CORRELATIONS BETWEEN THE RESULTS OF ANIMAL WELFARE ASSESSMENTS BY THE TGI 35 L AUSTRIAN ANIMAL NEEDS INDEX AND HEALTH AND BEHAVIOURAL PARAMETERS OF CATTLE

E Ofner*, T Amon[†], M Lins[†] and B Amon[†]

* BAL Gumpenstein, Federal Research Institute for Agriculture in Alpine Regions, Unit for Agricultural Buildings and Husbandry, Altirdning 11, A-8952 Irdning, Austria

[†] Institute of Agricultural, Environmental and Energy Engineering (ILUET), University of Agricultural Sciences Vienna (Universität für Bodenkultur Wien), Nussdorfer Laende 29–31, A-1190 Vienna, Austria

* Contact for correspondence and requests for reprints: elfriede.ofner@bal.bmlfuw.gv.at

Suitable systems for the assessment of animal welfare are in increasing demand. In Austria, the TGI 35 L Animal Needs Index is widely used and has been shown to be a feasible and reliable tool for animal welfare assessment on farms. Here we focus on the validity of TGI 35 L assessments, and explore the correlation between animal welfare as assessed by the TGI 35 L and animal health and behavioural parameters. From the results, it can be determined whether the criteria assessed by the TGI 35 L are preconditions for a high level of health and normal behaviour. Behaviour and health were examined in 11 cattle houses, totalling 169 animals. Behaviour was observed for two days on each farm. Data on resting behaviour, comfort behaviour, social behaviour, feed intake behaviour and eliminative behaviour were collected. Health was assessed using veterinary examinations carried out according to the General Clinical and the Orthopaedic Examination Proceedings. Significant correlations were found between the TGI scores and behaviour and health, including results for skin lesions and injuries. This indicates good validity of the TGI 35 L assessment system for cattle. A comprehensive system for the assessment of animal welfare on farms must comprise parameters of housing, climate, management and stockmanship, and animal-related parameters.

Keywords: *ANI, animal welfare, assessment system, cattle, TGI, validity*

Introduction

Authorities, farmers, consumers and retailers are showing increasing interest in improving the welfare of housed livestock. Labels guaranteeing that animal products originate from animal-friendly housing systems are now required. There is urgent need for reliable, feasible and valid tools for on-farm assessment of animal welfare. Assessment systems must take into account the complex nature of animal welfare.

In Austria, an index system, the TGI 35 L Animal Needs Index, is used for on-farm assessment of welfare. The TGI (German: Tiergerechtheitsindex) is synonymous with the

ANI (Animal Needs Index) used in many publications (eg Bartussek 1999). The TGI 35 L is broadly accepted and widely applied for certification of livestock products in organic farming and other labelling systems and for legislative requirements. It is also suitable as an advisory tool for farmers to help them identify areas of potential improvement in their housing systems.

TGI 35 L assessments comprise the following five aspects that are considered essential for animal well-being:
1. affording movement and locomotion ('Locomotion')
2. affording social interaction ('Social interaction')
3. type and condition of flooring ('Flooring')
4. light and air conditions ('Light/Air/Noise')
5. stockmanship ('Stockmanship')

The TGI system integrates parameters of housing, climate and management as well as animal-related parameters. The higher the TGI score, the better the fulfilment of animal needs (German: Tiergerechtheit). A comprehensive overview of this assessment system is given in Bartussek (1999). During its many years of application, the TGI 35 L has proved to be a feasible tool for on-farm assessment of animal welfare. In the past years, the Institute of Agricultural, Environmental and Energy Engineering (ILUET) has carried out intensive research into the quality of assessment of the TGI 35 L. Assessments have proved to be sufficiently precise and reliable (Amon *et al* 2001; Ofner *et al* 2001; Ofner *et al* 2002b). As well as precision, validity is a very important quality criterion. ILUET investigated the correlation between welfare as assessed by the TGI 35 L and animal health and behavioural parameters. If the TGI is a suitable measure of animal welfare, a high TGI score must correspond to a low level of health problems and behavioural disturbances. From the results, it can be determined whether the criteria assessed by the TGI 35 L ensure a high level of health and normal behaviour and whether there is a clear link with animal welfare.

Methods

Extensive literature reviews and expert interviews revealed parameters of animal health and behaviour that are mainly influenced by the housing system. The frequency of occurrence of these selected parameters was then assessed in 11 cattle houses (dairy and suckling cows) in three Austrian Federal Provinces. A total of 169 animals were observed.

On the same 11 farms, TGI assessments had been carried out beforehand by experienced TGI assessors. The TGI scores ranged from 11.5 to 43.8 TGI points (Figure 1). Correlations between the results of the TGI assessments and animal health and behavioural data were estimated using Spearman's correlation coefficient. Data were analysed in order to determine: 1) correlations with the total TGI score; 2) correlations with the scores of the five assessment sections of the TGI 35 L; and 3) correlations with every single score of the 30 criteria of the TGI assessment system.

Animal behaviour

Animal behaviour was directly observed during the daytime for two days on each farm. Observations were made of the following behavioural domains: resting behaviour, comfort behaviour, social behaviour, feed intake behaviour, and eliminative behaviour (Table 1).
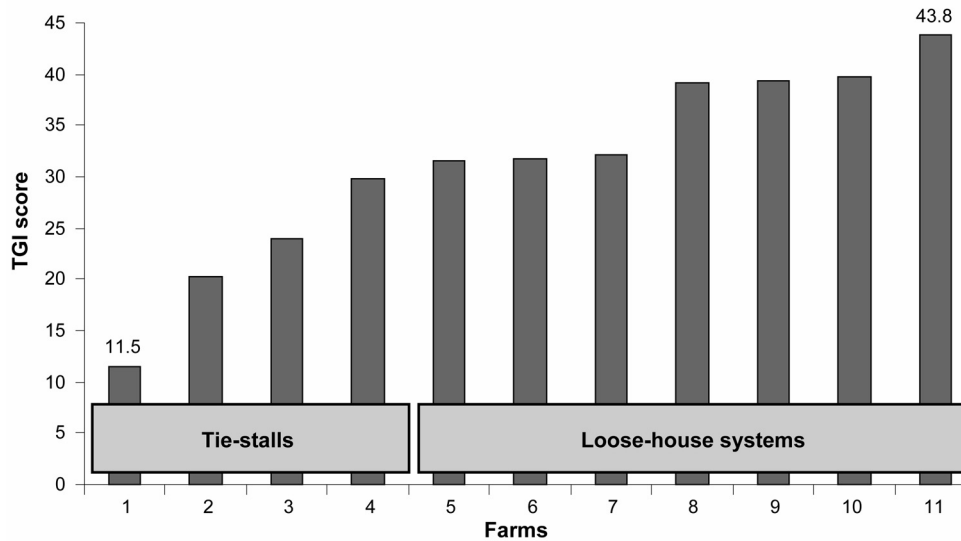
Figure 1   **TGI scores of the investigated farms.**

Table 1   **Parameters included in behaviour observations.**

Behavioural domains	Specific behaviour
Resting behaviour	Normal lying down and standing up
	Disturbed lying down and standing up
	Intention to lie down or to stand up
	Lying down with hindlegs first
	Standing up with forelegs first
	Lying positions
	Percentage of animals ruminating when lying
Comfort behaviour	Self-licking
	Scratching with hindleg
	Scratching against the stable equipment
Social behaviour	Friendly interactions
	Agonistic interactions
	Expressive behaviour
	Licking members of the herd
Feed intake behaviour	Driving away from feeding rack
	Pressing against the feeding rack
Eliminative behaviour	Species-specific eliminative behaviour
	Not species-specific eliminative behaviour

Animal health

Animal health was assessed by experienced veterinarians. Examinations were carried out according to a slightly shortened form of the standardised General Clinical Examination Proceedings (Baumgartner 1999) with the main emphasis on skin lesions and injuries and according to the Orthopaedic Examination Proceedings. Examinations were made of all cattle housed in the 11 cattle houses.

Skin lesions and injuries

The general clinical examination proceedings include observations of "hair coat, horns and surface of skin". In this research project, these parameters were given special attention. Each cow was inspected for skin lesions and injuries. The following body regions were examined: neck, nape of neck, dewlap, shoulder, elbow region, back, abdomen (including rib region and wall of abdomen), pelvis (including coxal tuberosity and ischial tuberosity), root of tail, region of thigh, knee and lower leg, dewclaw region, carpal joint, tarsal joint, and point of hock. Type, severity and size of lesions were assessed.

Orthopaedic Examination Proceedings

The Orthopaedic Examination Proceedings consist of four phases (Stanek 1997): collection of data, general examination of patient, physical examination of limbs, and conducting of specific tests. Special emphasis was given to the third phase, focusing on the examination of the elevated claw after light paring of the sole. On each farm, the claw health state of the 25% worst-affected cows was examined. The claws of a total of 36 cows were inspected for heel horn erosion, double sole, sole haemorrhage, sole ulcer, fissures and hollow wall, interdigital hyperplasia, ground border overgrowth and claw overgrowth.

Results and discussion

This section gives an overview of the results gathered in the experiments. Because of space limitations the results cannot be given in full. Details are given in Lins 2002, Ofner *et al* 2002a and Ofner 2003.

Correlations with the total TGI score

Significant correlations were found between the results of the total TGI score and animal behaviour parameters (Lins 2002; Ofner *et al* 2002a). As shown in Table 2, normal standing up and lying down increased significantly, while disturbed lying down decreased, with an increase in the TGI score. Improved environmental conditions, expressed as an increase in the TGI score, resulted in an increase in social interactions.

The total TGI score also correlated with parameters of animal health (Table 2). Frequency of skin lesions and injuries decreased with higher TGI scores. Hairless patches in the region of thigh, knee and lower leg, hock joint and point of hock, as well as reddening on hock joint, callosities on point of hock and scabs on point of hock, were reduced on farms with high TGI scores. An impaired state of nutrition was observed less often in cattle houses with a high TGI score. A normal state of eyes and conjunctiva was diagnosed more often, while qualitative and quantitative changes in colour of conjunctiva were less frequent. Physiological blood supply and state of jugular groove could be considered indicators of an intact cardiovascular system.

No clear correlation could be found between the TGI score and parameters gathered from Orthopaedic Examination Proceedings. This may be because of the multifactorial etiology of claw disorders (Greenough *et al* 1997) and because of the relatively small sample size of 36 cows.

As described above, correlations between the result of the TGI assessment and animal health and behaviour could be found at the level of the total TGI score. On the more detailed levels of the five assessment sections and the single criteria of the TGI assessment system, many additional correlations were found.

Table 2 **Correlations between the total score of TGI 35 L assessments and parameters of behaviour and health of 169 cattle.**

Animal behaviour	
Resting behaviour	
Percentage of normal lying down	0.69*
Percentage of normal standing up	0.64*
Percentage of disturbed lying down	–0.67*
Social behaviour	
Agonistic interactions	0.61*
Expressive behaviour	0.58^
Animal health	
General clinical examination proceedings	
Impaired state of nutrition	–0.53^
State of eyes and conjunctiva	0.63*
Blood supply and state of jugular groove	0.74**
Skin lesions and injuries	
Hairless patches ≤ 3 cm on the region of thigh, knee and lower leg	–0.66*
Hairless patches ≤ 3 cm on tarsal joint	–0.68*
Reddening on tarsal joint	–0.66*
Hairless patches ≤ 3 cm on point of hock	–0.71*
Callosities on point of hock	–0.66*
Scabs on point of hock	–0.68*

$**P \leq 0.01$; $*P \leq 0.05$; $^P \leq 0.1$ (tendency)

Correlations with the five assessment sections of the TGI 35 L

Significant to highly significant correlations were found between parameters of resting behaviour and the TGI scores in the assessment sections 'Locomotion', 'Social interaction' and 'Light/Air/Noise'. Comfort behaviour correlated with the TGI scores in the assessment sections "Flooring" and "Stockmanship". Social behaviour correlated with scores of all five sections of the TGI 35 L. Details of the results are given in Ofner *et al* (2002a). Parameters of animal health correlated with scores of all five sections of the TGI 35 L (Table 3).

Correlations with the scores of the single criteria of the TGI 35 L

The TGI assessment system consists of 30 single criteria. Although we cannot discuss every correlation here, the text gives some selected examples.

By providing access to an outdoor yard or pasture, an important contribution is made toward improving the condition of the animals' movement apparatus (eg skeleton, muscles, circulation). Thus it is appropriate that the TGI 35 L gives emphasis to the criterion of providing outdoor access. This was proven to be appropriate because it was found, for example, that the percentage of normal lying down was increased on farms which received a higher TGI score for outdoor yard or pasture. With an increase in the TGI score for outdoor yard or pasture, social behaviour was influenced positively.

The examination of skin and hair coat showed a clear decrease of lesions and injuries with rising TGI score for outdoor yard or pasture. When the TGI score was high, improved state of eyes, conjunctiva and oral cavity, health state of lungs and physiological blood supply and state of jugular system could be found.

Investigations showed that with improved 'Condition of the hooves' (assessed by TGI 35 L), the percentage of normal lying down increased significantly, while disturbed lying down decreased. Similar relationships were seen with the TGI criteria 'Technopathies'

and 'Animal health'. Assessment results of the criteria 'Condition of integument' and 'Technopathies' gathered by trained and experienced TGI assessors were in good agreement with abnormalities of tarsal joint and point of hock located by veterinarians during clinical examination. On the other hand, 'Condition of hooves' inspected by TGI assessors showed no connection with the result of the orthopaedic examination by vets. This may be explained by the relatively small sample size used for claw examinations but could also indicate that better procedures for examination of the state of claws by TGI assessors are needed.

Table 3   **Correlations between the scores of the five assessment sections of TGI 35 L and parameters of animal health of 169 cattle.**

Parameters of animal health	Assessment sections of TGI 35 L				
	1 **Loco-** **motion**	**2** **Social** **interaction**	**3** **Flooring**	**4** **Light/** **Air/Noise**	**5** **Stockmanship**
General clinical examination proceedings					
Impaired state of nutrition					–0.87**
Normal skin elasticity		0.57^			
Normal state of eyes and conjunctiva	0.73*	0.74**		0.64*	
Qualitative and quantitative changes in colour of conjunctiva	–0.72*	–0.73*		–0.63*	
Eye discharge				–0.61*	
Normal state of oral cavity	0.62*	0.59^		0.78**	
Cough			–0.62*		–0.53^
Blood supply and state of jugular groove	0.75**	0.75**		0.69*	0.63*
No abnormality in auscultation of lungs					0.76**
Slightly intensified vesicular breathing sound	–0.67*	–0.67*		–0.62*	
Moderately intensified vesicular breathing sound					–0.60^
Skin lesions and injuries					
Hairless patches ≤ 3 cm on dewlap	–0.66*	–0.66*		–0.66*	
Hairless patches ≤ 3 cm on region of thigh, knee & lower leg	–0.71*	–0.71*			
Hairless patches > 3 cm on region of thigh, knee & lower leg	–0.54^				
Scars/scabs/abrasions ≤ 3 cm on region of thigh, knee & lower leg	–0.66*	–0.66*		–0.66*	
Broken hairs on carpal joint	-0.71*	–0.73*			
Callosities on carpal joint			–0.59^	–0.62*	
Hairless patches > 3 cm on tarsal joint			–0.70*		–0.67*
Reddening on tarsal joint	–0.77**	–0.77**		–0.60^	
Hairless patches ≤ 3 cm on point of hock			–0.65*		–0.69*
Reddening on point of hock	–0.54^	–0.54^			
Callosities on point of hock	–0.58^	–0.58^			–0.61*
Scabs on point of hock			–0.62*		–0.71*

**$P \leq 0.01$; *$P \leq 0.05$; ^$P \leq 0.1$ (tendency)

Conclusions and animal welfare implications

This research project revealed clear connections between the results of animal welfare assessments by the TGI 35 L and animal health and behavioural parameters, which is a good indicator of the validity of the system. In housing systems that received a high TGI score, the animals were healthier and showed normal behaviour more frequently. A comprehensive

system for the assessment of animal welfare on farms must comprise parameters of housing, climate, management, stockmanship and animal-related parameters. Observations of health and behaviour are helpful in validating an assessment system. For the selection of suitable parameters, attention must be paid to the following points: several parameters of animal health and behaviour have a multifactorial etiology and do not result from details of the housing system only; examination gives only a snapshot of the health status of a herd (eg temporary infections can distort the results); changes in animal health and behaviour often appear only when the animal is affected by very bad conditions over a long period of time (eg respiratory diseases caused by bad climate); and, animals' ability to compensate is fairly extensive. Thus, a fine-tuned assessment of animal welfare by animal-based criteria is less feasible than by the TGI assessment system.

Environment-based criteria can be assessed feasibly and precisely and should be an integral part of any on-farm assessment system. Animal-based criteria can also be included if they assess further important aspects of animal welfare not covered by criteria relating to the animals' environment. Appropriate schemes for a feasible application are necessary. The reliable assessment of animal welfare by a suitable assessment tool is the basis for any improvement of animal welfare.

Acknowledgements

References

Amon T, Amon B, Ofner E and Boxberger J 2001 Precision of assessment of animal welfare by the "TGI 35 L" Austrian Animal Needs Index. *Acta Agriculturae Scandinavica (Section A — Animal Science) 30*: 114-117 (Suppl)

Bartussek H 1999 A review of the animal needs index (ANI) for the assessment of animals' well-being in the housing systems for Austrian proprietary products and legislation. *Livestock Production Science 61*: 179-192

Baumgartner W 1999 *Klinische Propädeutik der inneren Krankheiten und Hautkrankheiten der Haus- und Heimtiere. 4., vollständig neubearbeitete und erweiterte Auflage.* Parey Buchverlag im Blackwell Wissenschafts-Verlag GmbH: Berlin, Germany [Title translation: Clinical Propaedeutic of Internal Diseases and Skin Diseases of Domestic Animals. 4th Completely Revised and Extended Edition]

Greenough P L, Weaver A D, Broom D M, Esslemont R J and Galindo F A 1997 Basic concepts of bovine lameness. In: Greenough P L and Weaver A D (eds) *Lameness in Cattle, Edn 3* pp 3-13. W B Saunders: Philadelphia, USA

Lins M 2002 *Zusammenhänge zwischen der Punktezahl des Tiergerechtheitsindex TGI 35 L/1996 für Rinder und dem Verhalten von Milch- und Mutterkühen.* Masters thesis, Institute of Agricultural, Environmental and Energy Engineering, University of Agricultural Sciences, Vienna, Austria [Title translation: Correlations between the score of TGI 35 L/1996 for cattle and the behaviour of dairy cattle and suckling cows]

Ofner E 2003 *Eine umfassende Analyse der Beurteilungsqualität des Tiergerechtheitsindex TGI 35 L/1996 für Rinder.* Thesis, Institute of Agricultural, Environmental and Energy Engineering, University of Agricultural Sciences, Vienna, Austria [Title translation: Comprehensive view of the assessment quality of the Austrian Animal Needs Index TGI 35 L/1996 for cattle]

Ofner E, Amon B, Amon T and Boxberger J 2001 Assessment quality of the TGI 35 L Austrian Animal Needs Index. In: *Proceedings of the International Symposium of the C.I.G.R. 2nd Technical Section "Animal welfare considerations in livestock housing systems"* pp 79-86. October 23–25 2001, Szklarska Poreba, Poland

Ofner E, Amon T, Lins M, Amon B and Boxberger J 2002a Vergleich des Bewertungsergebnisses des Tiergerechtheitsindex TGI 35 L/1996 für Rinder mit ausgewählten Parametern des Tierverhaltens. In: *"Tierschutz und Agrarwende/Heimtiere", Proceedings of "Tagung der Fachgruppen Tierschutzrecht und Tierzucht, Genetik und Haltung"* pp 103-116. March 7–9 2002, Nürtingen, Germany. Deutsche Veterinärmedizinische Gesellschaft e.V. (DVG): Germany [Title translation: Comparison between the results of animal welfare assessments by the TGI 35 L/1996 for cattle and selected parameters of animal behaviour]

Ofner E, Amon T, Amon B, Lins M and Boxberger J 2002b Precision of the TGI 35 L Austrian Animal Needs Index for on-farm assessment of animal welfare (with special regard to the TGI 35 L for fattening pigs). *Animal Production in Australia 24*: 157-160

Stanek Ch 1997 Examination of the locomotor system. In: Greenough P L and Weaver A D (eds) *Lameness in Cattle, Edn 3* pp 14-23. W B Saunders: Philadelphia, USA