dog-like creatures, stood about 38cm in height (Axe, 1905; Ensminger, 1963, Braider, 1976). Over millions of years this animal underwent many physical and behavioural modifications as it adapted to dramatic environmental changes, developing many species and sub species most of whom did not survive the harsh Pleistocene climate (Axe, 1905, Ensminger, 1963, Braider, 1976).

Other notable physical changes (Macfadden, 1988b, Macfadden and Hulbert, 1988) to have taken place during the evolution of *Equus caballus* are an increase in height, the straightening of the spine, the flattening of the teeth (due to a change of diet to grass, instead of soft tropical leaves) and the lengthening and strengthening of the middle toe to

form the hoof. The second and fourth toes gradually formed slender bones, on either side of the cannon bone (Axe, 1905, Ensminger, 1963). During the Pliocene period a most important survival modification of muscles, tendons and ligaments took place which allowed horses to sleep while standing, thus facilitating a fast exit from predators (Dallaire, 1986). Fossils from the Owyhee desert in Nevada, U.S.A., indicate that early equids "showed adaptations in population dynamics and behavioural ecology allowing them to exploit new and changing environmental resources" (Goodwin, 2007): a trait which Goodwin (2007) views as a 'pre-adaption to domestication'.

Towards the end of the Miocene period, the principal strain, *mesohippus,* which later developed into the modern horse, evolved in North America, eventually migrated to South America and crossed the land bridge of the Bering Isthmus into Northern Asia. Though *Equus caballus* had disappeared from the Americas by the end of the Pleistocene period, due to unknown causes, this clade proliferated in environments which differed greatly from the lands of origin, reflecting a high degree of mobility and adaptability (Ensminger, 1963, Braider, 1976; Jansen *et al., 2002*). Remains of various equine types, which evolved during the late Pleistocene period, have been found in Europe, Asia and North Africa (Braider, 1976, McGreevy, 2004).

Such variation in type is due to geographic isolation and determined by the particular environmental niche in which the horse had settled (McGreevy, 2004), while the species ability to 'exploit a diverse range of terrains and climates by adaptive behaviour patterns has ensured the horse's survival' (Goodwin, 2007) which Darwin (1859) and Williams (2013) found to be true for all species. Thus, understanding how the horse evolved and understanding feral and free ranging horse behaviour will enhance our ability to manage horses and to subsequently improve their welfare.

## 2.3 Feral and free - ranging horses

### *2.3.1 Behavioural Ecology of Feral and Free Ranging Equines*

The horse is a flight animal relying on companions, caution, attention to safety and speed as well as the ability to suppress or mask pain (stress induced analgesia) as a means of self- preservation (Butler and Finn, 2009; Wagner, 2010; Contino and Khursheed, 2015). This non- ruminant herbivore has evolved as a 'trickle feeder', foraging as it moves forward, continually grazing, within a free roaming population (Mayes and Duncan, 1986;

Williams, 2004; McGreevy, 2004; Ransom, 2009). Feral and free-ranging horses are highly social animals, whose activities are restricted to a home range (Dawson, 2005;Csurhes *et al.,* 2009), usually in mountains and open plains but also woodlands, marshlands, and swampy forests, (Tyler, 1972; Fitzpatrick, 2005). Important requirements within a home range are water, feed and shelter. Social organization and environmental changes, such as occur during droughts, when bands of horses 'often coalesce into large herds of 100 or more' (Csurhes *et al.*, 2009) can lead to temporary or permanent shifts in the home range of an individual or group (Dawson, 2005; Csurhes *et al.*, 2009).

The limitation of resources on Sakhalin Island, which lies in the North Pacific Ocean, off the East Coast of Russia and North of Japan, and the Shackleford Banks, situated off the East Coast of the United States of America, in the Atlantic Ocean, and East of North Carolina, provide an example of the adaptability of feral equine social organisation. Horses on Barrier Island, like most feral horses share resources (Rubenstein, 1981;Marjamaeki *et al.*, 2013) and are not territorial, but those on the (Eastern) end (of the Island) do defend territories. These horses are not geographically territorial and home ranges are known to overlap (Rubenstein 1981;Marjamaeki *et al.,* 2013). Feeding and watering sites are frequently shared by two or more feral bands (Ransom, 2009). One band will wait by a waterhole, some distance away, until the group drinking has finished and departed. However the stallions of the feral population on the eastern part of the Shakleford Banks, where water resources are limited, actively defend supplies of fresh water, 'adopting territoriality as a survival strategy' Goodwin (2007). Such flexibility in equine behaviour 'has played an important role in adaption of the horse to the confines of the domestic environment' (Goodwin, 2007).

Studies of feral and wild horses have found little difference in behavioural ecology between the diverse bands of horses in the Northern and Southern Hemispheres (Tyler, 1972; Ransom *et al.*, 2007; Csurhes *et al.,* 2009; Ransom, 2009 and 2012). New Forest Ponies existed in Hampshire, England over a thousand years ago (Wentworth, 1944; Edwards, 1979; Fitzpatrick, 2005) the Mustang of North America (Braider 1976; Ensminger 1963; Ransom, 2012) for over 500 years, and the Australian Brumby (Dawson, 2005; Csurhes *et al.*, 2009) since the late eighteenth century. All three occupy vastly different environmental niches (Duncan, 1983). The home ranges of these feral horse populations, as discussed, differ in size from the smallest of 82-1020 ha, in the New Forest, England (Tyler, 1972) to the largest of about 72 $km^2$ in Australia (Csurhes *et al.*, 2009). Elevation of the home

ranges also varies greatly from 2,625 m (Ransom, 2012) to low-lying (sea level) off shore islands. (Csurhes *et al.,*2009). Temperature also shows a considerable range of variance both between and within home ranges. The lowest temperature within and between home ranges is -29.2$^{o}$ centigrade and as high as 40.0 $^{o}$ centigrade (Ransom, 2012).

The activity budgets of feral horses in the Northern and Southern Hemispheres are similar. Tyler (1972) found grazing occupied 67% of New Forest feral ponies' daily activity budget, and the daily grazing time budget of feral horses in North America, is 12 to 17 hours/day (Duncan, 1985; Ransom, 2012). Csurhes *et al.,* (2009) expressed the daily grazing time of Australian feral horses as between 10 to 17 hours/day. These researchers found the grazing time of the feral horses studied in Australia (Csurhes *et al.,* 2009), the USA (Ransom *et al.,* 2007) and the United Kingdom (Tyler, 1972) differed with the seasons, age and sex of the horse and feed availability (Duncan, 1985).

Feed is limited during the harsh winters of the Australian Alps and also in Colorado and Wyoming, USA, when horses feed on a variety of grasses, preferably green plant matter (Csurhes *et al.*, 2009), shrubs, hedges and trees, and sometimes bark and sticks (Waring, 1983). Droughts and bush fires cause considerable harm to grazing and water points (Dawson, 2005; Csurhes *et al.,* 2009; Ransom, 2012). Kuntz *et al.,* (2006) noted the ability of the 'feral or free ranging horse to alter the length of time spent grazing, a factor in the success of the horse during drought conditions, while relatively more time is spent sleeping and loafing in times of abundant feed than in other activities'.

A seasonal preference for clean grazing (Putman *et al.*, 1991) was observed in free-ranging New Forest Ponies who defecated in latrine areas in the New Forest grasslands in summer but due to slower grass production in the winter months such behaviour was less obvious (Waring, 1983). Mostly horses defecate along the trails leading to water. Stallions have been observed adding their faeces to existing piles (Tyler, 1972), but usually urinate on the faeces of mares. These faecal 'stud piles' (Tyler, 1972) facilitate communication or ownership status of certain resources (Feist and McCullough, 1976;McGreevy, 2004). Feral horses seldom stop to defecate, merely raising their tails, often placing the tail to one side as they continue walking. Defecation occurs approximately every two hours and urination about every 3.8 hours in summer, and less often in winter, when grazing is limited to about every 4.5 hours (Tyler, 1972; McGreevy, 2004).

### *2.3.2 Social Structure and Social Behaviour*

The feral or free ranging horse is a highly social animal whose social group is mostly stable, consisting of 1-3 mares and their offspring, plus an adult stallion (Tyler, 1972; Dawson, 2005; Ransom and Cade, 2009; Csurhes *et al.*, 2009). However herds of horses as large as 600 have been reported (Van Dierendonck *et al.*, 1995). McGreevy (2004) states such density and pattern of distribution is due to the provision of external resources enabling groups to 'become larger than those observed in the free-ranging state'. Herds as large as 30 mares to one stallion are common in the New Forest during the breeding season when stallions collect family bands to form a temporary harem (Gill, 1988). However predation risk is reduced when horses live in large groups (Pusey & Packer, 1997), thus larger groups may be formed when they are without cover on treeless plains (Molvar and Bowyer 1994; Ransom and Cade 2009). Lone or small bachelor groups account for the remaining males in the population, though aged females are sometimes seen leading a solitary existence. Thus the basic composition and organisation of a primary group, once established, rarely changes (Tyler, 1972; Houpt and Keiper, 1982; Csurhes *et al.*, 2009).

Each group has an alpha or leader, the other group members are followers. In undisturbed feral populations the alpha leader is always a stallion, (Tyler, 1972; Feist and McCullough ,1975), but when humans regulate the number of stallions in a population the alpha leader is a mare (Tyler, 1972; Houpt and Keiper, 1982; McCort, 1984; Keiper and Sambraus, 1986; Klimov, 1988; Boyd, 1991; Keiper and Receveur,1992) This behaviour is due to females forming strong hierarchical relationships as they are continually in close proximity to one another (Keiper and Receveur, 1992), thus reducing the dominance of the stallion.

Stallions herd or drive the group when they wish to move them away from another stallion, or to move to new pastures. They are also responsible for maintaining the harem, defending mares, (Waring, 1983; Boyd 1991) and are frequently are away from the band in order to recruit new mares (Ransom and Cade, 2009).

This behaviour is one reason for stability within the group, researchers (Tyler, 1972; Clutton-Bweave *et al.*, 1976; Houpt *et al.*, 1978; Fraser and Arave, 1992; Sigurjonsdottir *et al.*, 2003; Feh, 2005) have found the existence of strong, long term, linear social attachments are also a major stabilizing factor (Lehmann *et al.,* 2003), capable of minimizing conflict, and is therefore an important anti-predator strategy among primary

groups of feral horses (Feh, 2005). Newcomers are not readily accepted by the group. However group size frequently changes due to loss, reproduction and the movement of immature horses, together with the flexibility of the bachelor groups or when ageing stallions can no longer defend female group members (Tyler, 1972).

Social attachments within feral equidae begin with the birth of a foal, and within two hours of birth a reciprocal attachment develops between the foal and its dam. Fraser (2010) states that several primary and co-essential stages can be recognised as a 'pattern produced by the template of post-natal behaviour is sharply outlined' during the formation of the neonatal and maternal bond. This bond becomes stronger with continued association and remains until the next foal arrives. However if offspring are removed during their first or second year the dam often remains solitary. Tyler (1972) found these bonds were still evident after three years, and only weakened when the offspring left the group. However, Weeks *et al.,* (2000) reported that the influence of the mare wanes after weaning. Foals benefit from the rank of their dam while they are at her side, and even later the offspring of high ranking mares tend to acquire a similar rank (Tyler, 1972) even though Houpt (2002) maintains there is evidence that the foal does not have the dam's rank.

The order of a hierarchy once established does not alter; the alpha individual is generally large (Houpt *et al.*, 1978) or one of the older members, but not necessarily the oldest or the largest (Tyler, 1972; Ellard and Crowell-Davis, 1989; Van Dierendonck *et al.*, 1995; Sigurjonsdottir *et al.*, 2003; Rho *et al.*, 2004). These mares usually display a certain amount of aggressiveness and will repeatedly intimidate older and larger animals by chasing and physically shoving to maintain their hierarchical position, Tyler (1972), Houpt *et al.*, (1978) Houpt and Keiper (1982), Waring (1983), Keiper and Receveur (1992). These researchers have also recorded aggressive behaviour, which may include kicking and biting. Studies by Houpt and Keiper (1982) of feral and domestic horse groups show adult males are often subordinate to such mares and may not be overly aggressive or dominant.

Dominance submissive relationships can be expressed actively by overt antagonistic encounters where threats and withdrawal are visible (Miller and Dennisto, 1979; Houpt and Keiper, 1982). Fraser & Arave (1992) noted the control of space by the dominant individual was related to the ability to avoid conflict which provides a key to understanding the social

behaviour of horses (Crowell-Davis, 1993). Personal space of individuals is maintained by avoidance of conflict; the social distance, that is, inter-individual distance, of group members is generally no more than 23 meters apart (Ransom, 2012).

Behaviour of both male and female members of primary groups facilitates togetherness. Groups wait for, and call to, members who have become separated. Goodwin (1999) describes free ranging equine society as functioning on 'kinship, recognition and respecting another's space'. Thus the early social attachments developed at birth are an important function in reducing aggression and in maintaining cohesion within primary groups of feral equidae.

### *2.3.3 Reproduction*

Mares may show sexual receptivity throughout the year, but mostly they conceive only in the spring and summer months. Research has shown the amount of sunlight greatly influences the reproductive function of horses (Allen, 1979). Most mares come into oestrus within 11 days of foaling, some copulate only during the first heat after foaling. The mare is not receptive to the stallion when in dioestrus and will forcibly reject his advances (Ginther, 1974). When in oestrus the mare allows the stallion to smell, lick and bite her before mounting (Marinier *et al.*, 1988) and he will often remain with an oestrus mare during her heat period. Some stallions show a marked preference for certain mares, and have been known to reject others (Feist, 1971).

It is possible for a stallion to serve mares several times a day (Mills and Redgate, 2009) while mares have been known to mate several times in a day, often with different stallions. The libido of a stallion remains into advanced age, 20 years or so, but 'few maintain competitive sperm counts' even though his reproductive capacity 'maintaining competitive sperm counts' may have disappeared. A stallion's fertility begins to deteriorate when the horse is about ten years old (McGreevy,2004). Courtship is an important stimulus in releasing sexual behaviour in the stallion and in female receptivity. The mare's oestrus posture of raised tail is an important visual stimulus to the stallion. Olfactory stimuli also elicit a favourable sexual response (Asa, 1986). However the absence of both visual and olfactory stimuli does not inhibit adult males, whose response has been found to be dependent on sexual experience and conditioned reflexes (Wierzbowski, 1959). The loss of desire or ability to mount and intromit is usually the result of negative conditioning, often caused by discomfort, pain, especially arthritic, or a previous unsatisfactory breeding

experience. McDonnell (1989) cites masturbation as a problem in stallions that are used infrequently, while over use, and/or inappropriate handling by humans can also contribute to poor sexual performance.

The length of pregnancy varies between different breeds of horses as well as being influenced by environmental factors. The normal length of pregnancy is about 340 days, but can occur from 2 -3 weeks before or after, within this time frame (Rossdale, 1967, Jeffcott *et al.*, 1982). It is usual for feral mares to foal in the spring (Tyler, 1972). The first sign of parturition is the development of the udder and the enlargement of the teats. When parturition is imminent mares repeatedly lie down and stand up, paw with their forefeet and sweat, while frequently turning their heads to their flanks (Mills and Redgate, 2009).

Foaling mostly occurs at night (Jeffcott *et al.*, 1982), a mare may seek a secluded site, while others will remain where they are, letting the herd graze away from them. Others may foal surrounded by the entire herd (Tyler, 1972). Night foaling is a biological advantage which reduces the risk of predation (Mills and Redgate, 2009). The foal is usually delivered while the mare is in a recumbent position (Jeffcott *et al.*, 1982). Often the mare remains in this position for some time after the foal is born, thus allowing a large amount of blood to pass from the placenta to the foal before the cord is ruptured ( Mills and Redgate, 2009).

The foetal membranes are usually expelled within an hour of foaling, but in some cases may be retained for some hours. Expulsion usually occurs during decumbency, after repeated sessions of rolling and sometimes biting at their flanks. (Rossdale and Mahaffery,1958). Rarely are the membranes eaten, but they may be nosed, and sometimes nibbled (Virga and Houpt, 2001).

At such times flehmen is usually exhibited. Post parturient behaviour of the mare is protective towards her offspring, sheltering it from intruders, as well as vigorously licking it. Mares do not encourage direct contact between the foal and other members of the herd (Fraser, 2010). They either call their offspring to their side with a quiet nicker or else place their body between their foal and the intruder (Estep *et al.*, 1993).

### *2.3.4 Behavioural Development*

Behavioural development patterns fall into behavioural ontogeny, investigative behaviour, locomotor patterns, play, resting and sleep. The first can be observed within seconds of delivery, the new-born foal assumes a sternal position with head lifted (Boy and Duncan, 1979). Foals are precocial developers and within the second hour have perfected leg flexion and walking, and can move about easily (Fraser and Arave, 1992, Goodwin, 2007). At the end of two hours the foal has perfected its earlier abilities, being able to stand, walk and suckle, (Flower, 2010). It is able to vocalize, seek shelter beside its mother and interact socially with her. Fraser and Arave (1992) suggest this behaviour is 'a result of the successful completion of a series of modal action patterns known as the 5 steps'. Locomotor activity is present in horses from birth and is important throughout their lives. Though many foetal movements are obvious from the third month of gestation, the normal developmental progression of the neonate is the identification of five steps 'in the development of the primary mobility required by a foal before it takes its first mouthful of milk and the self-reinforcement of feeding can take place' (Fraser and Arave, 1992). The Five Steps are:

1. Recumbent co-ordination
2. Rising and quadrupedal stability
3. Ambulation
4. Maternal orientation
5. Teat seeking and sucking (Fraser and Arave, 1992)

The time taken to stand differs between breeds and sex. Fraser and Arave (1992) found Thoroughbred fillies gained their feet some 14 minutes before a Thoroughbred colt. Most new born Thoroughbred foals stand within 30 minutes to 3 hours after birth (Kohnke, 2012). Pony foals, needing 'less leverage to stand' gained their feet much earlier than Thoroughbred foals (Jeffcott, 1972). The average time taken to stand for all equine foals regardless of sex and breed is 30-60 minutes (Grogan and McDonnell 2005). Newly born foals have a strong desire to follow any moving object. This tendency continues until the second day when the foal remains close by the mare's side at all times. Research has determined how foals and dams recognise each other. Wolski, Houpt, and Aronson (1980), found vision and olfaction are the neonates' recognition cues, while the unique auditory cues of their offspring are important for mares in recognising their offspring when parted (Carson and Woodgush, 1983). Houpt (2002) and Carson and Wood-Gush's (1983)

study of dam / foal behaviour found that up to 2 weeks may be needed to consolidate the parent / offspring bond, however this bond declines as foals approach weaning age. Mares reject other foals with kicks and bites. Rarely do mares adopt orphaned foals (Cox, 1970), even though foals are willing to suck mares who are not their own mothers. Once the foal is standing the mare may guide the foal towards her udder, usually resting the leg closest to the foal and guiding the foal towards her teat (Mills and Redgate, 2009).

Fear of new objects is displayed within two hours of birth; however, with the security provided by the close proximity of the mare, the foal continues to investigate its surroundings (Boy and Duncan, 1979). Such investigatory behaviour occurs frequently throughout the day. The movement of their ears attests that foals are alert to changes and suspected stimuli within their environment. New sounds, odours and objects generally cause foals to become alert.

Distant investigation is conducted with the head held high, towards the source while eyes, ears and nostrils search for cues. When a nearby object is investigated the head is oriented and extended towards the object. Fear can often prevent close investigation when a foal is in an approach-withdrawal situation. Thus an anxious foal is often repelled by unknown or even imaginary objects (Boy and Duncan, 1979).

As the parent-offspring bond decreases, the bond between filly-filly, filly-colt, and colt-colt strengthens, thus social bonding begins as the age of the peer group increases, with foals forming attachments after the first two or three weeks. These attachments, or pair bonds, may last for life and are the “fabric of social groups” (McGreevy, 2010).

Crowell-Davis *et al*., (1987) noted the movement of foals between their dams and peer groups in a ‘variety of activities’, while (Tyler, 1972) noted the mare was responsible for bringing “them back together again’. The strength of the parent affiliation between mare-filly may be lifelong (Waring, 1983, McGreevy, 2004). Affiliative activities between pair bonds include allo-grooming, sometimes known as mutual grooming, i.e. resting head to tail, fly swishing and neck overlapping’ (Crowell-Davis *et al*., 1987) and is important in ‘maintaining social cohesion’ (Eady, 2010).

Foals remain with their natal group until maturity (Gill, 1988) even though weaning usually occurs between 8-9 months. Duncan (1980) found pregnant mares weaned their foals

shortly before the birth of the next foal, but if the mare is not pregnant the foal may continue to suckle for a year or more. As weanlings mature, and before leaving the natal band, they acquire knowledge of social and survival behaviour, especially of habitat and forage availability, such knowledge is an important factor in contributing to reproductive success (Gill, 1988).

Ransom and Cade (2009) in their study of feral horses in Colorado, Wyoming and Montana, USA, found locomotion occupied the third largest amount of the daily time budget. Locomotion is necessary for feral horses to move from one resource to another. Studies in Queensland, Australia, have found feral horses walk up to 50 km from water in search of suitable food (Csurhes *et al.*, 2009). Walking between resources was the preferred method of locomotion, observed by Ransom and Cade (2009) while the higher energy gaits, i.e. trotting, cantering and galloping were observed 'far less frequently'.

The normal locomotor patterns of gait can be disrupted by physiological abnormalities resulting from trauma, infections, chemicals and environmental factors such as nutrition or perinatal events. Such physiological abnormalities can be life threatening (Ensminger, 1963) to the feral horse as it may be unable to move to and from water and feed resources and is open to predation.

Play is a distinctive component of the development of the horse. Foals commence solitary play within a few days of birth (Crowell-Davis *et al.*, 1987, Boyd, 1988), while social play commences within the first month. Usually play consists of dashes around and away from the mare; other activity can be swerving, bucking and jumping. With age the mother becomes less the centre of activity, the foal interacting more with others about the same age.

In feral groups play mostly occurs between foals from different social groups, while 4% of play occurs between a filly and a colt with play between two fillies being the most common (Crowell-Davis *et al.*, 1987). Play enables foals to improve their survival skills, enhance fitness and build social relationships (Boyd 1991; Hughes 2005).

### *2.3.5 Activity Budgets*

Horses are highly social animals and remain in a group carrying out all activities together. Such group cohesion and group stability (Boyd and Bandi, 2002) is generated by

behavioural synchronization and is an important equine social feature. Apart from reducing predation (Jarman, 1974) it also reduces insect harassment (Duncan and Cowtan, 1980).

**Table 2.1 Normal time budget of a feral (free-ranging) horse ( Boy and Duncan 1979; Duncan 1985; Boyd *et al* 1988; Ransom and Cade, 2009)**

| **Activity** | **%** |
|---|---|
| Grazing | 60% |
| Standing, resting lying, relaxing | 26% |
| Moving | 6% |
| Other: grooming, comfort, standing, attentive and elimination | 8% |

A horse ferments its food in the hind gut while grazing and is mainly on its feet and may have to travel long distances through-out the day searching for food and water, grazing while travelling.

Horses lie down to sleep for about two hours a day, prone sleeping bouts may last for 10 or 20 minutes in duration and are interspersed throughout the day. A further two or so hours are spent sleeping while standing which is the most common form of resting during the day, while recumbent rest occurs between 00.00 and 4.00 h (Boyd *et al.*, 1988) The ability to sleep while standing is a survival mechanism allowing for quicker departure from predators (Dallaire, 1986). Not all horses in a group lie down at the same time, usually only one or two members of the group will lie down while the other group members act as look outs.

Usually rest occurs in two or more periods per day. Adult horses rest and sleep in the standing position but lie down for at least one rest period per day, usually at night. Rest occupies a significant part of each day for a foal. Sleep usually occurs in a sternal or lateral decumbency, but young foals have been observed resting in a standing position. Foals tend to lie together during rest periods; even foals from different social groups will group together at such times (Crowell-Davis *et al.*, 1985).

### *2.3.6 Domestication*

It is unclear when domestication of the horse took place. There are four distinct phases in the domestication process of the wild horse. In the first phase humans hunted wild horses for meat and skins, as depicted in Palaeolithic cave art as early as 30,000 BC at Lascaux, France (Waring, 1983). The second phase of domestication is the capture and penning of wild horses which are held for slaughter at a later date, as indicated by the bones of over 100,000 horses retrieved from middens at Derevieka in the Ukraine. Tests indicate the bones are mainly males and aged between 5-8 years (McGreevy, 2004) indicating selective slaughtering from a captive source. The third phase of domestication is the capturing of wild horses for use other than as a food source (Levine, 2002). The Botai people of the Ukraine captured horses for draft work firstly and then used them for riding. The final phase in domestication is the use of horses for draft work and riding. These horses are bred and raised in captivity, by humans, under controlled conditions in relation to their social organisation and activity budgets.

Most important indications of domestication are from changes in skeletons and teeth (Benecke and Driesch, 2003), changes in geographical distribution indicating populations of horses for the first time, and indications of changes in human behaviour connected in some way with horses in archaeological sites i.e. remains of horses in human burial sites, evidence of structures for use with horses such as yards, equipment, especially bits, chariots and drawings of horses being ridden, driven or depicting human power have been recorded (Anthony, 2007).

Recent discoveries in Kazakhstan indicate that the location of domestication of the horse may have occurred in Botai settlements. Many of the above indicators are found in archaeological sites in Kazakhstan dating back to 3500 BC (Levine, 2002; Outram *et al.*, 2009), demonstrating that there is evidence of early horse domestication by the Botai people. Analysis of organic residue 'reveals processing of mare's milk and carcass products in ceramics indicating a developed domestic economy encompassing secondary products' (Clutton-Bweave, 1992; Outram *et al.*, 2009). Outram *et al*., (2009) believes that 'Metrical analysis of horse metacarpals shows that the Botai horses resemble Bronze Age domestic horses rather than Palaeolithic wild horses from the same region'. A statement is included which agrees with findings by Jansen *et al*., (2002) findings that the domesticated horse is not descended from Przewalski's horse, having 66 chromosomes, while the domesticated horse has 64 chromosomes.

However some researchers classify domesticated horses as those that are bred and raised in captivity. All other horses are considered as being tamed, that is captured wild stock. Noticeable are the changes evident in size of domesticated horses, being both larger and smaller than wild equines (Bokonyi, 1978; Benecke and Driesch, 2003). The larger specimens are due to human management and care, while the smaller size is the result of being kept in yards and fed a restricted diet. Vila *et al.*, (2001) believe the smaller, slender limbs of equine skeletons recently discovered in Kazakhstan indicate these horses were managed in yards about 3,500 BC.

There is little concrete evidence as to where and when the riding of horses first began, but archaeological evidence points to the Eurasian Steppes of the Ukraine (Bibikova, 1969). Anthony *et al.*, (1991) believes the bevels and fractures on teeth from the remains of a stallion unearthed at Dereivka are 'consistent with the use of a bit' and that this horse is regarded as the first to be ridden and 'to have pre dated the invention of the wheel by at least 500 years' (Anthony *et al.*, 1991).

Once the horse was tamed, and ridden, economies changed, settlements altered: e.g. towns were fortified to protect the inhabitants from marauding raiders (Keegan, 1994), transportation increased and agriculture improved. The horse is the key to the rise of civilization and various cultures. Those countries with superior horse cavalry dominated warfare and were best suited in defence of their own country (Anderson, 1961; Gat, 2006).

Over the centuries the horse has demonstrated an ability to adapt to intensive management and a continually changing environment as well as a huge variety of work requirements demanded by humans (Goodwin, 2007). When the importance of social structure, behavioural ecology and activity budgets of the feral horse is considered, the demonstrated ability to adapt under such extreme conditions explains the survival of *Mesohippus* for nearly 60 million years (Darwin, 1859). Such morphological changes in the history of the Equidae 'can be accounted for by the neo-Darwinian theory of microevolution: genetic variation, natural selection, genetic drift and speciation' (Futuyma, 1986).

## 2.4 Development of the Thoroughbred racehorse

The Thoroughbred racehorse was developed in England during the 17th and 18th Centuries by crossing imported stallions of Eastern Blood with native English mares (Cook,1901). With the change in war tactics a lighter more agile horse was needed. The British ruler, Oliver Cromwell, saw this need and developed an important breeding establishment: "State papers reveal a definite expression of Cromwell's anxiety 'to furnish England' with Arabian horses" (Cook, 1901). These horses were eventually seized by King Charles II who continued the breeding of this new type of horse (Wentworth, 1944). Though these horses were bred for their agility it was soon evident they were extremely fast (Wentworth, 1944).

The stallions who have had the most influence on the development of the Thoroughbred breed are the Darley Arabian, the Godolphin Arabian and the Byerley Turk. These stallions were imported to England between 1689 -1730 (Cook, 1901; Wentworth, 1944; Hislop, 1948). The blood lines of all Thoroughbred racehorses in the world can be traced back to these stallions and though some lines have become weaker over time many of the horses are much faster than any of their antecedents (Wentworth, 1944; Willett, 1970). Many of the native English mares were descended from horses brought to England by the Romans and they already possessed Eastern ancestry (Cook, 1901; Wentworth, 1944; Ensminger, 1963). Later importations of mares to England were mainly of Barb origin, due to the difficulty in obtaining Arab mares (Cook 1901).

King Charles II of England imported Arab mares from the Levant. Known as the "royal mares" (Cook, 1901) they formed the basis of the most pure strain of the Thoroughbred racehorse. The importance of these mares is mentioned in the records of John Cheny, 1727 (Wentworth, 1944).

## 2.5 Early history of thoroughbred horse racing

There is evidence the Romans raced horses during their occupation of Britain, and that racing, usually between two horses, was a popular past time for hundreds of years (Bede, translated 1968 by L Sherley-Price). The first record of racehorses in Britain is of the Arabian horses Arundel and Truncefice (Wentworth, 1944) who raced as early as 1377. Turf history really begins with the reign of Charles II 1649-1685 (Hislop, 1948). During his reign he introduced a Spring and Autumn race meeting at Newmarket, England. Racing

colours, to determine horse ownership, were also introduced while the town of Newmarket became so popular that at one time Newmarket was considered the unofficial capital of England (Hislop, 1948).

The Jockey Club was established in Newmarket in 1750 (Hislop, 1948). The first volume of the Racing Calendar was published by Weatherby's in 1773, which they continue to publish to the present day. Weatherby's have acted with the Jockey Club since 1773 and today act as Secretary to the Club and manage racing at Newmarket (Hislop, 1948). In 1791 Mr. Weatherby published the first volume of the General Stud Book, this volume contained the pedigree of every horse 'of note' (Hislop, 1948) that had raced in the last fifty years in Britain. The General Stud Book still records details of every Thoroughbred horse foaled in Britain.

Many important practices and rules of racing were devised during the Victorian era (1837-1901) and are still in place today. Foremost of which was the starting of races by signalling with a flag; the use of a number board showing riders and runners; the insistence of the punctuality of all officials, jockeys, trainers, and owners; the introduction of parading all horses in the saddling paddock before the race as well as the preliminary canter to the starting post. Importantly, the practice of giving a present to the judge by the winning owner was abolished (Hislop, 1948). By 1855 major changes to the rules of racing were in place and included the establishment of the weight-for-age scale, a further improvement in starting, and the leasing of the greater part of the Newmarket training ground by the Jockey Club (Hislop, 1948).

In 1776 the largest and most important equine auction house in the world was founded by Richard Tattersall at Hyde Park Corner, London, on land rented (for a small amount), from Lord Grosvenor, for a period of 99 years. When the lease expired in 1865 Tattersalls moved to Knightsbridge, where the business continued to flourish. In 1965 sales of Thoroughbred horses commenced at the Park Paddocks, Newmarket, England, and continue to this day (Willett, 1987).

The annual turnover for the year 2012-1013 of 249 million guineas is a record, surpassing the previous record of 2007 (Arnold, 2013). The previous record for a Thoroughbred Broodmare of 4.6million guineas paid for 'Magical Romance', in 2006, was bettered by the

sale of a 5 year old Brood mare 'Immortal Verse' who was sold for 4.7 million guineas. Also selling at this sale was 'Dancing Rain' who brought 4 million guineas (Arnold, 2013).

### *2.5.1 The Beginning of Thoroughbred Horse Racing in Australia*

The introduction of horses to Australia was simultaneous with Australia's colonisation; included in the first shipment in 1788 were 1 stallion, 3 mares and 3 colts that were purchased at the Cape of Good Hope, South Africa. These horses were predominantly of Spanish blood (i.e. Andalusian) with some Persian /Arabian blood (Willett, 1970; Pollard, 1971; Carruthers, 2008).

They were 'not first class stock' (Pollard, 1971). Further importations of horses improved each generation, but it was not until 1799 when the first pure Thoroughbred stallion, 'Weavingham', (sometimes known as Young Weavingham) arrived in Australia, while the earliest record of the importation of a Thoroughbred mare (name unknown) is in 1825 (Onslow, 1891).

The first race meeting was held in 1810 by the 73rd Regiment at Hyde Park, Sydney. The Australian Jockey Club (AJC) was founded in 1842 and held its first meetings at Homebush, moving to Randwick in 1860 where it has remained ever since (Pollard, 1971; Carruthers ,2008). Race Clubs were formed in all the other capital cities in the 1800s but the AJC, continues to play a major role in the regulation of racing (Pollard, 1971; Carruthers, 2008).

Racing is administered by the Australian Racing Board Limited (ARBL) which supersedes the power of all principal clubs (ARB, 2012). This board is responsible for establishing all the rules of racing. There are 381 Race Clubs in Australia who staged 2,675 race meetings in 2012-2013 on 358 race tracks. In all 19,076 flat races were held in 2012-2013 and 92 jumping races. They raced for prize money of $435,385,165. The Melbourne Cup, the most prestigious staying race in Australia, has the highest prize money, $6,000,000, with the winner collecting a prize of $3,600,000 (ARB, 2012)[1].

[1] Black type races have the highest prize money and are the most prestigious of all races in the world. The details of any TBR who has won one of these races is printed in bold black ink block capitals in sales catalogues (www.Horseracinginfo.com.au/Australian-group-races).

### *2.5.2 Thoroughbred Racing Industry Economy*

The Thoroughbred racing industry has changed from its original concept of entertainment and recreation to an industry which is vital to the economy of Australia (Gordon, 2001). In the year 2005-06 the Thoroughbred racing industry provided approximately $5.04 billion in value added to the national economy. This represented 0.58 % of Gross Domestic Product (Australian Government Productivity Commission 2009).

The Gambling Productivity Commission inquiry found there was an estimated 48,680 full time jobs, and estimated 9,900 breeders employed 17,990 staff of whom 8% were based in non-metropolitan areas. A total of 4,700 trainers with a staff of 3,100, also in non-metropolitan Australia, and 1,000 jockeys are employed in the Australian Thoroughbred racing Industry (ARB, 2012).

The Gambling Productivity Commission inquiry also mentioned other areas of the economy engaged in servicing the racing industry, e.g. feed merchants, veterinarians, farriers, transport companies, caterers, hoteliers, and the fashion industry. When part time work, casual and unpaid work is taken into account closer to 230,000 people are involved in the Thoroughbred racing industry. Nearly $1.2 billion in taxes was generated, while taxes on wagering generated almost half of this amount (ARB, 2009).

On a per capita basis Australia has arguably the strongest racing industry in the world (Figure 2). Even in aggregate terms the Australian Thoroughbred Racing Industry (ATRI) ranks in the top 3 racing industries in the world on all industry indicators, notwithstanding its much smaller population and economy vis a vis competitors such as the US, Japan, Great Britain and France (ARB, 2013).

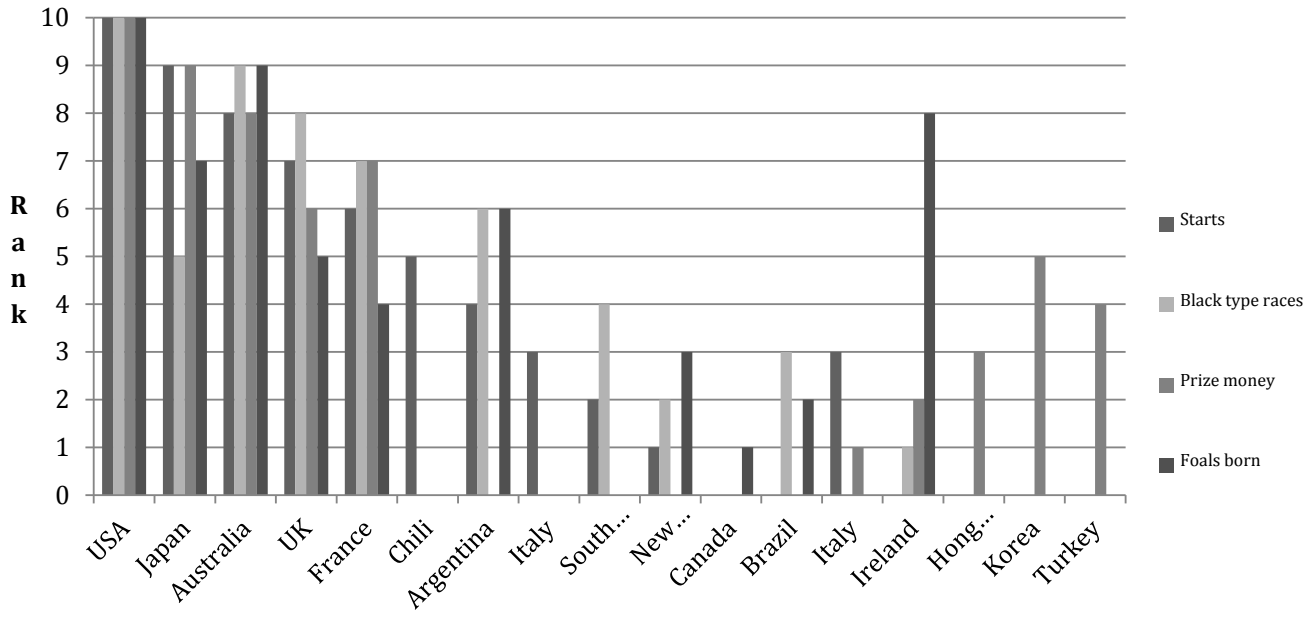


**Figure 2.1 Australian thoroughbred racing on a world stage (ARB, 2013).**

The importance of the racing industry to the Australian economy, as well as the effect the recent Global Financial Crisis had on the Australian racing industry is displayed in Figure 1. The greatest number of mares covered was (31,596) between the years 2005/2006 while the most live foals (18,758) were returned that year to the Australian Stud book for registration. The lowest number of mares covered (22,563) was in 2011/2012 while only 14,603 live foals were recorded, reflecting the effect of the Global Financial Crisis when a smaller number of mares were covered in 2011/2012. (ARB, 2012).

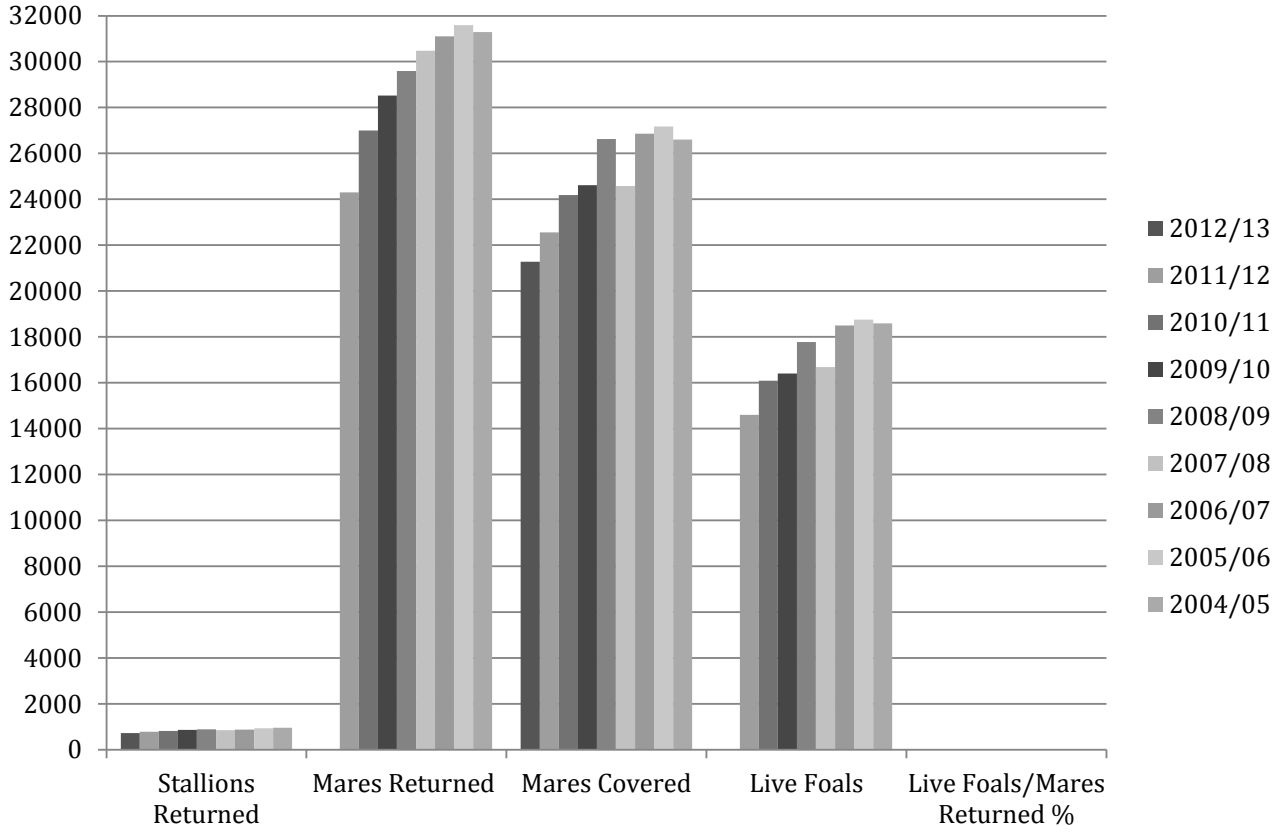


**Figure 2.2 Breeding statistics (ARB, 2013)**

Exports also dropped to their lowest level in 2007/2008 with 1,061 Thoroughbred horses exported while the number of imports dropped to their lowest level in 2012/2013 when only 1,141 Thoroughbred horses were imported into Australia. In 2006/07 New Zealand imported 1011 Thoroughbreds, the most Thoroughbred racehorses imported from Australia by any country between 2003/2004 - 2012/2013. China became a major importer in 2012/2013 with 106 Thoroughbreds imported, an increase of 14 from the previous year. The highest price ever paid for a thoroughbred yearling in Australia is $5,000,000 at the Inglis' sales in Sydney in 2013 (ARB, 2012). The Inglis' sales that year grossed $91,190,090 (the highest gross for Thoroughbred sales ever recorded in Australia), while the mean was also the highest ever recorded being $160,000 (Source:www.bloodhound.net.au).

The Thoroughbred horse racing industry depends on the care, welfare and wellbeing of the Thoroughbred racehorse that is the most intensively managed of all animals. Thus

there is a need to explore stakeholder opinion on the welfare and training of Thoroughbred racehorses.

## 2.6 Welfare Indicators for Thoroughbred racehorses

Since domestication, about 3,500 BC (Outram *et al.*, 2009), the horse has adapted to the managed environment and the extreme work-loads demanded from it to a limited degree. Casey (2007) states ‘the limits to which adaptation can occur is restricted by the flexibility in both behavioural and physical phenotype”.

The social structure of feral and free ranging horses is well established (Chapter 2.3.2). One reason for the survival of the horse is its highly adaptive nature (Goodwin, 2007; Ransom and Cade, 2009). Coupled with the importance of social structure for its survival is the existence of a specific home range supplying water, feed and shelter (Chapter 2.3.1), as well as the activity budget and the requirements of the equine digestive system (Chapter 2.3.5). It is extremely difficult for racehorses to be trained without compromising the welfare conditions of these issues.

Stable design frequently prevents physical and visual contact between equines (Dawkins, 1983; Marsden, 1995; Sainsbury, 1987; Clarke, 1987a), which are highly social animals, while frequent turnover of Thoroughbred racehorses may destabilise the group (Crowell-Davis, 1993; Goodwin, 2007). The husbandry and management of stabled horses has developed over many hundreds of years and is centred on methods convenient to humans, with little thought of equine innate behaviour (Goodwin, 2007). The time budget of the Thoroughbred racehorse differs from that of the feral or free ranging horse (Boy and Duncan, 1979; Duncan, 1985; Ransom and Cade, 2009) being denied its innate activity budget, its social structure, its freedom of choice, as well as a varied and changing environment.

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Though the link between nutritional needs, health and performance of the Thoroughbred racehorse is attended to with great care (AHIC, 2011), the digestive system of the 'trickle feeding' horse (McGreevy, 2004), which requires a constant amount of food, continually moving through its digestive tract, creates management problems (Nicol, 1999a) which may impact on the health and performance of the Thoroughbred racehorse. Typically cereals are fed in large quantities, in a small number of meals, with a limited amount of hay, all of which compromises the equine digestive system (Davidson and Harris, 2007).

## 2.7 Measuring Welfare

Frequently valid welfare indicators which address ethical concerns and moral responsibility for maintaining welfare do not exist. The ability to define and measure welfare is extremely difficult (Broom and Johnson, 1993,) and requires more than a single welfare measure (Mason and Mendel, 1993; Fraser, 1995; Johnsen *et al.,* 2001; Von Borell *et al.*, 2007). Both Dawkins (1990; 2004) and Dawkins and Manning (1998) cited the importance of an individual's health, emotional experience and perception of environment when assessing welfare.

Stull *et al*., (2005) gives examples of three animal welfare studies where the system was able to compare ranking within the programme but not between programmes. The objective 'was to provide an overview of the similarities and differences in content and scope of these programs' Stull *et al.*, (2005). The voluntary programs used to assess animal welfare on commercial dairies in this study in the United States of America were Humane Farm Animal Care (HFAC), which included minimum standards and a third- party audit system; Dairy Quality Assurance Centre (DQAC) and the University of California (UCD) program with self-assessments. A study compared the rank order of compliance scores for each program and ascertained the practical application of these programs on commercial dairies. The result of rank order for all programs indicated different indices were measured by each program and were not suitable for implementation ' due to the differences in their design, objectives and standards. (Stull *et al.,*2005). Thus careful planning of design, analysis and interpretation (Mason and Mendel, 1993; Gonyou, 1994) as well as the methodology of behavioural observation and validation (Mitlohner *et al.,* 2001) are all necessary factors in defining and measuring welfare.

It is possible to measure the wellbeing of Thoroughbred racehorses by various diagnostic tests, which include monitoring heightened cortisol levels (Colville and Bassert, 2002, Engel, 2003, Sjaastad *et al.*, 2003), as a response to poor welfare, and as an indicator of stress (Reinhardt and Cowley, 1992). Invasive welfare evaluation tests are, in themselves, stressful. However, as Skyner and Smith (2005) noted numerous variables affect cortisol levels, such as age, environment, weather conditions, and the time of day. As a consequence Smith (2004) advocated the need for more than one assessment method.

There is a growing interest in finding a less invasive method than cortisol analysis by which to assess the welfare of the Thoroughbred racehorse. Survey research is one such

method (Gordon, 2001; Hayek, 2004), which provides a means of seeking answers to a range of different questions, and may be qualitative or quantitative in approach (Amaratunga *et al.*, 2002), with qualitative methods being used more recently in some animal welfare studies (Velde *et al.*, 2002; Collins *et al.*, 2009; 2010). Unlike most surveys which are quantitative and deal with market analysis (Stitt-Gohdes and Crews, 2004), the 'Policy Delphi technique' (Linstone and Turoff, 1975), developed by the Rand Corporation for the US Military, is qualitative and permits researchers to combine reports by a group of experts into a single statement. Thus when a structured communication process is applied to a topic or problem, a group perspective can be obtained when discussion is between a group of informed, educated and experienced experts (Adler and Ziglio, 1996).

The iterative Delphi method collects and distils data from anonymous experts using a series of data collection rounds and analysis methods as well as providing feedback. Unlike Classical Delphi, which ranks issues and seeks consensus from homogeneous groups of experts, Policy Delphi is interested in 'an informed group presenting all the options and evidence for consideration'. The Policy Delphi is therefore 'a tool of analysis of policy issues and not a mechanism for making a decision' (Turoff, 1975).

The first objective in starting the Policy Delphi process is to identify a broad panel of experts (Garabed *et al.*, 2009). There is often criticism as to who is an 'expert' while Spoolder *et al*., (2003) queried levels of expertise. O'Loughlin and Kelly (2004) consider expertise to be less important in choosing experts than the level of awareness of the subject area. Bracke *et al.*, (2008) has shown that the occupation of 'experts' can affect the level of importance attributed by experts, with the opinion of experts differing within groups of experts, while an imbalance in the occupation of experts can result in a biased view (Vang, 1986). Vang (1986) argues experts may have little knowledge of scientific fact and reasoning, and are unable to consider all the facts, instead concentrating on small issues. The use of criteria either tertiary education based or demonstrating extensive experience in the field, or professional achievements in industry or organisations is an appropriate method to assess an 'expert', especially if care is taken not to overlap in areas of representation (Garabed *et al.*, 2009).

The strength in the Policy Delphi process lies in its flexibility and 'systematic control inherent in the Delphi design delivers an air of objectivity to the outcome' (Powell, 2003). Such advantages occur when anonymous individuals, with appropriate knowledge in a

given area, but having ‘different perspectives and differing cognitive abilities’ (Turoff and Hinze, 1996) can still express their views, no matter how dissimilar such views may be, and contribute to complex problems. Scott and Black (1991) noted the NIH method ignored extreme or minority views. Thus the Policy Delphi is useful when judgements of individuals are needed ‘to address a lack of agreement or an incomplete state of knowledge’ (Powell, 2003).

Hsu and Sandford (2007) criticised the Delphi method for having poor response rates. The use of vignettes describing compromised equine welfare is a novel way (Collins *et al.*, 2009) to secure respondent engagement and to prompt an adequate response (Barter and Renold, 2000). Wilks (2004) stated vignettes also avoided “ethical issues related to observational or interview based studies”. Vignettes could also overcome reporting bias often encountered with socially undesirable behavioural issues, when respondents give answers which they see as desirable to the researchers (Delgado-Rodriguez and Llorca, 2004). Hsu and Sandford’s (2007) criticism of slow response times is counted by the ability of the Delphi to allow respondents sufficient time to thoroughly consider the current problem (Stitt-Gohdes and Crews, 2004). Thus in preparing a well-developed welfare assessment system it is important to take into account scientific evidence as well as the opinions of experts (Turoff and Hinze, 1996, O'Loughlin and Kelly, 2004, Bracke *et al.*, 2008, Garabed *et al.*, 2009).

Other measuring and assessment systems of welfare exist. The National Institute of Health (NIH) uses pre-meeting consultation and discussion groups in order to reach a valid consensus of expert opinion (Fink *et al.*, 1984). However problems with this method lie in the ability for one or more group members to dominate the meeting and stifle discussion and idea generation (Glaser, 1980, Krueger and Casey, 2009).

Studies of equine welfare from management practices of 312 non-racing horses on Prince Edward Island in North America used a pretested questionnaire of owners and a veterinary examination of each horse to obtain body condition scores and incidents of stereotypic behaviour. The horses on Prince Edward Island are usually obese (Christie *et al.,* 2006). The researchers, Christie *et al.,* (2006) used this method of assessment because there was no single objective measurement that can be used to indicate the level of welfare. The two indices used were:

1. Body score as an index of physical welfare
2. Stereotypic behaviour as an index of mental welfare and satisfaction of the horse's nature (Christie *et al*., 2006).

The use of body condition scores is a reliable component of physical welfare (Leighton Hardman, 1984; Collins *et al.,* 2009) and is a measure of ' Freedom from Hunger', one of components of The Five Freedoms (Farm Animal Welfare Council, 2007). Thoroughbred horse Trainers are aware of the importance of an optimum condition score by 'regular monitoring of body weight' in detecting weight loss as an early sign when monitoring overtraining. The overtraining syndrome, which Evans (2007) likens to chronic fatigue, "is a serious threat to the animals' welfare" as the syndrome "is associated with a cortisol response to exercise" which decreased in over trained TBRs (Golland *et al.,* 1999). The aim in training racehorses is to win races and a physically fit horse is neither thin nor over-weight (Bailey, 1998a and 1998b; Kohnke *et al*., 1999; Collins *et al.,* 2009).

A study was undertaken in 2002-2003 of the welfare of 4903 working horses, mules and donkeys in Afghanistan, Egypt, India, Jordan, and Pakistan, using direct observation of health and behaviour parameters (Pritchard *et al*., 2005). The results of the study were to be used as the initial stage of a long term strategy to inform priorities for welfare intervention in working equines and to establish a welfare benchmark. Repetition of this assessment and comparison with a welfare benchmark could be used to assess changes in welfare over time (Pritchard *et al*., 2005). However, direct observation of the health of these working equids would produce an outcome different from the study of Thoroughbred racehorses whose ability to race is determined to a considerable extent by their locomotory, cardiovascular and respiratory fitness and soundness (Moyer *et al*., 1991; Evans, 2007). However it demonstrates the principle that the assessment of equid health and behaviour parameters by direct observation, at several time points and comparison with a welfare benchmark, is likely to be relevant in the assessment of Thoroughbred racehorse welfare.

It is possible to evaluate animal welfare in farms using either the Animal Needs Index (ANI), developed to assess Farm animal welfare (Bartussek, 1995), or the similar TGI 35L, Animal Needs Index, which assess husbandry and management to produce an overall welfare score. Poor conditions within one area can be compensated for by a better score in another area, but only when the poor conditions are immediately removed (Bartussek,

1995). This method is based on the production of farm animals, e.g. milk and egg production, their longevity and reproductive ability (Johnsen *et al.,* 2001). These parameters are of limited relevance when assessing Thoroughbred racehorse welfare. None of these previous equine welfare assessment methods were suitable for assessing the welfare of Thoroughbred racehorses (TBRs) (Christie *et al.,* 2006) due to the unique and intensive management of Thoroughbred racehorses and the differences in their husbandry, management and work requirements.

## 2.8 Questionnaire development

In developing a survey such as mine on 'Determining opinions of Training Requirements for Thoroughbred Racehorses', a clearly defined hypothesis should be established, as well as defining the survey recipients, and a sufficent number of recipients to receive the survey. The use of a simple format, whose question and answer design (lacking in bias) was able to obtain accurate data and finally, a questionnaire pilot of sufficient sample size was personally administered to 10 people who were not at the stakeholders meeting, but who possessed ample knowledge of the subject (White *et al.*, 2005).

Survey recipients must be identified effectively, e.g. according to their role in the Australian equine industry. Groups will emerge, such as those having a strong health and welfare focus; those active on racing committees; those whose main livelihood is the equine industry; without being physically involved, and finally those stakeholders whose physical involvement was their main livelihood. Such identification of respondents is an important factor in obtaining the differing views of stakeholders in the Thoroughbred racing industry (Collins *et al.*, 2009).

### *2.8.1 Questionnaire Design*

Surveys can be created using Adaptive Conjoint Analysis (e.g. Sawtooth Software, Evanston, IL, USA), a statistical method capable of analysing stakeholder preference. This technique allows several factors to be considered jointly, rather than in isolation (assuming that complex decisions are not based on a single factor ( Johnson, 1974; Orme, 2002; 2010) and determines which combination of such issues is influential in determining the respondent's choice (King *et al.,* 2005; McEwan, 2011).

Surveys have been used to determine welfare problems, e.g. Pines *et al.,* (2007) used an ACA system and the opinions of stakeholders involved with the animal export industry. They identified 18 potential indicators to evaluate welfare indicators of sheep and cattle transported by ship. Similarly Fernie's (2008) online survey used Sawtooth's ACA system

(Johnston, 1974; Orme, 2002, 2010) in ‘A survey of the attitudes of stakeholders in the zoo industry towards the husbandry requirements of captive Great Apes’ 2012, and in ‘The Creation and Implementation of a Great Ape Welfare Index’ on a global scale (Fernie, 2008). Gurusamy *et al*., (2014) also used Sawtooth’s ACA system (Johnson, 1974; Orme, 2002, 2010) in ‘Identification of major welfare issues for captive elephant husbandry by stakeholders’ and the opinions of stakeholders in the Zoo industry to identify welfare attributes as well as online surveys in creating the welfare index ‘Assessment of the Welfare of Captive Asian Elephants (Elephas maximus)’ 2012. Gurusamy used behavioural and physiological data he obtained in the field to validate this research. The welfare index of captive Asian elephants can be used to determine the welfare status of elephants in a particular enclosure and to identify ‘areas of management inadequacies of improvement’ (Gurusamy, 2012).

## 2.9 Behaviour Studies

Carenzi and Verga (2007) in their ‘review of the scientific concept and definition’ of welfare consider animal welfare research as a tool to improve knowledge regarding animals ‘especially their physical and mental states’. Today there is an inceased awareness of animal welfare in developed countries, but the knowledge of the innate behaviour of any particular species is vital in understanding its welfare and in the subsequent use of this important research tool. Construction of an ethogram is a formal catalogue of various behaviours and may be constructed in many forms and levels of completeness and detail and is able “to classify most behaviours of a species” (McDonnell 2003). Thus behaviour studies by direct observation (McDonnell, 2003; Ransom and Cade, 2009; Tadich *et al.,* 2012) are central to welfare research and may offer advantages ‘for both animals’ quality of life as well as for humans who rear animals and rely on their performance’ Carenzi and Verga (2007).

There are many different sampling methods available (Altmann, 1974) however continuous sampling was chosen for this study (Altmann, 1974; Mitlohner *et al., 2001;* Ransom and Cade., 2009) using a list of behavioural categories to form an ethogram (McDonnell, 2003) and each behaviour recorded by an acronym (McDonnell, 2003;Ransom and Cade, 2009).

Lorenz (1955) believed behaviour was of such importance that the geological age of some behaviour patterns was as great as the most conservative bodily characteristics and that 'the comparative method to which we owe all or most of our knowledge concerning the

evolutionary history of living creatures is just as applicable to these behaviour patterns as to any organs '. Likewise Smith (1971) believes that ethologists may be correct in using behaviour as a basis for classifying animal species as an alternative to taxonomy based upon physical characteristics.

Abnormal behaviour is often a coping response to external stimuli that affect equine behaviour, i.e. adapting to a new environment, as is experienced by the stabled Thoroughbred racehorse (Cooper and McGreevy, 2007). Research into the causes and effects of these abnormal behaviour patterns have found preventive measures often increase stress (Cooper and McGreevy, 2007). Strategies to reduce stress, which are available to horses in the feral or free ranging state, such as fleeing from a stressful stimulus, are denied Thoroughbred racehorses, due to intensive management systems. The inability to reduce stress frequently results in compulsive obsessive behaviour (Bellisle *et al.*, 1998).

Thus the use of stakeholder surveys and direct observation behavioural studies of Thoroughbred racehorses in a training environment make it possible to obtain a more comprehensive view and assertain the individual Thoroughbred racehorses' coping ability.

## 2.10 Use of a welfare index

A Thoroughbred Racehorse Welfare Index would provide a greater understanding of the issues required in maintaining a high level of welfare. Such an index could be used as a template of training preferences and guidelines in countries developing a racing industry. The index will aid governments in formulating codes of practice (embodying welfare issues), and in legislating equine welfare.

The use of the Thoroughbred Racehorse Welfare Index would be enhanced by the following characteristics:

1. Easy checklist format to assess welfare standards within the racing industry.
2. The index is unambiguous and ensures common interpretations across assessors.
3. The index is non-invasive.
4. The index corresponds with current knowledge of welfare/husbandry requirements

## 2.11 Thesis Hypothesis

The hypothesis of this thesis is that the creation, validation and experimental implementation of a Thoroughbred Racehorse Welfare Index will highlight those aspects of Thoroughbred Racehorse husbandry which require most improvement and rank Thoroughbred Racehorse husbandry in a uniform way.

## 2.12 Experimental hypotheses

1. Stakeholders' opinions will provide information on the importance of those issues which are necessary in obtaining the most favourable welfare in Thoroughbred racehorse management.

2. The welfare index created from the surveys will enable the evaluation of Thoroughbred racehorse management using a cumulative score.

3. The index can be validated through behavioural studies of Thoroughbred racehorses in training establishments together with personal interviews of those trainers in whose stables the observations took place.

4. The attitudes and opinions of Thoroughbred racehorse trainers about the welfare and management of Thoroughbred racehorses can be captured in an Australian wide online survey.

# CHAPTER 3

# A SURVEY OF STAKEHOLDERS TO DETERMINE OPINIONS OF WELFARE REQUIREMENTS FOR THOROUGHBRED RACEHORSES

## TABLE OF CONTENTS

# LIST OF TABLES

## 3.1 Introduction

The racing industry is frequently challenged by a well-informed public on welfare issues and the high wastage rates of racehorses within the Thoroughbred racing industry. Therefore it is vital to the racing industry that the publics' perception of the industry is improved and the publics' involvement encouraged. The Thoroughbred racing industry is a valuable component of the Australian economy with an ever increasing range and quality of services where recreational and entertainment services provide employment to a vast number of people throughout Australia. Of concern is the competition for spectator and monetary input. Implementation of a welfare industry will improve the public perception of the racing industry and encourage public involvement.

Australia supplies many Thoroughbred racehorses to Asia. The welfare index will assist these countries in the development of their racing industries by providing a 'template' of training preferences and guidelines. By targeting issues caused by encroaching urbanisation and industrialisation of areas specific to production, keeping, training, and racing of the Thoroughbred the Welfare Index will benefit regulatory bodies concerned with the sustainability of the racing industry, as well as the environment and welfare of the Thoroughbred racehorse.

Many of the guidelines used by Racing Authorities and organizations do not represent uniform and optimal welfare requirements for Thoroughbred racehorses. Currently there is no valid reliable and feasible tool available to assess Thoroughbred racehorse welfare, therefore an online adaptive conjoint analysis survey, relying heavily on questionnaire design and statistical analysis, will be used to determine Thoroughbred racehorse welfare problems. The study will utilise the opinions of stakeholders in the Racing Industry to identify appropriate welfare indicators.

The Commonwealth government's Department of Agriculture, as well as many Australian states, have model codes of welfare, specific to horses. Breaking a relevant code is not an offence, but if an animal suffers as a result of such actions then the offence could come under the Prevention of Cruelty to Animals Act. It is the responsibility of Australian local government legislation to enforce a code of practice. Although Thoroughbred horse racing in Australia is state structured, there is

‘overarching governance at the national level through the Australian Racing Board’ (RIRDC, 2006).

The regulations of the AJC cover most legal and insurance issues as well as many welfare and management requirements in the training and racing of the Thoroughbred racehorse. Once the racehorse is no longer registered to race, i.e. retired from race training and used in some other way, it is then covered by the Australian Horse Industry Council’s code of practice (AHIC, 2011), which covers animal welfare, land transport and biosecurity considerations. The Equestrian Federation of Australia’s (EFA) code of practice covers most of the sport horse regulations. Many of these horses are retired Thoroughbred racehorses.

Regarding stable (stall) size, the Occupational Health and Safety regulation released by the Western Australian Government for Racing (Worksafe, 2013) do not give minimum standard requirements in square metres but require ‘stable boxes (to) have enough room to allow a person to turn a horse and move around the horse’ (Worksafe, 2013). These requirements, based on minimum standards do not address the welfare of the horse in terms of the size of the animal or the size of the stable (stall). There is no scientific evidence to validate the reason for this stipulation. There are no measurements given for roof height, which could be as important for the welfare of the stabled horse as are the dimensions of floor size. Such minimum standards imply a risk management approach.

The purpose of this study is to create a tool to assess husbandry and standards of welfare within the Thoroughbred racing industry and to provide a basis of welfare standards. As a precursor, it is necessary to identify the relative importance of various husbandry and management options for Thoroughbred racehorses which have implications for their welfare.

## 3.2 Materials and methods

### *3.2.1 Selection of Stakeholders*

Invitations were sent to 15 different national associations connected with the TB racing industry in Australia, selected from the Australian Jockey Club web page, Aushorse, and Racing Journals from all Australian States. Acceptances were received from 9 associations. The Queensland Trainers Association, the Racehorse Transporters Association, Australian Farriers and Blacksmiths Association, Federation of Australian Bloodstock Agents, Queensland Racing, Thoroughbred Breeders Association Queensland, Australian Veterinary Association, Queensland Racehorse Owners Association, Show Horse Queensland.

The Queensland Jockeys' Association apologised for being unable to send a delegate, due to important race meetings taking place in two different locations on that particular day. It was not possible to invite a 'strappers' (grooms) delegate as no association existed either at Federal or State level for this important stakeholder group.

National Associations of each of the 9 accepting stakeholder groups within the Thoroughbred racing industry were asked to send up to two representatives to a stakeholder meeting held at the University of Queensland, Gatton Campus on Thursday 20$^{th}$, May 2010, facilitated by Professor Natalie Waran of Edinburgh University, commencing at 10am and finishing at 4pm. A written statement of the meeting's objectives was provided to each stakeholder some weeks prior to the meeting, informing them of the projected outcome, the stakeholders were asked to consider welfare issues, as identified in the synopsis, and to suggest indicators capable of identifying these issues. An outline of the overall project, design and methodology was also provided, as well as explaining that it aims to develop a welfare index for TB racehorses in Australia, together with an invitation to speak for approximately 5 minutes in their relevant area.

Stakeholders from the following diverse groups were chosen by the researchers to avoid overlap of the Groups A-D in representation (Garabed *et al*., 2009).

Breeder (n=2), Owner (n=2), Veterinarians, from general practice, (n=3), Sales (n=1), Farrier (n=1), Transport (n=1), Trainer (n=1), Government (Queensland Racing) (n=1), Retraining/Show horse (n=1).

The facilitator initially described Welfare Indices and their application in animal industries, then the stakeholder representatives discussed the following key husbandry issues: breeding, weaning, transport, racing, training, horsemanship, horse use post- racing, and nutrition, stabling, health, disease, sales, environment, heat, humidity, ventilation, whips and racing gear. The results were recorded electronically on a white board, grouping issues as follows: fourteen key issues, each representing an important welfare characteristic, were identified. Up to four different possible husbandry levels for each issue were also identified. The first of the levels represented the ideal husbandry situation for Thoroughbred racehorse welfare down to the least desirable husbandry option. The fourteen issues and levels, emerging from this discussion, were pivotal in the development of a broader stakeholder survey, which aimed to 'determine opinions of Welfare Requirements for Thoroughbred Racehorses', thus ensuring comprehension and workability of the process (Powell, 2003).

### *3.2.2 Creation of the Issues and assigned levels*

The fourteen key husbandry issues, and the relevant levels identified at the stakeholders' meeting, and selected for the online survey were: horsemanship, weaning, stabling, environment, heat and humidity, ventilation, transport, wastage, gear, track design and surface, health and disease, education of the horse, whips, and nutrition. The three to four levels of husbandry in order of declining importance were determined (Table 3.1). These issues are chosen by the stakeholders. They are examples and are not meant to be all embracing. We realise this could have been worded better and thank you for pointing it out.

**Table 3.1 Issues, levels and their utility values from the thoroughbred racehorse-husbandry questionnaire**

| Issues | | Levels | Utility Values* |
|---|---|---|---|
| Horsemanship | 1 | All staff are experienced and well trained, employing knowledge of equine behaviour in management and training. | 62.29 |
| | 2 | 50% of staff are experienced and well trained and sometimes employ knowledge of equine behaviour in management and training. | -3.89 |
| | 3 | None of the staff are experienced or well trained, and do not employ knowledge of equine behaviour in management and training. | -58.40 |
| Health and disease | 1 | Regular attention to health. Appropriate use of analgesics, tranquilizers, and parasitic control. | 62.35 |
| | 2 | Some attention to health. Occasional use of analgesics, tranquilizers and parasitic control medication. | -14.68 |
| | 3 | Infrequent attention to health. Analgesics, tranquilizers and parasitic control medication used only when absolutely necessary. | -47.66 |
| Education of horse | 1 | Regular training from birth, through weaning, sales preparation and transporting, riding, track work, barrier habituation and racing. | 52.80 |
| | 2 | Some handling as a foal, through to weaning, sales preparation and transportation, riding, track work, barrier habituation, and racing. | 7.38 |
| | 3 | No handling as a foal or weanling. Little preparation for sales and transporting. Riding and track work rushed with no habituation to the barrier. | -60.18 |
| Track design | 1 | Gradual turning cambered turf track. | 51.01 |

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| and Surface | 2 | Gradual turning cambered synthetic track. | 27.03 |
| | 3 | Tight turning cambered turf track. | -33.12 |
| | 4 | Tight turning cambered synthetic track. | -44.91 |
| Ventilation | 1 | Good ventilation; fans in every stable; good ventilation in transport. | 48.72 |
| | 2 | Some ventilation; fans at the end of stable corridors; some ventilation in transport. | 6.12 |
| | 3 | Poor ventilation; stable walls of solid construction to 110cm with wire mesh above; inadequate ventilation in transport. | -54.84 |
| Stabling | 1 | Large 5m x 5m x 6m stable with free use of attached yard. | 37.72 |
| | 2 | Stable 3.6m x 3.6m x 4m with free use of attached yard. | 14.26 |
| | 3 | Stable 5m x 5m x 6m with no use of attached yard. | -8.39 |
| | 4 | Stable 3.6m x 3.6m x 4m with no use of attached yard. | -43.59 |
| Weaning | 1 | Two weanlings isolated together in a stable which allows visual and physical contact with neighbouring horses. | 26.65 |
| | 2 | Removal of one mare at a time from a group of mares and foals in a large paddock, until all mares are removed from the group. | 24.29 |
| | 3 | One weanling in a stable which does not allow visual or physical contact with neighbouring horses. | -50.94 |
| Transport | 1 | Skilled driver, experienced staff for loading and off-loading horses. | 51.43 |
| | 2 | Semi-skilled driver, experienced staff for loading and off-loading horses. | -7.98 |
| | 3 | Staff with limited experience in driving, loading and | -43.45 |

| | | | |
|---|---|---|---|
| | | off-loading horses. | |
| Nutrition | 1 | Attention to age and training requirements of individual horse in order to balance fibre / grain intake, with proven supplement requirements, and access to additional green forage. | 47.81 |
| | 2 | Attention to age and training requirements of individual horse in order to balance fibre / grain intake with proven supplement requirements, infrequent access to additional green forage. | 0.85 |
| | 3 | Standard nutritional program for all horses regardless of racing program, no additional green forage. | -48.66 |
| Wastage | 1 | Horse retired for equestrian sports. | 30.44 |
| | 2 | Horse retired from racing to a breeding farm. | 22.85 |
| | 3 | Horse given away as race record was insufficient for breeding or temperament unsuitable for retraining in equestrian sports. | -16.37 |
| | 4 | Horse sent to a slaughterhouse, unsuitable for further use. | -36.92 |
| Heat and humidity | 1 | Horses rarely exposed to climatic variation; some acclimatisation following transport; stable design allows for good temperature control. | 31.25 |
| | 2 | Horses sometimes exposed to climatic variation; some acclimatisation following transport; stable design allows for some temperature control. | 12.37 |
| | 3 | Horses regularly exposed to climatic variations; inadequate acclimatisation following transport; poor stable design for temperature control. | -43.63 |
| Whips | 1 | Whipping the horse occasionally throughout the race. | 23.71 |
| | 2 | No use of whip, jockeys ride with hands and heels. | 10.91 |
| | 3 | Whipping a tired horse regularly in the last 100 metres | -34.61 |

| | | | |
|---|---|---|---|
| | | of the race. | |
| Environment | 1 | Use of wood shavings. Stable / yard design allows only visual contact with other horses. | 3.44 |
| | 2 | Use of wood shavings. Stable / yard design allows physical and visual contact with other horses. | 0.10 |
| | 3 | Use of straw bedding. Stable / yard design allows physical and visual contact with other horses. | -1.45 |
| | 4 | Use of straw bedding. Stable / yard design allows only visual contact with other horses. | -2.09 |
| Gear | 1 | No blinkers or tongue tie. | 14.74 |
| | 2 | Use of blinkers, but no tongue tie. | 1.57 |
| | 3 | Use of tongue tie and blinkers. | -7.55 |
| | 4 | Use of tongue tie but no blinkers | -8.76 |

*Positive Utility values represent levels indicating a high rating and negative ones represent a low rating.

### *3.2.3 The on-line survey, "Determining Opinions of Welfare Requirements for Thoroughbred Racehorses"*

In February, 2011, an on–line survey of questions in vignette format (Barter and Renold, 2000; Wilks, 2004) for each of the fourteen issues, and levels within the issues, was sent to 1773 stakeholders in Australia. Selection of stakeholders was not random but based on their having prior knowledge and awareness of the subject. A link to the survey was sent by e-mail to stakeholders in the following 9 groups: 315 breeders, 793 trainers, 26 owners, 135 veterinarians, 37 transporters, 119 farriers, 93 sales, 245 racing administrators and 10 TBR (Thoroughbred Racehorse) re-trainers. The participants' addresses were sourced from Racing journals, web sites, Thoroughbred sale catalogues, Racing magazines, Thoroughbred Stud Farm breed catalogues and telephone books. The e-mail addresses of owners were not available using these resources and were obtained by approaching owners on race days and asking if they would participate in the on-line survey and provide an e-mail address.

The first page of the survey introduced the questionnaire, which was accompanied by a consent form, together with a brief explanation of the research project and instructions on how to complete the survey, as well as the approximate time it would take to complete it. Participants were advised of their right to withdraw at any time and who to contact if necessary as well as an opportunity to comment on the survey. They were also advised that the survey had been approved by the Human Ethics Committee of the University of Queensland, project number 2011000067.

The survey was created using an adaptive conjoint analysis programme (Sawtooth Software, Evanston, IL, USA). This statistical method is capable of analysing stakeholder preference by allowing several factors to be considered jointly, rather than in isolation (assuming that complex decisions are not based on a single factor (Johnson 1974). The method also determines which combination of such issues is influential in determining the respondent's choice. The survey consisted of the four following sections, with the last three forming the adaptive conjoint analysis (ACA) system (Orme, 2002).

**Section 1.** Demographics. Information was collected on the respondent's gender, age, and they were then asked to indicate the highest level of education they had achieved: Primary school, High school, University, Tafe or some other form of education. Respondents were asked to advise in what capacity they were involved with Thoroughbred racehorses, either as a Breeder, Farrier, Owner, Practicing Veterinarian, Retrainer of Thoroughbred racehorses for other purposes, Transporter, Trainer, Racing administration, or Sales. Respondents were also asked the total time of involvement with Thoroughbred racehorses, either 1-6 months, 7-12 months, 13-48 months or over 48 months. The final demographic question asked the respondents to nominate the country where this experience was gained; Australia, United Kingdom, Japan, France Ireland, U.S.A., Germany or Other.

**Section *2.*** Respondents ranked the issues in order of importance for Thoroughbred racehorses' wellbeing '1' being the most important and '14' being the least important. According to the software designers, 'it gives the paired

comparisons a much better starting point' (Brian McEwan, 2011, personal communication).

**Section 3a.** Asked respondents: 'If two Thoroughbred racehorse training establishments were acceptable in all other ways, how important would this difference be to you?' The respondent rated each Level of the Issues in terms of importance of the difference using a five point scale. The Conjoint analytical process places a certain value on each of these levels. **(**Orme 2002).

**Section 3b.** Respondents were asked 'to rate the following training requirements for Thoroughbred racehorses in terms of acceptability'. The respondent rated each level of each Issue in terms of acceptability using a five point scale.

**Section 4.** Importance of Levels. This section used conjoint analysis to present the respondent with a series of paired-comparisons. The relative importance of each Issue was determined from paired comparisons based on the learned preferences for the Levels within each Issue of the previous section (King *et al* 2005). Each question comprised two vignettes (Barter and Renold, 2000; Delago-Rodriguez and Llorca, 2004) each with two different Levels of the same two Issues and the respondent was asked for the strength of their preference for one or other vignette. Using a 9-point scale, respondents were asked 'if two Thoroughbred racehorse establishments are identical in all other ways, which is better for the Thoroughbred racehorses' wellbeing?'

The Levels of some Issues were considered to be incompatible with other Levels of different Issues and consequently 6 Levels of selected Issues were prohibited from appearing with certain other Levels of the Issues in the survey to avoid conflicts of opinion in the discriminant process. An example is: In the issue 'Weaning': the Level ' Removal of one mare at a time from a group of mares and foals in a large paddock, until all mares are removed from the group' was prohibited from appearing with the level 'tight turning cambered track' of the Issue 'Track design', as the two are incompatible. Weaning is concerned with TBRs whose average age is five months. At this age they are extremely immature and are not ridden. Track work and surface is experienced by TBRs once they are ridden and commence their first training

preparation usually at about twenty to twenty four months. Please see page 54. Table 3.5.

### 3.3 Pilot study

Using the survey, as constructed in Sawtooth, individual consultation of the pilot study was under taken by the researcher with 10 Thoroughbred racing industry stakeholders in February, 2011. The pilot study stakeholders were each personally interviewed and their comments noted. Where necessary, changes were made and the pilot study was then presented to stakeholders who had not attended the inaugural meeting or been interviewed for the first pilot study. No further changes were made.

### 3.4 Statistical analysis

ACA/Hierarchical Bayes software (Sawtooth Software) was used to estimate final individual Level Importance Values using Bayes algorithm, i.e. those issues which rate highly are indicated by a positive Level Importance Value, and those issues with a low rating have a negative value. A measure of how much difference each issue makes in the total score for each respondent is the Importance Value. An Issue with an Importance Value of 10% is twice as important as another issue with a value of 5%, i.e. ratio data. Those levels which respondents rated highly were indicated by a positive value and those with a low rating receive a negative value. Thus the Issue Importance values together with the Level Importance Values were obtained from the Sawtooth Software.

General linear models were tested for the effect of demographics (age, gender, level of education, stakeholder group, experience, and country where experience was gained) on the Issue Importance Values, but the residuals were not normally distributed. Attempts to manipulate the data mathematically still did not produce normally distributed residuals. Thus Moods median nonparametric statistics, as recommended by Siegel and Castellan (1988) were used to extract the median values and the probability that differences between them were significant. Siegel & Castellan (1988) suggested that there is ‘no alternative to the median test when one or more observations are off the scale’.

**Table 3.2 Number of stakeholder responses**

| Stakeholder | Total Sent | Total Responded | % Stakeholder response | % Proportion of overall respondents |
|---|---|---|---|---|
| Breeders | 315 | 48 | 15 | 21 |
| Trainers | 793 | 56 | 7 | 25 |
| Owners | 26 | 25 | 96 | 11 |
| Veterinarians | 135 | 38 | 28 | 17 |
| Transporters | 37 | 4 | 11 | 2 |
| Farriers | 119 | 8 | 7 | 4 |
| Sales | 93 | 15 | 16 | 7 |
| Racing Admin | 245 | 21 | 9 | 9 |
| TBR Retrainers | 10 | 9 | 90 | 4 |
| **TOTAL** | **1773** | **224** | **12.6%** | **100%** |

The demographic results for the question relating to the respondents length of practical experience indicated a need to collapse the first two categories of 1-6 months (2 respondents) and 7-12months (2 respondents) into one category as there were less than 6 respondents in the two categories. Consequently a median reanalysis resulted in three categories for experience:

1-12 months
13-48 months
48 months and over

The survey yielded 224 completed and 179 incomplete responses, the latter were discarded. Overall response rate was therefore 23% and completed response rate was 13%. The highest response rate was from the trainers (25%) and the lowest response rate from the transporters (2%) (Table 3.2).

## 3.5 Results

**Table 3.3 Respondents demographic characteristics (n=224)**

| Demographic | No of Respondents (%) |
|---|---|
| Gender | |
| Male | 126 (56.3) |
| Female | 98 (43.8) |
| | |
| Age Years | |
| Under 19 years | 0 (0.0) |
| 19-24 | 3 (1.3) |
| 25-30 | 16 (7.1) |
| 31-40 | 37 (16.5) |
| 41-50 | 64 (28.6) |
| 51-60 | 60 (26.8) |
| 61+ | 44 (19.6) |
| | |
| Highest level of education achieved | |
| Primary School | 5 (2.2) |
| High School | 51 (22.8) |
| Technical and further education college | 56 (25) |
| University | 105 (46.9) |
| Other | 7 (3.1) |
| | |
| Primary involvement with Thoroughbred racehorses | |
| Breeder | 48 (21) |
| Farrier | 8 (4) |
| Owner | 25 (11) |
| Practising veterinarian | 38 (17) |
| Retainer/Show horse/other suitable use | 9 (4) |
| Transporter | 4 (2) |
| Trainer | 56 (25) |
| Racing administration | 21 (9) |
| Sales | 15 (7) |

| Amount of practical experience with Thoroughbred Racehorses | |
|---|---|
| 1 - 12 months | 8 (4) |
| 13-48 | 12 (5) |
| over 48 | 204 (91) |
| | |
| Country in which experience was gained | |
| Australia | 219 (97.77) |
| United Kingdom | 2 (0.89) |
| Japan | 0 |
| France | 0 |
| Ireland | 0 |
| USA | 0 |
| Germany | 0 |

The majority of respondents were male (57%) and were mostly aged between 41-60 years. When asked to indicate the highest level of education achieved, 47% indicated they had a University degree, 28% had completed Primary school, or High School and 25% had graduated from Technical and Further Education (TAFE) (Appendix 2, p187). Though research indicates bias exists (de Vaus 2002) among internet access, users of the internet decline with age, type of occupation and level of qualification which could explain a possible bias existing in the response to the completion of the survey. However there is a further possibility of bias occurring with trainers who believe their yard may have a higher standard of welfare practices being more inclined to fill out the survey.

The respondents with the greatest primary involvement with Thoroughbred racehorses were the trainers (25%) and those with the least involvement were transporters (2%) (Appendix 1, p186).

Most respondents had practical experience with Thoroughbred racehorses of more than 48 months (Table 3.2) while only 2% had the least experience of less than 6 months. For most respondents this experience was gained in Australia (98%) and

1% of respondents gained their experience in the United Kingdom or in another country (Appendix 3, p188).

### *3.5.1 Issue importance values: Ranking of Importance Values*

The median Importance Value for each of the 14 issues ranged from 2.80 to 8.80 (Table 3.5). The issues ranked in order of the most to least important were: horsemanship[a] > health and disease[ab] = education of horse[ab] >ventilation[b]> track design and surface[c] = stabling[c] = weaning[c] = transport[c] = nutrition[c] > wastage[cd] = heat and humidity[cd] > whips[de] = environment[de] > gear[f].

**Table 3.4 Median values and Wilcoxon sign ranked 95% Confidence Intervals for the 14 issues, as assessed by respondents (n = 224)**

| Welfare Issue | Estimated Median | Confidence Interval | |
|---|---|---|---|
| | | Lower | Upper |
| Horsemanship | 8.800 | 8.600 | 9.050 |
| Health and disease | 8.500 | 8.250 | 8.750 |
| Education of horse | 8.500 | 8.250 | 8.750 |
| Track design and Surface | 7.600 | 7.350 | 7.900 |
| Ventilation | 8.000 | 7.750 | 8.250 |
| Stabling | 7.350 | 7.050 | 7.60 |
| Weaning | 7.550 | 7.300 | 7.800 |
| Transport | 7.250 | 6.950 | 7.500 |
| Nutrition | 7.450 | 7.150 | 7.700 |
| Wastage | 7.150 | 6.800 | 7.450 |
| Heat and humidity | 6.850 | 6.600 | 7.100 |
| Whips | 6.550 | 6.200 | 6.900 |
| Environment | 6.000 | 5.600 | 6.350 |
| Gear | 2.800 | 2.450 | 3.050 |

* N = Number

**TABLE 3.5 Median importance values of each issue for each stakeholder group and the significance of differences between stakeholder groups**

| Issues | Breeder | Farrier | Owner | Practising Veterinarian | Retraining Racehorses | Transporter | Trainer | Racing Administration | Sales | Probability |
|---|---|---|---|---|---|---|---|---|---|---|
| Horsemanship | 9.00 | 8.50 | 8.60 | 8.90 | 8.70 | 11.05 | 8.50 | 8.90 | 9.10 | 0.680 |
| Health and Disease | 8.45 | 7.25 | 8.20 | 8.80 | 8.60 | 8.05 | 8.45 | 8.70 | 8.90 | 0.760 |
| Education of horse | 8.30 | 8.65 | 7.90 | 8.40 | 8.80 | 10.55 | 8.50 | 8.20 | 8.70 | 0.712 |
| Track Design and Surface | 7.40 | 9.30 | 7.40 | 7.20 | 7.40 | 6.00 | 7.90 | 7.50 | 7.40 | 0.641 |
| Ventilation | 8.05 | 8.70 | 7.10 | 8.10 | 8.70 | 6.95 | 8.45 | 7.40 | 7.60 | 0.138 |
| Stabling | 7.40 | 7.00 | 7.50 | 7.20 | 9.20 | 6.80 | 7.70 | 7.20 | 5.60 | 0.553 |
| Weaning | 7.95 | 7.20 | 7.50 | 7.70 | 6.70 | 7.90 | 8.00 | 7.80 | 7.00 | 0.024 |
| Transport | 7.30 | 7.20 | 7.10 | 7.40 | 6.00 | 9.20 | 6.70 | 7.10 | 6.50 | 0.278 |
| Nutrition | 7.80 | 5.90 | 7.90 | 6.50 | 6.40 | 9.10 | 8.00 | 7.10 | 8.10 | 0.014 |
| Wastage | 7.40 | 7.50 | 7.00 | 6.55 | 6.70 | 7.00 | 8.00 | 7.20 | 7.40 | 0.289 |
| Heat and Humidity | 6.70 | 5.80 | 6.90 | 7.45 | 6.60 | 7.85 | 6.80 | 6.80 | 6.10 | 0.554 |
| Whips | 6.50 | 7.60 | 7.10 | 6.50 | 7.90 | 6.30 | 6.80 | 6.80 | 7.70 | 0.231 |
| Environment | 6.50 | 6.55 | 6.00 | 5.75 | 5.90 | 5.50 | 5.80 | 7.00 | 6.40 | 0.849 |
| Gear | 0.25 | 0.65 | 2.50 | 1.20 | 5.60 | 3.10 | 1.50 | 0.30 | 0.00 | 0.791 |

### *3.5.2 Effects of Demographics and Importance Values*

**Table 3.6 The effects of stakeholder gender on the median importance values for each issue**

| Welfare Issue | Male | Female | Probability |
|---|---|---|---|
| Horsemanship | 8.80 | 8.90 | 0.788 |
| Health and Disease | 8.45 | 8.60 | 0.699 |
| Education of Horse | 8.80 | 8.25 | 0.178 |
| Track design and Surface | 7.75 | 7.20 | 0.077 |
| Ventilation | 8.00 | 7.90 | 0.625 |
| Stabling | 7.10 | 7.50 | 0.189 |
| Weaning | 7.50 | 7.50 | 0.973 |
| Transport | 7.20 | 7.10 | 0.567 |
| Nutrition | 7.10 | 7.85 | 0.007 |
| Wastage | 7.20 | 7.20 | 0.933 |
| Heat and Humidity | 6.95 | 6.80 | 0.762 |
| Whips | 6.65 | 7.00 | 0.439 |
| Environment | 6.35 | 6.25 | 0.880 |
| Gear | 1.20 | 1.40 | 0.511 |

**Table 3.7 The effects of stakeholder age on the median importance values for each issue**

| Welfare issue | 19-24 | 25-30 | 31-40 | 41-50 | 51-60 | 61+ | Probability |
|---|---|---|---|---|---|---|---|
| Horsemanship | 7.10 | 8.20 | 9.20 | 9.10 | 8.60 | 8.70 | 0.241 |
| Health and Disease | 5.90* | 9.70 | 9.10 | 8.40 | 8.20 | 8.15 | 0.028 |
| Education of Horse | 6.30 | 9.10 | 9.00 | 8.65 | 8.40 | 8.25 | 0.404 |
| Track design and Surface | 6.80 | 7.15 | 7.70 | 7.35 | 7.70 | 7.40 | 0.285 |
| Ventilation | 7.10 | 7.75 | 8.50 | 7.95 | 7.95 | 7.80 | 0.195 |
| Stabling | 7.20 | 7.00 | 8.10 | 7.20 | 7.50 | 7.00 | 0.513 |
| Weaning | 7.10 | 7.60 | 7.60 | 7.10 | 8.05 | 7.40 | 0.468 |
| Transport | 5.70 | 6.85 | 7.70 | 7.15 | 7.10 | 6.95 | 0.548 |
| Nutrition | 7.70 | 7.10 | 7.90 | 7.10 | 7.40 | 7.70 | 0.364 |
| Wastage | 7.20 | 7.20 | 7.10 | 7.30 | 7.30 | 7.20 | 0.909 |
| Heat and Humidity | 5.80 | 6.85 | 7.10 | 6.80 | 6.80 | 6.90 | 0.782 |
| Whips | 7.00 | 6.80 | 5.90 | 7.05 | 6.10 | 7.65 | 0.183 |
| Environment | 7.10 | 6.35 | 5.10 | 6.40 | 6.10 | 6.50 | 0.208 |
| Gear | 7.10 | 1.35 | 0.00 | 2.30 | 2.40 | 3.30 | 0.090 |

Respondents with least experience rated the TBRs' environment as highest LIV and transport was rated highest by those with most experience. The importance of nutrition increased with experience (Appendix 1, p186).

There were no significant effects of stakeholder group on Issue Importance levels except for weaning, which was rated most important by trainers (8.0), then transporters (7.9), racing administrators (7.8) etc. up to retraining racehorses (7.2)(P = 0.02). Gender only

influenced the IIV for nutrition, which was rated more important (7.9) by females than males (7.1)(P = 0.007). Respondent age only influenced the IIV rating of health and disease, which generally declined with age, from 9.70 for 19-30 year old respondents to 8.15 for 61+ (P = 0.028).

### 3.6 Discussion

This study was undertaken to establish a uniform ranking system of the issues important for the husbandry and welfare of the Thoroughbred racehorse. Previously no studies existed that were capable of assigning such a weighting or ranking system. Therefore it is impossible to support the rankings of this study with the literature.

General linear models were tested for the effect of demographics on the Importance Values for each issue. The test revealed the residuals were not normally distributed; attempts to manipulate the data mathematically still did not produce normally distributed residuals so non-parametric statistics were used employing probability and median values. This could be a reason why few significant differences (2) occurred. When the probability is less than 0.05 then it is significant.

No correction method was used to correct for the problem of multiple comparisons. The Bonfferoni Method is the most basic simple interactive statistical analysis procedure to use for multiple comparisons but problems arise if more than one test in a particular study is undertaken. That increases the risk of a type one error of incorrectly declaring a difference. The alpha level is usually set at 0.05 meaning there is a one in twenty chance of statistical tests to show ‘something’, when there is ‘nothing’ (Perneger, 1998). As more statistical tests are undertaken the chance of finding one test statistically significant, due to chance fluctuation, increases. Thus there is a need to adjust the alpha level downwards to maintain the value for statistical significance at 0.05. Unfortunately, when the risk of making a type one error is reduced, the chance of making a type two error increases.

Expert opinion contributed to the development of the survey being sent to a wide variety of stakeholders in the Thoroughbred racing industry. The wide variety of Stakeholders involved in this study was considered necessary because of the variance of their views, due to their diverse backgrounds and professions, on issues which are important for the welfare of the Thoroughbred racehorse. Owners had the highest response rate at 96%,

with the Retrainers of Thoroughbred race horses next with 90% and Veterinarians (28%) were the third highest responders, Sales responded at the rate of 16%, closely followed by the Breeders at 15% followed by Racing administration at the rate of 9%. The response from Trainers and Farriers was the same, at 7%. The high response rate from owners is probably due to being individually approached by the researcher for their email addresses, which are not available on the internet, nor do owners have a web page, and owners' addresses are not available from Race Clubs of Thoroughbred racehorses or in Racing Journals, Thoroughbred sales catalogues, Racing magazines, Thoroughbred Stud Farm breed catalogues or telephone books, so the researcher approached individual owners and after informing them about the study asked if they would supply their email address. Most owners complied with this request and were forthcoming with their on-line addresses, and promptly completed the survey.

The next highest response came from the TBR Retrainers, who undertake the task of retraining racehorses when they have finished racing. TBRs are then re-homed to suitable people for use in: equestrian sports, polo, trail riding, showing, or as companion animals. The high response rate indicates the perceived importance TBR Retrainers place on reducing wastage of Thoroughbred racehorses within the Racing industry.

Significant differences occurred in the Issues Nutrition and Weaning. Nutrition was ranked by the Transporters as second highest to their own industry, but was the highest in the stakeholder ranking. As previously observed, involvement in a particular industry or profession tends to be rated as most important by those involved (Pines *et al.,* 2007; Phillips, 2009). However this was not the case in this instance, as Transporters are not involved in feeding and nutritional programs of Thoroughbred racehorses, this is the domain of the Trainers. Weaning showed a significant difference with Trainers rating it the highest, but interestingly the Transporters rated it second in importance while the Retrainers of Thoroughbred racehorses rated weaning as the least important issue. As TBR Retrainers are mostly involved with older horses it is surprising they are not more aware of the effect of weaning on the development of stereotypic behaviours. Conversely they may not have had experience with TBRs exhibiting stereotypic behaviours as those TBRs may have been culled at an earlier age, as they are often not deemed worthy of retraining. The uniformity of results within the Industry is a high indication of cohesiveness within the Thoroughbred Racing industry.

A Welfare Index logically emerges from the survey, together with a range of other communication methods. The results of the survey 'Determining Opinions of Welfare Requirements For Thoroughbred Racehorses' produced statistical data from which Utility Values and Importance Values can be used in the following equation to produce a Welfare Index for Thoroughbred racehorses.

$$TRWI = \sum_{i=1}^{14} \left( \frac{UV_i - Min_i}{Max_i - Min_i} \right) \frac{IS_i}{100}$$

Where:

$UV_1$ = Individual Utility Value

$Min_1$ = Minimum Utility Value

$Max_1$ = Maximum Utility Value

$IS_1$ = Issue Importance Score

This equation was used by Fernie in 'The Creation and Implementation of A Great Ape Welfare Index' (2008) and also by Gurusamy in 'Assessment of the Welfare of Captive Asian Elephants (Elephas maximus)' (2012).

The stakeholders in the Thoroughbred racehorse Welfare survey ranked the issues consistently throughout, individual differences occurred with age where those people in the 41-50 age group rated horsemanship the highest and those in the youngest group, 19-24 rated this Issue as the least important. Females rated horsemanship as the most important issue while males rated gear the least important.

Mostly there was a consensus throughout the study except for the significant difference occurring in the Nutrition and Weaning Issues. Agreement with the Scientific Literature occurred for all Issues except in the case of Nutrition and Weaning.

## 3.7 Implications for equine welfare

The Welfare Index for Thoroughbred Racehorses will provide effective monitoring of Thoroughbred Racehorse welfare as it is able to identify differences in the main Welfare Issues. The index for Thoroughbred racehorses will assist those countries who are developing their racing industries by providing a template of training preferences and guidelines. This index will also assist Race committees in the development of facilities of existing and new racing complexes. A welfare index will improve the public's perception of the racing industry and encourage public involvement.

## 3.8 Validation of Issue Rankings from the Thoroughbred Racehorse Welfare Index with the Scientific Literature

### *3.8.1 Introduction*

Thoroughbred racehorses are subjected to a variety of management and housing practices throughout Australia. Evaluating the importance of various issues as well as the differences employed in management and housing should improve both the knowledge and welfare of the Thoroughbred racehorse. Most studies of animal welfare regard social structure as an important element of the species in defining relationships between individuals through competition, cooperation, dominance, social units, care of off spring and use of resources (Wilson, 2000). Yet this important issue was not raised at the Stakeholders meeting when the issues for the development of a Thoroughbred Racehorse Welfare Survey were determined. Therefore a short over view of this issue is repeated with specific reference to validating the results of the Thoroughbred Racehorse Welfare Survey (TBRWS).

The following 14 issues, identified at the stakeholder meeting, will be discussed as to their perceived importance for welfare. Validation of the rankings of these issues, from the Thoroughbred racehorse welfare index with the scientific literature will also be undertaken.

### *3.8.2 Social Structure*

The horse is a prey animal whose choice of social living is a means of self - preservation together with speed and agility (Levine, 2002; McGreevy, 2004). Their many behavioural patterns are predictable, and are directly linked to their survival. Konrad Lorenz (1955) stated 'the comparative method to which we owe all or most of our knowledge concerning the evolutionary history of living creatures is just as applicable to these behaviour patterns

as to any organs.' Thus an appropriate social structure exists in all mammalian species in order to meet social, reproductive and psychological needs (Price and Stoinski, 2007).

The feral or free ranging horse is a highly social animal who forms 'bands' or social units, consisting of 1-3 mares on average, together with their offspring, plus an adult harem stallion (Tyler, 1972; Dawson, 2005; Csurhes *et al.,* 2009; Ransom & Cade, 2009) Sometimes these bands may grow to 20 or so animals (Gill ,1988). Group size varies and could be a response to the environment as well as population density Ransom and Cade (2009). Lone or small bachelor groups account for the remaining males in a population, and occasionally solitary aged females may be sighted. The basic composition and organization of a primary group rarely changes (Tyler, 1972; Houpt & Keiper, 1982; Boyd, 1991; Czurhes *et al.,* 2009). The group remains in their daily activities with only occasionally losses or additions throughout the year.

Ethological organization within feral horse bands is a dominance hierarchy where adult males, as a rule, rank at the top of feral groups, but the literature has 'conflicting functional explanations for hierarchical structures' (Ransom & Cade 2009). Feist & McCullough (1975), Tyler (1972), believe that in undisturbed feral populations the alpha leader is always a stallion. However when humans regulate the number of stallions in a population the alpha leader is always a mare (Houpt & Keiper, 1982; McCort, 1984; Keiper & Sambraus, 1986; Klimov, 1988; Keiper & Receveur, 1992). Keiper and Receveur (1992) believe this is due to mares being in close proximity to one another and forming 'strong hierarchical relationships' thus reducing male dominance.

Houpt *et al*., (1978) found the alpha individual is generally large, but not one of the older members, while research by and Keiper and Sambraus (1986) Rho *et al.,* (2004) found that age is linearly correlated with social rank as are other factors such as size, aggressiveness, and the length of residence within a group. Such animals usually display a certain amount of aggressiveness and will repeatedly intimidate older and larger animals. Once a hierarchy is established the order remains unaltered. Foals benefit from the rank of their dams while at side, and even later, the offspring of high ranking mares tend to acquire a similar rank.

Stallions herd or drive the group when they wish to move them away from another stallion, at such times frequently displaying aggressive behaviour (Boyd, 1988). Equine researchers Houpt *et al*., (1978) Miller and Dennisto (1979) and Boyd (1991), Lehmann *et al*., (2003), considered dominance was determined by age, with the dominant mare leading the band to new pastures, water and shelter, while the stallion occupied a herding role (Waring, 1983; Ransom & Cade, 2009).

Herding behaviour is not the only reason for the stability of the group. Researchers have found the existence of strong social attachments is a major stabilizing factor among primary groups of feral horses. Such attachments are reinforced by mutual grooming, food sharing, rest and play (Boyd, 1988 & 1991). The social attachments common in primary social groups of feral horses commence at the family level. A mare's attachment to her foal begins at birth and the reciprocal attachment of the foal to its dam has generally begun within two hours of foaling, and known as bonding. Social play starts within the first month with other members of the group, (Boyd, 1988 &1991; Mills & Redgate, 2009).

Many juveniles form pair bonds (Waring, 1983; Crowell-Davis *et al*., 1987; McGreevy, 2004) while bonds formed between fillies can remain for life (Waring, 1983). Mares do not leave their group willingly with a strange stallion, while young fillies may be abducted from the group only when their stallion can no longer defend them, simply through being out numbered. There is also a readiness to reject outsiders (Tyler, 1972).

Dominance-submissive relationships can be expressed actively by overt antagonistic encounters where threats and withdrawal are visible. Usually a mild visual threat is all that occurs, aggression is not a common behaviour (McDonnell, 2003) and is usually expressed between young horses, but Fraser and Arave, (1992) believe 'free-ranging equine society functions on kinship, recognition and respecting another's space'.

The activities of horses are restricted to a specific range. When removed from this territory they show a tendency to return. Important requirements within a range are water, feed and shelter. Feral horses do not defend home ranges which may overlap with other bands in the population. Feeding or watering sites are frequently shared by two or more feral bands Ransom (2009).

When a Thoroughbred racehorse commences training as a racehorse it is subjected to management and husbandry methods developed for the convenience of humans, over many hundreds of years, with little thought for the welfare of the horse. Modern training methods are continually challenged to improve conditions both in training and in race procedures. Central to the issue of welfare is the high level of wastage within the industry.

Thoroughbred racehorse training requires horses to be accommodated in individual stables, (sometimes with a yard attached), which prevents the socializing (Cooper & Mason, 1998) and foraging behaviour of free ranging horses (Keiper and Sambraus, 1986). The time budget of stabled horses is dramatically different from that experienced in a free range state when horses move continually throughout a twenty four hour day over a large area in their quest for food, water and shelter (Houpt, 2005). Thus, apart from using a great deal of energy the free ranging horse is continually moving through a changing environment, and is confronted by new and changing situations, with which it has to cope. The boredom (Edgar, 2010) of being confined within a stable's four walls for hours, sometimes for more than 80% of the day, and sometimes for months on end, is bound to evoke an unfavourable response from an animal which is both active and inquisitive.

### *3.8.3 Horsemanship*

The importance of qualified staff was given the highest ranking by the stakeholders surveyed in the TRWS and is supported by a review of the literature. The FAWC 2007 have recognised high levels of stockmanship (horsemanship) as having the most important influence on the welfare of animals, and have recognised the 'Three Essentials of Stockmanship' as being as important to animal welfare as are the 'Five Freedoms'. The 'Three Essentials of Stockmanship' are:

a. Knowledge of animal husbandry. Knowledge of biology and husbandry of the species which includes knowledge of how their needs may best be met at all times.
b. Skills in animal husbandry: Ability to demonstrate skills in handling, care, treatment, observation, problems and detection.
c. Personal qualities: 'affinity and empathy with animals, dedication and patience' (FAWC, 2007).

The FAWC believes the 'Three Essentials of Stockmanship' should form the basis of all stockmanship training, education and motivation (FAWC, 2007).

The Rural Industries Research and Development Corporation (RIRDC) Horse Research program commenced in 1995 and the Horse Plan for 2006 to 2011 stated one of its 6 missions was to 'enhance the skills, knowledge and capability of people in the horse industry.' The RIRDC Horse Plan, 2006-2011, which so bravely stated the 6 missions, is no longer listed (RIRDC, 2006).

In 2000 the president of the Australian Horse Council sought to commission a large study to estimate the economic contribution of the horse industry. At that time the economic contribution from the Thoroughbred Racing Industry of $2.4 billion was the only available estimate' (RIRDC 2001). It was believed this did not include a substantial proportion of the horse industry. A decision was made to undertake a study of the Racing Industry by building a general equilibrium model of the industry and the usefulness of the resulting model. Included in the plan was the issue of Animal Welfare, with community concerns, over the health of animals involved in all aspects of the industry. The welfare of humans in the sport, was another issue, with occupational health and safety concerns, that needed to be addressed. 'The outcome of the study was that development of a general equilibrium model would be very data intensive and data was not currently available to support such a model (RIRDC. 2001)'. Thus the plan did not proceed.

Equine welfare can *be* improved by altering the traditional management practices of Thoroughbred racehorses by increasing foraging time and through the presentation of a variety of forages (McGreevy, 1996) and maintaining adequate gastrointestinal function (Sjaastad *et al.,* 2003; Aleman *et al*., 2013) which incorporates the evolutionary needs of the horse in every day management of the Thoroughbred racehorse (Kohnke *et al.,*1999; Colville and Bassert, 2002). Improvement of educational facilities for staff, focusing on racing industry requirements, enriching stabling environments and employing staff who have 'an affinity and empathy with animals, dedication and patience' (FAWC, 2007) are all ways to improve the welfare of the Thoroughbred racehorse. For instance the chief executive of the Australian Racing Board has stated a desire to alter the penalties for incorrect whip use if demanded by unfavourable circumstances (McGauran, 2015).

There are no residential programs training young people in necessary horsemanship skills in Australia that are comparative with the internationally recognised Irish and English Thoroughbred Stud Breeding Courses. Nor are there training and accreditation programs for transport drivers and transport grooms as exist in the United Kingdom, where several approved centres train candidates throughout the country. The Hong Kong Jockey Club, in Hong Kong, fully funds a residential training and accreditation scheme for young people in the skills of stable management, track work riding and race riding. Australia needs schools capable of improving horsemanship, which are able to overcome the lack of adequate knowledge of: equine biology, equine behaviour, equine welfare, experience in handling horses, knowledge of the racing industry and the requirements of working with Thoroughbred racehorses, communication skills when informing staff as to the care of the Thoroughbred racehorses, and an ability to cope with staff shortages, and frequent staff changes.

Racing Queensland recently offered a 'Racehorse Training and Management course which offers theoretical and practical knowledge and skills related to the operation of a Thoroughbred racehorse training business.' Similar courses are offered in NSW by TAFE and the National Centre for Equine education in Victoria. Mandatory training for stable hands in Victoria was introduced in 2011. Similar programs exist in Tasmania, South Australia and Western Australia. Racing Industry Training scheme in Western Australia trains people to be either: jockeys, track work riders, stable hands, equine dentists, farriers, or trainers. Occupational Health and Safety in Western Australia recently released a check list for Trainers to complete (Worksafe, 2013). The minimum requirement for horse boxes stated that 'boxes have enough room to allow a person to turn a horse and move around the horse safely' (Worksafe, 2013). The results from the survey 'Determining Opinions of Welfare Requirements for Thoroughbred Racehorses' found that 37.72 % of stakeholders preferred stables to be 5m x 5m with a ceiling height of 6m with free use of an attached yard, while the minimum sized stable 3.6m x 3.6 with a ceiling height of 4m with no use of an attached yard received the lowest score of -43.59.

### *3.8.4 Health and Disease*

The Stakeholders ranked this issue as second only to Horsemanship indicating the importance Health and Disease has for the Welfare of the Thoroughbred racehorse. Modern training methods of Thoroughbred racehorses frequently cause psychological and

physiological changes in response to alterations of the Thoroughbred racehorse's natural equilibrium (Sjaastad, *et al.,* 2003). Such changes often cause deterioration in health as well as a lowered immune system (Colville and Bassert., 2002). A lowered immune system exposes the equine to a wide range of infectious and parasitic diseases (McLean 1973). Horses that are transported either by road or air are especially prone to respiratory tract infections, including viruses, bacteria and mycoplasmas (Racklyeft and Love, 1990; Collins *et al.,* 1999; Waran *et al.,* 2007a; Van Erck-Westergren *et al.,* 2013). The literature stresses the ethical concerns regarding the care of racehorses while in training, highlighting the need for regular exercise, provision of companions and sufficient mental stimulation (Rollin, 2000) and that the tasks required of Thoroughbred racehorses (both physical and psychological) are within their natural range of capabilities (Casey 2007).
The areas of housing, exercise, feeding and usage differ from the social structure, behavioural ecology, and activity budgets of feral and free ranging horses. Those areas in intensive Thoroughbred racehorse management systems which trigger welfare problems are: performance-related clinical problems, intensive management (Dixon, 2010), stable design, nutrition, training methods and transportation (Racklyeft and Love, 1990; Collins *et al.,* 1999; Waran *et al*., 2007b; Van Erck-Westergren *et al.,* 2013). The ethical concerns regarding the care of Thoroughbred racehorses while in training must include the regular exercise of horses, the provision of companions and

> **Freedom from pain, injury, and disease:** by prevention or rapid diagnosis and treatment.
>
> **Freedom to express normal behaviour:** by providing sufficient space, proper facilities and company of the animal's own kind.
>
> **Freedom from fear and distress:** by ensuring conditions and treatment which avoid mental suffering.

Various methods employed in training the Thoroughbred racehorse frequently disturb the animal's natural equilibrium, triggering adverse physiological changes in response to adverse conditions, e.g. factors in the external environment such as cold, or heat, prolonged exercise or physical injury, or internal factors such as pain, and psychological pressure (Sjaastad *et al.*, 2003; Aleman *et al.,* 2013). These changes are due to a rise in the adrenaline hormones in preparation for the fight/flight response (Engel, 2003). Sympathetic nervous system effects include increased heart rate and output, increased blood pressure, alteration in blood profusion (more blood pumping through active skeletal

muscles and less through the abdominal organs), dilated air passages in the lungs and decreased gastrointestinal function (Colville and Bassert, 2002). All are indictors of stress.

Stress related abnormal behaviour is an indication of an animal attempting to cope with its environment (Fraser and Broom, 1990; Broom, 1991) and manifests as an anxious and distracted animal unable to concentrate on important activities such as feeding and self-preservation, yet animals in the wild are constantly subjected to varying amounts of stress. Goodall (1990) notes an ability to reduce stress levels using behavioural strategies to re-balance psychological homeostasis. Flight enables the horse to remove itself from the event or stimulus which is causing stress, but flight is denied the Thoroughbred racehorse due to various constraints applied by man.

Most strategies available to horses in the wild are denied the Thoroughbred racehorse due to various intensive management systems (Newby, 2015) which are rarely concerned with equine social structure, activity budgets and behavioural ecology. Such husbandry, the result of negative welfare, frequently results in compulsive obsessive behaviour (Bellisle *et al.*, 1998). Thus stress induced abnormal behaviour can be extremely dangerous to all concerned, especially at the direct and active interface between man and animal, when the horse is being ridden, a situation which can be life threatening to both horse and jockey (Blackshaw *et al.*, 1983; Press *et al.*, 1995)

### *3.8.5 Education of the Thoroughbred Racehorse*

Stakeholders responded to the issue of Educating the Horse in the TRWS (Thoroughbred Racehorse Welfare Survey) by ranking it as almost important as Health and Disease. Horses who are habituated to humans (Dawkins, 1980) from birth suffer less stress than those who are not habituated to humans. The correct use of foundation training (McLean and McLean, 2008) and learning theory applied consistently (McGreevy, 2004; Waran *et al.* 2007b; McLean and McLean 2008) in training Thoroughbred racehorses improves safety and welfare levels and provides a solid base for continued training in other equestrian pursuits (McLean & McLean, 2008).

Because horses are prey animals they will often flee from dangerous and painful situations, therefore early handling and training of the Thoroughbred foal through to adulthood is of optimum importance lest their avoidance of fearful situations develop into problem behaviour (Waran *et al.*, 2007b).

Once a horse has mastered how to learn, the learning of new tasks proceeds remarkably quickly. Not only cues but also responses have to be learnt. Thus the earlier a foal is handled, the better (Heird *et al.*, 1981; Blackshaw, 1986; Waran *et al* 2007b). Intermittent handling modifies a developing horse's behaviour gradually, thus habituation and 'desensitisation programs should use only the lowest thresholds of fear' in order to overcome the trauma of subsequent 'foundation training'.

Foundation Training is a term now used to replace 'breaking-in', which implies negative welfare implications (McLean and McLean, 2008). Foundation training is 'the layer installed in the earliest stages of training and provides the base for all further training and is the part that requires re-training when problems arise' (McLean and McLean, 2008).

Thoroughbred foals are handled frequently from birth and usually ridden at about 18 months. Some researchers believe early handling by competent staff could hold welfare benefits (Mills, 1998; Waran *et al.*, 2007b) as exposure to visual stimuli while relatively impressionable can be accepted as 'normal' (Dawkins 1980; McGreevy 2004; Cooper and Albentosa, 2005) and is irreversible and remains for life (Miller, 1998). Waran *et al.,* (2007b) states there are ‘welfare advantages for the foal that learns to tolerate rather than struggle’ which Miller (1998) believes ‘reduces defensive aggression’.

Foals reared in naturally complex environments are given the opportunity to develop their learning ability when young, especially when coupled with the plasticity of their behaviour which Waran *et al.,* (2007b) believes has the opportunity to develop behaviours ‘to suit human requirements’ a process which is denied those young horses who are ‘simply turned out to pasture’ (Waran *et al.,* 2007b).

McGreevy (2004) cautions about 'the best practice in the formative years of a horse's life,' instead of ‘muscling in on the mare/foal bonding process,’ focus should be on ‘offering opportunities for appropriate socialization’. McGreevy (2004) stresses the importance of sensitization (the opposite of habituation) in early training programs i.e. when foals are taught to move away from tactile stimuli. Sensitization is a precursor to negative reinforcement and as such ensures the foal will become ‘a safe and responsive working animal in later life’ McGreevy (2004).

Most Thoroughbred racehorse foals in Australia are born on Thoroughbred breeding farms of many hundreds of hectares which are situated on fertile land with abundant water, adequate shelter, and an equable climate. The social structure of the various groups of Thoroughbred mares closely resembles that of free ranging horses when the stallion is removed (2.3.2), thus maintaining the hierarchical order. The foal develops, under these conditions, in a low stress environment, in much the same way as does a feral foal: i.e. pair bonds are formed, play is experienced, and allo-grooming is perfected (Boyd, 1991; McDonnell, 2003; McGreevy, 2004; Houpt, 2005, 2011) Research has found that earlier experience by TBRs of the natural environment as foals, similar to that of the feral horse, may subsequently help the TBR to cope with " stressful situations or conditions"(Dodman *et al.,* 2005).

During these early months the foal may experience frequent episodes of habituation (by humans) through handling and road transport (with the mare, if she is to be covered by a stallion on another breeding farm, sometimes undertaking a journey of more than 24 hours) or to be treated at a veterinary clinic. All of this is extremely stressful both to mare and foal and can develop into compulsive obsessive behaviour (Heird *et al.*, 1981).

### *3.8.6 Track Design and Surface*

The high lameness rates (Boden, 2008) associated with poor track design and lack of surface care is a welfare concern (Mason and Bourke, 1973; Buckingham and Jeffcott, 1990; Larkin, 1995; Bailey, 1998a and 1998b) as is failure to prepare the Thoroughbred racehorse sufficiently for a specific race. Insufficient preparation can lead to sub-optimal performance and often breakdown of the Thoroughbred racehorse, increasing the risk of injury, exhaustion and in some cases death (Bailey, 1998a and 1998b; Evans, 2007).

Recovery time after a period of race training (Holmes *et al.,* 2014) is also an important welfare issue as insufficient rest can prevent bone remodelling, also the development of chronic fatigue (if not addressed) can develop if the horse is over raced (McDonnell, 2003; Evans ,2007). Over racing is known to cause adverse behavioural and physical responses which resting for several weeks does not correct. This syndrome (Hall *et al.,* 2008) is best detected by regular monitoring of body weight and attention to mood changes (Evans, 2007). Bone remodelling occurs during the first 10 weeks of a rest period that correlates with the length of time the Thoroughbred racehorse has been in training during any given preparation (Holmes *et al.,* 2014).

Most injuries to Thoroughbred racehorses are track related (Boden, 2008), with shin soreness being a major cause of lameness in young Thoroughbred racehorses in Australia (Mason and Bourke, 1973; Buckingham and Jeffcott, 1990; Moyer *et al.,* 1991; Larkin, 1995; Bailey ,1998a and 1998b; Boden, 2008). Shin soreness is a major welfare concern and is often responsible for Thoroughbred racehorse wastage (Mason and Bourke, 1973; Buckingham and Jeffcott, 1990; Larkin, 1995; Bailey, 1998a and 1998b; Evans, 2007).

Research undertaken into the wastage of horses within the Racing industry by The Australian Government has shown severe fractures leading to breakdown are the most common cause of wastage (Moyer *et al*., 1991; Bailey, 1998a and 1998b; Kohnke, 2005; RIRDC, 2006 ; Boden, 2008). Most race horses are trained on public race courses where records of training injuries are not maintained, and are less visible to the public than those sustained on race day (Jeffcott *et al*., 1982). Racing injuries sustained on race days are recorded by veterinarians employed by the race club. Evans (2007) states that the recording of training injuries is 'fundamental to the process of investigating the causes of the problem (and) is fundamental to any commitment undertaken to improve racetrack design, development and maintenance'.

Synthetic tracks are becoming more common especially in those areas affected by drought where water shortages affect the maintenance of the track (Kohnke, 2005). Very little is known about injuries sustained on synthetic tracks but research by Pickersgill *et al*.,(2000) noted 'results were suggestive of a protective effect of training horses on equitrack surfaces'. Research into synthetic tracks is urgently needed (Evans, 2007). The ranking of Track Design and Surface as being equally important for the well-being of the Thoroughbred racehorse with Stabling, Weaning, Transport and Nutrition (Table 3.5) is an indication of the stakeholders concern for the care and management of the Thoroughbred racehorse while in training, and underlines the need for improvement in Horsemanship standards.

### *3.8.7 Ventilation*

Not only do stables compromise both physical and visual contact but they frequently have poor circulation and air quality compounded by management practices which include the use of hay, straw, dusty feeds, bedding and ammonia concentrations (Clarke, 1987a). The respiratory system of the horse may also be affected by poor quality air (Clarke, 1987a;

McGorum *et al.,* 1998; Huffman, 2010), which could result in obstructive pulmonary disease (Lees and Higgins, 1985; Clarke, 1987a; Van Erck-Westergren *et al.,* 2013). Researchers have found that ventilation of stables can affect the amount of time a horse spends standing: 40% (Kiley-Worthington, 1987) and 47% of their time feeding, as opposed to the feral horse that spends an average of 20% of their time standing and 50-70% grazing (Duncan, 1985, Ransom and Cade, 2009). The restricted environment of stables interferes with the normal pattern of locomotion which is severely reduced. Huffman (2010) found adequate ventilation should be mandatory in all new stabling as well as the inclusion of ceiling fans. High levels of dust endotoxins can lead to respiratory disease (McGorum *et al*., 1998) whilst excessive air flow is believed to stimulate the sensitive nerves in the nose and can also be responsible for stereotypic behaviour such as head shaking (Mills *et al*., 2001).

### *3.8.8 Stabling*

The normal behaviour of the horse is dramatically altered when stabled; social grouping does not occur, exercise is limited, foraging does not occur, feed is concentrated, (requiring a short time to consume), time budgets altered so that boredom (Edgar, 2010) is a frequent outcome. Stereotypic behaviours are common place, believed by many to be coping mechanisms to environmental stressors (McGreevy et al., 1995; Cooper and Mason 1998; McGreevy and Nicol, 1998a; Waran and Henderson, 1998). However the scientific literature (3.8.9) identifies abrupt and often brutal weaning practices as the main cause of oral stereotypic behaviour, while locomotor stereotypic behaviour occurs most often when a horse is moved from the breeding farm to training stables. Such behaviour has been identified as a form ‘of frustrated escape response’ Kiley-Worthington (1987). The effects of isolation, confinement, altered time budget and concentrated feed all play a role in the development of stereotypic behaviour as the Thoroughbred racehorse attempts to cope with these stressors and as Winskill et al., (1995) states, stereotypic behaviour is not a vice but ‘rather an indication of improper management’.

There are many different housing systems used in Thoroughbred training establishments, from covered barns to loose boxes and open shelters (Clarke, 1987a; Sainsbury, 1987). Long lines of loose boxes are the most common type of stabling in Australia, but they are being superseded by large barns where horses are housed in loose boxes under one large roof (Bell, 2015). Thoroughbred racehorses have greater access to physical and visual contact with their conspecifics when housed in shelters than those animals housed in

loose-boxes, which may be completely enclosed on three sides, with the stable door the only opening (Cooper and Manson, 1998).Shelters are open on one or more sides and connected to a yard, or in some cases a grassed paddock. The latter is usually the case at Thoroughbred racehorse spelling (resting) establishments.

The restricted environment of stables severely reduces the normal pattern of locomotion. Houpt, (2005) found free-ranging or feral horses take up to 10,000 paces per day when grazing. Thus stabling of Thoroughbred racehorses who are fed a high grain ration, can cause many welfare problems (Section 2.5.2). Such welfare problems can be due to enforced immobility (sometimes stable confinement is as much as 90% of the day) often followed by intense physical activity, frequently resulting in the painful muscle syndrome Azoturia (exertional rhabdomyolysis) (McLean 1973; Harris *et al.,*1990; Macleay et al., 1999), the cause of damaged muscle fibres. The resultant isolation and boredom (Mal *et al.,* 1991; Jezierski, 1992; Edgar, 2010) of nothing to do is frequently a trigger for the commencement of stereotypic behaviour, i.e. behaviour which is unvarying, repetitive and pointless, manifested as locomotor stereotypic behaviour, such as box walking and/or weaving (Nicol, 1999a) or oral stereotypic behaviour that is, crib biting, wind sucking, wood chewing and licking, and standing inactive (Willard *et al.,* 1977; Kiley-Worthington, 1983 and 1987; Mason, 1991; McGreevy *et al.*, 1995; Mills and Nankervis, 1999; Cooper *et al.,* 2000; McDonnell, 2003; Cabib, 2006; Cooper and McGreevy, 2007; Tadich *et al.,* 2012), Various devices are frequently employed to prevent, but not cure, abnormal behaviour (McGreevy and Nicol, 1998 a & b; McBride and Cuddeford, 2001).

### *3.8.9 Weaning*

Research has shown weaning is extremely stressful for both mother and foal (Harris 1996) and is a trigger for poor welfare, with many neonate oral stereotypies commencing at this time. Research has also shown that gradual weaning of foals is less stressful than an ‘abrupt weaning event’.(Holland *et al.,* 1996; Nicol, 1999b; Waters et al., 2002). The survey ’Determining Opinions of Welfare Requirements for Thoroughbred Racehorses’ found stakeholders preferred ‘weaning to consist of two weanlings isolated together in a stable which allows visual and physical contact with neighbouring horses’. This method is time consuming in so far as the weanlings then have to be weaned from each other (Houpt *et al* .,1984). Also there is a tendency for one weanling to bully the other weanling, and sometimes inter sucking occurs.(Houpt *et al.,* 1984 ) However, findings of the Bristol

University four year study of foals weaned between 3 and 9 months found less incidence of oral stereotypic behaviour when ‘one mare is removed at a time from a group of mares and foals (in a paddock) over a period of weeks until all mares are removed from the group’. Studies by Houpt *et al*., (1984) and McCall *et al*.,(1985) support these findings.

The Trainers rated weaning as the most important issue, underlining the management problems they frequently encounter with Thoroughbred race horses’ stereotypic behaviour. Knowledge of equine behaviour, especially social structure, should alter weaning management by encouraging the less stressful weaning method. Dietary constituents at weaning may also have far reaching effects. McGreevy (1996) and Waters *et al.,* (2002) both found grain based dietary supplements fed, prior to weaning, developed stereotypic behaviours, supporting the relationship between diet and oral stereotypy in adult stabled horses, as documented by Holland *et al*., (1996), Johnson *et al*., (1998), and Nicol *et al*., (2001). These researchers also noticed a reduction in stress levels of weanlings when the immature digestive system of foals was not required to digest high energy/protein rations of the more traditional starch and sugar supplement. Research advocates a fat and fibre rich pasture supplement (Davidson and Harris, 2007). Not only does this diet lower the development of stereotypic behaviour but also prevents the development of gastrointestinal ulcers (Holland *et al.,* 1996; Nicol, 1999a and 1999b; Nicol *et al.,* 2001; Waters *et al.,* 2002; Davidson and Harris, 2007; Lester *et al.,* 2008).

The weanling is subjected to more intensive handling as it develops and is prepared for sale as a yearling. If harsh methods are used and /or the yearling becomes confused the handling becomes a welfare trigger. When learning to lead (the stop and go responses) the yearling experiences the first lessons in classical conditioning and negative reinforcement (McGreevy and McLean, 2010b) this is the beginning of 'foundation training' which McLean & McLean (2008) describe as being the foundation for all further training. Thoroughbreds are usually ridden when they are about eighteen months old, usually occurring soon after they have been sold at one of the Thoroughbred yearling sales which occur at the beginning of each year in most states in Australia. Stereotypic behaviours such as box walking and weaving may occur at this time (McGreevy, 2004). Thus the stress of leaving their home range (the breeding farm), the breaking of all affiliations made on the breeding farm, the trauma of the sale ring, and the fear of new surroundings and

management can be compounded into some form of compulsive obsessive behaviour which usually manifests as weaving or box walking (McGreevy, 2004).

### *3.8.10 Transport*

Transporters rated the transport of Thoroughbred racehorses as considerably more important than other issues. Studies by Pines *et al.,* (2007) and Phillips (2009) found that those involved in a particular industry or profession will rate that particular industry or profession as more important for the wellbeing of livestock than those industries or professions with which they are not involved. However, Gurusamy (2012) argues it is important to 'consider primarily the interests of the animals'.

Research has identified horse transportation as a welfare trigger, reporting illnesses such as 'acute colitis, laminitis, transit tetany, trailer choke, and mild azoturia' (Cregier,1981and 1982; Kusunose and Torikai, 1996; Doherty *et al*.,1997). Various scientific studies using biochemical indicators and physiological factors as stress indicators have been undertaken to determine optimal transport methods for horses (Leadon *et al.,* 1989 and 1990; Leadon 1994; Raidal *et al.,* 1995 ; Van Erck-Westergren *et al* ., 2013).

Horses have been transported over long distances for many hundreds of years, mostly by sea transport which was once the only method available (Onslow, 1891). The disease associated with sea travel became known as 'Shipping Fever', a combination of pleurisy and pneumonia, affecting 6% of horses transported long distances (Waran *et al.,* 2007a). In the 19$^{th}$ century rail travel became increasingly popular in moving horses from isolated properties in Australia to selling centres in the cities. Transporting horses by rail lost popularity in the 20$^{th}$ century with the improvement of the road network and the development of selling centres in country areas of Australia. Now days it is common to fly race horses to interstate race meetings (Waran *et al*., 2007a).

The first international flights (in 1980) were those of Thoroughbred stallions who shuttled to Australia from the northern hemisphere for the breeding season in the spring/summer months (Waran *et al.,* 2007a). Transporting Thoroughbred racehorses by air has similar welfare implications to road travel: i.e. confinement, isolation, the need to familiarise horses before transport, and access to ample water supplies (Friend *et al.,* 1998; Friend, 2000). Dehydration is a major problem, as is weight loss, while respiratory disease, or, as

it is colloquially known 'Shipping Fever' (Waran *et al.,* 2007a) is a major concern with air transportation (Raidal *et al.*, 1995). 'Shipping Fever' can also occur in horses transported by road and is caused by a horse's head being tied in such a way as to prevent the horse lowering and raising its head thus preventing effective draining of the upper respiratory tract (Racklyeft and Love 1990; Collins *et al.*, 1999; Waran *et al.*, 2007a; Van Erck-Westergren *et al,* 2013).

There are many areas where the risk of injury to horses during transport can be reduced. Horses facing the rear of the vehicle have shown minimal loss of balance, carry their heads lower, make less contact with the sides of the vehicle and show a less rigid body position than when forward facing (Slade, 1987; Waran *et al*., 1996). Studies of orientation (Cregier, 1982; Kusunose and Torikai, 1996; Doherty *et al.*, 1997) have not presented a clear preference among horses for travel either facing forward or towards the rear of the transport. Familiarising horses with one another before transport, with frequent rest and water breaks during the journey, especially in hot weather, when dehydration can occur, is recommended (Mansmann and Woodie, 1995; Friend *et al*., 1998; Friend, 2000). Frequent servicing and maintenance of the transport, keeping the transport clean, sufficient ventilation, reducing interior dust levels and attention to the removal of any sharp protruding metal objects (Mansmann and Woodie, 1995) are other ways to reduce injury to horses during transport. Horses transported either by road or air are especially prone to respiratory tract infections, including viruses, bacteria and mycoplasmas (Racklyeft and Love 1990; Collins *et al.,* 1999; Waran *et al*., 2007a; Van Erck-Westergren *et al.,* 2013).

Thoroughbred racehorses are transported many times in their life and many do not show transport stress (Cargill, 1999). However some Thoroughbred racehorses may suffer a negative experience such as a fall, unfamiliar orientation, or short head ties (Mansmann and Woodie 1995; Collins *et al.*, 1999, Waran *et al.*, 2007a). Negative transport experiences may leave the animal fearful of transportation and can result in poor loading behaviour (McGreevy, 2004).

There are many professional Thoroughbred horse Transport companies operating in every state in Australia and their vast network is capable of moving horses within and between States. Transportation of thoroughbred racehorses in Australia occurs regularly every day. Many are taken to the race track for exercise or to race meetings. The Primary Industries

Standing Committee Model Code of Practice for the Welfare of Animals, in Australia (SCARM, 2003) covers Land Transport of Horses in report 62 (SCARM, 2003) and is particularly clear on those areas of potential stressors e.g. 'loading, unloading, confinement, isolation, inappropriate grouping, motion of the vehicle, and environmental conditions' (SCARM, 2003; Waran, 2007). Transportation by air has similar welfare implications to road transport, but the incidents of shipping fever, trauma and frenzy and colic, are greatly reduced by the ability to diagnose and treat these occurrences while in the air (Waran *et al.,* 2007a). Research by Leadon (1994) and Leadon *et al.,* (1989 and 1990) has shown transportation by air increases the incidence of respiratory disease due to aircraft environmental conditions.

There has been little research into the effect of transport on the performance of Thoroughbred racehorses, however Linden *et al.,* (1991) found performance may be compromised when journeys are long i.e. 24 hours or more (Stull and Rodiek, 2000). Waran *et al*., (2007a) believe some horses are less stressed by transportation than others. Other influences which can impact on welfare during transportation are the care, skill and experience of the driver, ventilation of the vehicle and road surface (Mansmann and Woodie, 1995). Today many training establishments are located on race courses therefore reducing the need for day to day road transport (ARB, 2012).

### *3.8.11 Nutrition*

It is of interest that the Transporters rated Nutrition as the most important issue for the well -being of the Thoroughbred racehorse, second only to the Issue, Transport. Transporters of Thoroughbred racehorses handle many animals each day, varying from brood mares and foals to yearlings and horses in training. The body score condition varies according to age and work requirements, broodmares and young stock consume 3% of their body weight per day while adult horses consume 2.5% (Leighton Hardman, 1984). Thus transporters are aware of the difference between condition scores of Thoroughbred racehorses according to their age and work requirements and see nutrition as an underlying factor.

The Five Freedoms (FAWC, 2007) lists ‘freedom from hunger and thirst’ as a welfare requirement, but feeding underlies most welfare structures, especially the specific requirements of the Thoroughbred Racehorse which requires the maintenance of a ‘Body Condition Score (BCS) between 2 and 4 (on a scale of 0 = emaciated to 5 = obese).

Research has found horses that are significantly under or over-weight suffer from poor welfare' (Kohnke *et al.,* 1999; Collins *et al.,* 2010).

The living conditions of the Thoroughbred racehorse are determined by humans, but only when the environment is suitable for the horse can its greatest inherited potential be realised (Leighton-Hardman, 1984). Leighton-Hardman (1984) expressed 'Environment' as Accommodation + Nutrition + Management + Disease, and believed a poor environment created stress factors which impact on nutrition and health.

The horse is a non-ruminant herbivore suited to a high fibre, low starch diet (Davidson and Harris, 2007), a diet which is unable to fulfil the energy requirements of the Thoroughbred racehorse. Davidson and Harris (2007) advocate a feeding programme which closely resembles that of the feral or free ranging horse. Such a diet cannot supply the energy needs of the Thoroughbred racehorse (Kohnke *et al.,* 1999). However Mills and Clarke (2007) recommend that twice as much energy should be supplied from 'a roughage source (rather) than from concentrates', and that fresh clean water be 'available at all times'.

The digestive system of the Thoroughbred racehorse can also cause welfare problems in the intensively managed stabled Thoroughbred racehorse with decreased gastrointestinal function which often results gastric ulcers, colic and laminitis (McGreevy, 1996; Ecke and Hodgson, 1996; More, 1999; Hilmo, 2013). Feral or free ranging horses spend between 50-70% of their day grazing (Duncan, 1985; Cooper and McGreevy, 2007; Ransom and Cade, 2009; Ransom, 2012) while Thoroughbred racehorses are fed high energy concentrated grain diets (which they consume quickly) along with some hay, often finding nothing to do when the meal is finished. The eating time budget for stabled horses may be as low as 15% ( McGreevy, 1996; McGreevy *et al.,* 2001). The amount of forage is also important. McGreevy (1996) found when the quantity of forage dropped below 6.8 kg abnormal behaviour increased, while providing a variety of forages produced a reduction in abnormal behaviour.

Modern Management of the Thoroughbred racehorse requires the feeding of a high energy diet of small hard feed rations at designated times throughout the day, thus disturbing the animal's natural equilibrium (Sjaastad *et al.,* 2003). Although Thoroughbred racehorses are fed a carefully balanced diet 'formulated to me*et* all the horse's dietary

needs, they may not meet the horse's behavioural needs' (Kohnke *et al.,* 1999; Cooper & McGreevy, 2007). Decreased gastrointestinal function (Colville and Bassert, 2002; Lester *et al.,* 2008) leads to problems within the digestive system causing colic, laminitis and often high levels of gastric ulcers as a consequence (Hilmo, 2013). Nicol *et al.,* (2002) and Lester *et al.,* (2008) found the pain associated with gastric ulcers was a factor in the development of stereotypic behaviour in stabled Thoroughbred racehorses. These findings are supported by McGreevy (1996) and Waters *et al.,* (2002).

### *3.8.12 Wastage*

Wastage is defined as 'any injury or disease that involves an interferrence with the training schedule of a Thoroughbred racehorse resulting in lost days in work, and prolonged rest or retirement from racing (Bailey, 1998a and 1998b; Holmes *et al.,* 2014). Many Thoroughbred racehorses are retired from racing at a young age, some TBRs never race, for reasons usually due to unsoundness, injury, unsuitable temperament or insufficent speed (RIRDC, 2006). Most injuries are track related (Jeffcott *et al.,* 1982; Buckingham and Jeffcott ,1990; Bailey 1998a and 1998b). Efforts to reduce wastage due to injury and unsoundness by improving track design and surface can be complemented by improved training methods. However, in a French study, (Ödberg and Bouissou, 1999) of 3000 non-racing horses of which 66.4% died between the ages of 2 and 7, they cite inappropriate behaviour as the reason for wastage. Orthopaedic or respiratory failure was not deemed responsible for wastage, unlike data from the Australian racing industry (Jeffcott *et al,* 1982) which targets orthopaedic reasons for wastage in Thoroughbred racehorses (RIRDC, 2006). Perkins (2005) suggests that the fewer number of fatalities to female TBRs may be due to early retirement to the breeding farm, while owners will keep castrated males in training for some years.

Greater advantage needs to be made of retraining TBRs so they have a life after racing. Improvements in foundation training (Mclean and McLean, 2008) i.e. more time spent in the education of young horses so that foundation training is well established, as well as skilled horsepeople to re-educate the TBRs (Geelen, 2013) . An improvement in riding standards (McGreevy, 2004)is also an important factor in lowering wastage rates in the Thoroughbred racing industry. Further knowledge of learning theory will improve training methods, and with the correct use of foundation training (McLean and McLean, 2008) will continue equine education and improve behaviour modification (McGreevy, 2004) and thus lower wastage.

### *3.8.13 Heat and Humidity*

Goer *et al.,* (1996) found acclimatisation was one of the best ways to manage equines in adverse weather condidtions. Though equines have a wide thermal tolerance (-10 - $30^0$ C (Clarke, 1987a; Marlin *et al.,* 1996), they tolerate cold extremely well (McBride *et al.,* 1983). Queensland has no specific code for equine welfare, but Section17 of the Animal Care and protection Act 2001 covers equine welfare but does not mention the use of rugs in summer heat (Queensland Government 2001) which makes thermo - regulation difficult (Snow, 1987; McGreevy, 2004). Snow (1987) states "if the two factors causing heat gain are operating at very high levels at the same time the regulatory mechanisms will be overwhelmed and can be potentially life threatening," which may result when transit stress and environmental changes cause haematological changes in blood biochemistry (Leadon *et al.,* 1990). Leadon (1994) noted transport stress could be responsible for haematological changes while Goer *et al*., (1996) found that exposure to hot and humid conditions for as little as '5 days for periods of 4 hours per day resulted in lower core temperatures and reduced fluid loss in response to a standardised exercise test compared with those not exposed'.

Queensland has no specific separate code for equine welfare. Horses are however covered under the Duty of Care, Section 17 of the Animal Care and Protection Act 2001. Unfortunately this protection has not reached those horses subjected to heavy daytime rugging throughout Queensland's summer heat (Queensland Government, 2001). McGreevy (2004) states 'horses are often seen using shaded areas, natural wind breaks, sun baking and even wading in water to regulate body temperature'. McGreevy (2004) states thermoregulation 'is often made difficult by the use of rugs', and the discomfort caused by over- heating can result in skin disorders and in extreme cases can be life threatening, due to haematological changes in blood chemistry (Snow, 1987; Leadon *et al.,* 1990).

### *3.8.14 Whips*

The use of whips in Thoroughbred racing is strictly controlled both in usage and in the design of the whips. Even so, the psychological pressure and pain inflicted by whips (Sjaastad, *et al.,* 2003) may have a detrimental effect on the winning of a race. Research (Deuel and Lawrence, 1987) has shown the detrimental effect such usage has in shortening the stride and increasing the number of strides (Deuel and Lawrence, 1987) of the TBR. Thus whip use may not be a prerequisite for winning a race, as by shortening the

length of the racehorse's stride and altering the Thoroughbred racehorse's rhythm a race could be lost. This fact was emphasised by the winning jockey[2] of the AJC Derby, held at Randwick, Sydney Australia, 2014, who, on dismounting stated he had ' ridden hands and heels' as he did not want to 'unbalance the horse by drawing the whip, due to the conditions of the rain affected track' (Roots, 2014). Research by Ueda *et al.,* (1993) has shown 38% of breakdown injuries occur after the use of the whip. Whip design is also a contentious issue (McGreevy and Evans, 2015) as the design of some whips inflicts more pain than others (e.g. Padded whips), and over use of any whip can result in stress induced analgesia, i.e. the ability to mask pain (Contino and Khursheed, 2015).

In 2009 the Thoroughbred Racing Industry's rules for the use of whips, their size and composition were changed to bring Australian Racing Industry standard of welfare rules closer to whip design and use in other countries thus determining the racing industry standard of welfare. The high value of Thoroughbred racehorses and the Veterinary costs involved in treating breakdown cases may induce owners, trainers and jockeys to seek alternative methods to abusive whip use.

### *3.8.15 Environment*

Racing administration rated environment more highly than other stakeholders. Until recently most horses were stabled privately, giving Racing administration very little control over the environment. Most Australian Racing bodies regularly inspect stables to see if they are compliant with Animal Welfare Policies of their respective States (Racing Queensland Limited, 2010) but there is no rule advocating the length of sunlight a Thoroughbred racehorse needs each day.

Training requirements frequently demand that Thoroughbred racehorses are exercised in the early morning long before sun up. In many cases horses in intensive training are confined indoors for 90% of the day (McGreevy *et al*., 1995; Cooper and Mason, 1998; Edgar, 2010). Researchers Nielsen *et al* (1995) found horses confined indoors for lengthy periods during the day could suffer from changes in calcium, phosphorus and vitamin D levels in serum, and bone. Stressors from the weight of the rider or intensive training increase the amount of bone remodelling and therefore increase the need for vitamin D (Nielsen *et al*., 1995). The study found horses with adequate access to sunshine each day

[2] Hugh Bowman, rider of Criterion. A.J.C Derby. Randwick Australia. 12 April 2014

are rarely vitamin D deficient. When free use of an attached yard was provided, horses spent most of the daylight hours standing in the sun (researcher's personal observation). Yards can be as isolating for equines as stables, (Mal *et al*., 1991; Jezierski, 1992) but when well designed to allow visual, physical and auditory contact with adjoining equines they contribute an adaptive value as 'social tendencies are an advantageous species-specific trait of the horse' (Mills and Nankervis, 1999). Thus the free use of attached yards provides a choice of environment for thoroughbred racehorses.

Different types of bedding are used e.g. straw, wood shavings, shredded paper or cardboard and sometimes sand. Though TBRs show a preference for straw bedding, Mills *et al* (2000) found an increase in bedding related activities, such as eating the bedding.

### *3.8.16 Gear*

Gear was consistently rated as the least important Issue in the survey 'Determining Opinions of Welfare Requirements for Thoroughbred Racehorses' with the Stakeholders. The Retrainers, (people who retrain racehorses for other use, when the TBRs' racing career has ended), were the most concerned with the gear that is used during racing.

Casey (2007) believes painful conditions occur when horses are kept in conditions which 'are incompatible with their natural physiology'.

Not only do management practices in the Thoroughbred racing industry frequently compromise the welfare of the Thoroughbred racehorse (Franklin et al., 2002) but welfare can also be compromised by riding related problems due to the difference in riding standards (McGreevy, 2004; McGreevy and McLean, 2010a). Back pain is a common cause of poor performance and is usually the result of poorly fitting saddles (Harman, 1995; Jeffcott et al., 1999), while girth tension could reduce performance either due to pain and discomfort or a decrease in air flow or volume (Bowers and Slocombe, 2000).

The horses' mouth is extremely sensitive and for this reason should be treated with great care when making the connection between horse and rider (Schulte and Baumann, 2002). The response of the horse to the rider's signals is an important part of a young horse's education, thus it is important for the rider to give clear signals (Schulte and Baumann, 2002).

Fortunately most racehorses are ridden in the simplest and kindest of bits (Schulte and Baumann, 2002). For centuries bits have been used as a means of controlling and stopping horses, stopping being the major concern (McGreevy and McLean, 2010a). In Thoroughbred racing, stopping is not an issue. Most bits are a simple snaffle. Racing does

not require alteration of the natural outline of the horse, as required by some equestrian sports (Schulte and Baumann, 2002; McGreevy, 2004). Tongue ties, tongue clips and some nose bands are allowed in order to prevent the horse getting its tongue over the bit, or swallowing its tongue, as can occur when racing. Their use is a safety issue and is approved by the ARB (Villella, 2014).

A recently Australian designed bit (IntelligentInventions, www.bitbankaustralia.com.au/winning-tongue-plate) is available which prevents horses from getting their tongues over the bit or hanging outside the mouth and also stops horses from pulling and bolting.

This bit can also eradicate head shaking and prevents the displacement of the soft palate, something the tongue tie cannot do. (Franklin *et al.* 2002).

Blinkers have been used for hundreds of years on horses who pull carts and work in horse teams as a means of preventing shying or bolting (McGreevy, 2004) and their use on the racecourse is partly for the same reason. Blinkers are commonly used in racing to increase the animals' focus and to eliminate the fear of horses racing beside, and, or behind them (McGreevy, 2004) but mainly they are used for the safety of all concerned.

### 3.9 Conclusion

The Stakeholder's response to the survey identified the relative importance of various husbandry and management standards within the Thoroughbred racing industry (as described in Chapters 2&3), which are important for the welfare of the Thoroughbred racehorse. The response to the survey found everyone was cohesive in their view except in Nutrition, see section 3.8.11 and Weaning, and see section 3.8.9. Nutrition was rated by males to be less important than by females, and rated highly by Transporters 3.8.10., second only to their own industry. Nutrition is an important factor in preventing the development of stereotypic behaviour in young foals when being weaned (McGreevy, 2004).

The results for the Issue, Weaning, did not agree with the Scientific Literature, a view which is important for the welfare of the Thoroughbred racehorse as this Issue is fundamental in preventing many of the stereotypic behaviours which develop at this critical time in the life of the equine neonate.

Thus further research into Nutrition and Weaning may improve both nutrition and weaning practices, which could lead to the eradication of stereotypic behaviour especially oral stereotypies.

# CHAPTER 4

## AN ASSESSMENT SURVEY OF THOROUGHBRED RACEHORSE WELFARE THROUGH BEHAVIOURAL MEASURES.

## TABLE OF CONTENTS

# LIST OF FIGURES



# LIST OF TABLES

## 4.1 Introduction

Early equines developed ‘adaptations in population dynamics and behavioural ecology’ to ‘successfully exploit new and changing environmental resources’ (Darwin, 1859; Lorenz, 1955; Rubenstein 1981, McGreevy, 2004; Kuntz *et al.,* 2006; Goodwin, 2007), a trait Goodwin (2007) views as ‘pre adaption to domestication’. Thus the Thoroughbred racehorse may have inherited an ability to adapt to the vastly different environment and behavioural ecology of the intensive management systems of modern Thoroughbred training establishments (Rubenstein 1981, Goodwin, 2007; Williams, 2013).

The time budget of the Thoroughbred racehorse is determined by the management system, differing greatly from that of the free ranging or feral horses who spend 70% of the day foraging (Boy and Duncan 1979; Duncan 1985; *Boyd et al* 1988; Ransom and Cade, 2009), as compared to the Thoroughbred racehorse who spends as little as 10% of the day consuming a diet of concentrates and hay (Marsden, 1995).

## 4.2 Measuring welfare in Thoroughbred racehorses

Currently there is no valid reliable and feasible tool available to assess Thoroughbred racehorse welfare therefore an online adaptive conjoint analysis survey; with involvement of industry in questionnaire design was used to determine Thoroughbred racehorse welfare. The study utilised the opinions of stakeholders in the Australian Thoroughbred Racing Industry to identify appropriate welfare indicators. The findings were validated by a non-invasive assessment of Thoroughbred racehorse welfare through behavioural measures in Thoroughbred racehorse training establishments (Mitlohner *et al.,* 2001). This was related to attributed scores of the TRWI for the training establishments. All observational procedures were approved by the University of Queensland Animal Ethics Committee, Approval number 2011000067.

## 4.3 Materials and methods

### *4.3.1 Training Establishments*

A letter was sent to thirty Thoroughbred racing trainers in South East Queensland, who were chosen at random from registered Trainers in this region (Racing Queensland Magazine, 2013), requesting permission to carry out behavioural studies in their training establishments. No fewer than six racehorses in training was required for an

establishment to be included in the study. Twenty eight positive responses were received, and two training establishments were rejected, leaving 26, one having less than six horses in work, and the other due to timing difficulties.

### *4.3.2 Management and TBR Behaviour*

The daily routine of all of the training establishments was similar, with the day starting about 4 am when the racehorses were taken to the track for exercise. While out of their boxes the stables were cleaned and fresh bedding added. In most cases the horses were stabled on the race course, or had access to a private training facility, thus there was no need of transportation (Collins *et al.,* 1999; McGreevy, 2004; Waran *et al.,* 2007a). Those TBRs who were stabled off the track were transported either by transport vehicle or a trailer float to an exercise facility (Linden *et al.,* 1991; Cargill, 1999; Stull and Rodiek, 2000).

The racehorses were warmed up before commencing work, either by spending some minutes on a walking machine or by walking in an exercise area other than on the racetrack. Racehorses worked at a fast pace on Tuesday and Thursday morning. Some Tuesdays were set aside for practice starts or 'jump outs' which consist usually of three or four racehorses jumping out of the barrier (starting gate) and galloping approximately 400-800 metres. 'Jump outs' formed part of the early education of the racehorse, enabling the jockey and trainer to assess the level of race preparedness of the racehorse. Short race (barrier or starting gate ) trials occurred on Tuesdays, when 'jump outs' were not being held, involving five to seven or eight horses with a pace that is faster than in jump outs, and jockeys wearing race colours, thus accustoming the horse to race day procedure. The barrier (starting gate) trials were useful in assessing the fitness of the race horse and the most suitable race distance for a particular racehorse.

After morning exercise the TBRs were hosed down, then put on a rotary walking machine to cool and dry off, which could take 10 or 15 minutes before returning to their stables for feeding. The day was usually spent resting in the stable, until the afternoon, when they were either taken out to graze while held on a lead line or more exercise on the walking machine. Cleaning took place again while the stables were empty. On completion of the stable cleaning process the TBRs were returned to their stables for the evening meal which consisted of concentrates and hay, sometimes hay being offered again later in the evening.

The training establishments consisted of three distinct stabling categories common to racing establishments (Cooper and Mason, 1998; Mills and Clarke, 2007):

1. Barn type with corridor down the middle of the building with stables facing inward on both sides of the corridor.
2. Side by side stables opening outwards onto an open grassed area.
3. Yards with a roofed area, enclosed on one or more sides.

The size of the smallest stables was 3.30m x 3.70m with a ceiling height of 3.00m and the size of the largest 5.00m x 5.00m with a ceiling height of approximately 6.4metres while the mean was depth 4.76m, the mean width 3.96m, and the mean height 3.88m (Table 4.1). Four training establishments did not have attached yards to the stable or the use of a yard. Six of the nine training establishments had yards attached to the stables, but one trainer did not allow free use of the yards. Generally Thoroughbred racehorses were rotated between stable and yard, thus ensuring all horses had some hours, each day out of their stable. In the case of the four establishments without yards these TBRs were confined to their respective stables for 24 hours per day, except for the time spent exercising on the track or on the walker.

**Table 4.1 Mean size of training establishments' individual stables**

| Stable | Length (m) | Width (m) | Height (m) | Notes |
|---|---|---|---|---|
| **1** | 5.0 | 5.0 | 6.4 | Barn design, corridor down the middle. Attached yard not in use. No fans |
| **2** | 5.0 | 5.0 | 6.4 | Barn design. Corridor down the middle. Free use of attached yard. No fans |
| **3** | 6.0 | 2.2 | 3.7 | Yard with covered shelter at far end of yard. Physical and visual contact. No fans |
| **4** | 3.7 | 3.6 | 2.6 | Side by side design. No grass. No yard. Visual contact only. No fans |
| **5** | 6.4 | 3.7 | 2.2 | Yard with covered shelter at far end. Physical & visual contact. No fans |
| **6** | 3.8 | 3.7 | 3.4 | Barn design. No yards. Fans in corridor. Physical and visual contact |
| **7** | 3.7 | 3.6 | 3.5 | Side by side design, grassed area. No physical or visual contact. |
| **8** | 3.8 | 3.7 | 3.4 | Barn design. No yards. Fans in corridor. Physical and visual contact |
| **9** | 5.9 | 3.8 | 3.5 | Side by side design. Yard partly covered. NO fans .Physical and visual contact |
| **10** | 5.4 | 4.7 | 4.0 | Open barn cluster design. 3 yards not covered, shaded by trees. No fans. Visual contact. Not all stables had physical contact. |
| **11** | 4.4 | 4.3 | 4.2 | Barn design. Some yards. External air vent to ceiling. Physical and visual contact |
| **12** | 3.7 | 3.3 | 3.0 | Side by side design. Some yards. Ceiling fans. Physical and visual contact |
| **13** | 5.1 | 4.9 | 4.2 | Open barn, Heavy wire mesh, self-ventilating. Physical and visual contact. Side by side and back to back design. |

### *4.3.3 Behaviour Observation*

A continuous recording method was used for all occurrences of behaviour (Altmann, 1974). Each TBR was identified by their colour, sex and age at the commencement of observation. The age of each TBR was obtained from the year of birth brand.

Data collection of behavioural variables occurred in 13 training establishments chosen from the 26 given above. The establishments were chosen for the differences in stable design, stable size, and attachment of yards or not, or no yards, with a total of 156

Thoroughbred racehorses housed in five training establishments in Brisbane and eight in the Toowoomba and Westbrook area in South Eastern Queensland, Australia. Mean TBR age was 3.5 years, SEM 0.134, median 3 years, range 1-9. There were 46 females (all entire) and 87 males (3 entire).

### *4.3.4 Development of the Ethogram*

An ethogram was developed to investigate the complete range of behaviours occurring throughout the observation period. Behavioural descriptions of equines were consulted, describing equine behaviour both in free range conditions (Ransom and Cade, 2009; McDonnell, 2003) and in stabling situations (McGreevy *et al.,* 1995; Cooper and McGreevy, 2007; Tadich *et al.,* 2012).

Primary behaviour categories were determined as Maintenance, Social, Locomotion, Oral, Abnormal, Repetitive Behaviour, Response to External Stimuli and Other (Altmann, 1974). This basic ethogram was extended to include additional categories that are specified below e.g. *Maintenance* included feeding and drinking, elimination, lying, resting, sleeping, standing, rubbing and scratching (Table 4.2).

### *4.3.5 Pilot Study*

A Pilot Study was conducted by two observers continuously recording the behaviour of the same TBR. The two observers sat side by side on a ladder (height of 90mm) which allowed maximum visual exposure. Inter-observer reliability was ensured by comparing behaviour assessments from the two observers, with modification of definitions as necessary. Each observer had a stop watch to continuously record all individual behaviours occurring within a 15 minute period. Twelve horses were observed in four groups of three stables at the followings times: 0700-0800, 1100-1200 and 1500-1600h. The 12 horses used in the pilot study were not used in the behaviour study.

### *4.3.6 Observation Method*

Observations took place at the 13 different racehorse training establishments in South East Queensland and were carried out by the same two observers for the observational period which ran from 24$^{th}$ April to 18$^{th}$ May 2012. During this time the minimum temperature ranged from 5.6$^{0}$C to a maximum of 24.4$^{0}$C. Of the 156 Thoroughbred racehorses for which recordings commenced, only 133 were used in the final analysis, as 23 horses were removed during the study to fulfil racing commitments.

The Thoroughbred racehorses were observed for three sessions each of 30 minutes, in four groups of three horses by the two observers, from 0700-0800, 1100-1200 and 1500-1600h. Viewing arrangements were as for the pilot study, but at the completion of 15 minutes the observers changed TBRs, ensuring the continuous recording of the six horses under observation. Thus each Thoroughbred racehorse in the study was observed for 90 min and total time for the observation of 133 Thoroughbred racehorses was 200 hours.

## Table 4.2 Behavioural parameters for Thoroughbred racehorses (Equus caballus)

| Behaviour | Description |
|---|---|
| Maintenance | A description of an animal's daily activities that serve to keep the animal alive and well (McDonnell, 2003). |
| Feeding | The ingestion of feed. The TBRS anticipated the arrival of their feed with an increase in activity and sometimes performing stereotypic behaviour, see door banging. (McDonnell, 2003; Houpt, 2011). |
| Drinking | The imbibing of water. Drinking usually occurred at the same time as feeding; sometimes there was a difference of drinking rhythms (Houpt, 2011). |
| Elimination | The voiding of faeces or urine. The behaviour is sexually dimorphic (McDonnell, 2003) with females' eliminating at random with no specific attention to their faeces or urine. Stallions and geldings tended to pile faeces and urinate in the same area in the stable (McDonnell, 2003). |
| Lying | Lying down with head up or with head and legs outstretched (McDonnell, 2003; Petherick, 2010). TBRS rest or sleep in either lateral or sternal recumbency. Lying occurred after morning exercise and/or feeding and on days after racing (trainers personal communication) |
| Standing resting | Standing in a relaxed posture head slightly lowered and eyes partly closed, usually one hind leg flexed, ears rotated laterally (McDonnell, 2003; Ransom & Cade, 2009; Fureix et al 2012). Standing resting was characterised by a general lack of attention and inactivity and was a transition period between wakefulness and sleep. |
| Standing sleeping | Standing sleep with closed eyes and head lower than the back (McDonnell, 2003). At such times the equine body was supported by the equine stay apparatus (Dallaire, 1986). |
| Standing Inactive | Dull and quiet manner and/or lethargic, associated with "physical illness, weakness or severe social stress" (Heleski *et al.,* 2002; McDonnell, 2003; Dodman *et al.,* 2005; Evans, 2007; Hall *et al.,* 2008), or the TBR may be exhausted from recent racing (personal communication from TBR trainer). |
| Rubbing and scratching | "Licking, biting, rubbing and scratching part of the body."(McDonnell, 2003). Often called auto groom ( when self grooming ), allo grooming ( when two TBRs groom each other). |

| | |
|---|---|
| Social Communication | Communication is both visual (using signals made by postures and expressions of the ear, tail, face and mouth) (Houpt, 2011) and auditory i.e. Vocalisations (whinnies, neighs, snorts, squeals and grunts) and sounds i.e. Hooves (pawing and stamping) as well as chemical cues (McDonnell, 2003). |
| Play | Object play (McDonnell, 2003) involves the manipulation and contact of an object which may be inanimate or animate. The management restrictions of stabled TBRS prevent most types of play. |
| Sniffing | Drawing air in through the nostrils (McDonnell, 2003; Pellis & Pellis, 2010) the TBRS frequently placed their nose close to the object of interest and sniffed. |
| Aggression | Aggression involves the extension of the head and neck towards an individual with flattened ears, threats and bites (McGreevy, 2004). Recognised by agonistic signalling (McDonnell and Haviland, 1995). Occurring mostly at feed time between conspecifics when indicating ownership of their feed (Goodwin, 2007). Stabled TBRS sometimes demonstrated ownership of space (Goodwin, 2007) and aggression towards humans who failed to respond to subtle threat signals (Rees, 1993). |
| Vocalisation | Are “sounds produced by TBRs via their vocal tract” (Weary, 2010). Snorts and snickers are from the nose, with mouth closed; while a squeal is defensive and like the neigh or whinny was given with the mouth open (Houpt, 2011). Neighing or whinnying was frequently heard either in greeting or indicating anxiety i.e. When separated from conspecifics. Snorts and sneezing were frequently heard when TBRs exercised. |
| Locomotion | Walking, a voluntary symmetrical gait with 2, 3, or 4 legs supporting the TBR. Observed as a slow four beat forward movement with an equal interval of time between footfalls (Flower, 2010). |
| Walking | A forward movement in four beats. The only observed form of locomotion occurred between water and feeding stations or between a yard and the stable when free use of a yard was available (Ransom and Cade, 2009). |
| Oral stereotypic behaviours | Repetitive aimless behaviour performed with the mouth with no obvious goal or function (Mason, 1991). Such behaviour can interfere with time spent resting or feeding (Cooper & McGreevy, 2007). |
| Wind sucking and crib biting | Crib biting is a sudden in taking of air as the TBR repeatedly grasps a fixed object, tensing the neck muscles and at the same time pulling back as air is sucked into the oesophagus (McGreevy, 2004). Wind sucking does not involve grasping but in all other aspects is the same as crib biting (McDonnell, 2003; Tadich *et al*., 2012). Both crib biting and wind sucking were frequently observed behaviours. |

| | |
|---|---|
| Chewing objects | Chewing is a “side to side grinding motion of upper and lower jaw on an object in the mouth” (McDonnell, 2003). TBRs occasionally chewed wooden objects such as the top of the stable door or the divider rails of the stable. |
| Sham chewing | Sham chewing occurs with an empty mouth moving the jaw or tongue in a repetitive movement (Willard *et al.,* 1977; McDonnell, 2003). |
| Licking | Licking occurs when contact of an object is made with the tongue (McDonnell, 2003). Some TBRs licked the side of the metal feeder for long periods and others licked door handles and wooden stable divider walls. (Willard *et al.,* 1977; Tadich *et al.,* 2012). |
| Yawning | Yawning occurs by opening the mouth wide and slowly inhaling air, sometimes moving the jaws from side to side (McDonnell, 2003). |
| Locomotor stereotypic behaviours | Abnormal repetitive behaviour patterns which are performed with no obvious goal or function. TBRs move in a repetitive pattern around the stable, swaying the body from side to side, moving the head in a repetitive manner, stomping of one or more legs, or wall or door kicking and/or banging. This repetitive behaviour can interfere with time for feeding and/ or resting (Cooper & McGreevy, 2007). |
| Box walking | Is a stylized repetitive locomotion performed at any gait, usually along a perimeter (McDonnell, 2003).TBRs walk repetitively in a pattern, usually along one wall of the stable with the head high and the neck drawn back into the shoulders, before turning to move in the opposite direction, in the same intense manner. Other TBRs may use circular or figure 8 patterns. There is no apparent purpose as to where the TBR is going. (Kiley-Worthington, 1983; (Tadich *et al.,* 2012). |
| Weaving, swaying and treading. | Weaving is a rhythmic manner of repeatedly moving the body, head, neck, shoulders and forelimbs, from side to side, sometimes including the hind limbs as well (Mills & Nankervis, 1999).those stables with preventative weaving grills fitted to openings, such as doors or windows prevent weaving to a large extent but treading may then occur i.e. moving limbs up and down on the same spot (Kiley-Worthington, 1987). |
| Door banging | Repeatedly knocking the door or walls with a fore-hoof (Kiley-Worthington, 1983; Mills and Nankervis, 1999).feeding time may be anticipated by repeated door banging. |
| Head tossing | Head tossing involves moving the head up and down, usually ending in a jerky motion (Cooper *et al.,* 2000; Tadich *et al.,* 2012). |
| Pawing | Continual movement of one foreleg up and down in a digging motion, sometimes directed towards the ground, sometimes directed towards the stable door (McDonnell, 2003; Tadich *et al.,* 2012). |

| | |
|---|---|
| Response to external stimuli | Sometimes referred to as stand-stare or standing alert or standing attentive. (McDonnell, 2003). |
| Looking | Standing motionless and rigid for some minutes with ears stiffly upright and forward and nostrils slightly dilated (Ransom and Cade, 2009). Described by McDonnell (2003) as standing alert. TBRs spent a great deal of time in this behaviour. |
| Startle | Head held erect with upright ears and oriented towards the startle object. Startle is a reaction to external stimulus in a surprised way as though suddenly shocked or frightened, sometimes the TBRs rushed away or turned suddenly, with tense neck and back (researcher's personal observation) |

### *4.3.7 Ascribing a Welfare Index Value to Each Training Establishment*

The stakeholder survey (Chapter 3) of the issues for Thoroughbred racehorse welfare, chosen by expert opinion, was utilised to attribute highest, middle or lowest possible utility values for each issue which were then adjusted by Importance Scores to give each racing establishment an Index Score out of 100%.

### *4.3.8 Statistical Analysis*

An initial analysis used stepwise regression, with forwards-backwards model fitting with alpha values to enter and remove of 0.15, to relate the Welfare Index attributed to each of the 13 stables to the mean value of 26 behaviour predictors for each stable. As one of the resulting correlated variables was clearly not linearly related to the Welfare Index, a quadratic component was calculated for this variable. Pearson Correlation coefficients were calculated for the 26 behaviours (Appendix 4a, p189) A Principal component Analysis was conducted on the $\log_{10}$ of behaviour values + 1, as a result of non-distribution of the latter. Age and gender effects were evaluated by analysis of variance of $\log_{10}$ transformed values of the behaviour + 1, with gender as a factor and age as a covariate.

## 4.4 Results

Horses on average spent most time feeding 32%, then standing 21%, looking 20%, standing inactive 16%, walking 5%, drinking 1%, licking 1%, elimination 0.7%,
resting 0.56% rubbing 0.3%, sniffing 0.3%, weaving 0.2%, chewing objects 0.2%, out of sight 0.2%, aggression 0.2%, head toss 0.1%, wind suck/crib 0.1%, lying 0.09%, startle 0.08%, pawing 0.05%, playing 0.05%, box walking 0.04%, vocalisation 0.03%, yawning 0.02%, sham chewing 0.01%, door banging 0.006% (Table 4.3).

**Table 4.3 Mean values for behaviours, % time spent by each horse.** Values were derived from antilog -1 of ($log_{10}$ transformed values + 1) in descending order.

| Behaviour | Mean, % time | SEM | Coefficient of variation, % |
|---|---|---|---|
| Feeding | 32.00 | 0.162 | 1.87 |
| Standing Sleeping | 21.60 | 0.088 | 1.02 |
| Looking | 20.05 | 0.088 | 1.02 |
| Standing inactive | 16.30 | 0.244 | 2.82 |
| Walk | 4.55 | 0.085 | 0.98 |
| Drinking | 1.16 | 0.191 | 2.20 |
| Licking | 1.01 | 0.208 | 2.39 |
| Elimination | 0.70 | 0.80 | 2.00 |
| Standing resting | 0.56 | 0.247 | 2.85 |
| Rubbing | 0.32 | 0.159 | 1.83 |
| Sniffing | 0.26 | 0.151 | 1.74 |
| Weaving | 0.25 | 0.211 | 2.43 |
| Chew object | 0.23 | 0.185 | 2.14 |
| Out of sight | 0.21 | 0.247 | 2.85 |
| Aggression | 0.18 | 0.14 | 1.62 |
| Headtoss | 0.13 | 0.13 | 1.53 |
| Windsuck | 0.10 | 0.15 | 1.75 |
| Lying | 0.09 | 0.16 | 1.90 |
| Startle | 0.08 | 0.12 | 1.40 |
| Pawing | 0.05 | 0.09 | 1.09 |
| Play | 0.05 | 0.01 | 1.34 |
| Box walk | 0.04 | 0.08 | 1.02 |
| Vocal | 0.03 | 0.07 | 0.90 |
| Yawn | 0.02 | 0.07 | 0.80 |
| Sham chewing | 0.01 | 0.06 | 0.71 |
| Door Banging | 0.01 | 0.03 | 0.40 |

### *4.4.1 Correlation Matrix*

Drinking was highly negatively correlated with the locomotive stereotypies (Table 4.4), particularly weaving, but also box walking and head tossing and positively correlated with resting. Similarly, feeding was highly negatively correlated with weaving, and also windsucking and chewing objects, but not correlated with resting. Feeding was negatively correlated with walking, but not box walking. Despite the fact that drinking and feeding were negatively correlated with weaving, weaving being a stereotypic behaviour, caused by stress, and is positively correlated with both elimination and aggression, indicating aggression was not part of normal behaviour. The indication is that stress caused elimination is not normal behaviour.

There appeared to be another group of associated behaviours, rubbing, sniffing, playing, yawning, looking and aggression. As expected, sniffing was associated with pawing, indicating the latter had an investigative function.

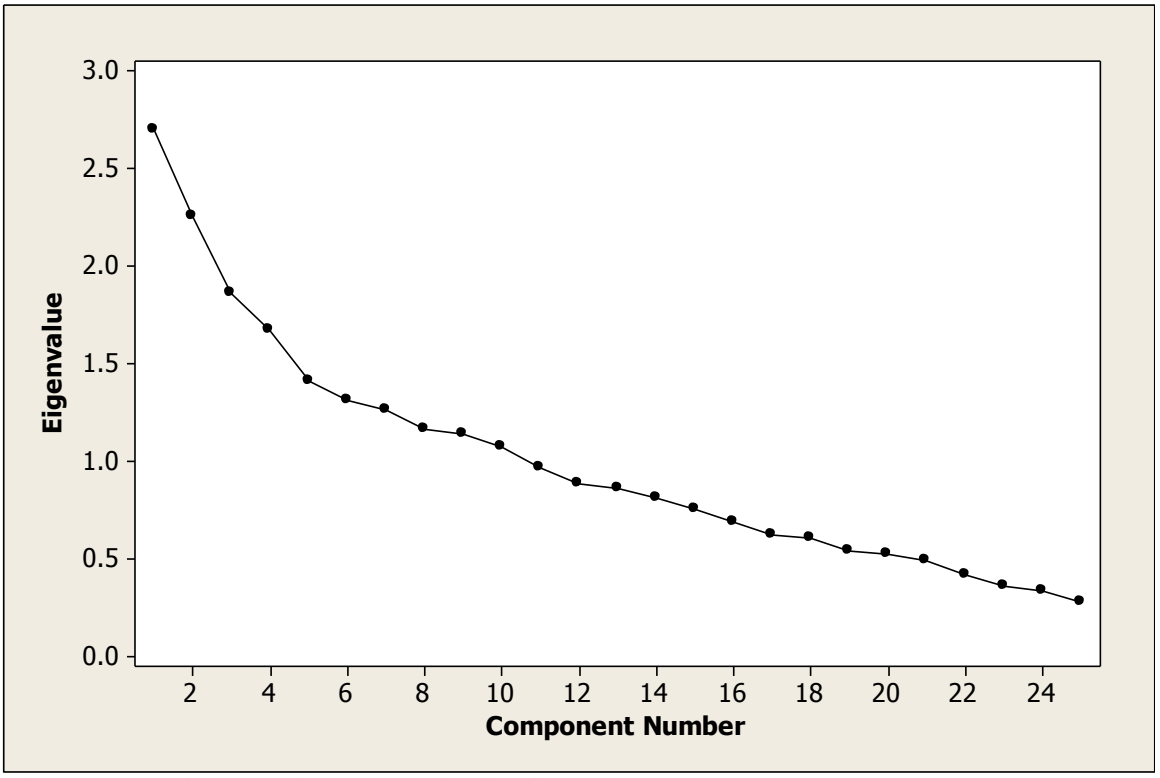


**Figure 4.1 Eigen values of principal components**

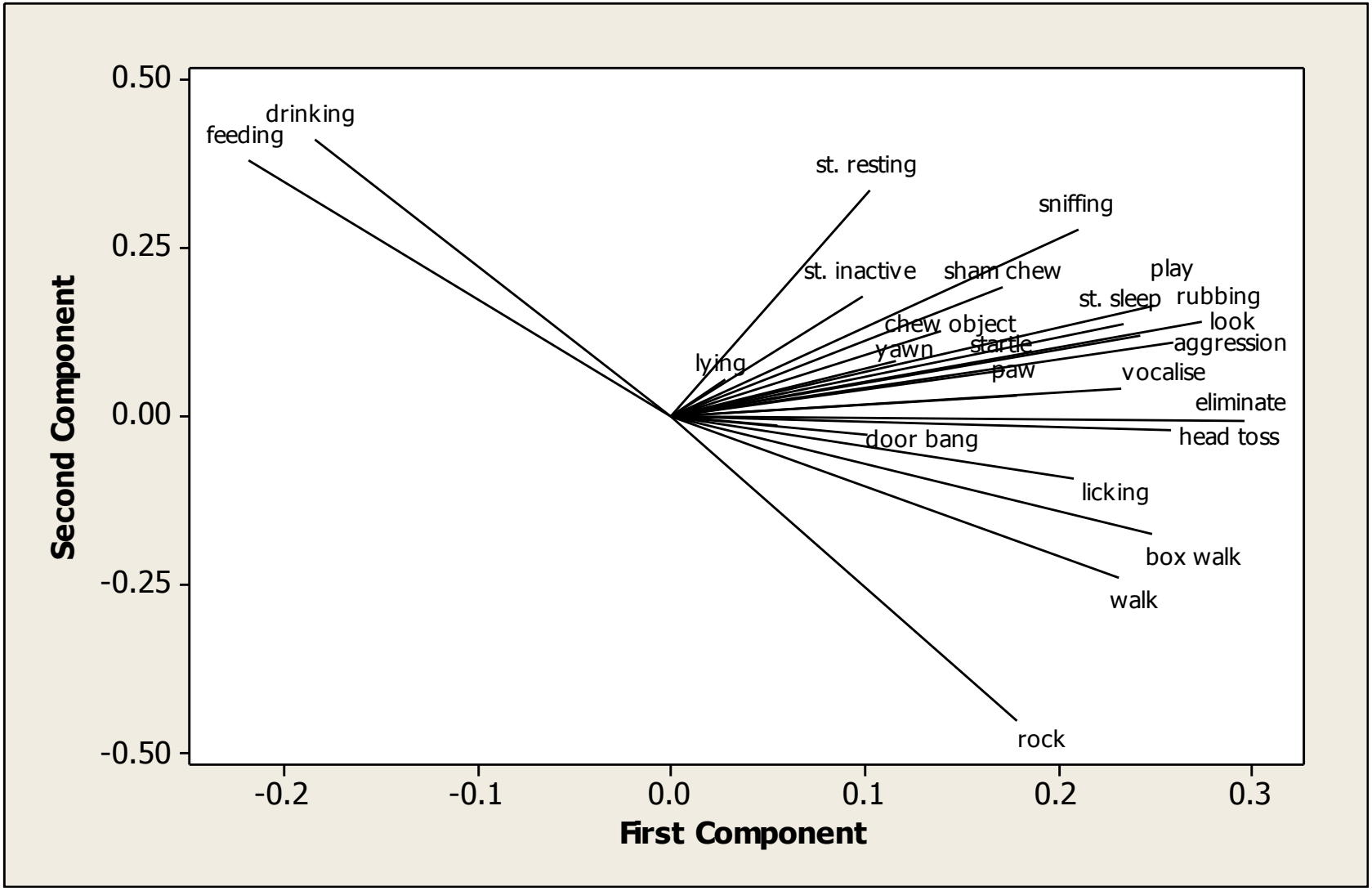


**Figure 4.2 Behaviours in first and second components of principal component analysis. Resting = standing resting, standing = standing sleeping and inactivity = standing inactive**

Principal component analysis shows that there were approximately 10 components with Eigen values over 1(Figure 4.1), and numbers 1 and 2 are displayed graphically (Figure 4.2). In this, feeding and drinking are closely related and are antagonistic to weaving, walking and box walking**.** PC3 is concerned with oral stereotypies, windsucking, chewing objects, inactivity and standing (Table 4.5). In another PC (4) windsucking is negatively correlated with lying. In PC5 head tossing and sham chewing feature prominently, similarly in PC 6 yawning and box walking, PC7 door banging, pawing and chewing objects and PC 8 door banging and aggression.

**Table 4.4 Eight principal components for behaviours of TBRs in stables (n=133)**

| Variable | PC1 | PC2 | PC3 | PC4 | PC5 | PC6 | PC7 | PC8 |
|---|---|---|---|---|---|---|---|---|
| Drink | -0.18 | 0.41 | 0.06 | 0.13 | -0.19 | -0.01 | 0.02 | -0.18 |
| Feeding | -0.22 | 0.38 | 0.20 | -0.28 | -0.09 | 0.09 | 0.05 | 0.07 |
| Elim | 0.30 | -0.01 | 0.08 | 0.18 | -0.19 | 0.08 | 0.07 | 0.16 |
| Lying | 0.03 | 0.06 | -0.24 | -0.38 | -0.29 | 0.05 | -0.20 | 0.16 |
| St. resting | 0.10 | 0.34 | -0.20 | 0.31 | 0.19 | -0.02 | 0.09 | -0.18 |
| St. inactive | 0.10 | 0.18 | -0.31 | 0.08 | -0.23 | 0.11 | 0.31 | 0.24 |
| St. sleep | 0.23 | 0.14 | -0.35 | -0.13 | -0.02 | -0.11 | 0.13 | 0.10 |
| Rubbing | 0.27 | 0.14 | 0.19 | 0.12 | 0.09 | -0.03 | -0.23 | 0.04 |
| Aggress | 0.24 | 0.12 | 0.21 | 0.15 | 0.01 | 0.16 | 0.14 | 0.44 |
| Vocal | 0.23 | 0.04 | -0.13 | -0.25 | 0.23 | 0.31 | -0.03 | -0.24 |
| Sniffing | 0.21 | 0.28 | 0.26 | 0.17 | 0.13 | 0.10 | 0.08 | 0.16 |
| Boxwalk | 0.25 | -0.17 | -0.04 | -0.21 | -0.02 | 0.33 | 0.18 | -0.20 |
| Walk | 0.23 | -0.24 | -0.04 | -0.12 | -0.15 | -0.22 | -0.21 | -0.11 |
| Play | 0.25 | 0.16 | 0.15 | -0.06 | -0.22 | 0.33 | -0.11 | -0.28 |
| Windsuck | 0.06 | -0.01 | -0.40 | 0.32 | 0.03 | 0.05 | -0.00 | 0.01 |
| Chewob | 0.14 | 0.13 | -0.39 | 0.20 | -0.09 | -0.22 | -0.36 | -0.02 |
| Shamchew | 0.17 | 0.19 | 0.04 | -0.17 | -0.40 | -0.08 | -0.20 | -0.03 |
| Licking | 0.21 | -0.09 | 0.15 | -0.03 | -0.33 | -0.21 | 0.13 | 0.16 |
| Yawn | 0.12 | 0.08 | 0.24 | -0.08 | 0.08 | -0.55 | -0.06 | 0.04 |
| Weave | 0.18 | -0.45 | 0.09 | 0.27 | -0.15 | 0.09 | 0.06 | 0.07 |
| Doorbang | 0.10 | -0.03 | 0.07 | 0.01 | -0.20 | -0.21 | 0.52 | -0.47 |
| Headtoss | 0.26 | -0.02 | -0.01 | -0.26 | 0.41 | 0.02 | -0.09 | 0.17 |
| Paw | 0.18 | 0.03 | 0.18 | 0.25 | 0.03 | 0.03 | -0.32 | -0.33 |
| Look | 0.26 | 0.11 | -0.03 | -0.16 | 0.11 | -0.12 | 0.04 | -0.08 |
| Startle | 0.17 | 0.07 | -0.06 | -0.13 | 0.25 | -0.30 | 0.30 | -0.05 |

**Table 4.5 Significant effects of gender on horse behaviour**

| | Female | Male | SED | P value |
|---|---|---|---|---|
| Elimination ($log_{10}$ % time) | 0.72 | 1.04 | 0.097 | 0.03 |
| (% time) | 5.3 | 11.0 | | |
| Rubbing ($log_{10}$ % time) | 0.47 | 0.74 | 0.089 | 0.05 |
| (% time) | 2.9 | 5.5 | | |

Males spent about twice as much time in elimination and rubbing compared with females (Table 4.6). No other behaviours were affected by gender. Windsucking (P = 0.003) and to a lesser extent box walking (P = 0.05) increased with age of horse (Figure 4.3).

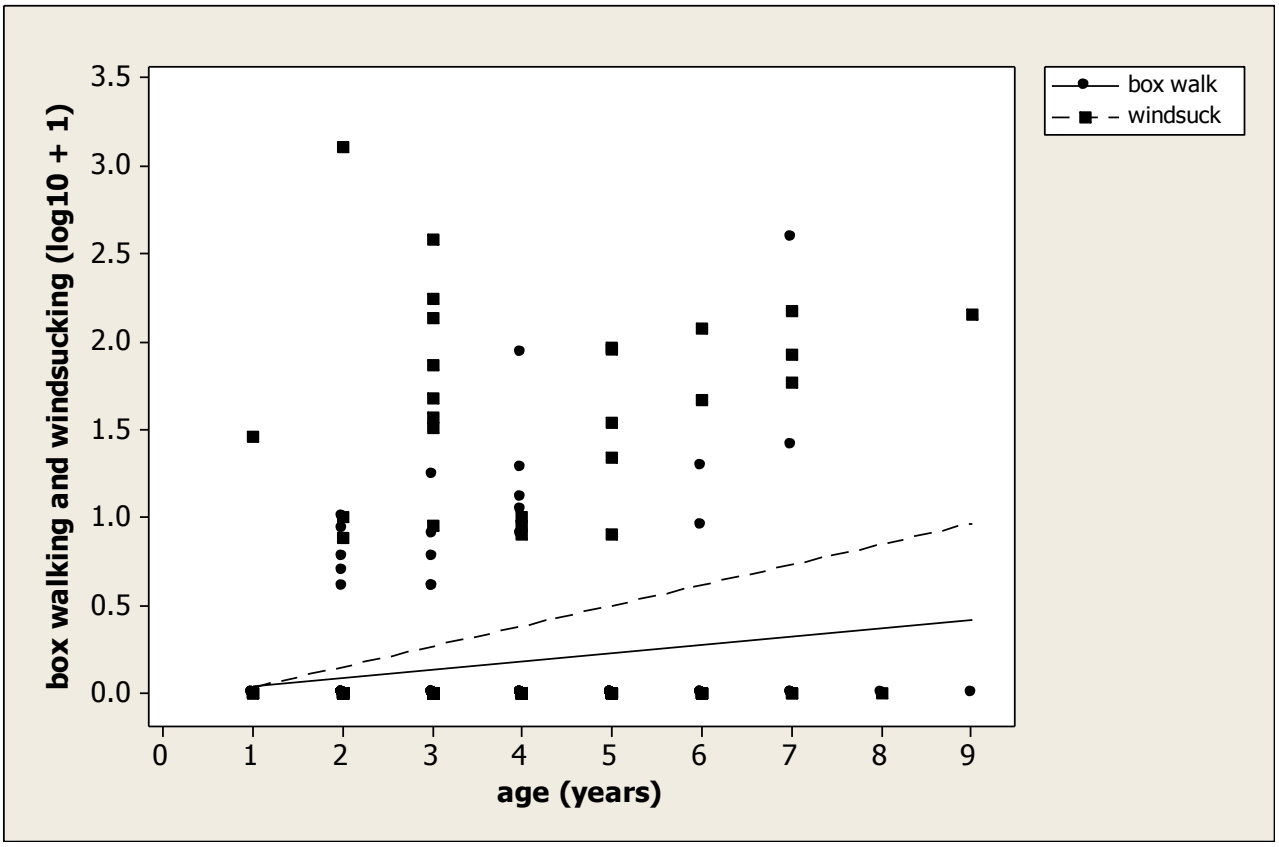


**Figure 4.3 Changes in box walking and windsucking with age.**

### *4.4.2 Correlations of Behaviours to the Welfare Index of Each Stable*

Three predictors were significantly related to the Welfare Index: standing inactive, startle and box walking (Table 4.72). Standing inactive was negatively related to the Index (Figure 4.2). Startle was positively related (Figure 4.5) to the Welfare Index indicating that when a TBR is startled it is responding to an external stimulus. A similar reaction in the feral horse would evoke a swift departure (positive welfare, being lifesaving) but in the stabled TBR the positive reaction is expressed by a tense neck and back as it is unable to flee. Box walking was also negatively related but with a major influence of a single stable. A fourth behaviour, elimination, tended to be related (P=0.08). Cubic relationship, suggested that the Welfare Index and Elimination were positively related at low values of both, but were unrelated at high values (Figure 4.6). Only one of the Welfare Index Issues, Nutrition, was correlated with horse behaviour when tested by stepwise regression. Stables with high

ratings for the Issue Nutrition tended to have horses that spent longer feeding and less time drinking (Appendix 4a).

**Table 4.6 Stepwise regression coefficients and probability values for four steps of correlating 26 behaviours with the TRWI.**

| **Step** | **1** | **2** | **3** | **4** |
|---|---|---|---|---|
| Constant | 0.87 | 0.78 | 0.82 | 0.73 |
| Inactivity | -0.00031 | -0.00027 | -0.00032 | -0.00026 |
| *P* | 0.03 | 0.03 | 0.006 | 0.01 |
| Startle | | 0.012 | 0.013 | 0.010 |
| *P* | | 0.05 | 0.02 | 0.05 |
| Box walking | | | -0.0029 | -0.0035 |
| *P* | | | 0.03 | 0.01 |
| Elimination | | | | 0.0028 |
| *P* | | | | 0.08 |
| S | 0.122 | 0.105 | 0.086 | 0.074 |
| $R^2$ | 36.3 | 56.7 | 74.3 | 82.9 |

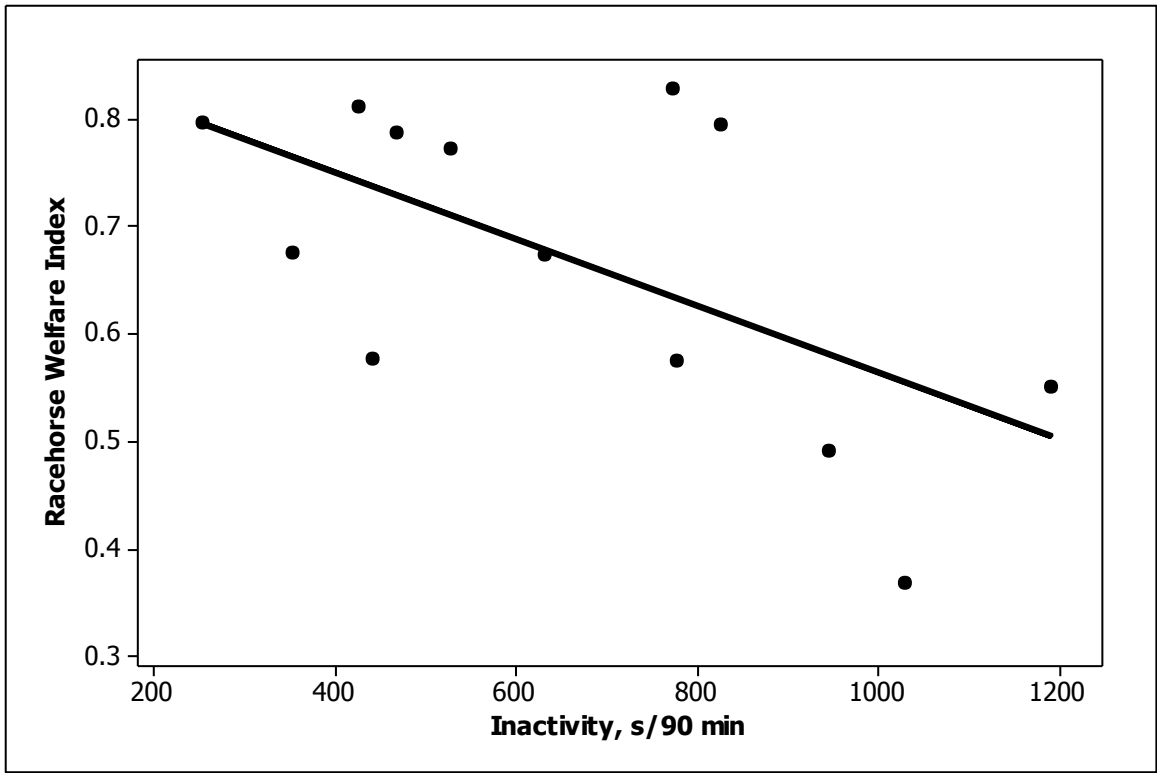


**Figure 4.4 Negative relationship between inactivity and the TRWI.**

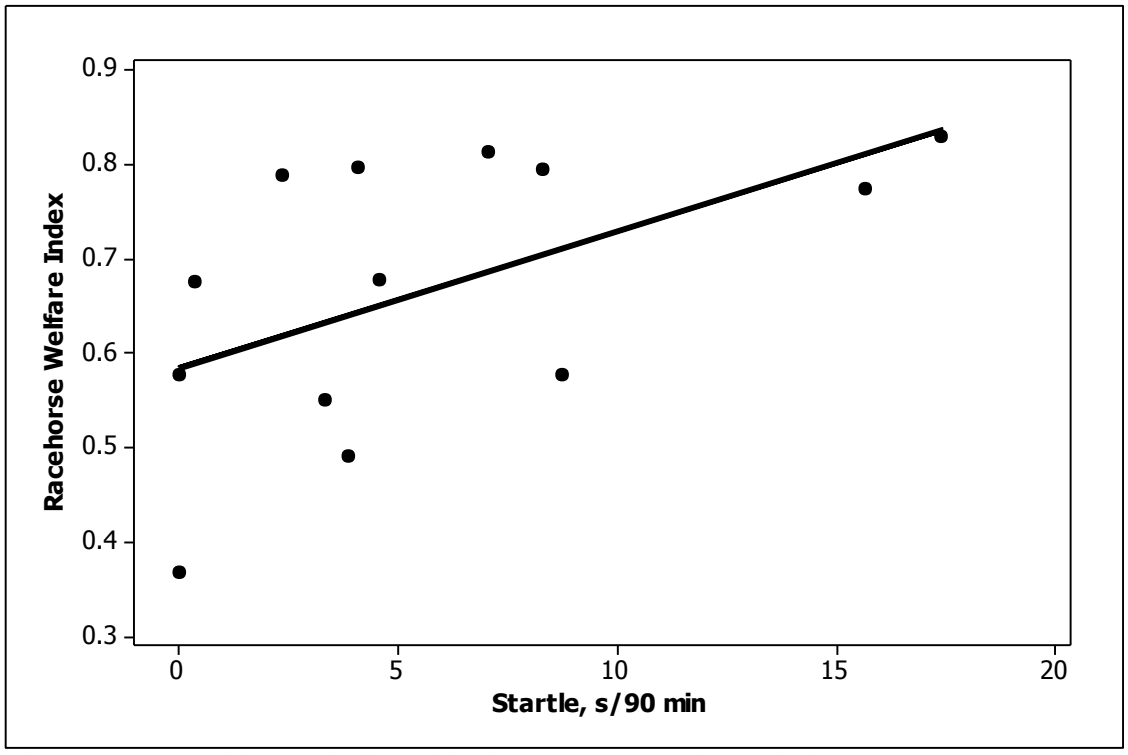


**Figure 4.5 Positive relationship between startle and the TRWI.**

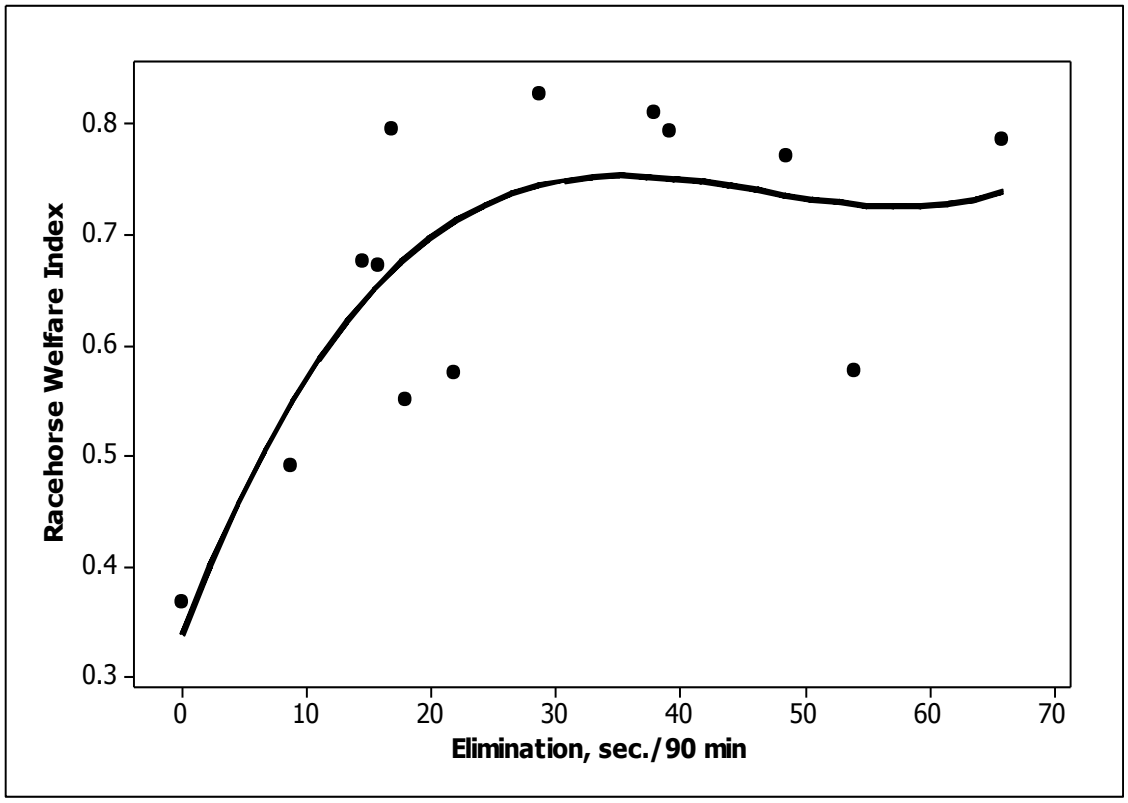


**Figure 4.6 Positive cubic relationship between elimination and the TRWI.** When horses are fed a high grain diet, with little roughage, elimination is low due to the reduction in total bulk consumed in 24 hours, thus explaining the positive cubic relationship of stables with a low welfare index and elimination.

**Table 4.7 Stepwise regression coefficients and probability values for two steps of correlating behaviours with the nutrition issue and the thoroughbred racehorse welfare index.**

| **Step** | **1** | **2** |
|---|---|---|
| Constant | 0.27 | 0.23 |
| Feeding | 0.00003 | 0.00006 |
| *P* | 0.05 | 0.003 |
| Drinking | | -0.00028 |
| *P* | 0.164 | 0.02 |
| S | 0.164 | 0.127 |
| $R^2$ | 30.5 | 62.3 |

## 4.5 Discussion

Equines have shown an ability to adapt to population dynamics and behavioural ecology which has allowed them to "successfully exploit new and changing environmental resources" (Darwin, 1859; Lorenz, 1955; Rubenstein 1981; McGreevy, 2004; Kuntz *et al.,* 2006; Goodwin, 2007). Goodwin (2007) views this trait as a pre adaption to domestication. The intensive management systems of the Thoroughbred racehorse have tested this ability of adaptation to vastly different environments and behavioural ecology with conflicting results which indicate the TBRs may modify or change their behaviour in an effort to cope with the loss of previous comfort and welfare (Rushen and Mason, 2006). Poor Welfare in TBRs is often indicated by stereotypic behaviour (Broom and Johnson, 1993) which is caused by the TBR's inability to perform highly motivated normal behaviours and appears "to be related to physical, nutritional or social environmental aspects of domestic management" (Golland *et al.,* 1999; Heleski *et al.,* 2002; McDonnell, 2003; Dodman *et al.,* 2005; Evans, 2007; Hall *et al.,* 2008).

Non-invasive measures were used to validate the findings of an online adaptive conjoint analysis survey, with involvement of industry in the questionnaire design, in determining TBR welfare. Faecal and salivary cortisol was not used as an indicator of stress. Collection methods of this steroid hormone, though non-invasive (Colville and Bassert, 2002; Engel, 2003; Sjaastad *et al.,* 2003) can be stressful, while numerous variables, such as age, environment, weather conditions, and the time of day, affect cortisol (Skyner and Smith, 2005).

The stabled TBR is often required to stand next to, or lie in, its own excrement for many hours in unclean stables, which is also stressful. Studies of pastured domestic horses indicate a preference for grazing areas devoid of faeces and thus defecate in latrine areas (Tyler, 1972; Waring, 1983; Putman *et al.,* 1991). Extremely stressful conditions are known to cause excess elimination, e.g. Ecke & Hodgson (1996) found transportation was a cause for the development of colitis. TBRs who experience the stress of environmental changes and alteration to their work loads are at a high risk of gastrointestinal dysfunction (Colville and Bassert, 2002; Sjaastad *et al.,* 2003; Mills and Clarke, 2007; Hall *et al.,* 2008; Lester, 2008; Aleman *et al.,* 2013). Urination increases with water intake but decreases with exercise and is an indicator of social distress in isolated horses (McGreevy, 2004).

Transportation whether by road, sea, rail or air is detrimental to the welfare of the Thoroughbred racehorse due to many stressors e.g. lack of ventilation, isolation, inexperienced driver and / or strapper, rough roads, short head ties, lack of food or water, long journeys, orientation within the vehicle and associated health problems such as acute colitis, laminitis, transit tetany, trailer choke, and mild azoturia (Cregier, 1981; Cargill*.,* 1999; Waran *et al.,* 2007a).

Feeding is the most basic, primitive and persistent of all behaviours for without it the TBR would not survive, or grow, nor eventually reproduce (Kyriazaks, 2010). Grazing occupies from 60% to 80% of a 24 hour day in a rhythmic pattern in feral and free range horses (Boy and Duncan 1979, Duncan 1985, Boyd *et al* 1988, Ransom & Cade, 2009; Houpt, 2011) while stabled TBRs spend as little as 40% feeding (Kiley-Worthington, 1987) . See Chapter 2.3.5 for Activity Budgets.

Observations of TBR management found that after exercise, the morning was taken up with Maintenance behaviour, feeding and resting being of primary importance (McDonnell, 2003; Ransom & Cade, 2009). Racehorses were fed small amounts of hay and concentrates in small meals (Kohnke *et al.,* 1999; Davidson and Harris, 2007; Houpt, 2011). Initially TBRs ate their concentrates which were then followed by hay.

Periods of rest and sleep typically follow exercise and feeding (McDonnell, 2003; Ransom & Cade, 2009). Rest standing is a transitional state between wakefulness and sleeping; the TBR is relaxed with the head slightly lowered and eyes half or nearly closed. During standing sleep SWS can occur (McDonnell, 2003), due to the stay apparatus of their legs (a survival mechanism) which “supports the entire equine body without muscular control” (Dallaire, 1986) allowing them to remain standing while asleep. Standing sleeping can be as short as 15 minutes or spread over four or five bouts amounting to about five hours per day (Goodwin, 2007; Houpt, 2011). When standing inactive TBRs are lethargic, their head lowered and ears upright. An abnormal amount of time spent in unusual postures may be associated with physical discomfort, and may indicate problems “associated with physical illness, weakness, or severe social stress” (Golland *et al.,* 1999; Evans, 2007) which is associated with poor welfare (Heleski *et al.,* 2002; McDonnell, 2003; Dodman *et al.,* 2005; Hall *et al.,* 2008).

Many of the horses lie down after morning exercise and feeding, sometimes classified as comfort behaviour. Lying is important for the recovery of TBR's "body systems, health and safety" (Petherick, 2010) and is the time when deep sleep (REM) occurs, i.e. only when the TBR is in lateral or sternal recumbency with the head supported by the muzzle touching the ground (Houpt, 2011). Deep sleep is important for "health and conserving energy and aiding thermoregulation and maintenance of physiological efficiency" (Dixon, 2010) and "occurs in several short bouts in any 24 hours totalling about 2 hours "(Goodwin, 2007).

Elimination includes urination and defecation which is sexually dimorphic (McDonnell, 2003). The distinct male and female forms of defecation (McDonnell, 2003; Ransom & Cade, 2009) were observed as males tended to make faces' piles and urinated in one area of the stable. Females defecated and urinated indiscriminately within the stable. Elimination was a frequent occurrence, with defecation occurring more often than urination (McDonnell, 2003). The amount and frequency of elimination varied according to the amount of food and water consumed (McDonnell, 2003).

Rubbing and Scratching was a common occurrence and is often classified as auto groom (McDonnell, 2003). Due to the physical restrictions of stable design and management this behaviour replaced that of allo-grooming (Crowell-Davis *et al.,* 1987; Eady, 2010).

Social communication, both visual and auditory (Houpt, 2011), occurred in the form of:

a) Object play, involved contact and manipulation of inanimate objects (McDonnell, 2003). Play was restricted due to management restrictions of the stabled TBR.

b) Sniffing (Pellis & Pellis, 2010) occurred when the TBR investigated a novel object or odour. Such behaviour McDonnell (2003) noted, may often involve other investigatory behaviour such as pawing, looking, smelling and mouthing.

c) Aggression is both a deliberate and intentional demonstration of intent to cause damage to another, by fighting, attacking and display (Marchant-Forde 2010). Goodwin (2007) states "much of the aggression in domestic horses is due to management conditions" due to defending feed and/or "failure by handlers to respond to more subtle threat signals". Aggressive threats escalate from mild nose

wrinkling and ear flattening to eventually biting (Rees, 1993). While defensive threats begin with nose wrinkling and ear flattening and end in kicking (Waring, 1983).

d) Vocalisations are “sounds produced by TBRs via their vocal tract” (Weary, 2010). A neigh or whinny can be either a greeting or indicate anxiety i.e when separated from conspecifics. Snorts and sneezing are frequently heard when TBRs are exercising. Snorts and nickers are from the nose, with mouth closed, while a squeal is defensive and like the neigh or whinny occurring with the mouth open (Houpt, 2011).

In the late afternoon the TBRs were taken from their stable to allow stable cleaning and bedding to be replaced. Where possible the TBRs were taken to pasture for a period of 30 minutes or so. Other TBRs were exercised on walkers for a similar time during the cleaning process. Walking was the only form of Locomotion displayed by the TBRs during the observation period.

Locomotor stereotypic behaviours occurred during the observations with the TBRs either box walking (Kiley-Worthington, 1983; Tadich *et al.,* 2012) in a repetitive aimless pattern, which could form a figure 8, a circle or along a wall in the stable, or moving rhythmically from side to side i.e. weaving (Mills & Nankervis, 1999) or treading, with their limbs moving aimlessly up and down on the same spot. Door banging occurred frequently in anticipation of feeding with the TBR knocking the door or walls with a fore-hoof (Kiley-Worthington, 1983; Mills and Nankervis, 1999). Head tossing frequently occurred in anticipation of feeding and Involved repeatedly moving the head up and down, sometimes this behaviour is called nodding (Cooper *et al.,* 2000; Tadich *et al.,* 2012). Pawing also occurred in anticipation of feeding, the TBR using one slightly elevated fore hoof in a forward direction and then drawing the leg sharply backward and at the same time dragging the toe in a digging movement (McDonnell, 2003; Tadich *et al*., 2012).

Oral stereotypies also occurred during the stable observations, most common was windsucking and crib biting, both behaviours involve tensing the neck muscles and taking in a breath, crib biters grasped a solid object, while wind sucking did not involve grasping (McDonnell, 2003; Tadich *et al*., 2012). Chewing objects, is similar to wind sucking/ crib

biting and can damage stable fittings, especially when wooden. Pieces of wood or splinters may be broken away and ingested subsequently harming the TBR (McDonnell, 2003; Tadich *et al*., 2012). Sham chewing was also observed with the TBR's mouth empty while repetitively moving the jaw and tongue (Willard *et al.,* 1977; McDonnell, 2003). Repetitive licking of the sides of buckets, walls, floors and door latches also occurred, without a nutritional purpose attached to this behaviour (Willard *et al.,* 1977; Tadich *et al.,* 2012). Yawning was observed during long inhalations, with the TBR's mouth wide open, at times moving the jaws from side to side (McDonnell, 2003). Stereotypic behaviour has been known to impinge on the time TBRs spend on Feeding and Resting (McGreevy *et al.,* 2001). This may result in a decrease in energy and in body weight while lack of Rest is frequently a precursor to stress and could be due to pain from gastric ulcers. Inactivity was positively correlated with windsucking and chewing objects, which are both oral stereotypies, and negatively correlated with pawing, which is a locomotor stereotypy, suggesting that the motivations for these two types of stereotypy are antagonistic.

Oral stereotypies in young TBRs usually begin at weaning time and are caused by feeding high energy grain rations (McGreevy, 2004; Davidson and Harris, 2007) and /or a brutal weaning method (McGreevy, 1996; Waters *et al.,* 2002). While locomotor stereotypy is a response to the restricted stable environment which severely reduces the normal pattern of locomotion (Carlstead, 1998; Houpt, 2005) as well as the stress of leaving their home range when all affiliations made at the breeding farm are broken (McGreevy, 2004).

Looking was the most common of the TBR's response to external stimuli; the head would be orientated towards the object or animal with an elevated rigid neck with ears erect and slightly dilated nostrils (McDonnell, 2003; Ransom and Cade, 2011). Startle occurred less frequently and is a "rapid behavioural reaction to a sudden stimulus and is associated with a number of neuro-hormonal changes related to stress" (Taylor, 2010). The TBR's head is up with erect ears, tense neck and back, and may rush away or turn suddenly (Researcher's Personal Observation).

Polydipsia, excessive drinking (Fraser and Arave, 1992) can be an oral stereotypic behaviour, psychogenic polydipsia (Houpt, 2011), resulting from stress while urination increases with stress (Fraser and Arave, 1992). Excessive drinking may also be a symptom of disease or medication (McGreevy, 2004), and was not observed in the stable

observations. When drinking was observed it was classified as Maintenance behaviour (McDonnell, 2003) and not associated with stress.

Weaving is a stereotypic locomotor activity and its positive correlation with elimination and aggression is explained by the thwarted desire of TBRs to move away from excrement (Tyler, 1972; Waring, 1983; Putman *et al.,* 1991), while aggression results from the instability of a TBR training establishment where the membership and rank of TBRs to a social group is constantly changing (Crowell-Davis, 1993; Goodwin, 2007). Response to unstable management conditions usually occurs at feeding time, or was due to TBRs' threats or signals being ignored or misread by their handlers or as a result of unidentified pain.

Equines are adept at learning avoidance responses to pain, where flight is impossible (Goodall, 1990), as in the stabled TBR (Bellisle *et al.,* 1998), the equine will use defensive aggression to avoid or remove itself from the source of pain (Miller, 1998) which is frequently caused by gastric ulcers (Cargill, 1999).

The most variable behaviours (Table 4.3) were weaving, chewing objects, inactivity, resting, elimination and drinking which can all be associated with stress (Casey, 2007; Cooper & McGreevy, 2007).

## 4.6 Conclusion

The results of this study conclude that the Australian wide survey of the opinions of stakeholders in the Australian Racing Industry (ARI) identified appropriate welfare indicators which were validated by a non-invasive assessment of Thoroughbred racehorse welfare through behavioural observation measures in Thoroughbred racehorse training establishments.

Identification of improvement in the TRWI score by subsequent administration of the TRWI with behavioural observation measures in TBR training establishments would identify their value to TBRs by reassessing their behaviour score .Thus any correlation of behavioural improvement with TBR training establishments is important in establishing the value of the TRWI as a non- invasive measure of Thoroughbred racehorse welfare.

**Acknowledgements**

I most sincerely thank the Thoroughbred race horse Trainers in South East Queensland, Australia, who allowed me and my assistant to observe TBR behaviour in their stables and the stakeholders in the Australian Thoroughbred Racing Industry for their support in this study.

# CHAPTER 5

# DEVELOPMENT AND VALIDATION OF A THOROUGHBRED RACEHORSE WELFARE INDEX AND AN AUSTRALIAN SURVEY OF THE HUSBANDRY PRACTICES FOR THOROUGHBRED RACEHORSES IN AUSTRALIAN TRAINING ESTABLISHMENTS

## TABLE OF CONTENTS

# LIST OF FIGURES



# LIST OF TABLES

## 5.1 Abstract

Currently no reliable non-invasive welfare measuring system for the Thoroughbred racehorse exists in Australia, or anywhere in the world. I investigated the environment, management systems and husbandry of Thoroughbred racehorses in racing establishments throughout Australia, in order to validate a welfare measuring system for Thoroughbred racehorses previously developed. In this process the expert opinion of racing industry stakeholders was initially used to identify those aspects for successful Thoroughbred racehorse management. An Australia-wide survey of racing industry stakeholders was then conducted to identify which parameters are important for welfare in a training establishment. Using a welfare index derived from this information, we surveyed trainers to discover how well they were providing for their horses' welfare. Trainers performed well on horsemanship and health/disease aspects. Provision for ventilation, transportation and nutrition were also scored at high levels. However, provision for weaning, wastage, assisting horses to cope with heat stress, stabling and education of the thoroughbred racehorse were all at a lower level of performance, indicating a need for improvement in these welfare issues. It is concluded that the welfare measuring system evaluated is able to discriminate between trainers offering varying levels of welfare in the major issues for racehorse training establishments.

## 5.2 Introduction

The Racing Industry is continually challenged to improve Thoroughbred racehorse (TBR) conditions both in training and race procedures, particularly those identified as welfare issues. The training of the TBR is often based on management and husbandry methods that have been determined over many years to be convenient to humans, but not necessarily scientifically evaluated. The deficiencies in the thoroughbred racing industry are sometimes due to a lack of space, especially as old race courses are increasingly surrounded by suburbia and lack adequate training and housing facilities for the TBR. Race track design (track shape, size and surface), appropriate housing (allowing adequate space and physical and visual contact for the TBRs), training methods, performance-related clinical problems and transportation, including an adequate and safe area for horse transports on race courses (Waran *et al.,* 2007a; Boden, 2008), are all welfare issues which need to be addressed.

Thoroughbred racing is controlled in Australia by The Australian Racing Board (ARB) which was established in June 1998 (ARBL, 2014), now the Australian Racing Board Ltd., (ARBL) and formed into a company limited by guarantee (ARBL, 2014). Though Thoroughbred horse racing in Australia is state structured there is overarching governance at the national level through the ARBL.

The ARBL, under its constitution can make, change and administer the Australian Rules of Racing and "do all things whatsoever that the Board considers to be conducive to developing, encouraging, promoting or managing the Australian thoroughbred racing industry" (ARBL, 2014). This overarching governance at the national level, through the ARBL, compliments local government legislation, enforcing codes of practice (RIRDC, 2006) where conformity to minimum standards and guidelines is required (Chapter 3). However, minimum standards are not always able to address all of the major factors affecting the welfare of the stabled TBR, for example the height of the stable must be in relation to the size of the TBR. Sainsbury (1987) gives stable sizes 'for most horses of 4 m x 4 m' and for ponies a smaller size (3.3 mx 3.3 m) is given. The roof height recommended by Sainsbury (1987) for Barn type stabling is '3m at the eaves and rising to the ridge of about 8m'.

The Australian Thoroughbred racing industry's original concept of entertainment and recreation (ARBL, 2014) has changed to being one of an industry with economic importance, and, on a per capita basis, currently is the strongest racing industry in the world (Figure 2.1, Chapter 2). This industry is dependent on the well-being of the Thoroughbred racehorse. As a result, we undertook a survey of racehorse trainers (Appendix 5, p196) to examine their provision for the welfare of their horses, using issues included in the Thoroughbred Racehorse Training Index developed previously.

## 5.3 The Survey

The same fourteen issues and levels as used in the Thoroughbred Racehorse Training Index (Table 3.1) were used in a survey of TBR Trainers within Australia. Approval for the survey was obtained from the Human Ethics Committee of the University of Queensland (project number 2011000067). The survey, (Appendix 5, p194) which contained two sections with a total of 19 questions, in vignette format (Barter and Renold, 2000; Wilks, 2004) was created using Sawtooth Software (Sawtooth Software, Evanston. Il. USA)

A letter accompanied the survey containing a brief explanation of the research project and instructions on how to complete the survey, as well an approximate time for completion. Participants were advised of their right to withdraw from the survey at any time, who to contact if necessary and the opportunity to enter a draw for a prize (16kg of "Salkavite", Ranvet Pty. Ltd, Banksmeadow, NSW, Australia).

### *5.3.1 Distribution of the Survey*

A link to the online survey was initially sent by email to 655 trainers within Australia. The trainers' email addresses were initially just those used previously for the stakeholders' survey sent to trainers in 2010. However, many of these addresses were no longer valid (613 returned unopened). Then 405 new email addresses were sourced from web sites and state racing directories and sent out on 13th July 2014, of which 71 were undeliverable. A reminder was sent on the 7th September 2014, requesting completion of the survey.

As emails were returned unopened and it was known that many trainers in Australia live in areas not connected to the internet, hard copies of the survey were sent to 250 trainers' street addresses, obtained from Racing Journals, web sites and state racing directories, together with a stamped addressed envelope.

### *5.3.2 Section 1 – Demographics*

This consisted of 5 questions, firstly requesting information as to the respondents' gender and age. Respondents were asked to indicate the highest level of education they had achieved: Primary School, High School, Technical and Further Education College, University or other. Respondents were also asked to advise the total time of involvement with Thoroughbred racehorses. Finally respondents were asked in what country they had gained this experience.

### *5.3.3 Section 2 – Welfare and Management*

This consisted of 14 questions, the first of which asked the respondent how experienced their staff were, followed by a question regarding how well the health and disease problems of their TBRs were attended to. This was followed by questions concerned with the education of racehorses, the design and surface of race tracks, ventilation, both in the stable and in transporters, the amount of space the thoroughbred racehorse has in the

stable, and if there was a yard attached or not. Other questions dealt with weaning methods, the skill of transport drivers, nutritional needs and availability of green forage, how the trainers coped with wastage of TBRs, whether their TBRs were exposed to extreme weather conditions, how often their TBRs were whipped in races, the environment in which the TBRs were kept and finally how often tongue ties and or blinkers were used.

### *5.3.4 Pilot Study*

A pilot study was administered to 3 Thoroughbred racehorse trainers in June 2014. Their comments were noted and where necessary, minor changes were made to the survey.

## 5.4 Statistical Analysis

Data were subjected to simple descriptive statistics. Relationships between issues were explored with a principal component analysis with a forward backward fitting of components, using the Minitab v15 statistical package. Likelihood ratio Chi-Squared analysis was used to determine the significance of gender differences in trainers' responses. Sometimes the data for each question in the survey was too small for a statistical application, when this occurred it was combined with other levels in that question but only when questions in each respective level were compatible with each other. Questions which were unable to be combined and were not significant, i.e. there was no difference between men or women, were Horsemanship, Health and Disease, Ventilation, Stabling, Transport, Heat and Humidity, Whips, Environment, Gear.

## 5.5 Results

### *5.5.1 Response Rate*

The total number of complete email and postal surveys received was 58 (32 by email and 26 were postal). Overall (including all sent questionnaires) in the first round of email approaches 655 were sent, of which 613 were undeliverable. The second round of newly sourced e-mail addresses had 405 approaches with 71 undeliverable. In the second approach, 108 were undeliverable. Thus a total approach of 1060 emails with 792 undeliverable emails (613+71+108), resulting in 268 delivered emails. From these there were 50 responses, 32 complete and 18 incomplete which were discarded, and 218 did not reply. Overall response rate for the survey was 11.9%, 3.0% for email and 14.0% for the hard copy, giving an overall completed response rate for both surveys of 4.4%. Actual

(including only delivered questionnaires) response rate from delivered emails was 57.5% and from hard copy was 12.1%, with an overall actual response rate of 28.5%.

#### *5.5.1.1 Section 1 – Demographics*

The majority of the respondents were male (74%) and mostly aged over 40 (76%), (Table 5.1). When asked to indicate the highest level of education achieved, almost half of the respondents had finished education at high school. Nearly all had more than forty-eight months experience with TBR's, gained in Australia.

#### *5.5.1.2 Section 2 – Welfare Provision for the issues in the TRWI*

The responses to the issue Horsemanship indicated that 81% of trainers had staff that were well trained and experienced, with knowledge of equine behaviour, equine husbandry, management and training with an affinity and empathy for TBRs (FAWC, 2007). A total of 5% of trainers had staff that lacked the ability to evaluate health and welfare and frequently resorted to force. The remaining 12% of trainers said approximately half their staff were able to evaluate health and welfare.

Trainers responded to Health and Disease in a positive manner with 95% regularly attending to health with the appropriate use of tranquilisers, analgesics and parasitic control, while 3.4 % of trainers gave some attention to health with occasional use of analgesics, tranquilisers and parasitic medication and the remaining 2% said they attended to health infrequently and tranquilisers, analgesics and parasitic control medication were used only when absolutely necessary.

A total of 53.4% of trainers said their TBRs education involved regular training from birth to weaning, sales preparation and transporting, riding, track work, barrier habituation and racing for their preparation to commence race training, while a further 12.4% said their horses came to them with some of the above education and a small percentage, 4%, said the TBRs had little or no preparation before commencing training.

A gradual turning cambered turf track was the most common type of race track, used by 45% of trainers. While 13.8% raced on a tight turning cambered turf track, and 7% raced on a gradual turning cambered synthetic track, only 5% raced on a tight turning synthetic track. Different types of race track and surface that were not described in the questionnaire

amounted to 29%. Some trainers said their horses raced on dirt or grass while another trainer raced on sand. Other trainers complained about the roughness of country tracks.

Good ventilation, with fans in every stable, and well ventilated transportation, was reported by 50% of the trainers, while 29% had some other type of ventilation that was not listed in the questionnaire. When asked to describe what this difference was they listed walk-in, walk-out stables, or open air stables. Those training establishments without fans in every stable, but at the end of the stable corridors, and some ventilation in transport, amounted to 17%. Only 3% of stables were reported to be of a solid construction with poor ventilation to at least 110 cm, with wire mesh above and inadequate ventilation in transport.

The percentage of TBR trainers who had large stables, i.e. 5 x 5 x 6 m, with free use of an attached yard was 36%. A further 24% had the same sized stables but no free use of an attached yard. The survey found that 14% of trainers had small stables i.e. 3.6 x 3.6 x 4 m with no use of an attached yard and 5% of trainers had stables of the same size but with free use of an attached yard. The trainers who had some other type of stabling amounted to 21% and these stables were mostly walk-in, walk-out buildings with free use of the attached yard, or a shelter that was open on three or four sides and situated within a yard.

The trainers' response to weaning advised that a majority, 52%, had no knowledge of the weaning process. The isolation of two weanlings together in a stable allowing visual and physical contact with neighbouring horses was the preferred practice for 22% of trainers. 14 % of trainers chose the practice of removing one mare at a time from a group of mares and foals, until all mares were removed and only foals remained.

A transport driver's skill is important to the welfare of the TBR when being transported, and 90% of trainers recognised this importance. Not all trainers (7%) employed skilled drivers who have experience in loading and off-loading TBRs, while 2% had staff with a limited experience. The option for an alternative to these questions was provided in the survey but only 2% said they had an alternative but did not say what those options were.

Nutrition was recognised by 78% of trainers as important to the well-being of the TBR, paying attention to age and training requirements of individual horses and balancing fibre/grain intake as well as providing access to additional green forage. Those trainers who provided green forage infrequently to the TBR's amounted to 17%, while 3% had

other ways of supplying nutrition to TBRs. They did not describe this procedure. Only 2% of trainers did not supply any green forage.

The high percentage of trainers who were unaware of what happens to the TBR (34%) after racing was slightly higher than those TBRs who were retired to equestrian sports (33%). The lowest number was horses sent to the slaughterhouse at 1.7% and those given away for other purposes, due to poor temperament, insufficient race record for breeding and being unsuitable for equestrian sports was 14%. The trainers did not often say what the 14% of TBRs were used for, but in many cases it was later reported that they would become companion animals (personal communication, Thoroughbred horse trainers). Those TBRs who were retired to a breeding farm amounted to 17%.

Heat and Humidity responses suggested that 50.0% of trainers rarely exposed their TBRs to climatic variation. TBRs were subjected to acclimatization following transport with the stable design allowing good temperature control while 37.0% were sometimes exposed to climatic variation with some acclimatization following transportation; the stable design allowed for temperature control. The remaining 8.6% were regularly exposed to climatic variation with inadequate acclimatisation following transport and their stables were poorly designed for temperature control. Finally 3.4% had some other method of dealing with heat and humidity, but they did not describe what that method was.

The whip use question found that 62% of trainers used whips occasionally throughout the race, with 21% agreeing to the whipping of horses regularly in the last 120 metres of the race if the horses were tired. However, 17% did not use whips; the jockeys rode with 'hands and heels'[3].

The trainers were asked the type of Environment the TBRs were kept in, and whether the yard design allowed physical and or visual contact with conspecifics as well as the type of bedding, i.e. wood shavings or straw bedding. A total of 47% of trainers used wood shavings with a stable yard allowing only visual contact with conspecifics, while 29% used wood shavings with physical and visual contact with conspecifics. When asked if they used an alternative to the survey environment possibilities, 19% said they did use an alternative,

[3] Hands and heels' describes a jockey riding without using the whip, but urging the horse forward with his/her heels and a light (hand) contact on the reins.

but not all trainers specified what that alternative was. Three trainers (6.8%) used sand for bedding while another trainer used pine saw-dust. Straw bedding was the least popular with 4% of trainers having stables with both physical and visual contact and only 2% using straw with only visual contact. One trainer said his TBRs had physical and visual contact when in yards during the day but did not have physical and visual contact when in their stables at night.

Gear was concerned with the use of blinkers and tongue ties, and 59% said they used both, while 24% used neither. Blinkers but no tongue tie was used by 16% with 2% of trainers using a tongue tie but no blinkers.

**Table 5.1 Demographics of trainers' survey of welfare issues and levels within the thoroughbred horse racing industry**

| | | | |
|---|---|---|---|
| Q1 | Gender | Count | Percentage |
| | Male | 43 | 74.1 |
| | Female | 15 | 25.9 |
| | | | |
| Q2 | Age | Count | Percent |
| | <19 | 1 | 1.7 |
| | 19 – 24 | 2 | 3.5 |
| | 25 – 30 | 5 | 9.0 |
| | 31 – 40 | 6 | 10.3 |
| | 41 – 50 | 18 | 31.0 |
| | 51 - 61 | 26 | 45.0 |
| | | | |
| Q3 | Highest level of education | Counts | Percentage |
| | Primary School | 3 | 5.2 |
| | High School | 27 | 46.6 |
| | Technical and further education college | 14 | 24.1 |
| | University | 14 | 24.1 |
| | Other, please specify | 0 | 0 |
| | | | |
| Q4 | Total Time of Involvement with TBRs | Count | Percentage |
| | < 1 month | 2 | 3.5 |
| | 1 – 12 months | 1 | 1.7 |
| | 13 – 48 months | 1 | 1.7 |
| | > 48 months | 54 | 93.1 |
| | | | |
| Q5 | Where did you mostly gain this experience | Count | Percentage |
| | Australia | 53 | 91.4 |
| | United Kingdom | 0 | 0 |
| | Japan | 0 | 0 |
| | France | 1 | 1.7 |
| | Ireland | 0 | 0 |
| | Germany | 0 | 0 |
| | Other, please specify | 4 | 7.0 |

**N=58**

**Table 5.2 Welfare and management of trainers' survey of welfare issues and levels within the thoroughbred horse racing industry**

| Welfare and Management | Issue | Count | % |
|---|---|---|---|
| | | | |
| Q1. Horsemanship<br><br>How experienced are your staff? | 0. Failed to answer question | 1 | 2.0 |
| | 1. All staff are experienced and well trained employing knowledge of equine behaviour in management and training | 47 | 81.0 |
| | 2. Approximately half the staff are experienced and have the ability to evaluate health and welfare | 7 | 12.0 |
| | 3. None of the ability to evaluate health and welfare and frequently resort to force | 3 | 5.2 |
| | | | |
| Q2. Health and Disease<br><br>How well are your horses' health and disease problems attended to? | 1. Regular attention to health appropriate use of analgesics, tranquilizers and parasitic control | 55 | 95.0 |
| | 2. Some attention to health. Occasional use of analgesics, tranquilizers and parasitic control medication | 2 | 3.5 |
| | 3. Infrequent attention to health. Analgesics, tranquilizers and parasitic control medication used only when absolutely necessary | 1 | 2.0 |
| | | | |
| Q3. Education of the Thoroughbred racehorse<br><br>To what level are your horses educated when sent to you for race training? | 0. Failed to answer question | 1 | 2.0 |
| | 1. Regular training from birth through to weaning sales preparation and transporting, riding, track work, barrier habituation, and racing | 31 | 54.0 |
| | 2. Some handling as a foal, through to weaning sales preparation and transportation, riding, track work, barrier habituation and racing. | 24 | 41.4 |
| | 3. No handling as a foal or weanling, little preparation for sales and transporting, riding and track work rushed with no habituation to barrier | 2 | 3.5 |
| | | | |
| Q4. Track Design and Surface<br><br>What type of track do your horses race on? | 1. Gradual turning cambered turf track | 26 | 45.0 |
| | 2. Gradual turning cambered synthetic track | 4 | 7.0 |
| | 3. Tight turning cambered turf track. | 8 | 14.0 |
| | 4. Tight turning cambered synthetic | 3 | 6.0 |
| | 5. Other, please describe | 17 | 29.3 |
| | | | |
| Q5. Ventilation<br><br>How good is the ventilation for your horses? | 1. Good ventilation: fans in every stable good ventilation in transport | 29 | 50.0 |
| | 2. Some ventilation: fans at end of stable corridors some ventilation in transport | 10 | 17.2 |
| | 3. Poor ventilation: stable walls of solid | 2 | 3.5 |

| | | | |
|---|---|---|---|
| | construction to at least 110cm with wire mesh above; inadequate ventilation | | |
| | 4. Other, please describe | 17 | 29.3 |
| | | | |
| Q6. Stabling<br><br>How much space do your horses have? | 1. Large stable (approximately 5m x 5m with ceiling height approximately 6m), with free use of attached yard. | 21 | 36.2 |
| | 2. Small stable (approximately 3.6m x 3.6m with ceiling height approximately 4m) with free use of attached yard. | 3 | 5.2 |
| | 3. Large stable (approximately 5m x 5m with ceiling height approximately 6m), with no use of attached yard. | 14 | 24.1 |
| | 4. Small stable (approximately 3.6m x 3.6m with ceiling height approximately 4m) with no use of attached yard. | 8 | 14.0 |
| | 5. Other, please describe | 12 | 21.0 |
| | | | |
| Q7. Weaning<br><br>Which weaning process was used for the majority of the horses that you train? | 1. Removal of one mare at a time from a group of mares and foals in a paddock, until all mares are removed from group | 8 | 14.0 |
| | 2. Two weanlings isolated together in a stable which allows visual and physical contact with neighbouring horses | 13 | 22.4 |
| | 3. One weanling in a stable, which does not allow visual or physical contact with neighbouring horses. | 3 | 5.2 |
| | 4. Unknown | 30 | 52.0 |
| | 5. Other, please describe | 4 | 7.0 |
| | | | |
| Q8. Transport<br><br>How skilled are your transport drivers? | 1. Skilled driver, very experienced in loading and offloading horses | 52 | 90.0 |
| | 2. Semi-skilled driver, some experience of loading and offloading horses | 4 | 7.0 |
| | 3. Staff with limited experience in driving, loading and offloading horses | 1 | 2.0 |
| | 4. Other, please describe | 1 | 2.0 |
| | | | |
| Q9. Nutrition<br><br>Do you tailor your horses' nutritional needs to their requirements? Including giving green forage? | 1. Attention to age and training requirements of individual horses in order to balance fibre / grain intake with addition of proven supplement requirements and access to additional green forage | 45 | 78.0 |
| | 2. Attention to age and training requirements of individual horses in order to balance fibre / grain intake with proven supplement requirements, infrequent access to additional green forage | 10 | 17.2 |
| | 3. Standard nutritional program for all horses | 1 | 2.0 |

| | | | |
|---|---|---|---|
| | regardless of racing program, no additional green forage | | |
| | 4. Other, please describe | 2 | 3.5 |
| | | | |
| Q10. Wastage<br><br>What happens to your horses when retired from racing? | 1. Horse retired from racing to a breeding farm | 10 | 17.2 |
| | 2. Horse retired for equestrian sports | 19 | 33.0 |
| | 3. Horse given away as race record was insufficient for breeding or temperament unsuitable for retraining in equestrian sports | 8 | 14.0 |
| | 4. Horse sent to slaughterhouse, unsuitable for further use | 1 | 2.0 |
| | 5. Unknown or other, please describe | 20 | 34.5 |
| | | | |
| Q11. Heat and Humidity<br><br>Are your horses exposed to extreme climate conditions? | 1. Horses are regularly exposed to climatic variations; inadequate acclimatization following transport; poor stable design for temperature control | 5 | 9.0 |
| | 2. Horses sometimes exposed to climatic variation; some acclimatization following transport; stable design allows for some temperature control | 22 | 38.0 |
| | 3. Horses rarely exposed to climatic variations; good acclimatization following transport, stable design allows for good temperature control | 29 | 50.0 |
| | 4. Other, please describe | 2 | 3.4 |
| | | | |
| Q12. Whips<br><br>How often are your horses whipped in their races? | 1. Whipping horses occasionally throughout the race | 36 | 62.07 |
| | 2. Whipping horses regularly in the last 100 meters of the race if they are tired | 12 | 21.0 |
| | 3. No use of whip, jockeys ride with hands and heels | 10 | 17.2 |
| | | | |
| Q13. Environment<br><br>What is the environment in which the horses are kept? | 1. Use of wood shavings. Stable / yard design allows only visual contact with other horses | 27 | 47.0 |
| | 2. Use of wood shavings. Stable / yard design allows physical and visual contact with other horses | 17 | 29.3 |
| | 3. Use of straw bedding. Stable / yard design allows physical and visual contact with other horses | 2 | 3.5 |
| | 4. Use of straw bedding. Stable / yard design allows only visual contact with other horses | 1 | 2.0 |
| | 5. Other, please specify | 11 | 19.0 |
| | | | |
| Q14. Gear | 1. No blinkers or tongue tie | 14 | 24.1 |
| | 2. Use of blinkers, but no tongue tie | 9 | 15.5 |

| | | | |
|---|---|---|---|
| Do you use blinkers and tongue tie routinely? | 3. Use of tongue tie and blinkers | 34 | 59.0 |
| | 4. Use of tongue tie but no blinkers | 1 | 2.0 |
| | | | |

### 5.6 Determination of the TRWI from Survey Respondents

Analysis of the data calculated by Sawtooth Software was generated from the results of an Australian wide survey, 'Determining Opinions of Welfare Requirements for Thoroughbred Racehorses by Stakeholders in the Thoroughbred Racing Industry' which was circulated among nine stakeholder groups, as described in chapter 3. The average Importance Scores and the average Utility Values for each of the 14 Issue Levels, as generated by Sawtooth Software, were used to calculate the values for the Thoroughbred Racehorse Welfare Index score.

Firstly the average Utility Values were zero centred. There were between two and four Utility Values for each Importance Score, which corresponds to the Levels chosen for each Issue. By summing the Utility Values a score of zero is obtained. The rescaling of the values produces a maximum Utility Value of one (maximum contribution) and a minimum Utility Value corresponding to zero (minimum contribution) while the middle Utility Values score between one and zero according to their relative importance. The contribution of each Utility Value is weighted according to the Importance Score of each issue. **T**he TRWI was obtained using the following formula:

$$TRWI = \sum_{i=1}^{14} \left( \frac{UV_i - Min_i}{Max_i - Min_i} \right) \frac{IS_i}{100}$$

Where:

$UV_1$ = Individual Utility Value

$Min_1$ = Minimum Utility Value

$Max_1$ = Maximum Utility Value

$IS_1$ = Issue Importance Score.

**Table 5.3 Creation of TRWI from utility values obtained from issues, levels and their level of importance values from the Thoroughbred racehorse husbandry questionnaire and the trainers' survey.**

| Issues | | Levels | Utility Values | Contribution to TRWI |
|---|---|---|---|---|
| Horsemanship | 1 | All staff are experienced and well trained, employing knowledge of equine behaviour in management and training. | 62.29 | 8.80 |
| | 2 | 50% of staff are experienced and well trained and sometimes employ knowledge of equine behaviour in management and training. | -3.89 | 3.97 |
| | 3 | None of the staff are experienced or well trained, and do not employ knowledge of equine behaviour in management and training. | -58.40 | 0 |
| Health and disease | 1 | Regular attention to health. Appropriate use of analgesics, tranquilizers, and parasitic control. | 62.35 | 8.50 |
| | 2 | Some attention to health. Occasional use of analgesics, tranquilizers and parasitic control medication. | -14.68 | 2.55 |
| | 3 | Infrequent attention to health. Analgesics, tranquilizers and parasitic control medication used only when absolutely necessary. | -47.66 | 0 |
| Education of horse | 1 | Regular training from birth, through weaning, sales preparation and transporting, riding, track work, barrier habituation and racing. | 52.80 | 8.50 |
| | 2 | Some handling as a foal, through to weaning, sales preparation and transportation, riding, track work, barrier habituation, and racing. | 7.38 | 5.08 |
| | 3 | No handling as a foal or weanling. Little preparation for sales and transporting. Riding and track work rushed with no habituation to the barrier. | -60.18 | 0 |
| Ventilation | 1 | Good ventilation; fans in every stable; good ventilation in transport. | 48.72 | 8.00 |
| | 2 | Some ventilation; fans at end of stable corridors; some ventilation in transport. | 6.12 | 4.71 |
| | 3 | Poor ventilation; stable walls of solid construction to 110cm with wire mesh above; inadequate ventilation in transport. | -54.84 | 0 |
| Track design and surface | 1 | Gradual turning cambered turf track. | 51.01 | 7.60 |
| | 2 | Gradual turning cambered synthetic track. | 27.03 | 7.01 |
| | 3 | Tight turning cambered turf track. | -33.12 | 1.15 |
| | 4 | Tight turning cambered synthetic track. | -44.91 | 0 |

| | | | | |
|---|---|---|---|---|
| Weaning | 1 | Two weanlings isolated together in a stable, which allows visual and physical contact with neighbouring horses. | 26.65 | 7.55 |
| | 2 | Removal of one mare at a time from a group of mares and foals in a large paddock, until all mares are removed from the group. | 24.29 | 7.32 |
| | 3 | One weanling in a stable which does not allow visual or physical contact with neighbouring horses. | -50.94 | 0 |
| Nutrition | 1 | Attention to age and training requirements of individual horse in order to balance fibre / grain intake, with proven supplement requirements, and access to additional green forage. | 47.81 | 7.45 |
| | 2 | Attention to age and training requirements of individual horse in order to balance fibre / grain intake with proven supplement requirements, infrequent access to additional green forage. | 0.85 | 3.82 |
| | 3 | Standard nutritional program for all horses regardless of racing program, no additional green forage. | -48.66 | 0 |
| Stabling | 1 | Large 5m x 5m x 6m stable with free use of attached yard. | 37.72 | 7.35 |
| | 2 | Stable 3.6m x 3.6m x 4m with free use of attached yard. | 14.26 | 5.23 |
| | 3 | Stable 5m x 5m x 6m with no use of attached yard. | -8.39 | 3.19 |
| | 4 | Stable 3.6m x 3.6m x 4m with no use of attached yard. | -43.59 | 0 |
| Transport | 1 | Skilled driver, experienced staff for loading and off -loading horses. | 51.43 | 7.25 |
| | 2 | Semi-skilled driver, experienced staff for loading and off-loading horses. | -7.98 | 3.43 |
| | 3 | Staff with limited experience in driving, loading and off- loading horses. | -43.45 | 0 |
| Wastage | 1 | Horse retired for equestrian sports. | 30.44 | 7.15 |
| | 2 | Horse retired from racing to a breeding farm. | 22.85 | 6.34 |
| | 3 | Horse given away as race record was insufficient for breeding or temperament unsuitable for retraining in equestrian sports. | -16.37 | 2.18 |
| | 4 | Horse sent to a slaughterhouse, unsuitable for further use. | -36.92 | 0 |
| Heat and humidity | 1 | Horses rarely exposed to climatic variation; some acclimatization following transport; stable design allows for good temperature control. | 31.25 | 6.85 |

| | | | | |
|---|---|---|---|---|
| | 2 | Horses sometimes exposed to climatic variation; some acclimatization following transport; stable design allows for some temperature control. | 12.37 | 5.10 |
| | 3 | Horses regularly exposed to climatic variations; inadequate acclimatization following transport; poor stable design for temperature control. | -43.63 | 0 |
| Whips | 1 | Whipping the horse occasionally throughout the race. | 23.71 | 6.55 |
| | 2 | No use of whip, jockeys ride with hands and heels. | 10.91 | 5.11 |
| | 3 | Whipping a tired horse regularly in the last 100 meters of the race. | -34.61 | 0 |
| Environment | 1 | Use of wood shavings. Stable / yard design allows only visual contact with other horses. | 3.44 | 6.00 |
| | 2 | Use of wood shavings. Stable / yard design allows physical and visual contact with other horses. | 0.10 | 3.72 |
| | 3 | Use of straw bedding. Stable / yard design allows physical and visual contact with other horses. | -1.45 | 1.09 |
| | 4 | Use of straw bedding. Stable / yard design allows only visual contact with other horses. | -2.09 | 0 |
| Gear | 1 | No blinkers or tongue tie. | 14.74 | 2.80 |
| | 2 | Use of blinkers, but no tongue tie. | 1.57 | 1.23 |
| | 3 | Use of tongue tie but no blinkers | -8.76 | 0 |
| | 4 | Use of tongue tie and blinkers. | -7.55 | 0.14 |

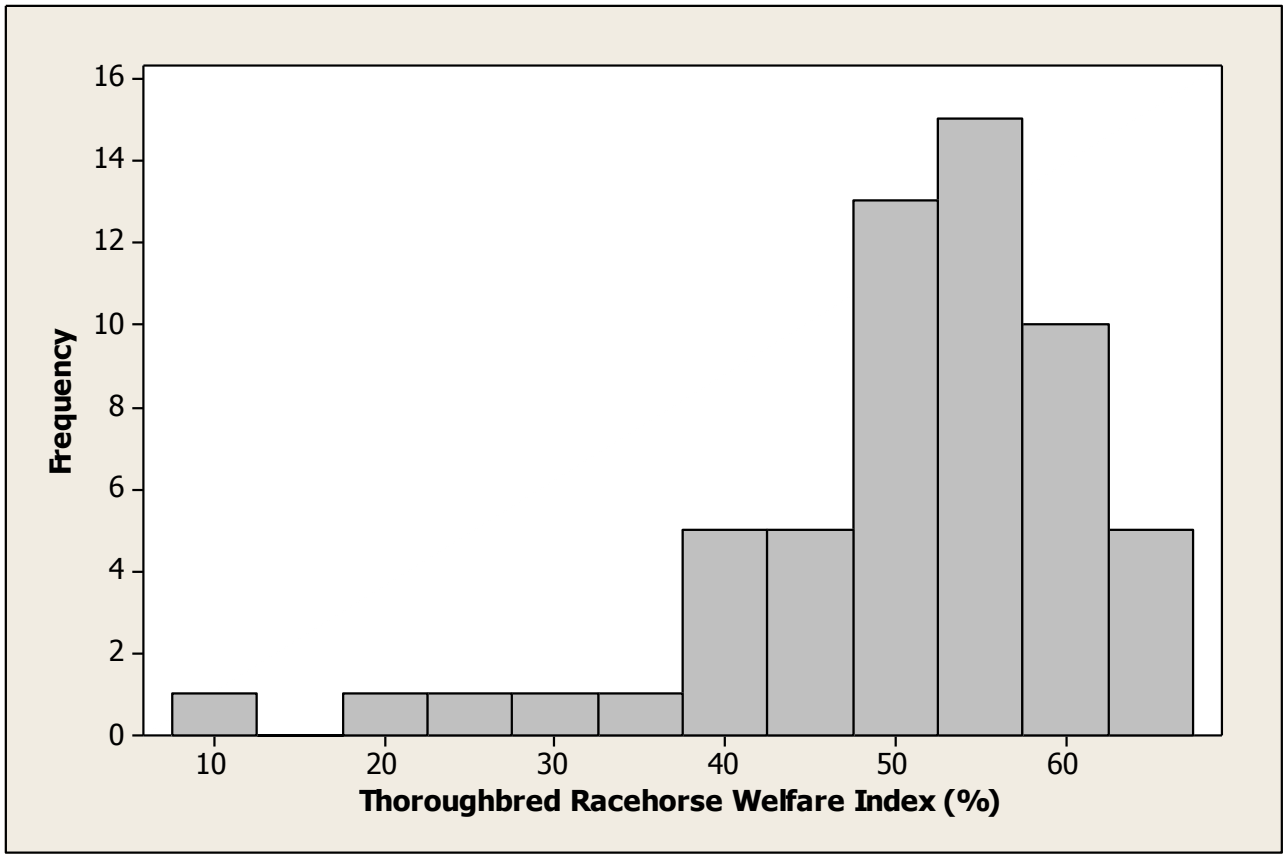


**Figure 5.1 Distribution of TRWI scores (%) for 58 trainers responding to the survey**

The 58 completed responses from the survey of 'Thoroughbred Racehorse Trainers in Australia' were used with the Utility Values from the Issues levels and their importance values from the Thoroughbred Racehorse-husbandry Questionnaire (Table 3.1) to obtain an index score. Utility Values were zero centred, and the contribution to the TRWI lowest value was always 0. The contribution of other levels was determined by scaling the Utility Values proportionately (Table 3.4. Estimated median). The distribution of TRWI's for the 58 trainers responding was not normally distributed as represented in Figure 5.1. Mean score was 50.75%, SEM 1.35, median 52.95% and the maximum score was 63.6% and minimum score was 11.6%.

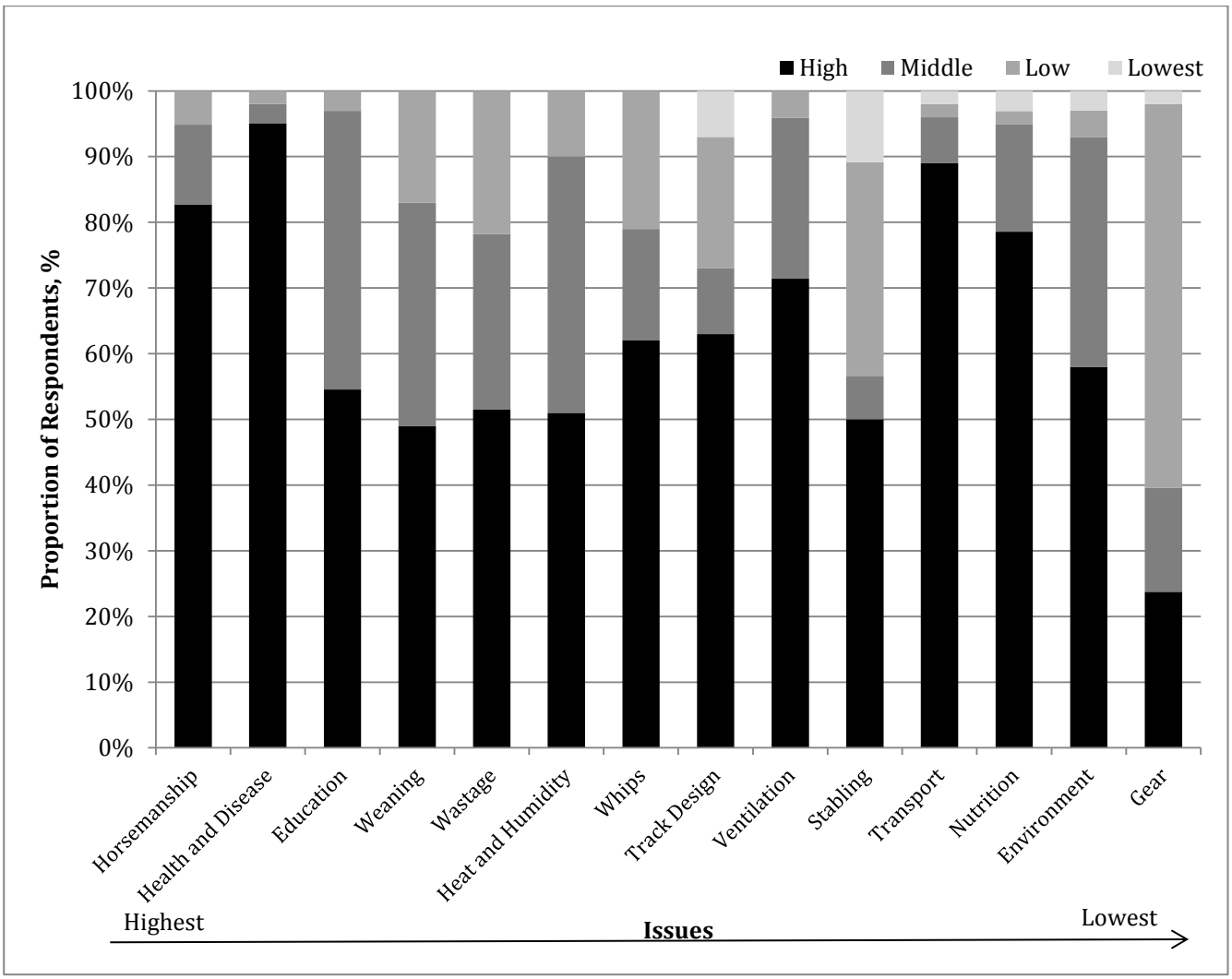


**Figure 5.2 The Percentage of TBR Trainers selecting each issue level in the questionnaire from the lowest level to the highest level, with issues ordered from highest (left hand side) to lowest (right hand side) importance.**

Figure 5.2 represents the performance of the training establishments in terms of numbers performing at the different levels for each issue. Issues for targeting are those towards the left (more important) and those with the low numbers of trainers with top (black) levels of provision. Of the issues, the first two from the left have trainers performing at good levels, but the next three have only about 50% performing at the top level. Scores of 81% and 95% were achieved for the top level in Horsemanship and Health and Disease, the first two highly scored issues indicating a high level of welfare. Those issues that were important but with a limited number of top achievers were Weaning, Wastage, Heat and Humidity, Stabling and Education of the TBR, with only about 50% performing at the top level, indicating there is a need for improvement in these welfare issues. Towards the lower level of importance Nutrition scored highly (slightly below 80%, achieving the top

level). Also towards the lower importance of the issue was Transport, with just under 90% achieving the top level. Towards the middle of the scale were the issues Track design and Surface, Whips, Ventilation and Environment, all with above 60% achieving the top level, with the exception of Environment which scored just under 60% indicating that there is a need for improvement in this issue. Gear had the lowest score of 24% achieving the top level, but it was not rated by the industry as an important issue.

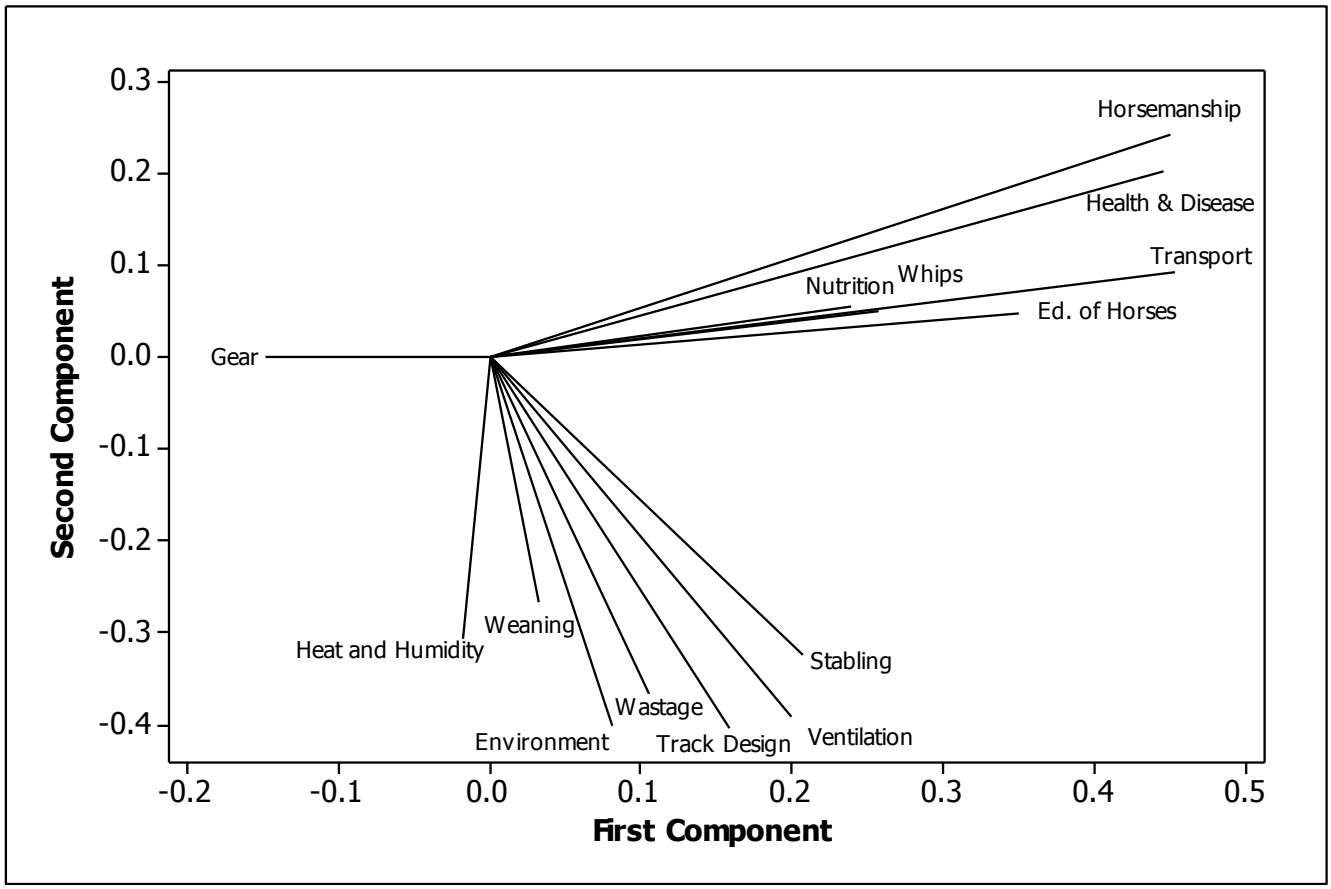


**Figure 5.3 Relationship between TRWI Issues and first and second principal components**

Figure 5.3 represents the percentage variance of five components which had Eigen values of more than 1.0, explaining 63% of the variance, and the loading plot for the first two, which explained 20 and 15% of the variance, respectively, is illustrated in Figure 5.1. These had Eigen values of 2.82 and 2.08, respectively. This showed that the use of gear was antagonistically related with animal-related issues in the first Principal component, which in turn were antagonistically related to facility-related issues, including ventilation, stabling, track design, environment, heat and humidity etc.

### *5.6.1 Gender differences in responses to the Trainers' Survey*

Of the 14 issues tested, five were found to be significant or close to significant:

Education of the Thoroughbred racehorse, following a combination of levels 2 & 3 (some or no education), women (W) were more likely than men (M) to say that horses received some or no education, whereas men were more likely to say that they received regular education ($X^2$= 3.7, P = 0.056).

In Track Design and Surface, after combining levels 2,3,&4, men were more likely than women to say that their horses raced on other types of track (Gradual turning turf M 17, F 9; Gradual or tight turf or synthetic M 10, F 5; Other M 16, F 1) ($X^2$= 6.1, P = 0.048)

For Weaning levels, 2 and 3 and 4 and 5 were combined. Compared to men, women were relatively more likely to say that the most common weaning practice was one or two weanlings in a stable (M = 8, F = 8) rather than removal of one mare at a time from a paddock (M = 7, F = 1) or unknown/other (M = 28, F = 6) ($X^2$= 6.4, P = 0.041).

After combination of Nutrition levels 2,3,&4, men were more likely than women to say that their horses' nutritional needs were tailored to their requirements, with access to supplements and green forage (M 36, F 9), whereas women were relatively more likely to report a less satisfactory standard of nutrition (M 7, F 6) ($X^2$= 3.3, P = 0.068).

When levels 2,3,&4 were combined in Wastage, men were most likely to say they did not know what happened to their horses when they finished racing (M = 20, F – 0), whereas women were relatively more likely to say that the horse was retired to a breeding farm (M = 5, F = 5) or that the horse was used for equestrian sports, given away or slaughtered (M = 18, F = 10) ($X^2$= 15.9, P < 0.001).

## 5.7 Discussion

The rate of response from the trainers to delivered invitations (29%) was better than the response rate from trainers for other surveys of the Thoroughbred racing Industry. My survey "The Thoroughbred racehorse-husbandry questionnaire" (Appendix 5, p.194) response rate for trainers was 25%. Gordon (2001) in discussing data collection for the RIRDC "The Horse Industry" report said' formal surveys failed to achieve a high enough response rate to be statistically valid' thus used 'an informal survey approach'. Hayek

(2004) in her study of “Epidemiology of horses leaving the racing and breeding industries” found the ‘generalisability of the data was questionable due to low response rates’. E-mail addresses were difficult to obtain, and the web site of trainers was usually blocked and required the interested person to supply an email address to which they might reply. Three trainers replied to the request to complete the survey by saying ‘they did not do surveys’. Trainers may be disinclined to complete surveys feeling that they are giving valuable information away.

The town and suburban addresses and phone numbers of trainers were relatively easy to obtain, as they are displayed in Racing Journals which list trainers’ licenses and registrations. However many of the street addresses proved to be invalid, especially for those hard copies sent to country areas, and consequently were returned unopened.

Unlike the assessment schemes used to assess welfare in farm and zoo animals, assessing the welfare of the Thoroughbred racehorse is more complex, given the husbandry and the work requirements of the TBR. Unlike farm animals where welfare can be partly assessed by the production of milk and eggs (Bartussek, 1995) and reproduction (Johnsen *et al.,* 2001), assessment for zoo animals now is often assessed by the management and environment that best equates with their respective wild environment. Such parameters are of limited relevance when assessing the welfare of Thoroughbred racehorses due to the restricted housing (Dawkins, 1983; Marsden, 1995) and feeding programs (Leighton-Hardman, 1984; Kohnke *et al.,* 1999; Davidson and Harris, 2007). These management systems are used because TBRs require individual management and high protein rations for peak performance.

The assessment of multiple contributing parameters in developing a Thoroughbred racehorse welfare index, as in the present study, is one method of improving husbandry and welfare especially when combined with behavioural parameters. Figure 5.3 demonstrated differences in response to animal and environment based issues. Here the use of gear was antagonistically linked to animal-related issues in the first Principal component which in turn was antagonistically related to facility-related issues. ‘The Great Ape Welfare Index’ (Fernie, 2008) and ‘Assessment of the Welfare of Captive Asian Elephants (*Elephas maximus*)’ (Gurusamy, 2012) are both studies using multiple parameters in the development of a welfare index.

### *5.7.1 Trainers Performance on individual issues*

The highest level of horsemanship was chosen by 81% of trainers (Fig 5.2). Only 5% of trainers admitted their staff was inexperienced and lacking in training and did not employ knowledge of equine behaviour to management and training. For instance-,knowledge of management and training are important factors in preventing the occurrence of Learned Helplessness (Standing Inactive) in TBRs, an abnormal behaviour, which results in the loss of motivation, anhedonia and stomach ulcers as well as weight loss (McDonnell, 2003; Cabib, 2006; Hall *et al.,* 2008). Trainers may have been reluctant to admit to any short comings in their staff.

This underlines the ethical concerns regarding the care of TBRs in race training, highlighting the need for regular exercise, mental stimulation and provision of companions (Racklyeft and Love, 1990; Cullinane, 1987; Collins *et al.,* 1999; Rollin, 2000; Colville and Bassert, 2002; Sjaastad *et al.,* 2003; Casey, 2007; Waran *et al.,* 2007b) whilst ensuring 'that their natural capabilities are able to cope with the task of being a racehorse' (Casey, 2007).

Health and Disease was placed high on the trainers' ranked list, with a score of 95% demonstrating the importance placed by trainers in insuring the physical capabilities of the TBR and giving it every chance to perform at its optimum level (Colvillle and Bassert, 2002; Sjaastad *et al.,* 2003; Casey, 2007; Evans, 2007; Waran *et al.,* 2007b).

The Education of the Thoroughbred racehorse Horse, received a score of 54% in the trainers' survey. This low score indicates there is a need for greater education of the TBR before it goes to the trainer to commence race training. The education of the TBR is an on-going process from birth. Waran *et al.,* (2007b) advocate the early handling and education of the foal to adulthood in order to prevent the development of problem behaviour provoked by the avoidance of fearful situations (Dawkins, 1980; McGreevy, 2004; Cooper and Albentosa, 2005). Early education and handling provides the basis for subsequent 'foundation training' (McGreevy, 2004; Waran *et al.,* 2007a; McLean and McLean, 2008).

Track Design and Surface was scored at the highest level by 63% of the trainers. The high score may be due to their awareness of the number of injuries sustained by TBRs on the racecourse (Moyer *et al.,* 1991; Bailey, 1998a; Boden, 2008; Whitton *et al*., 2013) where

poorly designed tracks and uncared for surfaces are a major welfare concern for TBRs (Bailey, 1998a; Evans, 2007; RIRDC, 2008). Rough country tracks could be due to drought conditions in many areas in Australia and to the limitations of financial and material resources. An industry report of 2008 stressed the need to maintain the moisture content of track surfaces during dry periods and urged for 'changes in track assessment and maintenance on city tracks as a way of formulating guidelines for maintenance of country tracks to reduce the risks of injury or death to horses racing on them' (Boden, 2007).

Ventilation was rated at the highest level by 70% of the trainers. Researchers (Lees and Higgins, 1985; Clarke, 1987a; Mills and Clarke, 2007) found that poor ventilation affects the respiratory system of the TBR, sometimes leading to obstructive pulmonary disease (Van Erck-Westergren *et al.,* 2013). In situations with poor ventilation a horse will stand for longer periods of time than is normal, indicating a stressful situation (Kiley-Worthington, 1987).

Stable design was rated at the highest level by just 46% of the trainers. Design is changing in Australia due to the up-grading of city and metropolitan race courses. A new track and stabling for 400 TBRs on the racecourse at Brisbane's Eagle Farm race course is currently under construction (Bell, 2015). Royal Randwick in New South Wales began an extensive refurbishment of the facilities in 2011, including the race track as well as on course stabling for 600 horses (AJC, 2010).

Many of the older racecourses and sale centres are now surrounded by suburbia which increases the pressure on the amount of space available for new and adequately designed stabling (Clarke, 1987a; Cooper and Manson, 1998; Nicol, 1999a and 1999b; Houpt, 2005; Ransom and Cade, 2009). Improved stable design will aid in the control of climatic variation e.g. Tie up stalls at race courses are frequently situated so the TBR stands in the sun all day (Racing Queensland Limited, 2010). Many stables are too small (Sainsbury, 1987) with the roof height rarely considered (Petersen *et al.,* 2006).

The Australian Horse Welfare Protocol (2011) states the stable size 'should not be less than 12 square metres with a ceiling height not less than 2.4 metres' (AHIC, 2011) Occupational Health and Safety regulations differ between Australian States and are based on minimum requirements which do not address the welfare of the TBR in terms of

the size of the TBR to the size of the stable, nor do they include the roof height (Queensland Government, 2001). Sainsbury (1987) advocates stables measure 4x4 m with a ceiling height at the eaves of 3m rising to the roof ridge of 8 metres. The survey found that 36% of trainers in Australia used stables with a floor size of approximately 5 x 5 m with a ceiling height of approximately 6 m and free use of an attached yard, while only 5% of stables were approximately 3.6 x 3.6 m with a ceiling height of approximately 4 m and free use of attached yard.

Weaning was rated at the highest level by just 49% of the trainers, with 52.0% of trainers having no knowledge of how their TBRs are weaned (Table 5.2). The management of foals at weaning time is crucial in the prevention of oral stereotypies. Research at Bristol University, U.K. (Nicol, 1999a; Waters *et al.,* 2002) has demonstrated the gradual removal of one mare at a time from a group of mares and foals until no mares remain aids in the prevention of oral stereotypies. Research has also found foals that are paddock weaned in small groups had similar time budgets to feral horses (Heleski *et al.,* 2002). Davidson and Harris (2007) suggest a fat and fibre rich pasture supplement at weaning time will not only lower the development of stereotypic behaviour but will also prevent the development of gastrointestinal ulcers (Holland *et al.,* 1996; Nicol,1999a; Waters *et al.,* 2002; Lester *et al.,* 2008). Thus Breeders need to take greater care at this critical time when weaning TBR foals.

Wastage was scored by the trainers at 52%. Many trainers, especially male trainers, were unaware of what happens to TBRs when they finish racing, while women trainers are more likely to know what happens to TBRs when they finish racing, indicating empathy towards the TBR who may be retired to a breeding farm or used for equestrian sports or given away. Re-homing is a desirable option, with many TBRs sold for a small amount or given away for equestrian sports (Geelen, 2013). Many TBRs never reach the race course due to injury, an intractable temperament or being too slow (Bailey, 1998b; Odberg and Bouissou, 1999; RIRDC, 2006). When injuries prevent further use (Holmes *et al.,* 2014), or the temperament is unsuitable or their breeding is considered below the commercial level they may be destroyed. As the trainer rarely owns the TBR it is the owner who makes the final decision (Bailey, 1998a and 1998b).

Transport was scored at the top level by 90% of trainers indicating the importance placed by the trainers on this important management issue. The Queensland Government

Compulsory Code of Practice for Land Transport of Livestock, Animal Care and Protection Act, 2001 covers the transportation of all horses and particularly focuses on potential stressors (Cregier, 1982; Linden *et al.,* 1991; Kusunose and Torikai, 1996; Doherty *et al.,* 1997; Collins *et al.,* 1999; Stull and Rodiek, 2000; Waran *et al.,* 2007a; Van Erck-Westergren *et al.,* 2013).

Nutrition was recognised by 78% of trainers as important to the well-being of TBRs, since it was achieved at the highest level (McGreevy, 1996), while 17.2% of trainers provided infrequent access to green forage. A standard nutritional diet was provided by just 2.0% of trainers, regardless of the racing program, who did not provide additional green forage. Trainers who provided an alternative Nutritional program amounted to 3.4%; they did not describe what that different Nutritional program was. Nutrition was the only issue to correlate with the behaviours observed in our stable study (chapter 4.6.2) of the TRWI. Thoroughbred horse trainers are aware of the importance of an optimum condition score by monitoring body weight, which is a component of physical welfare (Leighton-Hardman, 1984; Kohnke *et al.,* 1999; Collins *et al.,* 2009) and is also one of the Five Freedoms (FAWC, 2007), measuring Freedom from Hunger. To win races, the aim of racehorse trainers world-wide, (Bailey, 1998a and 1998b; More, 1999) is a physically fit racehorse, neither thin nor overweight (Kohnke *et al.,* 1999; Collins et al., 2010).

Cooper and McGreevy (2007) argued that although the diet may be carefully balanced and 'formulated to meet all the horse's dietary needs they may not meet the horse's behavioural needs' i.e. the difference in feed management to the grazing patterns of the feral horse (Cooper and McGreevy, 2007; Ransom and Cade, 2009; Ransom, 2012). In the training management system discrete meals are delivered two or three times a day as opposed to the continuous grazing behaviour of the feral horse (Tyler, 1972; Duncan, 1985; Ransom *et al.,* 2007; Csurhes *et al.,* 2009; Ransom, 2012). The decreased gastrointestinal function that ensues (Colville and Bassert, 2002; Lester *et al.,* 2008) can lead to problems of the digestive system, resulting in colic, laminitis and gastric ulcers (Hilmo, 2013). Gastric ulcer pain is a factor in the development of TBR's stereotypic behaviour (McGreevy, 1996; Nicol *et al*., 2002; Waters *et al.,* 2002; Lester *et al.,* 2008). Thus to meet the TBR's nutritional and behavioural needs a diet of balanced nutrition with a variety of forage is important in maintaining adequate gastrointestinal function (Lester *et al.,* 2008), and in preventing gastric ulcers and stereotypic behaviour (McGreevy, 1996).

Heat stress management was scored at the highest level by 50 % of trainers (Table 5.2), TBRs with some exposure amounted to 38%, whilst only 8.6% were regularly exposed to temperature variation. Most TBRs have a wide tolerance of temperature variation; equines can cope with a temperature range varying from freezing to high heat in desert conditions, and relative humidity can be as high as 100% (Ransom and Cade, 2009). Research with competition horses travelling from temperate climates to hot humid countries has shown that successful acclimatization of these animals is possible over a period of 21 days (Geor *et al.,* 1996; Marlin *et al.,* 1996). Racing Queensland's Animal Welfare Policy (RQAWP) covers the care of TBRs racing in extreme heat, i.e. ambient temperature of $35^{o}$ C or above and the wet bulb global temperature (WBGT) shade is $26^{0}$ C or above (Racing Queensland, 2010). The policy states that 'horses should be stabled out of the sun and in areas that are breezy'. Race course design should take into account the movement of the sun throughout the year when designing day stalls on racecourses (Sainsbury, 1987).

A total of 62% of trainers scored the use of whips as 'occasionally, throughout the race' while 21% admitted that their horses were whipped regularly in the last 100 metres of the race, even though they were tired. Only 17.2% said their jockeys did not use a whip, but rode with hands and heels (Table 5.2). The RSPCA draws attention to the whip rules which allow jockeys to use the whip as often as they like in the last 100 metres of the race (McGreevy *et al.,* 2012) thus allowing the TBR to be struck as many as 13 consecutive times (Whips in Racing, RSPCA no date). The padded whip is designed so that a portion of the whip is not padded, and where the different sections meet there is a hard knot. Recent research by McGreevy and Evans (2015) found horses were struck with this part of the whip on 64% of occasions when the whip was used. Though the Australian Racing Industry (ARI) is signatory to international guidelines to prevent TBRs being whipped on the flank and abdomen a film by the RSPCA showed that TBRs were hit 75% of occasions on the flank and abdomen and on 13 occasions hit on the head (Stewart, 2012).

The horse evolved as a prey animal (Butler and Finn, 2009; Wagner, 2010; Contino and Khursheed, 2015), with stress-induced analgesia i.e. the ability to mask pain, probably the reason why the horse is less likely to show pain than humans. Newby (2015) believed 'the TBRs had learnt to tolerate the whip' which can be described as learned helplessness or standing inactive (McDonnell, 2003; Evans, 2007). Excessive whipping of an exhausted horse, when it no longer can respond may cause ' learned helplessness' or 'standing

inactive' (McDonnell, 2003). Standing inactive was a behaviour commonly noted in the stable observations (chapter 4), which detailed this behaviour occupied 16% of recorded time for each horse.

There is evidence that the rules regarding whip use are frequently breached (McGreevy et al., 2012). Furthermore; the jockey's fine is small compared to the winning horse's prize money e.g. the winning ride in the Cox Plate[4] in 2013 was worth $80,000, yet the jockey riding the winning horse was fined only $1000 for excessive whip use (Payne, 2013). The Chief Executive of the ARBL said "The ARBL would be fully supportive if stewards reversed the result of a race over (the) use of the whip if circumstances demanded it" (Exelby, 2015). This may be one way in preventing overuse of the whip. At a later interview the Chief Executive (Peter McGauran) of the ARBL said 'the industry would further restrict the use of the whip or do away with it completely if there was evidence that repeated whipping inflicted pain' (McGauran, 2015). McGreevy and McLean (2010a) state it is 'important that the whip is not used to deliver sharp punitive pain'. Use of the whip can be seen as punishment (for not running fast enough). Both Mills (1998) and McGreevy and McLean (2010b) believe punishment 'is best avoided, as it presents a range of problems that amount to abuse', all of which contravene the welfare requirements determined by the Five Freedoms for Animal Welfare (FAWC, 2007).

An environment which included physical and visual contact with other TBRs was selected by just 29% of trainers. Wood shavings and a stable yard allowing only visual contact was the most popular stabling system, with 47% of the trainers selecting this option (Table 5.2). Research has shown physical and visual contact is important for the wellbeing of TBRs (Feist and McCullough, 1976; Leighton Hardman, 1984; Goodwin, 2007) yet few trainers provided physical contact.

Wood shavings used by most trainers are more absorbent than straw, and are rarely eaten by the TBR, but straw bedding is sometimes eaten by the TBR (Crowell-Davis, 1993; Cooper and Manson, 1998; Rollin, 2000; Mills *et al.,* 2000;Goodwin, 2007).

[4] The Cox Plate ($ 3,000,000) is a major Group 1 race in Australia, run over 2040 metres, worth $1,800,000 to the winning owner.

This may explain why horses that are bedded on straw have fewer oral stereotypies than horses bedded on shavings (McGreevy *et al.,* 1995; Mills *et al.,* 2000; Tadich *et al.*, 2012). Cooper and McGreevy (2007) in 'Stereotypic behaviour in the stabled horse' and (Waran, 2007) cite bed eating as a re-directed behaviour, which involves 'the ingestion of bedding substrates such as straw, paper or shavings (Mills *et al.,* 2000). They cite this behaviour as more common in horses that do not have access to high fibre forages such as hay, and it is more common in horses that are bedded on straw than those on rubber, paper or shavings. McGreevy *et al.,* (1995) noted 'horses on straw also have fewer oral stereotypies such as crib biting'.

Trainers opted against physical contact in the stable yard. Some stable designs (Sainsbury, 1987; Mills and Clarke, 2007) have full height walls, 'justified by the need to prevent cross infection of airborne pathogens' (Clarke, 1987a and 1987b; Mills and Clarke, 2007). Trainers fear that physical contact may result in injury thus TBRs are kept in individual stables (Mills and Clarke, 2007).

Few trainers reported the highest score for use of gear, i.e. no blinkers or tongue ties (Table 5.2). The use of Tongue Ties is approved by the ARBL, and is a safety issue and its' use alone was reported by 2 % of trainers, while Blinkers alone were used by 15.5% (Australian Racing Board, 2009). Tongue Ties and Blinkers were used by the most trainers (59%) mainly for the safety of all concerned (McGreevy, 2004; McGreevy and McLean, 2010b). They are approved by the ARBL and can be used singularly or in combination.

Gender differences occurred in only 5 of the 14 issues that were tested, and they were found to be significant or close to significant. Men were more likely to lack clarity in their responses than were women, for instance in Education of the TBR men said their TBRs received regular education, while women were more inclined to answer the question in a straight forward manner admitting their TBRs received little education or none at all. Nutrition was also given a favourable response by men, whereas women were relatively more likely to report a less satisfactory standard of nutrition. Women demonstrated a more sympathetic approach to the welfare of TBRs than did men, demonstrating empathy for the TBR, whereas men tended to close their minds to a situation over which they had little control, with their responses being guarded for the following issues e.g. Wastage, Weaning, Track Design and Surface.

### *5.7.2 Limitations of the Study*

Interpretation of some issues may have caused confusion e.g. Environment, when visual contact was preferred above visual and physical contact. The respondent may have surmised that to have physical contact meant more than one TBR would be in the stable at any time. Physical contact is possible between horses in adjoining stables when partitions are not solid, but made of bars, slats or heavy wire, wide enough to allow horses to sniff and or touch one another. Trainers may have been reluctant to admit to any short comings by their staff in the knowledge of horse behaviour and TBR handling ability.

## 5.8 Conclusion

The multiple parameter assessment method used in this study indicates that it is possible to assess the welfare of TBRs by using important husbandry issues and Thoroughbred racehorse based parameters. Although horsemanship and health and disease control were mainly claimed to be at the highest level, there was significant room for improvement in education of the horse, weaning practices, wastage and managing heat and humidity and track design and surface. Lesser gains could be had by improving the rules of whip and gear use but the latter was not seen to be important for welfare.

# CHAPTER 6

# GENERAL DISCUSSION

## TABLE OF CONTENTS

## 6.1 Introduction

Welfare is a multi-faceted integral part of training the Thoroughbred racehorse and is continually challenged by a well-informed public on the standard of various welfare issues, while the method and intensity of management of Thoroughbred racehorses differs throughout the world. My aim was to develop a Welfare Index for Thoroughbred Racehorses (Chapter3), which was able to compare the welfare status of Thoroughbred racehorses in different training establishments and identify those areas which were in need of improvement. It was important to gain stakeholder (expert) opinion at an initial meeting and to rank the identified issues as a starting point. The welfare index (TRWI) emerged from a Stakeholder Survey (Chapter3), based on the identified welfare triggers and adequately synthesises the body of research findings relating to the problems of TBR welfare as opposed to presenting a collection of ad hoc ideas.

The fourteen husbandry and welfare issues of various aspects of health, welfare, physical and psychological wellbeing that were identified by expert opinion (Chapter 3) were incorporated into an Australian wide survey. The survey was sent to a wide variety of Thoroughbred racing industry stakeholders who came from such diverse backgrounds and professions as Owner, Breeder, Trainer, Farrier, Veterinarian, Transport, Sales, and Retraining of TBRs, who also had a good working background and knowledge of the Thoroughbred racing industry. The scientific literature, together with the review of the stakeholders' selected issues, supports the views of the stakeholders and the importance of these issues in the management and welfare of the Thoroughbred racehorse thus identifying coherence within the Thoroughbred racing industry.

The results were validated by behavioural observation (Chapter 4) of 133 Thoroughbred racehorses in 13 different training establishments in South East Queensland as well as the administration of a survey of Thoroughbred racehorse trainers throughout Australia (Chapter 5). This survey used the same issues and levels as did the stakeholders' survey "Determining Opinions of Training Requirements for Thoroughbred Racehorses" (Chapter3). The results from the Australian wide survey, "Determining Opinions of Training Requirements for Thoroughbred Racehorses" were validated by relating variations within the Thoroughbred racehorse behavioural study and the Trainers' survey with the Thoroughbred Racehorse Welfare Index.

Major outcomes from the research found that the TRWI demonstrated the ability to rank and assess Thoroughbred racehorse welfare as well as identifying those issues whose husbandry and welfare needed improvement i.e. horsemanship, health and disease, education of the Thoroughbred racehorse, track design and surface, ventilation, stabling, weaning, transport, nutrition, wastage, heat and humidity, whip use, environment and gear.

The survey used the Sawtooth Software Adaptive Conjoint Analysis (ACA) method to evaluate individual Level Importance Values. The levels rated highly by respondents received a positive value and those with a low value received a negative value. Issues that were important for Thoroughbred racehorse welfare and management were ranked in order of preference, thus enabling the development of a Thoroughbred Racehorse Welfare Index (TRWI) score for each training establishment based on current conditions (Chapter 5) and allowing the identification of those areas in management in need of improvement. As no previous study had been undertaken to establish a uniform ranking or weighting system of issues important for the husbandry and welfare of the Thoroughbred racehorse it was impossible to support the rankings with the literature. Other studies of equine welfare exist (Pritchard *et al.,* 2005; Petersen *et al.,* 2006; Christie *et al.,* 2006; Collins *et al.,* 2010; Tadich *et al.,* 2012), but none are specific to the management and welfare of the Thoroughbred racehorse and many studies obtained data by using invasive methods (Colville and Bassert, 2002; Engel, 2003; Sjaastad *et al*., 2003).

## 6.2 Practical Implication of the Work

As modernisation of third world countries advances, the increasing wealth brings greater leisure time for enjoyment of sport and other recreational activities. Thoroughbred horse racing is already enjoyed in many of these countries and it is in these countries that The Thoroughbred Racehorse Welfare Index will have many practical and important uses. The scientific justification of the ‘Development of the Thoroughbred Racehorse Welfare Index’ is the ability of the TRWI to pinpoint the husbandry and management issues that are most at risk of having poor welfare standards, as well as ranking these issues. In practical terms the 13 welfare indicators and the areas which might be most in need of immediate improvement or research are:

1. **Horsemanship:** Provision of adequate facilities for young people to gain instruction in Horsemanship.

2. **Health and Disease:** Veterinarians to be consulted more frequently by TBR trainers on the parameters involving the use of vitamins, minerals and therapeutic drugs.

3. **Education of the Horse:** Breeders to play a larger role in frequent and gentle education of foals through to their sale as yearlings.

4. **Track Design and Surface:** New race tracks to be designed by expert track designers with frequent track maintenance to eradicate hard and uneven surfaces.

5. **Ventilation**: Adequate ventilation in all stables and transports, once again calling on the services of experts who understand air flow.

6. **Stabling:** Physical and visual contact at all times. Stables to be larger than the minimum size (3.6x3.6x4m) with adequate roof height as determined by expert opinion (Sainsbury 1987). Provision of one yard to every three stables.

7. **Weaning:** Methods to be gentler: by removing one mare at a time (the dam of the oldest weanling) until all mares are removed. An older equine is left with the weanlings as a nanny. Nutrition is most important at this time with the requirements of a fat and fibre diet for the weanlings' immature digestive system.

8. **Transport**: Attention to adequate ventilation and a dust free interior.

9. **Nutrition:** The provision of fibre at frequent intervals in every 24 hours. See Weaning for Nutrition of weanlings.

10. **Wastage:** A more rigorous approach to identify the causes of wastage: Track Design and Surface, Education of the TBR, Weaning, Stabling and certain aspects of Horsemanship e.g. bone remodelling. Lack of identification of poor welfare in these issues contributes to the Wastage of the TBR.

11. **Heat and Humidity:** Provision of fans or air conditioning in stables. Provision of acclimatisation following transport.

12. **Whips**: Alteration to race rules to less frequent use of whips in the last 100 metres of any race. Whip design to be altered immediately. Immediate disqualification when it is proved the jockey has struck a horse on the head with the whip.

13. **Environment:** The design of all yards and stables to allow physical and visual contact with conspecifics.

### *6.2.1 Cost of Implementing Results*

Those areas in Australia that are most in need of improvement are often the Race tracks out-side Metropolitan areas which have limited available funds. Race track design and surface (Chapter 5) are poorly designed and have limited surface care, with the design of many race courses being too small with tight turns and insufficient camber (Kohnke, 2005), even though land availability is seldom a problem in country areas. The reason for small country race courses is the cost incurred in track maintenance, so smaller courses are installed without consideration of the dangers involved and subsequent wastage of TBRs, and sometimes their riders, when racing on small, tightly turning tracks. This type of track can lead to dorsal metacarpal disease of the TBRs' front cannon bones (Moyer *et al.,* 1991; Bailey, 1998a and 1998b; Boden, 2008), sometimes ending in fracture. The cost of track maintenance and surface design should be considered if wastage of TBRs is to be lowered. The safety and welfare of both TBR and rider is of vital importance, race tracks are used every day and most injuries occur at training (Moyer *et al.,* 1991; Bailey, 1998a and 1998b; Boden, 2008). The Australian government could consider assisting the ARI by subsidising race clubs with poorly designed and maintained tracks, especially as the ARI contributes many billions of dollars annually to the Gross Domestic Product (Gordon, 2001).

Changing weaning practices in Australia could be achieved at little cost to all concerned. Weaning methodology (Houpt *et al.,* 1984; Heleski *et al.,* 2002) as outlined in this thesis (Chapter 2.5.7), involves some time and thought in organising the new procedure of removing the mare, the dam of the oldest foal, from a group of mares and foals, and continuing to do so until all wet mares are removed from the paddock (or field) leaving an older equine as a stabilising influence (the nanny). Further research at a more in depth level than in my Stakeholders' survey of the Breeders, regarding nutrition, weaning and foal and weanling education would also be useful in improving TBR welfare.

New stabling facilities are under construction on many of the older race courses in Australia, and it is hoped that physical and visual contact is available for all TBRs. The optimum dimensions of these stables are not known, and little research has been undertaken in the past. Sainsbury's (1987) work is concerned with stabling in the Northern Hemisphere and in many cases is not suitable as reference material for the construction of stabling in Australia and other countries that do not experience severe winter conditions (below freezing) or tropical conditions. Researching adequate types of stabling could be funded by commercial partnerships between universities and relevant industry and government bodies.

The establishment of adequate facilities where young people can gain instruction and experience in Horsemanship could be implemented by Governments and Race clubs working in combination on disused racetracks with retired TBRs. Implementation of a scheme, similar to that in Hong Kong, where many of the homeless find an enjoyable lifestyle and ongoing employment, could be a useful way of providing instruction and experience in Horsemanship as well as helping those less fortunate.

### *6.2.2 Implementation and Enforcement of the TRWI*

By highlighting the most critical aspects of TBR welfare issues the TRWI has the potential to improve TBRI practices. Racing boards are responsible for the design of race tracks and surface care. Bailey (1998) stated 'the ARI has not adopted a rigorous approach in identifying the causes of wastage associated with track injuries within the racing industry' (Australia has the highest incidence of shin soreness in the world, of up to 80%, as opposed to the UK of between 9-17%, Kohnke, 2005). To counter claims of unacceptable injury rates racing boards can implement improvements in track design and surface care and introduce policies that address areas of welfare concern, identified by the TRWI. Central to the issue of race track design and surface would be the improvement of race tracks with small radius bends and track banking as well as the softening of hard track surfaces (Kohnke et al., 2005); all are important issues in reducing Wastage in TBRs. The TRWI has the ability to highlight the importance of safety issues in race track design, in order to lower the incidence of track related injuries of both horses and jockeys in Australia, and in countries with similar climates whose race tracks have hard surfaces.

Racing boards can provide adequate educational facilities for staff with a focus on racing industry requirements, as well as improving on - track stabling and the employment of staff that have an affinity and empathy with Thoroughbred racehorses.

Consequently the public's perception of the industry would improve. Importantly the TRWI will aid governments in formulating codes of practice (embodying welfare issues) and in legislating equine welfare. The use of the index is enhanced by the easy checklist format of the TRWI in assessing welfare standards within the racing industry. This index is also unambiguous and ensures common interpretations across assessors as well as being non-invasive. Many welfare studies are invasive e.g. measurement of heightened cortisol levels (Colville and Bassert, 2002; Engel, 2003; Sjaastad et al., 2003), indicating increased stress, which measures poor welfare, but is in itself stressful.

It is hoped the TRWI will be accepted and used by all the various National and State Associations who are linked to racing in Australia. The TRWI can be seen as closing the gap between research and practice due to its practicality, its significance and the importance of the research.

The chief problems in implementing the TRWI will be the lack of funding available for research into Thoroughbred racehorse welfare and the reluctance of Racing Clubs, and Town Planners to change codes of practice. However, data pertaining to the welfare of thoroughbred racehorses is rare and my approach to measuring welfare by Stakeholders' and Trainers' surveys, and the observational study of 133 Thoroughbred racehorses in full training, provides results that could be used by Governments, Racing Clubs and Town Planners. These organisations could use the TRWI to identify management practices in need of improvement as well as providing funding for relevant further research.

### 6.3 Difficulties Encountered and Other Research Methodologies

Major difficulties were encountered in obtaining the email addresses of racehorse trainers. E mails are the perfect way to send surveys. Sawtooth Software is a sophisticated and time saving method of handling both the survey and the data. Hard copies are not as quick, nor are they linked into a survey/data system such as Sawtooth Software. Hard copies are also more expensive than emails, especially with the inclusion of a stamped addressed envelope, to encourage a greater response, and they are considerably more

labour intensive than emails. The Racing industry does not list the email addresses of racing trainers by States, while some States are not listed at all. Many email addresses are out of date and are undeliverable. A method of listing trainers' email addresses for each State would assist in obtaining data, thus encouraging research, all of which can lead to an improvement in the management and welfare of TBRs.

In refining the TRWI only two changes would be made to the Thesis, firstly, alteration of the ethogram, and secondly, deletion of Gear from the list of Welfare Issues identified at the Stakeholders' meeting. In altering the ethogram stereotypies would simply be recorded as being either oral stereotypies or locomotor stereotypies. None of the sub-types, such as crib biting, windsucking, box walking and weaving would be individually recorded. The principal behaviours would be identified before the commencement of continuous recording, thus providing a more concise ethogram resulting in the simplification of data collection.

Gear could be deleted from the list of welfare issues, bringing the number to 13 issues instead of the original 14 as identified at the stakeholders' meeting. Gear was antagonistically related with animal-related issues in the first principal component analysis, which in turn was antagonistically related to facility-related issues that included ventilation, stabling, track design and surface, environment, and heat and humidity. Gear was consistently rated as unimportant both in the survey 'Determining Opinions of Welfare Requirements for Thoroughbred racehorses' and in the Trainers' survey where it had the lowest achieved rating.

To refine the TRWI, especially as an index is often prepared over a long period of time, it may be advantageous to test the deletion of Gear by administering a short survey of trainers regarding the use of blinkers and tongue ties, especially if usage was routine, sometimes or never, and in what combinations the blinkers and tongue ties were used.
It is possible to divide the results into two different groups. The first group being management, which would include horsemanship, weaning, education of the TBR, health and disease, nutrition, wastage, transport, heat and humidity. The second group would consist of stabling, racetrack design and surface, ventilation, whips, environment, and gear. A division of the welfare issues would then enable the index to determine the two groups of issues separately, thus identifying the area where Thoroughbred racehorse welfare is most at risk.

Other research methodologies are not as specific to the subject (Development of a Welfare Index for Thoroughbred Racehorses), as is the current study, for instance Tadich *et al.,* (2012)'s study of Chilean racehorses was concerned with estimating the prevalence of stereotypic and other behaviours in Chilean Thoroughbred racehorses by direct observation and examination of their associations with biological characteristics and management practices. A questionnaire was also administered to handlers. Collins *et al.,* (2010) in 'Evaluation of current equine welfare issues in Ireland: Causes, desirability, feasibility and means of raising standards' used a three round, web based Policy Delphi method to canvass opinion on the perceived most significant equine welfare issues. The aim of a Petersen *et al*., (2006) study of warm blood riding school horses in Schleswig-Holstein, Germany, was to gain an insight into the practical experience of horse keeping in Schleswig-Holstein. The concept of 'Evaluation of livery stables with regard to animal welfare' was developed by Beyer (1998) to determine high risk elements in livery stables e.g. stabling, environment, ammonia concentration, health and behavioural disturbances of individual horses using direct observation and a point system. All three of the above research methods, though concerned with equine welfare, do not develop a system of welfare assessment, and as such are not comparable to the TRWI which is a uniform welfare method capable of measuring husbandry within the Thoroughbred Racing Industry.

## 6.4 Conclusion

The development of the Thoroughbred Racehorse Welfare Index is the first attempt to produce a comprehensive welfare assessment. My preliminary validation suggests that the welfare indicators identified by stakeholders in the Australian Thoroughbred Racing Industry, using survey research, together with a non-invasive assessment of TBR behavioural measures in TBR training establishments can be used to assess the welfare of Thoroughbred racehorses.

The importance of developing the Thoroughbred Racehorse Welfare Index lies in its provision of a greater understanding of the issues required in maintaining a high level of equine welfare. This importance is enhanced by the ease of use of the TRWI, due to a checklist format to assess welfare standards within the racing industry.

The implications of my findings will provide TBR welfare guidance to the racing industry, both in Australia and in those countries developing a Thoroughbred racing industry. Governments could potentially also benefit from the Thoroughbred welfare Index in formulating codes of practice (embodying welfare issues) and in legislating welfare.

The data obtained from the continuous recording of TBR behaviour in this study could be of value in further research, especially in new stable design as well as stable layouts, as comparable data is not readily available. It is here that welfare needs improving, not only for physical and visual contact but in replicating more closely the natural way equines obtain their fodder and in giving some environmental choice.

Mostly there was consensus throughout the study, except for the significant difference occurring in Nutrition and Weaning issues. I found that Nutrition was the only issue to correlate with the Thoroughbred Racehorse Welfare Index. Nutrition is also important in the weaning of the equine neonate whose immature digestive system is unable to cope with grain based dietary supplements (McGreevy, 1996; Waters *et al.,* 2002), supporting the relationship between diet and oral stereotypy in adult stabled horses. Holland *et al.,* (1996), Johnson *et al.,* (1998), and Nicol *et al.,* (2001), all noticed a reduction in stress levels when weanlings were fed a diet high in fibre and fat.

The results for Weaning (Chapter 3.8.9) did not agree with the Scientific Literature, which emphasises a gradual weaning method, as indicated by research at Bristol University (Nicol 1999a). Studies by Houpt *et al.*, (1984) and McCall *et al.*, (1985) and Harris 1996 support these findings. The weaning results which favoured 'the isolation of two weanlings at a time in a stable allowing visual and physical contact with neighbouring horses' may explain the reason for the development of stereotypic behaviour, especially oral stereotypic behaviour. Further research into Nutrition and Weaning may improve both issues which could lead to the eradication of stereotypic behaviour especially oral stereotypic behaviour.

The objective method of welfare assessment of Thoroughbred racehorses, as provided by the TRWI, can be further extended with a detailed analysis of husbandry parameters to evaluate individual TBR welfare with a profile similar to that of the Animal Needs Index used for farm animals (Bartussek, 1999) where farm production could be equated with races won, thus producing a multiple index evaluation.

The Thoroughbred Racehorse Welfare Index will not only help countries who are developing racing industries, but may also assist Race committees in developing facilities in existing and new racing complexes outside of Australia by using a uniform ranking system of the issues that are important for the husbandry and welfare of the Thoroughbred racehorse. Some changes to welfare issues (such as turf quality and its moisture holding capacity) used in the TRWI, may need to be made in order to apply the non-invasive multiple parameter assessment method, as used in this study, to Thoroughbred racing establishments worldwide. Index values could then be created for welfare assessment, as well as the identification of those issues in need of improvement. Following further research to identify required changes, the strength of the TRWI could lie, not only in its methodology to assess TBR husbandry and management, but also in its ability for comparisons to be made between racehorse training establishments both within Australia and internationally.

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# APPENDICES

**Appendix 1. Effects of experience on level importance values for each issue**

| Issues | 1 - 12 Months | 13 - 48 months | > 48 Months | Probability Value |
|---|---|---|---|---|
| Horsemanship | 7.2 | 8.25 | 8.9 | 0.08 |
| Health and Disease | 7.1 | 8.95 | 8.55 | 0.31 |
| Education of Horse | 6.6 | 7.75 | 8.55 | 0.08 |

| | | | | |
|---|---|---|---|---|
| Ventilation | 7.25 | 8.7 | 8 | 0.06 |
| Track design and Surface | 7.1 | 7.75 | 7.4 | 0.66 |
| Stabling | 7.15 | 7.90 | 7.3 | 0.66 |
| Weaning | 7.15 | 7.1 | 7.6 | 0.41 |
| Transport | 6.55 | 5.7 | 7.3 | 0.006 |
| Nutrition | 6.05 | 6.4 | 7.6 | 0.042 |
| Wastage | 7.15 | 7.05 | 7.3 | 0.096 |
| Heat and Humidity | 7.00 | 7.45 | 6.8 | 0.45 |
| Whips | 6.85 | 7.15 | 6.8 | 0.803 |
| Environment | 8.55 | 5.05 | 6.3 | 0.001 |
| Gear | 6.5 | 5.25 | 0.9 | 0.058 |

**Appendix 2. The effects of stakeholder qualifications on median importance values for each issue**

| | Primary School | High School | Technical and further education college | University | Other | Probability |
|---|---|---|---|---|---|---|
| Horsemanship | 7.90 | 8.70 | 8.60 | 9.00 | 9.20 | 0.212 |
| Health and Disease | 8.40 | 8.10 | 8.60 | 8.70 | 8.50 | 0.653 |
| Education of Horse | 6.40 | 8.30 | 8.50 | 8.50 | 8.10 | 0.714 |
| Ventilation | 6.40 | 8.20 | 7.95 | 8.00 | 7.10 | 0.696 |
| Track design and Surface | 8.00 | 7.80 | 7.50 | 7.30 | 7.40 | 0.725 |
| Stabling | 5.50 | 7.70 | 7.35 | 7.30 | 6.70 | 0.709 |
| Weaning | 7.40 | 7.50 | 7.45 | 7.70 | 7.00 | 0.117 |
| Transport | 6.90 | 6.70 | 7.50 | 7.20 | 7.10 | 0.434 |
| Nutrition | 9.10 | 7.50 | 7.10 | 7.60 | 7.10 | 0.407 |
| Wastage | 6.60 | 7.90 | 7.20 | 7.20 | 7.10 | 0.389 |
| Heat and Humidity | 8.10 | 6.50 | 6.80 | 7.00 | 4.10 | 0.500 |
| Whips | 5.90 | 6.80 | 7.20 | 6.70 | 5.20 | 0.478 |
| Environment | 6.80 | 5.80 | 6.75 | 6.20 | 3.10 | 0.041 |
| Gear | 5.20 | 1.30 | 1.40 | 0.70 | 1.30 | 0.973 |

**Appendix 3. The effects of stakeholder country of experience on median importance values for each issue**

| | Australia | UK | Japan | France | Ireland | USA | Germany | Other | Probability |
|---|---|---|---|---|---|---|---|---|---|
| Horsemanship | 8.80 | 10.45 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 9.00 | 0.305 |
| Health and Disease | 8.50 | 9.95 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 7.50 | 0.852 |
| Education of Horse | 8.40 | 11.55 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 7.30 | 0.311 |
| Ventilation | 8.00 | 6.80 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 7.30 | 0.347 |
| Track Design and Surface | 7.50 | 7.50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.50 | 0.225 |
| Stabling | 7.20 | 8.15 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 8.30 | 0.288 |
| Weaning | 7.50 | 9.70 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 7.50 | 0.305 |
| Transport | 7.10 | 7.65 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 7.90 | 0.207 |
| Nutrition | 7.40 | 5.90 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 7.00 | 0.305 |
| Wastage | 7.20 | 3.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 8.60 | 0.318 |
| Heat and Humidity | 6.90 | 7.85 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.70 | 0.305 |
| Whips | 6.80 | 4.15 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 5.80 | 0.322 |
| Environment | 6.40 | 3.75 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 5.80 | 0.313 |
| Gear | 1.30 | 3.55 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.852 |

**Appendix 4a. Pearson correlation coefficients of transformed behaviour values (log10 behaviour + 1, top value) and probability that the correlation is significant (bottom value)**

| | Drink | Feeding | Elim | Lying | St. resting |
|---|---|---|---|---|---|
| Feeding | 0.40 | | | | |
| | 0.0 | | | | |
| Elim | -0.02 | -0.15 | | | |
| | 0.84 | 0.10 | | | |
| Lying | -0.04 | 0.08 | 0.00 | | |
| | 0.63 | 0.34 | 0.98 | | |
| Standing resting | 0.24 | -0.05 | 0.08 | -0.15 | |
| | 0.01 | 0.61 | 0.33 | 0.08 | |
| Standing inactive | 0.01 | -0.01 | 0.06 | 0.11 | 0.23 |
| | 0.87 | 0.94 | 0.52 | 0.20 | 0.01 |
| Standing sleeping | -0.07 | -0.01 | 0.11 | 0.17 | 0.23 |
| | 0.40 | 0.90 | 0.23 | 0.06 | 0.01 |
| Rubbing | -0.01 | -0.14 | 0.09 | -0.01 | 0.17 |
| | 0.87 | 0.10 | 0.31 | 0.88 | 0.06 |
| Aggress | -0.03 | -0.01 | 0.24 | -0.09 | 0.03 |
| | 0.75 | 0.92 | 0.00 | 0.30 | 0.72 |
| Vocal | -0.08 | 0.00 | 0.11 | 0.06 | 0.09 |
| | 0.33 | 0.98 | 0.21 | 0.53 | 0.30 |
| Sniffing | 0.10 | 0.16 | 0.25 | -0.11 | 0.20 |
| | 0.27 | 0.07 | 0.00 | 0.20 | 0.02 |
| Boxwalk | -0.20 | -0.22 | 0.13 | 0.07 | -0.10 |
| | 0.02 | 0.01 | 0.15 | 0.44 | 0.23 |
| Walk | -0.25 | -0.24 | 0.15 | 0.06 | -0.11 |
| | 0.00 | 0.01 | 0.08 | 0.51 | 0.22 |
| Play | 0.05 | 0.10 | 0.11 | 0.07 | 0.07 |
| | 0.54 | 0.25 | 0.20 | 0.41 | 0.44 |
| Windsuck | 0.01 | -0.24 | 0.02 | 0.02 | 0.14 |
| | 0.95 | 0.01 | 0.84 | 0.82 | 0.11 |
| Chewob | 0.07 | -0.20 | 0.07 | 0.12 | 0.23 |
| | 0.46 | 0.02 | 0.42 | 0.19 | 0.01 |
| Shamchew | 0.13 | 0.08 | 0.14 | 0.18 | 0.02 |
| | 0.13 | 0.34 | 0.11 | 0.04 | 0.85 |
| Licking | -0.03 | -0.01 | 0.13 | 0.02 | -0.13 |
| | 0.70 | 0.93 | 0.15 | 0.80 | 0.15 |
| Yawn | -0.03 | 0.02 | 0.07 | -0.08 | -0.02 |
| | 0.78 | 0.79 | 0.43 | 0.38 | 0.78 |
| Weave | -0.33 | -0.45 | 0.26 | -0.17 | -0.20 |

| | | | | | |
|---|---|---|---|---|---|
| | 0.00 | 0.00 | 0.00 | 0.05 | 0.02 |
| Doorbang | 0.00 | -0.10 | 0.05 | -0.06 | 0.05 |
| | 0.97 | 0.24 | 0.58 | 0.47 | 0.54 |
| Headtoss | -0.27 | -0.11 | 0.02 | 0.05 | 0.05 |
| | 0.00 | 0.22 | 0.84 | 0.58 | 0.54 |
| Paw | -0.00 | -0.08 | 0.11 | -0.12 | 0.11 |
| | 1.00 | 0.37 | 0.23 | 0.17 | 0.22 |
| Look | -0.07 | 0.02 | 0.09 | 0.03 | -0.02 |
| | 0.42 | 0.85 | 0.32 | 0.73 | 0.85 |
| Startle | -0.02 | -0.05 | 0.04 | 0.02 | 0.11 |
| | 0.85 | 0.60 | 0.65 | 0.79 | 0.21 |
| Outofsight | 0.18 | 0.19 | -0.18 | 0.01 | -0.26 |
| | 0.04 | 0.03 | 0.04 | 0.88 | 0.00 |

| | **St. inactive** | **St. sleep** | **Rubbing** | **Aggress** | **Vocal** |
|---|---|---|---|---|---|
| St. sleep | 0.21 | | | | |
| | 0.02 | | | | |
| Rubbing | 0.02 | -0.10 | | | |
| | 0.80 | 0.28 | | | |
| Aggress | 0.11 | 0.08 | 0.22 | | |
| | 0.20 | 0.38 | 0.01 | | |
| Vocal | -0.01 | 0.25 | 0.07 | -0.01 | |
| | 0.91 | 0.00 | 0.40 | 0.91 | |
| Sniffing | 0.05 | 0.08 | 0.26 | 0.27 | 0.08 |
| | 0.59 | 0.35 | 0.00 | 0.00 | 0.35 |
| Boxwalk | 0.03 | 0.07 | 0.06 | 0.01 | 0.25 |
| | 0.78 | 0.46 | 0.51 | 0.91 | 0.00 |
| Walk | -0.04 | 0.16 | 0.02 | -0.05 | 0.14 |
| | 0.62 | 0.07 | 0.79 | 0.55 | 0.10 |
| Play | 0.11 | 0.01 | 0.26 | 0.16 | 0.18 |
| | 0.19 | 0.91 | 0.00 | 0.07 | 0.04 |
| Windsuck | 0.17 | 0.17 | -0.07 | -0.04 | 0.01 |
| | 0.05 | 0.05 | 0.43 | 0.63 | 0.91 |
| Chewob | 0.17 | 0.20 | 0.15 | -0.04 | 0.02 |
| | 0.05 | 0.02 | 0.09 | 0.62 | 0.81 |
| Sham chew | 0.09 | 0.11 | 0.087 | 0.12 | 0.01 |
| | 0.29 | 0.20 | 0.32 | 0.18 | 0.88 |
| Licking | 0.04 | 0.15 | 0.14 | 0.10 | -0.03 |
| | 0.68 | 0.08 | 0.10 | 0.25 | 0.73 |
| Yawn | -0.12 | 0.02 | 0.18 | -0.01 | -0.07 |
| | 0.22 | 0.79 | 0.03 | 0.96 | 0.44 |
| Weave | -0.08 | -0.12 | 0.00 | 0.10 | -0.04 |
| | 0.36 | 0.18 | 0.98 | 0.24 | 0.67 |
| Doorbang | 0.09 | 0.05 | -0.01 | -0.03 | -0.03 |
| | 0.33 | 0.57 | 0.92 | 0.71 | 0.77 |

| | | | | | |
|---|---|---|---|---|---|
| Headtoss | -0.01 | 0.16 | 0.15 | 0.13 | 0.25 |
| | 0.91 | 0.06 | 0.08 | 0.14 | 0.00 |
| Paw | -0.19 | 0.00 | 0.12 | 0.12 | 0.03 |
| | 0.03 | 0.99 | 0.18 | 0.17 | 0.77 |
| Look | 0.02 | 0.16 | 0.18 | 0.12 | 0.15 |
| | 0.84 | 0.07 | 0.04 | 0.17 | 0.09 |
| Startle | 0.01 | 0.12 | 0.04 | 0.13 | 0.09 |
| | 0.88 | 0.17 | 0.65 | 0.15 | 0.32 |
| Outofsight | -0.29 | -0.14 | -0.21 | -0.22 | -0.13 |
| | 0.00 | 0.11 | 0.01 | 0.01 | 0.14 |

| | **Sniffing** | **Boxwalk** | **Walk** | **Play** | **Windsuck** |
|---|---|---|---|---|---|
| Boxwalk | -0.02 | | | | |
| | 0.78 | | | | |
| Walk | -0.07 | 0.06 | | | |
| | 0.42 | 0.50 | | | |
| Play | 0.16 | 0.20 | 0.04 | | |
| | 0.06 | 0.02 | 0.63 | | |
| Windsuck | 0.01 | 0.06 | -0.09 | -0.09 | |
| | 0.91 | 0.47 | 0.32 | 0.33 | |
| Chewob | -0.09 | -0.12 | 0.07 | 0.07 | 0.26 |
| | 0.29 | 0.18 | 0.43 | 0.45 | 0.00 |
| Sham chew | 0.06 | 0.09 | 0.12 | 0.23 | -0.10 |
| | 0.51 | 0.30 | 0.17 | 0.01 | 0.26 |
| Licking | 0.06 | 0.12 | 0.14 | 0.05 | -0.04 |
| | 0.49 | 0.16 | 0.10 | 0.56 | 0.62 |
| Yawn | 0.16 | -0.06 | 0.07 | 0.00 | -0.09 |
| | 0.07 | 0.51 | 0.41 | 0.97 | 0.29 |
| Weave | -0.05 | 0.16 | 0.25 | 0.05 | 0.09 |
| | 0.61 | 0.07 | 0.00 | 0.53 | 0.31 |
| Doorbang | -0.01 | 0.08 | 0.04 | 0.12 | -0.08 |
| | 0.88 | 0.35 | 0.65 | 0.17 | 0.39 |
| Headtoss | 0.07 | 0.16 | 0.07 | 0.08 | -0.11 |
| | 0.43 | 0.07 | 0.42 | 0.34 | 0.22 |
| Paw | 0.19 | -0.01 | 0.10 | 0.19 | 0.07 |
| | 0.03 | 0.95 | 0.26 | 0.03 | 0.40 |
| Look | 0.16 | 0.18 | 0.13 | 0.09 | 0.10 |
| | 0.06 | 0.04 | 0.14 | 0.29 | 0.25 |
| Startle | 0.04 | 0.08 | 0.04 | -0.01 | -0.02 |
| | 0.67 | 0.36 | 0.65 | 0.94 | 0.83 |
| Outofsight | -0.21 | -0.07 | 0.06 | -0.14 | -0.20 |
| | 0.02 | 0.41 | 0.51 | 0.10 | 0.03 |

| | **Chewob** | **Sham chew** | **Licking** | **Yawn** | **Weave** |
|---|---|---|---|---|---|
| Sham chew | 0.12 | | | | |
| | 0.15 | | | | |
| Licking | -0.01 | 0.08 | | | |

| | | | | | |
|---|---|---|---|---|---|
| | 0.96 | 0.39 | | | |
| Yawn | -0.01 | 0.13 | 0.16 | | |
| | 0.88 | 0.15 | 0.07 | | |
| Weave | -0.03 | -0.09 | 0.27 | -0.11 | |
| | 0.70 | 0.30 | 0.00 | 0.21 | |
| Doorbang | -0.11 | 0.03 | 0.14 | 0.06 | 0.07 |
| | 0.23 | 0.72 | 0.11 | 0.47 | 0.42 |
| Headtoss | 0.00 | 0.04 | 0.05 | 0.10 | -0.00 |
| | 0.97 | 0.68 | 0.56 | 0.23 | 0.96 |
| Paw | 0.08 | 0.08 | 0.06 | 0.05 | 0.09 |
| | 0.39 | 0.37 | 0.53 | 0.60 | 0.30 |
| Look | 0.12 | 0.06 | 0.12 | 0.08 | -0.15 |
| | 0.17 | 0.50 | 0.18 | 0.34 | 0.09 |
| Startle | 0.08 | 0.05 | -0.04 | 0.15 | -0.00 |
| | 0.35 | 0.57 | 0.64 | 0.09 | 0.96 |
| Outofsight | -0.15 | 0.03 | -0.09 | 0.10 | -0.09 |
| | 0.09 | 0.77 | 0.32 | 0.25 | 0.31 |

| | **Doorbang** | **Headtoss** | **Paw** | **Look** | **Startle** |
|---|---|---|---|---|---|
| Headtoss | -0.10 | | | | |
| | 0.24 | | | | |
| Paw | 0.05 | 0.05 | | | |
| | 0.56 | 0.54 | | | |
| Look | 0.10 | 0.14 | 0.06 | | |
| | 0.28 | 0.12 | 0.48 | | |
| Startle | 0.16 | 0.21 | -0.06 | 0.16 | |
| | 0.06 | 0.02 | 0.52 | 0.07 | |
| Outofsight | -0.02 | -0.20 | -0.02 | -0.23 | 0.11 |
| | 0.84 | 0.03 | 0.82 | 0.01 | 0.2 |

## Appendix 4b Abbreviations of the Pearson correlation coefficients of transformed behaviour values.

| | |
|---|---|
| Elim | Elimination |
| Aggress | Aggression |
| Boxwalk | Boxwalking |
| Windsuck | Windsucking |
| Chewob | Chewing on objects |
| Shamchew | Sham chewing |
| Outofsight | Out of sight |
| St. sleep | Standing sleep |
| St. inactive | Standing inactive |
| St. resting | Standing resting |
| Headtoss | Head toss |

**Appendix 5. Trainer's survey of welfare issuers and levels within the thoroughbred horse racing industry**

**SECTION 1 - DEMOGRAPHICS**

Q1 Gender:
Please select from the following.

- ☐ Male
- ☐ Female

Q2 Please select your age group:

- ☐ Under 19 years
- ☐ 19-24
- ☐ 25-30
- ☐ 31-40
- ☐ 41-50
- ☐ 51-60
- ☐ 61+

Q3 Please select your highest achieved level of education:

- ☐ Primary School
- ☐ High School
- ☐ Technical and further education college
- ☐ University
- ☐ Other, please specify

Q4 What is your total time of involvement with Thoroughbred racehorses?

- ☐ Less than 1 month
- ☐ 1-12 months
- ☐ 13-48 months
- ☐ Over 48 months

Q5 Where did you mostly gain this experience?

- ☐ Australia
- ☐ United Kingdom
- ☐ Japan
- ☐ France
- ☐ Ireland
- ☐ Germany
- ☐ Other, please specify _____

**SECTION 2 - WELFARE AND MANAGEMENT**

Q1 Horsemanship
How experienced are your staff?

- ☐ All staff are experienced and well trained, employing knowledge of equine behaviour in management and training.
- ☐ Approximately half of the staff are experienced and have the ability to evaluate health and welfare.
- ☐ None of the staff have the ability to evaluate health and welfare and frequently resort to force.

Q2 Health and Disease

- ☐ How well are your horses' health and disease problems attended to?
- ☐ Regular attention to health. Appropriate use of analgesics, tranquilizers and parasitic control.
- ☐ Some attention to health. Occasional use of analgesics, tranquilizers and parasitic control medication.
- ☐ Infrequent attention to health. Analgesics, tranquilizers and parasitic control medication used only when absolutely necessary.

Q3 Education of Horses
To what level are your horses educated when sent to you for race training?

- ☐ Regular training from birth through to weaning, sales preparation and transporting, riding, track work, barrier habituation, and racing.
- ☐ Some handling as a foal, through to weaning, sales preparation and transportation, riding, track work, barrier habituation and racing.
- ☐ No handling as a foal or weanling. Little preparation for sales and transporting. Riding and track work rushed with no habituation to barrier

Q4 Track Design and Surface
What type of track do your horses race on?

- ☐ Gradual turning cambered turf track.
- ☐ Gradual turning cambered synthetic track.
- ☐ Tight turning cambered turf track.
- ☐ Tight turning cambered synthetic track.
- ☐ Other, please describe _____

Q5 Ventilation
How good is the ventilation for your horses?

- ☐ Good ventilation: fans in every stable; good ventilation in transport.
- ☐ Some ventilation: fans at end of stable corridors; some ventilation in transport.
- ☐ Poor ventilation: stable walls of solid construction to at least 110cm with wire mesh above; inadequate ventilation in transport.
- ☐ Other, please describe _____

Q6 Stabling
How much space do your horses have?

- ☐ Large stable (approximately 5m x 5m with ceiling height approximately 6m), with free use of attached yard.
- ☐ Small stable (approximately 3.6m x 3.6m with ceiling height approximately 4m) with free use of attached yard.
- ☐ Large stable (approximately 5m x 5m with ceiling height approximately 6m), with no use of attached yard.
- ☐ Small stable (approximately 3.6m x 3.6m with ceiling height approximately 4m) with no use of attached yard.
- ☐ Other, please describe_____

Q7 Weaning
Which weaning process was used for the majority of the horses that you train?

- ☐ Removal of one mare at a time from a group of mares and foals in a paddock, until all mares are removed from group.
- ☐ Two weanlings isolated together in a stable which allows visual and physical contact with neighbouring horses.
- ☐ One weanling in a stable which does not allow visual or physical contact with neighbouring horses.
- ☐ Unknown
- ☐ Other, please describe _____

Q8 Transport
How skilled are your transport drivers?

- ☐ Skilled driver, very experienced in loading and offloading horses.
- ☐ Semi-skilled driver, some experience of loading and offloading horses.
- ☐ Staff with limited experience in driving, loading and offloading horses.
- ☐ Other, please describe _____

Q9 Nutrition
Do you tailor your horses' nutritional needs to their requirements, including giving green forage?

- ☐ Attention to age and training requirements of individual horses in order to balance fibre / grain intake with addition of proven supplement requirements and access to additional green forage.
- ☐ Attention to age and training requirements of individual horses in order to balance fibre / grain intake with proven supplement requirements, infrequent access to additional green forage.
- ☐ Standard nutritional program for all horses regardless of racing programme, no additional green forage.

☐ Other, please describe _____

Q10 Wastage
What happens to your horses when retired from racing?

☐ Horse retired from racing to a breeding farm.
☐ Horse retired for equestrian sports.
☐ Horse given away as race record was insufficient for breeding or temperament unsuitable for retraining in equestrian sports.
☐ Horse sent to slaughterhouse, unsuitable for further use.
☐ Unknown or other, please describe _____

Q11 Heat and Humidity
Are your horses exposed to extreme climatic conditions?

☐ Horses are regularly exposed to climatic variations; inadequate acclimatisation following transport; poor stable design for temperature control.
☐ Horses sometimes exposed to climatic variation; some acclimatisation following transport; stable design allows for some temperature control.
☐ Horses rarely exposed to climatic variations; good acclimatisation following transport; stable design allows for good temperature control.
☐ Other, please describe _____

Q12 Whips
How often are your horses whipped in their races?

☐ Whipping horses occasionally throughout the race.
☐ Whipping horses regularly in the last 100 metres of the race if they are tired.
☐ No use of whip, jockeys ride with hands and heels.

Q13 Environment
What is the environment in which the horses are kept?

☐ Use of wood shavings. Stable / yard design allows only visual contact with other horses.
☐ Use of wood shavings. Stable / yard design allows physical and visual contact with other horses.
☐ Use of straw bedding. Stable / yard design allows physical and visual contact with other horses.
☐ Use of straw bedding. Stable / yard design allows only visual contact with other horses.
☐ Other, please specify _____

Q14 Gear
Do you use blinkers and tongue tie routinely?

- ☐ No blinkers or tongue tie.
- ☐ Use of blinkers, but no tongue tie
- ☐ Use of tongue tie and blinkers.
- ☐ Use of tongue tie but no blinkers.

**END OF SURVEY**

To participate in the draw to win a 16kg tub of Salkavite, kindly donated by Ranvet Pty Ltd, please enter your phone number and/or email address. The winner of the draw will be advised by phone or email.
Phone Number: _____ Email: _____

To request feedback:
Email: _____

OUR SINCERE THANKS FOR COMPLETING THIS SURVEY, THE RESULTS ARE COMPELETLY ANONYMOUS.

Participants are free to discuss their participation in this study by emailing alison.mactaggart@uqconnect.edu.au.
If participants would like to speak to an officer of the University not involved in the study, they may contact the Ethics officer on +61 7 3365 3924.
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