IGN-Working Group "Group Housing of Dry Sows": Bartussek, H., Bünger, B., Edwards, S., Haidn, B., Jensen, K.H., Krispel, F., van Putten, G., Steiger, A., Troxler, J., Weber, R., Wechsler, B., Vermeer, H. und Wiedmann, R.:

# REPORT

on the IGN-WORKSHOP
## GROUP HOUSING OF DRY SOWS

# BERICHT

über den IGN-WORKSHOP
## GRUPPENHALTUNG TRÄCHTIGER SAUEN

09. bis 11. September 1998
an der BAL Gumpenstein

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# Forewords

The Austrian Federal Research Institute of Agriculture in Alpine Regions BAL Gumpenstein is devoted to research and development of agricultural methods and procedures that help to maintain agricultural cultivation and production in the mountainous areas of the alps and thus tries to contribute to a sustaining utilization and inhabitation of these ecologically sensitive regions. Our institute celebrated its 50th aniversary in 1997 and in 1999 commemorated the foundation of a department of agricultural buildings and animal housing 25 years ago. As concepts of sustainable agriculture increasingly have to include public acceptance of production methods, and besides ecological consideration therefore also have to reflect ethical demands of society, animal protection and animal welfare have been matters of concern ever since our department for animal housing was introduced a quarter of a century ago and have been well established by H. Bartussek, a member of IGN. Furthermore an increasing portion of the farmers within the Austrian alps and at their foothills are working on an organic basis and need advice on ethologically sound animal husbandry. Therefore it was a pleasure for me and a great honour for our institute to have been host to the IGN Workshop about "group housing of dry sows" from 9th to 11th of September 1998 and to be able to publish this report on behalf of IGN. To ensure a wide distribution of the results of this workshop, the report will be published in English supplemented by a German summary. Tables and figures will be headed and written in English and *German (kursiv)*.

Irdning, November 2000                                      *Dr. Kurt Chytil*
                                                    (director of BAL Gumpenstein)

The International Society of Livestock Husbandry (*Internationale Gesellschaft für Nutztierhaltung IGN)* works as a mediator between science and practice and uses various means to deal with the diverse aspects of livestock husbandry: Scientific meetings, the quarterly information journal "Nutztierhaltung", statements and comments on actual matters such as suggestions to draft texts of animal welfare legislation in various countries, the annual presentation of the *Schweisfurt Award for Excellent Research Projects in the Field of Appropriate Livestock Husbandry,* and the organisation of workshops on special topics. In 1998 a workshop was held on "Suffering in Animals" in Marburg/Germany and another one on "Ethological and Neurophysiological Criteria of Suffering, with Special Respect to Swine", in Bielefeld/Germany in 2000.

In the year 1998, the IGN decided to organise the workshop "Group Housing of Dry Sows" in Gumpenstein/Austria, presented in this report. To put the idea into action, the IGN invited 13 experts in the field of pig housing systems from Austria, Denmark, Germany, Switzerland, the Netherlands and the United Kingdom. In the frame of a concerted action, these experts assessed a total of 16 group housing systems. It was agreed upon that not only ethological criteria but also possible management risks linked to the various systems should be used as assessment tools. The noteworthy results achieved by the 13 experts not only consist of the ranking of 16 housing systems for dry sows but also of the very methods applied to make this ranking possible.

The IGN is grateful to the IGN-Working Group for having dealt with this subject, for initiating, organising and carrying out this intensive workshop in Gumpenstein, for exploring new ways to work out expert opinions about 16 group housing systems for dry sows, and for publishing the results in this report. In particular the IGN thanks the Austrian Federal Research Institute of Agriculture in Alpine Regions BAL for its hospitality and for editing this report. Many thanks also to Prof. Bartussek who worked hard to finish the text. This enables the presentation to an interested public and will contribute to improvements of dry sow housing. The IGN hopes for a wide distribution of the report for the benefit of the animals.

Witzenhausen, November 2000                          *Prof. Engelhard Boehncke*
                                              (President of the IGN from 1988 to 2000)

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# Group Housing of Dry Sows

## 1. Introduction

The International Society of Livestock Husbandry (*Internationale Gesellschaft für Nutztierhaltung*) IGN was founded in 1978 with the aim to promote those methods of treatment and husbandry of farm animals that are adequate to their biological needs, serve the idea of a sustainable development in treating the environment with care and allow for a positive human- animal relationship. Within the field of applied ethology, IGN tries to understand and consider the manifold behavioural needs and requirements of livestock and to draw the right conclusions for practical application of this knowledge in animal husbandry. IGN energetically emphasizes the acceptance of these results within the scientific and political discussions on animal welfare as well as within practical agricultural procedures. In heading for this goal, already several years ago members of IGN among many other things gathered and published sufficient evidence that individual housing of dry sows is incompatible with the claim for proper housing (VON LOEPER et al., 1987).

Whereas most European countries have not yet banned individual housing of dry sows, group housing systems for pregnant sows – also as outdoor systems – primarily have become quite common in the United Kingdom over the last fifteen years. They have also been increasingly introduced in Sweden as well as in Denmark since the early 1990s. Switzerland has been promoting group housing of pregnant sows for a couple of years, and in Austria there is an increasing interest shown by the organisations of organic husbandry and those marketing animal friendly products. Public opinion and, as a result of this, efforts in animal protection legislation in many European countries tend towards a ban on keeping sows tethered or in single crates. But, does it go without saying that the sole concept of keeping sows in group housing automatically ensures an animal´s well being?

The group housing systems used in Europe widely differ from each other regarding group sizes, feeding systems, the use of straw, spatial requirements per animal, the quality of flooring (slatted or solid), etc., resulting in quite a large number of different group housing systems spread all over the European countries. Nevertheless, very little comparative research has been done regarding the welfare of sows kept under such different conditions. The high costs of such research - if done in a reliable way with statistically sound conclusions - certainly is one of the reasons for the missing information. Nevertheless, without obvious reasons, some group housing systems are criticised and other systems are prefered or favoured although sufficient experimental data of the systems themselves are not available. Furthermore, for promoting group housing systems in respect to animal´s welfare by private marketing efforts or by public support, regulations or advice, the lack of knowledge about advantages and disadvantages of various group housing systems for pregnant sows must be considered as a severe obstacle.

At its general assembly in 1997, the IGN decided to meet the challenge and to try to prepare a paper presenting evidence about advantages and disadvantages of the most common or most important group housing systems for sows in Europe. It was considered to be very important to get a clear idea of possible problems involved and thus to become able to give justified information to the public and to the legislators. As a first and indispensable step towards such a paper, IGN decided to conduct and promote a workshop about group housing of pregnant sows. The project was prepared by a steering group headed by Gerrit van Putten (The Netherlands) - who initially proposed the whole idea - and was realized and carried out at the Federal Institute for Agriculture in Alpine Regions BAL Gumpenstein (Austria) in September 1998 under the chairmenship of Andreas Steiger (Switzerland). The approach applied can be described as a concerted methodical action of experts: participants were senior scientists and husbandry experts having ample personal experience with several group housing systems for pregnant sows. In preparing the meeting, it soon became clear that in countries with a small scale agricultural structure like Austria, Switzerland and Southern Germany, housing systems for smaller groups of dry sows (4 - 20 sows) are wide spread. On the other hand, in Denmark, Sweden, the United Kingdom and The Netherlands sows are frequently housed in larger groups (40 - 500 sows) as well. Thus it was decided to evaluate systems for smaller groups as well as systems for larger groups.

The workshop was scheduled for three days and could not be extended. This limited the amount of work that could be done but it also kept the participants under a certain time pressure. Last but not least, the available experience of the participants limited the number of systems that could be evaluated. In the end, 8 systems for smaller groups as well as 8 systems for larger groups were chosen, representing good examples for the practical approach planned.

## 2. Aims and exclusions of the workshop

The aim of IGN in organising the meeting was to detect essential differences in housing systems for dry sows in respect to their ability to meet the behavioural needs of the animals as well as the potential improvement of housing systems for dry sows. With this task, and regarding the limited time, not only was it necessary to detail the aims but also to define the areas that had to be excluded from the workshop.

### 2.1. Aims of the workshop

- The expert knowledge of the participants should be used in evaluating a variety of typical group housing systems for dry sows used in Europe regarding the welfare of the animals.

- Further, the housing systems chosen to be assessed should be evaluated in respect of management risks.

- The assessment should be conducted on system level assuming comparable and adequate management, hygiene, nutrition and care in all housing systems.

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- The results should contribute to a justified opinion about what kind of group housing systems for dry sows are comparably better for the animals, which ones show rather poor performance and what are the reasons for these differences and judgments.

- In pursuing the aims above, the assessment tool used should make the living conditions of the animals within the respective housing systems as transparent and understandable as possible.

- During the workshop the participants should work out, test and finalise an adequate procedure for comparing group housing systems on the basis of animal´s behavioural needs and management risks. The frame of this assessment system had been prepared to a large extent by the steering group in advance.

- The assessment tool should analyse the specific deficiencies and advantages and detect strong and weak points of housing systems assessed according to their fullfillment of ani-mal´s needs. Thus the results should aim for improvement of housing conditions in use in respect of animal welfare.

- The aims stated above should be accomplished at the workshop within the spare time of three days as agreed in advance.

## 2.2. Exclusions from the workshop

- It was not an aim of the workshop to assess labour conditions, technical and structural advantages or disadvantages of systems and buildings.

- The workshop did not aim to judge the effect of housing systems on the surrounding environment.

- It was not intended to assess systems economically.

- Therefore it was not intentional to come to an overall judgment about the group housing systems for pregnant sows including all aspects essential for the applicant (stockman), for the environment or for society.

- As animal housing should be assessed on system level, it was not the aim of this paper to come to a final conclusion that the wellbeing of sows would be unacceptably bad for sure in certain housing systems.

## 3. Procedures, material and methods

### 3.1. Experts involved

13 experts (of agronomy, veterinary medicine, biology, ethology and husbandry technology) of 6 European countries participated in the workshop as listed in *table 1* (in alphabetical order of surnames)[1] : These experts had been selected on the basis of sufficient expertise and know-how about group housing of sows ei-ther as a result of scientific experimental research or practical experience or both of these. All participants were members of IGN or had been invited by members of IGN. Thus it was assured that the participants agreed on the principles and aims of IGN in promoting ethologically sound animal husbandry.

### 3.2. Housing systems assessed

16 group housing systems for dry sows had been selected to be presented and evaluated. Short descriptions of systems were circulated to the participants in advance. Each system was well investigated or observed over several years by at least one of the participants. As not all evaluators were familiar with all 16 different housing conditions, an expert in each case presented at the workshop one or several systems by using floor plans and giving detailed information about management and system details. This part of the workshop turned out to be

*Table1:* **Participants of IGN-Workshop "Group housing of dry sows"**
*Tabelle 1: Teilnehmer des IGN-Workshops "Gruppenhaltung tragender Sauen"*

| | |
|---|---|
| Helmut Bartussek, Prof. Dr. (host) | **Austria**, Institute of Agricultural Engineering, Buildings and Economy, Federal Research Institute for Agriculture in Alpine Regions, BAL Gumpenstein,Irdning |
| Beate Bünger, Dr. | **Germany,** Federal Agricultural Research Centre, Braunschweig, FAL, Institute of Animal Science and Animal Behaviour, Mariensee/ Trenthorst, Neustadt/Mariensee. |
| Sandra A. Edwards, Prof. Dr. | **United Kingdom**, Department of Agriculture, University of Newcastle, Newcastle upon Tyne |
| Bernhard Haidn, Dr. | **Germany,** Bavarian Research Center of Agricultural Engineering of the Technical University of Munich, Freising-Weihenstephan |
| Karin Hjelholt Jensen, Dr. | **Denmark,** Department of Animal Health and Welfare, Danish Institute of Agricultural Sciences, Research Centre Foulum, Tjele |
| Franz Krispel, Dr. | **Austria**, Veterinary Chamber of Styria, St. Johann-Eichberg, governmental veterinarian district administration Leibnitz |
| Gerrit van Putten, Dr. | **Netherlands,** Institute of Animal Sience and Health (ID-DLO), Lelystad (retired since 1999: Driebergen-Rijsenburg, NL) |
| Andreas Steiger, Dr. (Chairman) | **Switzerland**, Division of Animal Husbandry and Welfare, Institute of Prof. Animal Breeding, University of Bern, Bern |
| Josef Troxler, Prof. Dr. | **Austria**, University of Veterinary Medicine, Institute of Animal Husbandry and Animal Welfare, Vienna |
| Roland Weber, Dr. | **Switzerland,** Swiss Research Institute of Agricultural Economics and Engineering, Centre for Proper Housing of Ruminants and Pigs, FAT, Tänikon |
| Beat Wechsler, PD Dr. | **Switzerland,** Swiss Federal Veterinary Office, Centre for Proper Housing of Ruminants and Pigs, FAT, Tänikon |
| Herman M. Vermeer, Ir. | **Netherlands**, Research Institute of Pig Husbandry, Rosmalen |
| Rudolf Wiedmann Agr.Ing. | **Germany**, Governmental Committee Tübingen, Department of Agriculture, Division of Animal Production, Tübingen |

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[1]  Christina Leeb, collaborator at the Institute of Animal Husbandry and Animal Welfare, University of Veterinary Medicine Vienna, participated in the workshop by helping to put achieved results into immediate actions needed; she also transfered the hand written data into Excel files and calculated first descriptive results.

quite time consuming as it took about 50 % of the three days schedule. 8 systems presented (no 1 – 8) are those for small groups of sows, between 4 and 20 sows, with manual or mechanic feeding. 8 systems (no 9 – 16) house large groups (40 to 500 sows) and are equipped by electronic feeding stations (EFS). All systems meet the legal animal welfare and general production requirements of the countries in which they are in use. For the purpose of standardized evaluation on a system level at the workshop, all systems were assumed to be managed properly (correct nutrition, proper hygiene, climatization and health programs) and to be run at impeccable technical state. Drawings of each system assessed, above all their floor plans, as presented at the workshop, are given in annex 1, figures 1 to 16. *Tables 2* and *3* give an overview of the systems selected.

## 3.3. Ethological criteria for the assessment of group housing systems

All 16 housing systems for dry sows characterised by *tables 2* and *3* above and the drawings of annex 1 were supposed to be assessed from an ethological viewpoint. The steering group suggested to achieve this aim by regarding so-called behavioural domains (ZEEB, 1974) that

*Table 2:* **Characteristics of 8 group housing sytems for dry sows in small groups (4 to 20 sows)**
*Tabelle 2: Kurzbeschreibung der 8 Gruppenhaltungssysteme für tragende Sauen mit Kleingruppen (4 bis 20 Sauen)*

| no. | housing system | Haltungssystem |
|---|---|---|
| 1 | stable groups[2] n = 8-12, partly slatted one-area pen, 2/3 solid floor, 1/3 slatted floor, 2,2 m²/sow, floor feeding 1x/d, small amount of chopped straw as feed additive, no litter, no roughage; if chopped sugar beet are mixed in the feed the solid floor becomes dirty and slippery caused by soft faeces | *stabile Gruppen[2] n = 8-12, Einflächenbucht mit Teilspaltenboden, 2/3 planbefestigt, 1/3 perforiert, 2,2 m²/Sau, Bodenfütterung 1x/T, geringe Menge von Strohhäcksel als Futterzusatz, keine Einstreu, kein Rauhfutter; bei Einsatz von Zuckerrübenschnitzel in der Ration wird der Boden durch weichen Kot schmutzig und rutschig* |
| 2 | stable groups n = 4-10, grouping within system, 3-area-pen, protected lying area littered (fresh straw twice per week), 1,2 m²/sow, slatted dunging area 1,9 m²/sow, locking single feeding crates, feeding 2x/d, roughage ad lib. by rack | *stabile Gruppen, n = 4-10, Gruppierung innerhalb des Systems; Dreiflächenbucht, eingestreute geschützte Liegefläche (frisches Stroh 2 x/Woche) 1,2 m²/Sau, Mistfläche mit Spalten 1,9 m²/Sau, Einzel- Einsperrfressstände, Fütterung 2 x/T, Rauhfutter ad lib. aus Raufe* |
| 3 | stable groups n = 4-10, two-area pen, combined lying and feeding cubicles on solid floor without litter 1,2 m²/sow, slatted dunging area 1,5 m²/sow, single feeding 2x/d, no roughage | *stabile Gruppen, n = 4-10, Zweiflächenbucht, Fress- Liegeboxen mit planbefestigtem Boden ohne Einstreu eingestreute 1,2 m²/Sau, Mistfläche mit Spalten 1,5 m²/Sau, Einzelfütterung 2x/T, kein Rauhfutter* |
| 4 | stable groups n = 6-8, grouping for 3 hours in separate pen, stabilization of groups during 3 weeks in insemination pen, two-area pen, solid lying area with sloped floor, floor heating, biofix feeding (pellets 110 g/minute) 1 m²/sow, slatted dunging area 1,1 -1,3 m²/sow, small quantity of ground straw or wood shavings on sloped floor, no further littering, no roughage | *stabile Gruppen, n = 6-8, Gruppierung in separater Bucht während 3 Stunden; Gruppenstabilisierung während 3 Wochen im Deckzentrum, Zweiflächenbucht, Liegefläche im Schrägbodensystem mit Bodenheizung, Biofixfütterung (Pellets 110 g/Minute) 1,0 m²/Sau, Mistfläche mit Spalten 1,1 – 1,3 m²/Sau, geringe Mengen von gemahlenem Stroh oder Sägespäne am Schrägboden, sonst keine Einstreu, kein Rauhfutter* |
| 5 | stable groups n = 8, grouping within system, two-area two-climate pens, lying area littered with straw 1,4 m²/sow, feeding trough with protection screens between animals within building, roofed outside dunging area 1,9 m²/sow, group feeding at trough (trough length 0,55 m/sow) 2x/d, no fixing of animals while feeding, no additional roughage | *stabile Gruppen, n = 8, Gruppierung innerhalb des Systems; Zweiflächenbucht mit Außenklimabereich, eingestreute Liegefläche 1,4 m²/Sau, Futtertrog mit Fressplatzteilern im Stallbereich, überdachter Außenmistplatz 1,9 m²/Sau, Gruppenfütterung am Trog (0,55 m/Sau Fressplatzbreite) 2 x/T, keine Einsperrfressstände, kein extra Rauhfutter* |
| 6 | stable groups n = 8, outdoor production, activity area 500 m²/ sow, resting kennels with straw litter 1,1 m²/sow, locking single feeding crates, feeding 1x/d, mud wallow, trees for shade, ground rotation every 120 d, electric fencing with double wire, no nose rings, no additional roughage | *stabile Gruppen, n = 8, Freilandhaltung 500 m²/Sau, eingestreute Liegehütten 1,1 m²/Sau, Einzel- Einsperrfressstände, Fütterung 1x/T, Schlammsuhle, Bäume als Schattenspender, Flächenwechsel alle 120 T, Doppeldraht- Elektrozaun, keine Rüsselringe, kein zusätzliches Rauhfutter* |
| 7 | stable groups n = 20, two-area two-climate pens, grouping within system, resting kennels with insulated concrete flooring and little ground straw 1 m²/sow, slatted dunging area 0,6 m²/ sow, locking single feeding crates for concentrates, additional maize silage ad lib. | *stabile Gruppen, n = 20, Gruppierung innerhalb des Systems; Zweiflächenbucht mit Außenklimabereich, Liegekisten mit wärmegedämmtem Betonboden und etwas Strohmehleinstreu 1,0 m²/Sau, Mistfläche mit Spalten 0,6 m²/Sau, Einzel-Einsperrfressstände für Kraftfutter, zusätzlich Maissilage ad lib.* |
| 8 | stable groups n = 24, two-area two-climate pens, grouping within system, deep litter lying area 1 m²/sow, roofed outside dunging and feeding area 1,2 m²/sow, locking single feeding crates, no additional roughage | *stabile Gruppen, n = 24, Gruppierung innerhalb des Systems; Zweiflächenbucht mit Außenklimabereich, Tiefstreu-Liegefläche 1,0 m²/Sau, überdachter Außenmistplatz mit Außenfütterung 1,2 m²/Sau, Einzel-Einsperrfressstände, kein zusätzliches Rauhfutter* |

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[2] small groups of sows are stable if the sows stay together throughout the whole dry period; *Sauen-Kleingruppen gelten als stabil, wenn die Tiere während der gesamten Trächtigkeitsperiode zusammen sind.*

*Table 3:* **Characteristics of 8 group housing sytems for pregnant sows in large groups (40 – 500 sows)**
*Tabelle 3: Kurzbeschreibung der 8 Gruppenhaltungssysteme für tragende Sauen mit Großgruppen (40 bis 500 Sauen)*

| no. | housing system | Haltungssystem |
|---|---|---|
| 9 | rotating groups[3] n = 40, multiple-area pens with kennels, stable subgroups[4] n = 8-10, formation of subgroups during 21 d in insemination area with permanent contact to group (grid), 4 protecting kennels with straw litter 0,8-1,0 m²/sow, daily littering, dunging- and activity area with concrete flooring 2,9 m²/sow, outside area with concrete floor 1 m²/sow, 1 EFS, start of  feeding 06:00, individual feed ad lib. according to age and state of pregnancy, roughage ad lib. by 2 racks | rotierende Gruppen[3] n = 40, Mehrflächenbuchten mit Liege-kisten, stabile Untergruppen[4] n = 8-10, Zusammenstellung der Untergruppen über 21 Tage im Deckzentrum mit ständigem Kontakt zur Gruppe (Gitter), 4 Liegekisten mit Stroheinstreu 0,8 - 1,0 m²/Sau, tägliches Nachstreuen, Mist- und Aktivitätsfläche mit planbefestigtem Betonboden 2,9 m²/Sau, Betonauslauf ins Freie 1 m²/Sau, 1 EFS (elektronische Futterstation),Fütterungs-beginn 06:00, individuelle Futterration ad lib.entsprechend Alter und Trächtigkeitsstadium, Rauhfutter ad lib. über 2 Raufen |
| 10 | dynamic group[5] n = 100, open-front deep-litter system, every week introduction of n = 6-8,  previously 1 week  in training pen with separate EFS, lying area 2,1 m²/sow, whole area approx. 3,0 m²/sow, fresh straw every week, concrete dunging area 0,2 m²/sow,  detecting boar within group, 3 EFS, feed according condition and state of pregnancy, start of feeding 16:00, no additional roughage | dynamische Gruppe[5] n = 100, Offenfront- Tiefstreusystem, jede Woche Einführung von n = 6-8, davor eine Woche lang in Gewöhnungsbucht mit eigener EFS, Liegefläche 2,1 m²/Sau, Gesamtfläche rund 3,0 m²/Sau, wöchentlich frisches Stroh, planbefestigte Mistfläche 0,2 m²/Sau, Sucheber in der Gruppe, 3 EFS, Fütterung entsprechend Kondition und Trächtigkeits-stadium, Fütterungsbeginn 16:00, kein zusätzliches Rauhfutter |
| 11 | dynamic group n = 500, every week introduction of n = 25-30, previously in training pen with separate EFS, deep-litter lying area within building 2,5 m²/sow, fresh straw daily or every second day, concrete dunging and activity area outside 2,1 m²/sow, 2 detecting boars within group, 10 EFS, start of feeding 06:00, no additional roughage | dynamische Gruppe n = 500, wöchentlich Einführung von n= 25-30, davor in Gewöhnungsbucht mit eigener EFS, Tiefstreu-Liegefläche im Stall, 2,5 m²/Sau, täglich oder jeden zweiten Tag frisches Stroh, planbefestigte Mist- und Aktivitätsfläche im Außenbereich 2,1 m²/Sau, 2 Sucheber in der Gruppe, 10 EFS, Fütterungsbeginn 06:00, kein zusätzliches Rauhfutter |
| 12 | dynamic group n = 80-200, introduction of new animals every 7 or 14 d without previous grouping, straw-littered lying area in uninsulated building 1,3 m²/sow, 2,5 m²/sow total area, partly slatted dunging-/activity area 1,2 m²/sow, detecting boar in group, 1 EFS per 50 sows, start of feeding cycle at midnight, no additional roughage | dynamische Gruppe n = 80-200, alle 7 oder 14 Tage Einführung von neuen Tieren ohne vorausgehendes Gruppieren, einge-streute Liegefläche im Kaltstall 1,3 m²/Sau, 2,5 m² Gesamt-fläche/S., Mist- und Aktivitätsfläche mit Teilspaltenboden 1,2 m²/Sau, Sucheber in der Gruppe, 1 EFS pro 50 Sauen, Fütterungs-beginn um Mitternacht, kein zusätzliches Rauhfutter |
| 13 | rotating group n = 40, stable subgroups n = 10, grouping before over 1 month in separate room,  4 protected lying boxes for 10 sows each with straw litter 1,0 m²/sow, fresh additional straw daily, slatted dunging/activity area 1,7 m²/sow, teaser- boar in adjacent separate pen, floor feeding of pelleted concentrates within lying area 2 x/d, rest of concentrates by 1 EFS according to indi-vidual condition of sows, start during 1st simultaneous meal, 2 rubbing brushes | rotierende Gruppe n = 40, stabile Untergruppen n = 10, davor Zusammenstellung der Untergruppen über 1 Monat in getrenntem Raum, 4 geschützte Liegebereiche für je 10 Sauen mit Stroheinstreu 1,0 m²/Sau, tägliches Nachstreuen, Mist- und Aktivitätsfläche mit Spaltenboden 1,7 m²/Sau, Sucheber in benachbarter Einzelbucht, Bodenfütterung von Kraftfutterpellets in den Liegeflächen 2x/T, geringe Mengen Rest- Kraftfutter über 1 EFS entsprechend individuellem Bedarf, Fütterungsbeginn während erster Bodenfütterung, 2 Kratzbürsten im System |
| 14 | like 13 but lying area on insulated concrete without litter 0,9 m²/sow, slatted dunging/activity area 1,6 m²/sow, 2 x/d floor feeding of maize silage within lying area, rest concentrates by 1 EFS according to sow body condition, no additional roughage | wie 13 aber Liegefläche auf wärmegedämmtem Beton ohne Einstreu 0,9 m²/Sau, Mist- und Aktivitätsfläche mit Spalten-boden 1,6 m²/Sau, 2 x/T Bodenfütterung von Maissilage im Liegebereich, Kraftfutter über 1 EFS entsprechend Körperkondition der Tiere, kein zusätzliches Rauhfutter |
| 15 | rotating group n = 30, stable subgroups n = 15, grouping after weaning for 3 h in separate room, stabilizing of subgroup during 42 d within service pen, establishing of subgroups every 3 weeks, small amount of chopped straw or wood shavings on solid lying area 1,0 m²/sow, slatted dunging/activity area 1,0 m²/sow, 1 EFS, no roughage | rotierende Gruppe n = 30, stabile Untergruppen n = 15, Grup-pierung nach dem Absetzen über 3 Stunden in getrenntem Raum, Gruppenstabilisierung während 42 T im Deckzentrum, Aufbau von Untergruppen alle 3 Wochen, geringe Mengen von Häckselstroh oder Sägespänen auf Beton- Liegefläche 1,0 m²/Sau, Mist- und Aktivitätsfläche mit Spaltenboden 1,0 m²/Sau, 1 EFS, kein zusätzliches Rauhfutter |
| 16 | dynamic group n = 40-100, periodic addition of sows after service, deep-litter lying area within building 1,3 m²/sow, feeding/dunging/ activity area outside of building 1,4 m²/sow, 4 parallel shifted EFS in outside run with roof (multiple feeding station), start of feeding in the morning, roughage ad lib. in rack | dynamische Gruppe n = 40-100, periodische Einführung von Sauen nach dem Decken, Tiefstreu- Liegefläche im Gebäude 1,3 m²/Sau, Fütterungs-, Mist- und Aktivitätsfläche im Freien 1,4 m²/Sau, 4 parallel versetzte EFS im Außenbereich überdacht (Mehrfachstation). Fütterungsbeginn am Morgen, Rauhfutter ad lib. aus Raufe |

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[3]  rotating groups are groups who, as a whole, change to another housing system according to the productive cycle. *Bei rotierenden Gruppen wechselt die gesamte Gruppe entsprechend dem Produktionszyklus in das jeweils entsprechend nächste Haltungssystem.*

[4]  a subgroup of sows is defined as stable, when the animals had the possibility to determine the social rank order in a separate room or pen and had enough time to get familiar individually. *Eine Untergruppe von Sauen gilt als stabil, wenn die Tiere die Möglichkeit hatten, in einem eigenen Raum oder einer separierten Bucht ihre Rangordnung festzulegen und genügend Zeit hatten, sich individuell kennen zu lernen.*

[5]  dynamic groups are those in which parts of the whole group, according to the productive cycle or depending on the need to introduce young animals, are changed more or less regularly. *Bei dynamischen Gruppen wird ein Teil der Tiere immer wieder entsprechend dem Produktionszyklus oder Remontie-rungsbedarf ausgewechselt.*

were used to decribe the behaviour of the sows in respect to functional areas of the respective housing systems.

The steering group prepared a list of behavioural domains to be used, based on the knowledge that group housing systems for dry sows are supposed to primarily allow for behavioural activities that are based on locomotion and for social behaviour in a species specific way, in order to avoid unnecessary social stress caused by spatial and structural restrictions. Also, feed intake, excretion and comfort of animals are fields of major behavioural concern in housing of pregnant sows. To illustrate the meaning of the behavioural domains, each domain should be characterized by two or more so-called key words. The key words had to be selected and defined according the essential needs of pregnant sows. Furthermore, the content of the key words should depict such observable behavioural elements dependent on the housing system that could be judged as clearly and unequivocally as possible. By these measures it should become possible to keep the process of assessment simple and yet assure results that could be generalized.

After adequate discussion, the group agreed on selecting the behavioural domains and key words, respectively, to characterize the domains shown in *table 4*.

The key words were chosen with respect to the criteria defined in *table 5* (page 6):

### 3.4. Assessment of management risks of group housing systems

Besides the behavioural domains and the key words regarding behaviour, the participants agreed on including an assessment of the management risks of each of the 16 housing systems. It was argued that mistakes and omissions in managing the housing and husbandry systems could cause severe detraction from welfare of animals, and that the probability of such deficiencies depending on the type of system therefore is an essential part of a judgment concerning the well being of the animals kept. Participants should judge these management risks by a simple linear scale as indicated below in chapter 3.5.1.

### 3.5. Method of assessing by concerted action of experts

The criteria used for evaluating the 16 group housing systems for dry sows were an essential tool. For this reason the respective proposal by the steering group was circulated well before the meeting to all participants. At the meeting itself the criteria were thoroughly discussed in detail, partly altered and supplemented, until all participants were convinced that everybody agreed on the same definition (description) of each key word of all behavioural domains. Discussion of assessment procedure as a whole, deciding about its details, reaching an unanimous agreement on all criteria and finalizing the assessment tool to be used by preparing an adequate grading sheet took about three quarters of a working day.

After having introduced the 16 housing systems, all 13 participating experts were asked to individually and separately evaluate each housing system by filling in grades for every item in this grading sheet, which contained 29 lines representing 7 behavioural domains and 22 key words, as well as one line for grading the management risks. Thus $13*16 = 208$ sheets of paper had to be filled in with $208*30 = 6240$ grading numbers. While the experts were involved in this task, a person simultaneously transfered the hand written numbers into a computer programme as soon as they were available. Filling in all grading sheets, typing the numbers into the PC and calculating a first summarizing descriptive result took about half a day of the workshop time.

Table 4: **Behavioural domains and determining key words for ethological assessment of group housing systems for dry sows as selected by the group of participating experts**
Tabelle 4: *Funktionskreise des Verhaltens und diese näher bestimmende Schlüsselwörter zur ethologischen Beurteilung von Gruppenhaltungssystemen trächtiger Sauen gemäß Auswahl durch die teilnehmenden Experten*

| behavioural domain *Funktionskreis des Verhaltens* | no | key words *Schlüsselwörter* |
|---|---|---|
| social behaviour *Sozialverhalten* | 1 | social hierarchy *soziale Rangordnung* |
| | 2 | stable (sub)group *stabile (Unter)gruppe* |
| | 3 | physical contact *Körperkontakt* |
| | 4 | space for bodylanguage *Raum für Körpersprache* |
| feed intake behaviour *Nahrungsaufnahmeverhalten* | 5 | simultaneous meals *gleichzeitiges Fressen* |
| | 6 | structured roughage *strukturiertes Rauhfutter* |
| | 7 | sufficient drinkers (ad lib.) *ausreichende Tränken* |
| | 8 | adequate individual rations *angemessene individuelle Futterrationen* |
| resting behaviour *Ausruhverhalten* | 9 | survey from lying area *Übersicht vom Liegebereich* |
| | 10 | protected lying area *geschützte Liegefläche* |
| | 11 | adequate bedding *ausreichend Einstreu im Liegebereich* |
| | 12 | adequate space and access to lying area *ausreichendes Platzangebot und Zugänglichkeit im bzw. zum Liegebereich* |
| eliminative behaviour *Ausscheidungsverhalten* | 13 | separate and adequate elimination area *getrennter und entsprechender Mistplatz* |
| | 14 | good grip on floor *rutschfester Boden* |
| comfort behaviour & thermoregulation *Komfortverhalten und Thermoregulation* | 15 | rubbing brushes or other equivalent devices *Kratzbürsten oder gleichwertige Einrichtungen zur Hautpflege* |
| | 16 | possibility for warming up *Möglichkeit sich zu wärmen* |
| | 17 | possibility for cooling down *Möglichkeit sich abzukühlen* |
| exploratory behaviour *Erkundungsverhalten* | 18 | access to open air *Auslaufmöglichkeit* |
| | 19 | possibility for exploration *Erkundungsmöglichkeiten* |
| | 20 | perception of environment *Wahrnehmung der Umwelt* |
| locomotory behaviour *Fortbewegungsverhalten* | 21 | adequate space *ausreichend Platz* |
| | 22 | good grip on floor *rutschfester Boden* |

*Table 5:* **Description of key words**
*Tabelle5: Beschreibung der Schlüsselwörter*

| | key words Schlüsselwörter | Description | Beschreibung |
|---|---|---|---|
| 1. | social hierarchy *soziale Rangordnung* | clarity of position of the animal within the group | *Eindeutigkeit der Rangposition jedes Tieres innerhalb der Gruppe* |
| 2. | stable (sub)group *stabile (Unter)gruppe* | stabilisation of social bonds between the animals of a group or of a subgroup | *Stabilität der sozialen Bindungen zwischen allen Tieren einer Gruppe oder Untergruppe* |
| 3. | physical contact *Körperkontakt* | ability for unrestricted physical contact between sows at any time | *Möglichkeit des jederzeit unbehinderten Körperkontaktes zwischen Sauen* |
| 4. | space for bodylanguage *Raum für Körpersprache* | quantity and quality of the space necessary for unrestricted social signalling, i.e. to clearly signal avoidance and escape of subordinate individuals | *ausreichender und entsprechend gegliederter Raum für unbehindertes Rangverhalten, z.B. für eindeutige Ausweichsignale rangniedrigerer Tiere* |
| 5. | simultaneous meals *gleichzeitiges Fressen* | all animals can eat at the same time | *alle Tiere können gleichzeitig fressen* |
| 6. | structured roughage *strukturiertes Rauhfutter* | something for gutfill and foraging behaviour | *Futter zur Magenfüllung und für Futtersuchverhalten* |
| 7. | sufficient drinkers (ad lib.) *ausrechende Tränken* | ad lib. access and sufficient numbers and tech-nical design of drinkers so that the swos can take in as much water as they need pyhsiologi-cally at any time | *ad lib. Zugang, entsprechende Zahl und Ausführung von Tränken, um den Sauen jederzeit die physiologisch erforderliche Wasserauf-nahme zu ermöglichen* |
| 8. | adequate individual rations *angemessene individuelle Futterrationen* | each sow can be fed individually and according her physiological needs and can eat undisturbed | *jede Sau kann entsprechend ihrem physiologischen Bedarf individuell gefüttert werden und kann ungestört fressen* |
| 9. | survey from lying area *Übersicht vom Liegebereich* | animals have an overview from lying area over the other parts of the pen or housing areas facilitating sufficient security while resting | *Sauen können von der Liegefläche aus die übrigen Buchtenbereiche so weit wahrnehmen, dass sie sich während des Ruhens sicher fühlen können* |
| 10. | protected lying area *geschützte Liegefläche* | lying area provides physical protection for undis-turbed resting behaviour | *die Liegefläche gewährt entsprechenden Schutz für ein ungestörtes Ausruhverhalten* |
| 11. | adequate bedding *ausreichend Einstreu im Liegebereich* | sufficient amount of impeccable straw or other adequate bedding material for comfortable lying and nest building behaviour | *ausreichende Menge von einwandfreiem Stroh oder eines anderen geeigneten Einstreumaterials für guten Liegekomfort und Nestbau-verhalten* |
| 12. | adequate space and access to lying area *ausr. Platzangebot und Zugänglichkeit im bzw. zum Liegebereich* | all sows can lie in resting area at the same time and in adequate lying positions (depending on thermal situation), any animal can leave or enter the lying area unrestricted by pen mates | *alle Tiere können gleichzeitig und in der Umgebungstemperatur entsprechenden Liegepositionen im Nestbereich liegen; jede Sau kann den Liegebereich unbehindert von Buchtgenossinnen ver-lassen oder betreten* |
| 13. | separate and adequate elimination area *getrennter und* entspre-*chender Mistplatz* | elimination area is adequately separated from resting area e.g. by a wall or sufficient distance and the spatial quantity and the quality of this area enables and stimulates species specific elimination behaviour | *der Mistplatz ist von der Liegefläche z.B. durch eine Trennwand oder ausreichenden Abstand in geeigneter Weise separiert, und sowohl Platzangebot als auch Ausführung ermöglichen und stimulieren artspezifisches Ausscheidungsverhalten* |
| 14. | good grip on floor *rutschfester Boden* | construction of floor of elimination area ensures sufficient grip to avoid slipping and damage to claws, legs and joints | *die Fußbodenausführung am Mistplatz gewährleistet eine ausreichen-de Rutschsicherheit und verhindert Schäden an Klauen, Beinen und Gelenken* |
| 15. | rubbing brushes or other equivalent devices *Kratzbürsten o. gleichw. Einrichtg. zur Hautpflege* | adequate rubbing facilities for grooming behaviour | *ausreichende und geeignete Kratzbürsten oder gleichwertige Ein-richtungen für Körperpflegeverhalten* |
| 16. | possibility for warming up *Möglichkeit sich zu wärmen* | adequate facilities for the animals to keep warm in cold weather, i.e. insulation and/or heating of building or floor in lying area, sufficient and dry bedding material, insulated kennels etc. in housing with cold climate | *Vorkehrungen zur Vermeidung überhöhter Wärmeverluste bei kaltem Wetter, z.B. Wärmedämmung und/oder Heizung von Gebäuden oder Liegeflächen, ausreichende und trockene Einstreu, gedämmte Liegekisten o.ä. in Außenklimaställen* |
| 17. | possibility for cooling down *Möglichkeit sich abzukühlen* | adequate facilities for the animals to keep suffi-ciently cool in hot weather, i.e. climatization of housing, uninsulated cool floors, water showering, possibility of wallowing in adequate substrates, shaded outside areas etc. | *Vorkehrungen gegen einen Wärmestau bei heißem Wetter, z.B. Gebäudeklimatisierung, ungedämmte kühle Bodenflächen, Sprühkühlung, Möglichkeit zum Suhlen, Schattenspender in Auslaufflächen usw.* |
| 18. | access to open air *Auslaufmöglichkeit* | spatial and temporal possibility to use an unroofed or roofed area with outside climate | *räumliche und zeitliche Möglichkeit eine unüberdachte oder überdachte Fläche im Freien zu nutzen* |
| 19. | possibility for exploration *Erkundungsmöglichkeiten* | extent of offer of information and new situations within the environment of the sows challenging their exploratory behaviour, such as regular novel substrates | *Angebot von Informationen und neuen Situationen innerhalb der Haltungsumwelt zur Befriedigung des Erkundungsverhaltens, wie z.B. egelmäßige Gaben neuer Einstreu* |
| 20. | perception of environment *Wahrnehmung der Um-gebung* | possibility for perception of the environment as part of coping behaviour, extent of facilitating predictability and controllability of the environment | *Möglichkeit zur ausreichend umfassenden Wahrnehmung der Umgebung als Teil des Anpassungsverhaltens,  Ausmaß der Erleichterung der Vorhersagbarkeit und Kontrollierbarkeit der Umwelt* |
| 21. | adequate space *ausreichend Platz* | enough space within the housing system to be used at any time or, if time restricted, regularly by the animals to enable sufficient and satisfying locomotion | *ausreichendes Platzangebot innerhalb des Haltungssystems, damit sich die Sauen jederzeit, oder bei zeitlicher Beschränkung regelmäßig, ausreichend und ihren Bedürfnissen entsprechend bewegen können* |
| 22. | good grip on floor *rutschfester Boden* | construction of floor within activity areas ensures sufficient grip to avoid slipping, even during rapid locomotion, and prevents damage to claws, legs and joints | *die Fußbodenausführung im Bewegungsbereich gewährleistet eine ausreichende Rutschsicherheit - auch bei schneller Fortbewegung - und verhindert Schäden an Klauen, Beinen und Gelenken* |

The final hours of the third day of the workshop were used to discuss and decide on the further procedure for evaluating and publishing the results. For groups of experts intending to use an assessment procedure of this kind, the experience indicated that it might be important for a final session with significantly more time to be scheduled. In particular, the questions of statistical evaluation of the data obtained and the distribution of work in writing the report could not be finalized within the time left at the workshop. A lot of correspondence became necessary after the workshop, as communication to clarify open questions between 13 persons spread all over Europe and intensively engaged in very different types of work turned out to be more difficult and time consuming than expected.

### 3.5.1. Grading of behavioural domains, key words and management risks

It was agreed to not only evaluate each facility represented by a key word within a behavioural domain, but also to evaluate each behavioural domain as a whole. In evaluating the facilities of the housing systems in respect to the respective key words, 3 grades should be used, with more points given if the situation in the housing system was judged to be better from an ethological point of view. The grading of the housing systems for each of the 7 behavioural domains as a whole should have a range between 1 and 5, as it was found necessary to distinguish more differentially in an overall assessment of the domains. The management risks of the systems should be graded analogously to the key words by 3 grades. All three scales were chosen in such a way that more points symbolise better conditions. The grading is shown in *table 6*.

In key words, the gradings mean that all key words with a mean grade lower than 2 were regarded as being between unsatisfactory and doubtful. Concerning the behavioural domains, all mean gradings below 3 stood for just acceptable conditions or worse. These scales were believed to be clear, simple and distinct. Thus, rather complicated ethological evidence and verbal descriptions of this evidence were transformed into comparable numerical values. In addition, the number

of negatively assessed key words and behavioural domains (= grade 1) could be used as a characteristic of the severity of deficiencies of a certain housing system.

Besides the grading points, it was decided to introduce additional methods of setting priorities and ways of evaluation according to the experts' opinion about the overall assessment of each housing system in respect to each behavioural domain, independent of the key words, and about the importance or significance of those in relation to all other behavioural domains in view of the animals' needs:

- If the participants had the feeling that the mean grading of all the key word grades they had assigned within the respective behavioural domain would not depict correctly the influence of the housing system on the animals' behaviour described by this domain, they had the opportunity to assign a grade to this behavioural domain that differed even strongly from the mean value of the respective key words. By this measure one could allow for deficiencies within some key words not to be compensated by good gradings of other key words, e.g. if one felt that a negative evaluation for a certain key word would contradict a rather positive overall judgment given by the average grading of the key words. On the other hand, one might be convinced that the housing system should be assessed better than the mean value of the key words because not all the important behavioural conditions were included or covered by the key words chosen and, considering those "hidden" conditions, the respective system

deserved a better evaluation within this domain. Finally, a certain key word might be considered as more important for the animals' well-being than others and this opinion could be taken into numerical account. By this method serious deficiencies stayed visible, but also weighting of key words and/or considering "hidden" conditions was possible.

- As a second form of evaluation, weighting factors for the behavioural domains should be introduced to take into consideration the relative significance or importance of a certain behavioural domain in relation to the others. As an example, one could be convinced that locomotion does not rate for the sows as high as social behaviour, but also, with similar weighting results, that the possibility of sufficient movement already is covered by considering species specific social behaviour as the normal behavioural elements, above all the antagonist ones, involved in social behaviour do have spatial requirements (e.g. sufficient area to escape after being defeated) and therefore systems adequate for normal social behaviour also meet other needs connected with space allowance (like exploration). This additional evaluation method therefore gave the possibility to take into account a differing significance of the behavioural domains for the behaviour of the sows and a possible overlap of the behavioural fields covered by the domains. It was agreed that the 13 assessors should distribute 100 points to the seven behavioural domains to express the relative importance of each of the

*Table 6:* **Grades to evaluate housing systems with respect to behavioural domains, keywords and management risks**
*Tabelle 6: Noten zur Bewertung der Haltungssysteme in Bezug auf Funktionskreise des Verhaltens, deren Schlüsselwörter und Managementrisiken*

| grade<br>*Note* | behavioural domains<br>*Funktionskreise* | key words<br>*Schlüsselwörter* | management risks<br>*Managementrisiken* |
|---|---|---|---|
| 1 | not sufficient or bad<br>*ungenügend oder schlecht* | unsatisfactory<br>*ungenügend* | high<br>*hoch* |
| 2 | just sufficient<br>*gerade noch genügend* | doubtful or medium<br>*zweifelhaft oder mittel* | medium<br>*mittel* |
| 3 | satisfying or medium<br>*befriedigend oder mittel* | satisfactory or good<br>*befriedigend oder gut* | low<br>*niedrig* |
| 4 | good<br>*gut* | - | - |
| 5 | very good or excellent<br>*sehr gut oder ausgezeichnet* | - | - |

domains for the welfare of the sows. The final weighting factors were determined on the basis of the median and not of the average. In this way, the extremes in the distribution do not effect the final weighting factors. By multiplying the grading points of each behavioural domain with its respective weighting factor, derived from the procedure to find those factors within the working group, and by summing up the points, it would be possible to compare the 16 different housing systems in respect to their evaluation within a certain behavioural domain as well as assessing to what extent the housing systems generally match animals' behavioural needs (apropriate management provided). In comparing both the grading results of the key words and the management risks one should easily be able to detect single deficiencies and merits of the housing systems assessed.

Annex 2 shows the final grading sheet to be used by the experts in assessing the housing systems.

### 3.5.2. Statistical analysis

The data first were checked for completeness, i.e. how many of the required and expected 6240 grade numbers actually had been assigned and how many were missing. The actual numbers given by the 13 assessors for 30 items of 16 housing systems were descriptively processed by the computer programme MS-Excel. In trying to test both the usefulness (accuracy, practicability and simplicity) of the applied procedure of assessment as well as the expected differences between the housing systems in respect of animals' welfare and management risks, the distribution of the values and differences between assessors as well as mean results and standard deviations for each housing system in respect to the behavioural domains, to the key words - both unweighted and weighted -, to the number of deficiencies and the management risks were obtained.

Further, in analyzing the correlations between key word gradings and behavioural domain gradings linear regressions were calculated. According to ESSL (1987) the calculation of the product-moment-correlation coefficient $r$ will yield an inaccurate result as $r$ requires that both random variables X and Y comply with a two dimensional normal distribution. Data given do not meet this condition and therefore the stochastic relation between the variables must be judged by a non-parametric procedure like the SPEARMAN rank correlation coefficient $r_s$, considering that there are connections (bonds) within both variables. Calculations of $r_s$ were applied on the correlations between key word rank values and behavioural domain rank values after the respective key word grade sums and the behavioural domain grades had been transformed into rank values (between 1 and 208). This was achieved by the PC programme MS-Excel with the function >RANK($X_{ij}$;\$X\$1:\$X\$208)<, with $X_i$ = observed key word grade sums and behavioural domain grades given by 13 assessors for 16 housing systems (i = 1....208). The differences between the 16 housing systems as well as the differences between the 13 experts in assessing those housing systems could be shown clearly just by descriptive statistics. Therefore it was not necessary to apply analysis of variance in looking upon the housing scores and the scores of individual assessors as experimental units, although a 2 factor- log- linear model without interaction could have been applied after transforming the primary 6240 non parametric grades to a sufficient normally distributed data sample by aggregating the grades for every single item to numerically larger units. To interpret the results in a more general sense, it would have been interesting to assign all 16 housing systems to 3 classes of factors (group size: large groups – small groups; exploration material: systems with straw – systems without straw; feeding regime: simultaneous feeding – no simultaneous feeding). This, in principle, would give the possibility

**Table 7:** **Distribution, average and median of 100 points given to 7 behavioural domains by 13 assessors to express the relative contribution of the behavioural domains to the welfare of dry sows in group housing systems, including the final chosen weighting factors in the last column.**

*Tabelle 7: Verteilung, Durchschnitt und Median von 100 Punkten vergeben für 7 Funktionskreise durch 13 Beurteiler als Ausdruck des relativen Beitrages der Funktionskreise zum Wohlbefinden von trächtigen Sauen in Gruppenhaltungssystemen, einschließlich der schließlich gewählten Wichtungsfaktoren in der letzten Spalte*

| Behavioural Domain *Funktionskreis-verhalten* | number of assessors per class of given points per domain: *Anzahl von Beurteilern pro Klasse vergebener Punkte pro Funktionskreis* | | | | | | | | average *Durchschnitt* | Median | **final weight factor** **Wichtungs-faktor** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0-5 | 6-10 | 11-15 | 16-20 | 21-25 | 26-30 | 31-35 | 36-40 | | | |
| Social *Sozial-* | | | | 3 | 4 | 4 | 1 | 1 | 27 | 25 | **5** |
| Feeding *Futteraufnahme* | | 1 | 1 | 6 | 4 | 1 | | | 21 | 20 | **4** |
| Resting *Ausruh-* | | | 9 | 4 | | | | | 16 | 15 | **3** |
| Comfort *Komfort-* | 1 | 7 | 3 | 2 | | | | | 12 | 10 | **2** |
| Exploratory *Erkundungs-* | 2 | 8 | 3 | | | | | | 10 | 10 | **2** |
| Elimination *Ausscheidungs-* | 5 | 7 | 1 | | | | | | 8 | 10 | **2** |
| Locomotion *Fortbewegungs-* | 8 | 4 | 1 | | | | | | 7 | 5 | **1** |

to prove the significance of these factors on the assessment results. However, having only a few housing systems in each factor class and even more, as the feeding regime class overlaps strongly the class of group size, significant differences would have required either very large differences in the mean values of the assessment results or a much larger sample size. The results showed that these conditions were not met and therefore it was refrained from analysing the results by variance of classes.

# 4. Results

## 4.1. Completeness of data

From the 6240 grades required, actually 6234 were obtained. 1 Assessor left out 1 value, another 2 and a third assessor 3 values. The error of 6 points missing from an intentional 6240 is less than 0,001 and will be neglected in further calculations.

## 4.2. Weighting factors for behavioural domains

The distribution of 100 points expressing the individual opinions of the 13 assessors about the relative importance of each of the behavioural domains for the animals' welfare is presented in *table 7*. The behavioural domains in *table 7* are sorted on average score.

Seven of the 13 assessors considered social behaviour as the most important domain and six assessors scored it equal to feeding behaviour. These relative factors show for instance that, within the context of this assessment tool, social behaviour was weighted five times heavier than locomotion. This offers the possibility to judge the systems not only on the basis of single behavioural domains, but also on the basis of a combination of all seven domains.

## 4.3. Grading on key word level including management risks

Gradings of 23 items, 22 keywords and management risks, of 16 housing systems by 13 assessors are shown in *table 8*.

The majority of the keywords show a grade distribution with similarly filled classes. But at 7 key words, i.e. physical

contact, sufficient drinkers, adequate space and access at lying area, separate and adequate elimination area, good grip on floor in elimination area, awareness of the environment and good grip on floor in activity area, scoring by grade 1 occured less than 10 times, so 95% of the grades were assigned in the classes sufficient and good. That could either mean that the key words are not very discriminative and therefore not adequate or that the housing systems selected for evaluation show low variability with respect to some environmental factors. The latter very likely applies as most of the key words mentioned with very little scoring in the class "1 = unsatisfactory" are either, in contrast to single housing of sows, related to typical aspects of any group housing systems (i.e. physical contact – grading even 2,9 -, adequate space and access to lying area, separated elimination area) or are related to facilities and management practices which, as stated in chapter 3.2., on purpose were assumed to be managed pro-

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*Table 8:* **Frequency of grading assigned by 13 assessors (total per line n = 13*16 = 208), mean values ∅ and standard deviation s for 22 key words and management risks for 16 group housing systems for dry sows**
*Tabelle 8: Häufigkeit der von 13 Beurteilern vergebenen Bewertungsnoten (Summe pro Zeile = 13*16 = 208), Mittelwerte und Standardabweichung s für 22 Schlüsselwörter und Managementrisiken bei 16 Gruppenhaltungssystemen für trächtige Sauen*

| Keywords/management risks *Schlüsselwörter/Managementrisiken* | gradings *Noten* | | | | |
| --- | --- | --- | --- | --- | --- |
| | 1 | 2 | 3 | ∅ | s |
| social hierarchy *soziale Rangordnung* | 18 | 65 | 125 | 2,51 | 0,49 |
| stable (sub)group *stabile (Unter)gruppe* | 18 | 82 | 108 | 2,43 | 0,40 |
| physical contact *Körperkontakt* | 7 | 7 | 194 | 2,90 | 0,34 |
| space for bodylanguage *Raum für Körpersprache* | 25 | 59 | 124 | 2,48 | 0,58 |
| simultaneous meals *gleichzeitiges Fressen* | 73 | 27 | 108 | 2,17 | 0,83 |
| structured roughage *strukturiertes Rauhfutter* | 49 | 60 | 99 | 2,24 | 0,63 |
| sufficient drinkers (ad lib.) *ausreichende Tränken* | 3 | 22 | 182 | 2,87 | 0,15 |
| adequate individual rations *angemessene individuelle Futterrationen* | 36 | 43 | 129 | 2,45 | 0,53 |
| survey from lying area *Übersicht vom Liegebereich* | 31 | 93 | 84 | 2,25 | 0,40 |
| protected lying area *geschützte Liegefläche* | 25 | 51 | 132 | 2,51 | 0,39 |
| adequate bedding *ausreichend Einstreu im Liegebereich* | 68 | 19 | 121 | 2,25 | 0,87 |
| adequate space and access to lying area *ausreichendes Platzangebot und Zugänglichkeit im bzw. zum Liegebereich* | 5 | 71 | 132 | 2,61 | 0,25 |
| separate and adequate elimination area *getrennter und entsprechender Mistplatz* | 5 | 43 | 160 | 2,75 | 0,26 |
| good grip on floor in elimination area *rutschfester Boden am Mistplatz* | 1 | 75 | 129 | 2,59 | 0,13 |
| rubbing brushes or other equivalent devices *Kratzbürsten oder gleichwertige Einrichtungen zur Hautpflege* | 67 | 97 | 44 | 1,89 | 0,46 |
| possibility for warming up *Möglichkeit sich zu wärmen* | 16 | 53 | 139 | 2,59 | 0,35 |
| possibility for cooling down *Möglichkeit sich abzukühlen* | 29 | 100 | 77 | 2,21 | 0,31 |
| access to open air *Auslaufmöglichkeit* | 139 | 5 | 64 | 1,64 | 0,87 |
| possibility for exploration *Erkundungsmöglichkeiten* | 43 | 68 | 97 | 2,26 | 0,62 |
| perception of environment *Wahrnehmung der Umgebung* | 9 | 86 | 113 | 2,50 | 0,34 |
| adequate space for locomotion *ausreichend Platz für Fortbeweg.* | 23 | 65 | 120 | 2,47 | 0,57 |
| good grip on floor in activity area *rutschfester Boden* | 8 | 92 | 108 | 2,48 | 0,26 |
| management risks *Managementrisiken* | 78 | 81 | 48 | 1,85 | 0,58 |

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perly and have an impeccable technical state, i.e. adequate water supply and non slippery flooring.

The argument that uneven distribution is caused by the housing systems rather than by key words is also confirmed by the very low mean grade value of the key word "access to open air" (1,64) as this primarily will be the effect of the given condition that 9 of the 16 housing systems do not offer an outside run to the sows at all. Nevertheless, some possible problems in defining the key words properly and clearly should not be neglected. At some of the 7 housing systems with outside exercise areas, the respective yards were partly or completely roofed. Evaluators differed in assessing this situation in respect to "access to open air" as the following example shows: Housing system number 8 is characterised by a roofed outside dunging and feeding area of 1,2 m²/sow in size. Yet at the key word "access to open air" this situation was scored by 8 assessors with grade 3, two assessors gave grade 2 and three evaluators graded 1.

## 4.4. Grading on the level of behavioural domains

In *table 9* the frequency of grading, average and standard deviation per domain are shown.

Except for the grading in comfort behaviour, all other behavioural domains are quite evenly distributed. The strong preference of gradings 4 and 5 in evaluation of comfort behaviour could again either mean that this behavioural domain is not sufficient discriminative to distinguish between systems or that the housing systems show low variability with respect to those environmental factors that allow satisfactory comfort behaviour. Looking at key word level, two of the three key words belonging to the domain of comfort behaviour show the same tendency, namely those which enable the animals to keep within thermoneutrality (keeping warm in winter as well as cool in summer).

The housing systems may vary only a little in this respect. The third key word belonging to the behavioural domain of comfort behaviour, the key word "rubbing facilities", also probably depending on the housing conditions, shows an opposite tendency as it scores more often in lower grades. In this case the asses-

*Table 9:* **Frequency of grading assigned by 13 assessors (total per line n = 13*16 = 208), mean values ∅ and standard deviation s for 7 behavioural domains for 16 group housing systems for dry sows**
*Tabelle 9: Häufigkeit der von 13 Beurteilern vergebenen Bewertungsnoten (Summe pro Zeile = 13*16 = 208), Mittelwerte und Standardabweichung s für 7 Funktionskreise von 16 Gruppenhaltungssystemen für trächtige Sauen*

| behavioural domains *Funktionskreise* | gradings / *Noten* | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| | *1* | *2* | *3* | *4* | *5* | ∅ | *s* |
| social behaviour *Sozialverhalten* | 3 | 14 | 73 | 81 | 37 | 3,65 | 0,90 |
| feed intake behaviour *Nahrungsaufnahmeverhalten* | 4 | 42 | 59 | 66 | 37 | 3,43 | 1,06 |
| resting behaviour *Ausruhverhalten* | 5 | 33 | 64 | 65 | 41 | 3,50 | 1,05 |
| eliminative behaviour *Ausscheidungsverhalten* | 13 | 50 | 65 | 49 | 31 | 3,17 | 1,14 |
| comfort behav. & thermoreg. *Komfortverhalten & Thermoreg.* | 1 | 11 | 25 | 66 | 105 | 4,26 | 0,90 |
| exploratory behaviour *Erkundungsverhalten* | 8 | 35 | 69 | 77 | 19 | 3,31 | 0,98 |
| locomotory behaviour *Fortbewegungsverhalten* | 11 | 24 | 48 | 52 | 73 | 3,73 | 1,21 |

sors may have made use of the given possibility to distinguish between key word scoring and domain scoring as described in chapter 3.5.1.

## 4.5. Relation between keyword grading and behavioural domain grading

*Figure 1* shows the overall relation between key word grading and grading of behavioural domains, scaling all grading sums of each of the 22 key words on the x– axis (min. = 22*1 = 22; max. = 22*3 = 66) and of all 7 domains on the y– axis (min = 7*1 = 7; max. = 7*5 = 35). In the figure a linear regression line is included and each dot within the graph represents

one or several identical of 208 pairs of values (208 = 13 assessors times 16 housing systems).

Annex 3 contains 7 further analogous *figures 6 to 12*, demonstrating the respective relations on the level of each of the 7 behavioural domains. Sample size again is always n = 208, but as many more grades assigned coincide, number of dots look much smaller there. Scaling of coordinates of those graphs consider the respective smaller ranges of possible minimum and maximum key word grade sums of each domain. Correlation coefficients and p- values were calculated only for the relations on domain level and are presented in *table 10*.
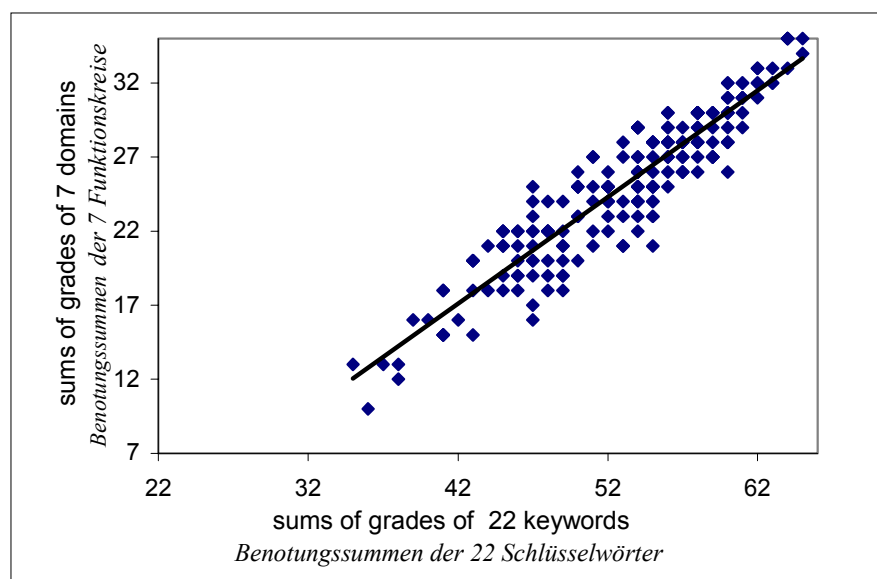


*Figure 1:* **Relation between gradings of 22 key words (min = 22; max = 66) and gradings of 7 behavioural domains (min = 7; max= 35); n = 208**
*Abbildung 1.: Zusammenhang zwischen der Benotung der 22 Schlüsselwörter (min=22; max=66) und der Benotung der 7 Funktionskreise des Verhaltens (min = 7; max= 35); n = 208*

*Table 10* contains coefficients of determination based on the SPEARMAN rank correlation coefficients for the ranked pair values $r_s$ and p– values of $r_s$ concerning the relation between key word gradings and behavioural domain gradings calculated for the 7 behavioural domains (as shown in annex 3, *figures 6 to 12*).

## 4.6. Grading on group housing system level

As an example for the frequency of the assigned gradings, mean values of key word scores and domain scores and the variation between 13 assessors on the housing level, *table 11* shows respective data including standard deviation for each item for the housing system number 1. The key word "good grip on floor" within the behavioural domain "elimination behaviour" was evaluated by 12 assesors only.

**Table 10: Correlation of 208 pair values of the relation between key word gradings and domain gradings for 7 behavioural domains according figures 6 to 12 of annex 3: Spearman rank correlation coefficient of ranked grading ($r_s$) and p-values of $r_s$ ($p$)**
*Tabelle 10: Korrelation der 208 Wertepaare für die Abhängigkeit zwischen Schlüsselwörter-Benotung und Funktionskreis-Benotung in den 7 Funktionskreisen gemäß Abbildungen 6 bis 12 des Anhangs 3: Spearman Rang Korrelationskoeffizient der nach Rängen geordneten Benotungswerte ($r_s$) und Irrtumswahrscheinlichkeit für $r_s$ ($p$)*

| behavioural domain *Funktionskreis des Verhaltens* | $r_s$ | $p$ |
|---|---|---|
| social behaviour *Sozialverhalten* | 0,838 | < 0,001 |
| feed intake behaviour *Nahrungsaufnahmeverhalten* | 0,895 | < 0,001 |
| resting behaviour *Ausruhverhalten* | 0,886 | < 0,001 |
| eliminative behaviour *Ausscheidungsverhalten* | 0,938 | < 0,001 |
| comfort behaviour *Komfortverhalten* | 0,796 | < 0,001 |
| exploratory behaviour *Erkundungsverhalten* | 0,909 | < 0,001 |
| locomotory behaviour *Fortbewegungsverhalten* | 0,971 | < 0,001 |

Down the line, the correlation coefficients determined for each of the 7 key word – domain relationships lie very close together and are all highly significant.

**Table 11: Frequency of grading assigned by 13 assessors (total per line n = 13), mean values Ø and standard deviation s for 7 behavioural domains, 22 key words and management risks for housing system 1**
*Tabelle 11: Häufigkeit der von 13 Beurteilern vergebenen Bewertungsnoten (Summe pro Zeile = 13), Mittelwerte und Standardabweichung s für 7 Funktionskreise, 22 Schlüsselwörter und Managementrisiken beim Haltungssystem 1*

| key words and **behavioural domains** *Schlüsselwörter und **Funktionskreise*** | 1 | 2 | 3 | 4 | 5 | Ø | s |
|---|---|---|---|---|---|---|---|
| social hierarchy *soziale Rangordnung* | | 1 | 12 | | | 2,92 | 0,28 |
| stable (sub)group *stabile (Unter)gruppe* | 1 | 5 | 7 | | | 2,46 | 0,66 |
| physical contact *Körperkontakt* | | 2 | 11 | | | 2,85 | 0,38 |
| space for bodylanguage *Raum für Körpersprache* | 7 | 4 | 2 | | | 1,62 | 0,77 |
| **social behaviour *Sozialverhalten*** | | 3 | 6 | 4 | | **3,08** | **0,76** |
| simultaneous meals *gleichzeitiges Fressen* | | 3 | 10 | | | 2,77 | 0,44 |
| structured roughage *strukturiertes Rauhfutter* | 8 | 5 | | | | 1,38 | 0,51 |
| sufficient drinkers (ad lib.) *ausreichende Tränken* | 1 | 4 | 8 | | | 2,54 | 0,66 |
| adequate indiv. rations *angemessene indiv. Futterrationen* | 11 | 2 | | | | 1,15 | 0,38 |
| **feed intake behaviour *Nahrungsaufnahmeverhalten*** | **3** | **6** | **4** | | | **2,08** | **0,76** |
| survey from lying area *Übersicht vom Liegebereich* | | 6 | 7 | | | 2,54 | 0,52 |
| protected lying area *geschützte Liegefläche* | 2 | 7 | 4 | | | 2,15 | 0,69 |
| adequate bedding *ausreichend Einstreu im Liegebereich* | 12 | 1 | | | | 1,08 | 0,28 |
| adequate space and access to lying area *ausreichendes Platzangebot und Zugänglichkeit im bzw. zum Liegebereich* | | 8 | 5 | | | 2,38 | 0,51 |
| **resting behaviour *Ausruhverhalten*** | **1** | **5** | **7** | | | **2,46** | **0,66** |
| separate and adequate elimination area *getrennter und entsprechender Mistplatz* | 1 | 6 | 6 | | | 2,38 | 0,65 |
| good grip on floor *rutschfester Boden* | | 5 | 7 | | | 2,58 | 0,51 |
| **eliminative behaviour *Ausscheidungsverhalten*** | **1** | **1** | **3** | **7** | **1** | **3,46** | **1,05** |
| rubbing brushes or other equivalent devices *Kratzbürsten oder gleichwertige Einrichtungen zur Hautpflege* | 11 | 2 | | | | 1,15 | 0,38 |
| possibility for warming up *Möglichkeit sich zu wärmen* | 1 | 7 | 5 | | | 2,31 | 0,63 |
| possibility for cooling down *Möglichkeit sich abzukühlen* | 3 | 8 | 2 | | | 1,92 | 0,64 |
| **comfort behav. and thermoreg. *Komfortverhalten and Thermor.*** | **1** | **4** | **8** | | | **2,54** | **0,66** |
| access to open air *Auslaufmöglichkeit* | 13 | | | | | 1,00 | 0,00 |
| possibility for exploration *Erkundungsmöglichkeiten* | 11 | 1 | 1 | | | 1,23 | 0,60 |
| perception of environment *Wahrnehmung der Umgebung* | 2 | 9 | 2 | | | 2,00 | 0,58 |
| **exploratory behaviour *Erkundungsverhalten*** | **3** | **9** | **1** | | | **1,85** | **0,55** |
| adequate space *ausreichend Platz* | 7 | 6 | | | | 1,46 | 0,52 |
| good grip on floor *rutschfester Boden* | 1 | 8 | 4 | | | 2,23 | 0,60 |
| **locomotory behaviour *Fortbewegungsverhalten*** | **2** | **7** | **4** | | | **2,15** | **0,69** |
| management risks *Management Risiken* | 1 | 7 | 5 | | | 2,31 | 0,63 |

*Table 12:* **Mean unweighted gradings by 13 assessors for 7 behavioural domains, 22 key words and management risks, sums of key word scoring, sums of domain scorings, number of deficiencies, mean values of lines (Ø), and standard deviations s of 16 group housing systems**

*Tabelle 12: Mittelwerte der von 13 Beurteilern vergebenen ungewichteten Bewertungsnoten für 7 Funktionskreise, 22 Schlüsselwörter und Managementrisken, Summen der Schlüsselwörter-Benotung, Summen der Funktionskreis-Benotungen, Mittelwerte der Anzahl von Mängeln sowie Zeilenmittelwerte (Ø) und Standardabweichungen für 16 Gruppenhaltungssysteme*

| key words/ behavioural domains *Schlüsselwörter/ Funktionskreise* | group housing systems *Gruppenhaltungssysteme* | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **Ø** | **s** |
| social hierarchy *soziale Rangordnung* | 2,92 | 3,00 | 2,92 | 2,85 | 3,00 | 2,92 | 2,92 | 2,92 | 2,31 | 1,85 | 1,62 | 1,69 | 2,38 | 2,38 | 2,46 | 2,08 | 2,51 | 0,49 |
| stable (sub)group *stabile (Unter)gruppe* | 2,46 | 2,92 | 2,77 | 2,62 | 2,85 | 2,85 | 2,46 | 2,54 | 2,46 | 1,85 | 1,69 | 1,77 | 2,69 | 2,62 | 2,46 | 1,92 | 2,43 | 0,40 |
| physical contact *Körperkontakt* | 2,85 | 3,00 | 1,62 | 2,92 | 3,00 | 3,00 | 3,00 | 3,00 | 3,00 | 3,00 | 3,00 | 3,00 | 3,00 | 3,00 | 3,00 | 3,00 | 2,90 | 0,34 |
| space for bodylanguage *Raum für Körpersprache* | 1,62 | 2,08 | 1,23 | 1,62 | 2,54 | 3,00 | 2,15 | 2,38 | 3,00 | 2,92 | 2,92 | 2,92 | 2,92 | 2,92 | 2,62 | 2,77 | 2,48 | 0,58 |
| **social behaviour *Sozialverhalten*** | **3,08** | **4,08** | **2,62** | **3,46** | **4,23** | **4,77** | **3,77** | **4,08** | **3,85** | **3,23** | **3,08** | **3,08** | **4,00** | **4,00** | **3,77** | **3,31** | **3,65** | **0,56** |
| simultaneous meals *gleichzeitiges Fressen* | 2,77 | 3,00 | 3,00 | 2,85 | 2,85 | 3,00 | 3,00 | 3,00 | 1,23 | 1,08 | 1,15 | 1,15 | 1,92 | 1,92 | 1,23 | 1,54 | 2,17 | 0,83 |
| structured roughage *strukturiertes Rauhfutter* | 1,38 | 2,77 | 1,31 | 1,15 | 2,85 | 2,69 | 2,38 | 2,46 | 2,85 | 2,31 | 2,31 | 2,23 | 2,62 | 2,38 | 1,15 | 3,00 | 2,24 | 0,63 |
| sufficient drinkers (ad lib.) *ausreichende Tränken* | 2,54 | 3,00 | 2,92 | 2,85 | 2,92 | 2,62 | 3,00 | 2,77 | 3,00 | 2,69 | 2,77 | 2,92 | 3,00 | 3,00 | 2,92 | 2,92 | 2,87 | 0,15 |
| adequate individual rations *angemessene individuelle Futterrationen* | 1,15 | 2,85 | 2,92 | 1,62 | 1,62 | 2,85 | 2,85 | 2,77 | 2,62 | 2,62 | 2,46 | 2,54 | 2,31 | 2,46 | 2,77 | 2,77 | 2,45 | 0,53 |
| **feed intake behaviour *Nahrungsaufnahmeverhalten*** | **2,08** | **4,62** | **3,77** | **2,46** | **3,46** | **4,46** | **4,38** | **4,23** | **3,31** | **2,92** | **2,85** | **2,92** | **3,62** | **3,54** | **2,46** | **3,85** | **3,43** | **0,77** |
| survey from lying area *Übersicht vom Liegebereich* | 2,54 | 2,54 | 1,46 | 2,08 | 2,00 | 2,23 | 1,77 | 1,62 | 2,77 | 2,69 | 2,38 | 2,23 | 2,62 | 2,46 | 2,69 | 2,00 | 2,25 | 0,40 |
| protected lying area *geschützte Liegefläche* | 2,15 | 2,85 | 1,92 | 2,15 | 2,38 | 3,00 | 2,85 | 2,92 | 3,00 | 2,15 | 2,08 | 2,08 | 2,85 | 2,92 | 2,62 | 2,31 | 2,51 | 0,39 |
| adequate bedding *ausreichend Einstreu im Liegebereich* | 1,08 | 2,92 | 1,00 | 1,00 | 2,62 | 3,00 | 1,69 | 3,00 | 2,69 | 3,00 | 3,00 | 2,69 | 3,00 | 1,23 | 1,15 | 3,00 | 2,25 | 0,87 |
| adequate space and access to lying area *ausreichendes Platzangebot und Zugänglichkeit im bzw. zum Liegebereich* | 2,38 | 2,85 | 2,23 | 2,23 | 2,77 | 2,92 | 2,15 | 2,38 | 2,54 | 2,85 | 2,69 | 2,77 | 2,85 | 2,69 | 2,69 | 2,77 | 2,61 | 0,25 |
| **resting behaviour *Ausruhverhalten*** | **2,46** | **4,46** | **1,77** | **2,38** | **3,62** | **4,62** | **3,08** | **3,92** | **4,15** | **3,92** | **3,77** | **3,46** | **4,46** | **3,15** | **3,00** | **3,77** | **3,50** | **0,81** |
| separate and adequate elimination area *getrennter und entsprechender Mistplatz* | 2,38 | 2,23 | 2,38 | 2,38 | 2,92 | 3,00 | 2,62 | 2,85 | 2,92 | 2,85 | 2,92 | 2,85 | 3,00 | 2,92 | 2,77 | 2,92 | 2,75 | 0,26 |
| good grip on floor *rutschfester Boden* | 2,58 | 2,46 | 2,58 | 2,67 | 2,62 | 3,00 | 2,62 | 2,46 | 2,62 | 2,46 | 2,69 | 2,54 | 2,69 | 2,69 | 2,62 | 2,69 | 2,62 | 0,13 |
| **eliminative behaviour *Ausscheidungsverhalten*** | **3,46** | **3,69** | **3,46** | **3,62** | **4,54** | **5,00** | **4,15** | **4,08** | **4,62** | **4,31** | **4,69** | **4,38** | **4,62** | **4,62** | **4,38** | **4,62** | **4,26** | **0,48** |
| rubbing brushes or other equivalent devices *Kratzbürsten oder gleichwertige Einrichtungen zur Hautpflege* | 1,15 | 1,77 | 1,62 | 1,23 | 2,00 | 2,46 | 1,69 | 1,69 | 2,15 | 1,69 | 1,77 | 1,92 | 2,77 | 2,77 | 1,77 | 1,77 | 1,89 | 0,46 |
| possibility for warming up *Möglichkeit sich zu wärmen* | 2,31 | 2,92 | 1,54 | 2,38 | 2,38 | 2,62 | 2,77 | 2,85 | 2,62 | 2,92 | 2,85 | 2,77 | 2,85 | 2,38 | 2,46 | 2,85 | 2,59 | 0,35 |
| possibility for cooling down *Möglichkeit sich abzu kühlen* | 1,92 | 2,15 | 2,00 | 2,15 | 2,54 | 3,00 | 2,54 | 2,38 | 2,54 | 2,00 | 2,25 | 1,77 | 2,08 | 1,92 | 2,15 | 2,31 | 2,23 | 0,31 |
| **comfort behaviour and thermoregulation *Komfortverhalten und Thermoregulation*** | **2,54** | **3,62** | **2,08** | **2,77** | **3,54** | **4,46** | **3,69** | **3,54** | **3,77** | **3,23** | **3,46** | **2,92** | **3,69** | **3,23** | **3,00** | **3,38** | **3,31** | **0,56** |
| access to open air *Auslaufmöglichkeit* | 1,00 | 1,00 | 1,00 | 1,00 | 3,00 | 3,00 | 1,00 | 2,38 | 2,31 | 1,00 | 2,85 | 1,00 | 1,00 | 1,00 | 1,00 | 2,69 | 1,64 | 0,87 |
| possibility for exploration *Erkundungsmöglichkeiten* | 1,23 | 2,38 | 1,23 | 1,15 | 2,85 | 3,00 | 1,92 | 2,62 | 2,85 | 2,54 | 2,77 | 2,54 | 2,46 | 2,15 | 1,77 | 2,69 | 2,26 | 0,62 |
| perception of environment *Wahrnehmung der Umgebung* | 2,00 | 2,08 | 2,00 | 1,92 | 2,54 | 3,00 | 2,31 | 2,46 | 2,77 | 2,77 | 2,85 | 2,54 | 2,85 | 2,69 | 2,54 | 2,69 | 2,50 | 0,34 |
| **exploratory behaviour *Erkundungsverhalten*** | **1,85** | **2,77** | **1,77** | **1,77** | **4,15** | **5,00** | **2,62** | **3,54** | **4,23** | **3,38** | **4,15** | **3,08** | **3,31** | **2,92** | **2,23** | **3,92** | **3,17** | **0,98** |
| adequate space *ausreichend Platz* | 1,46 | 2,08 | 1,38 | 1,69 | 2,77 | 3,00 | 2,00 | 2,46 | 3,00 | 2,85 | 3,00 | 2,62 | 2,85 | 2,85 | 2,46 | 3,00 | 2,47 | 0,57 |
| good grip on floor *rutschfester Boden* | 2,23 | 2,31 | 1,85 | 2,23 | 2,62 | 2,85 | 2,23 | 2,54 | 2,69 | 2,54 | 2,77 | 2,54 | 2,46 | 2,54 | 2,54 | 2,77 | 2,48 | 0,26 |
| **locomotory behaviour *Fortbewegungsverhalten*** | **2,15** | **2,92** | **1,85** | **2,54** | **4,15** | **4,85** | **2,85** | **3,69** | **4,62** | **4,38** | **4,69** | **4,15** | **4,23** | **4,23** | **3,69** | **4,69** | **3,73** | **0,97** |
| **key word sum *Summe Schlüsselwörter*** | **44,1** | **55,2** | **42,9** | **44,7** | **57,6** | **63,0** | **51,9** | **56,5** | **57,9** | **52,6** | **54,8** | **51,1** | **57,2** | **53,9** | **49,8** | **56,5** | **53,1** | **5,53** |
| domain sum *Summe Funktionskreise* | 17,6 | 26,2 | 17,3 | 19,0 | 27,7 | 33,2 | 24,5 | 27,1 | 28,5 | 25,4 | 26,7 | 24,0 | 27,9 | 25,7 | 22,5 | 27,5 | 25,1 | 4,22 |
| number of deficiencies *Anzahl Mängel* | 7,92 | 2,31 | 9,77 | 6,92 | 1,23 | 0,15 | 2,92 | 1,15 | 1,62 | 4,00 | 3,00 | 4,00 | 1,77 | 3,15 | 5,08 | 2,15 | 3,6 | 2,65 |
| Management risks *Managementrisiken* | 2,31 | 2,85 | 2,62 | 1,93 | 2,64 | 1,57 | 2,29 | 2,43 | 1,43 | 1,21 | 1,00 | 1,31 | 1,57 | 1,57 | 1,29 | 1,57 | 1,85 | 0,59 |
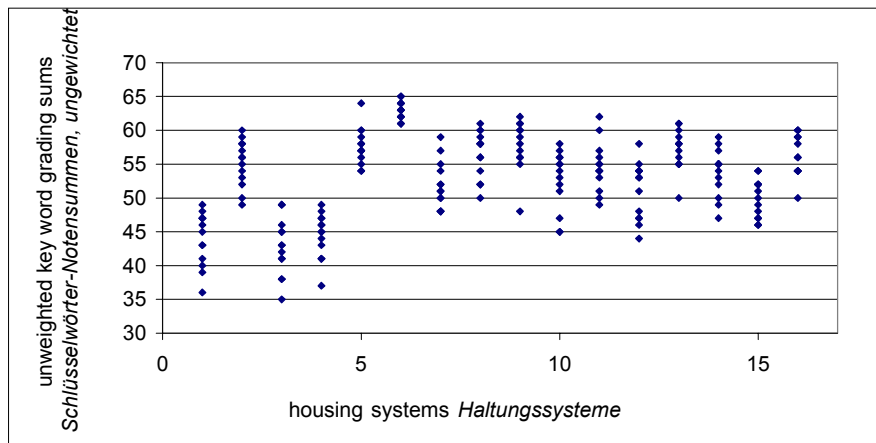
*Figure 2:* **Unweighted key word grading sums of 16 housing systems (x-axis)**
*Abbildung 2: Summen der ungewichteten Benotungswerte der Schlüsselwörter für 16 Haltungssysteme (x-Achse)*
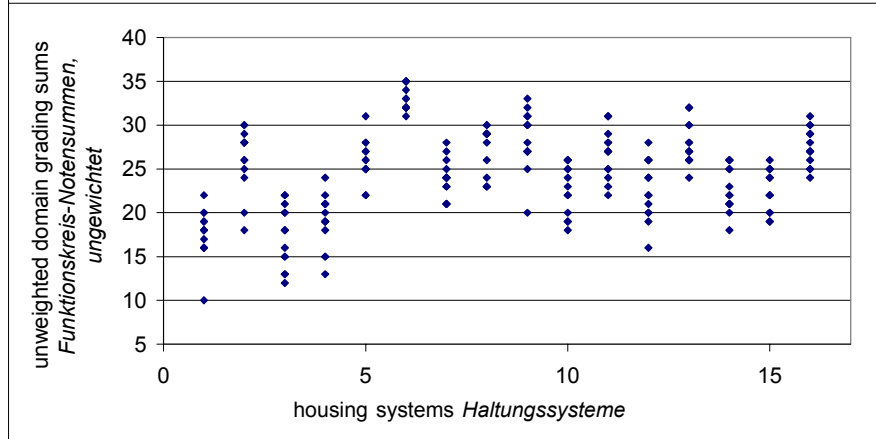


*Figure 3:* **Unweighted behavioural domain grading sums of 16 housing systems (x- axis)**
*Abbildung 2: Summen der ungewichteten Benotungswerte der Funktionskreise*



*Figure 4:* **Weighted grading sums of key words of 16 housing systems (x-axis)**
*Abbildung: 4 Summen der gewichteten Schlüsselwörter- Benotungswerte für 16 Haltungssysteme (x-Achse)*



*Figure 5:* **Weighted grading sums of behavioural domains of 16 housing systems (x- axis)**
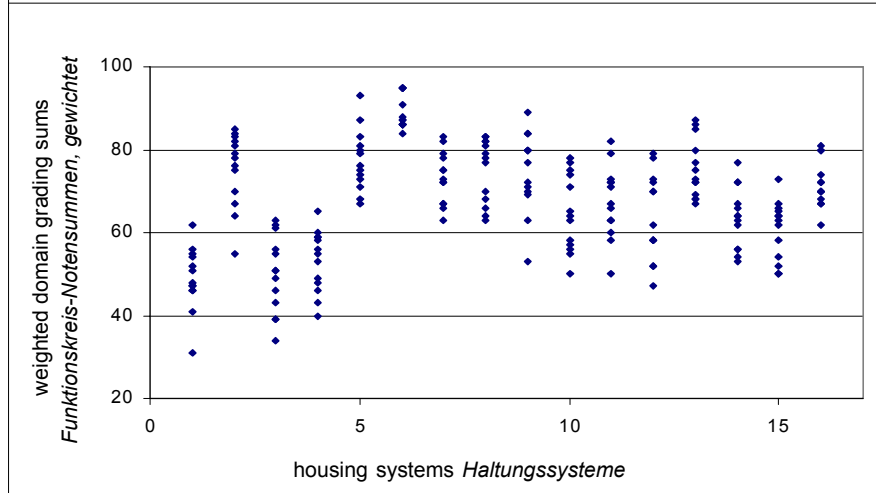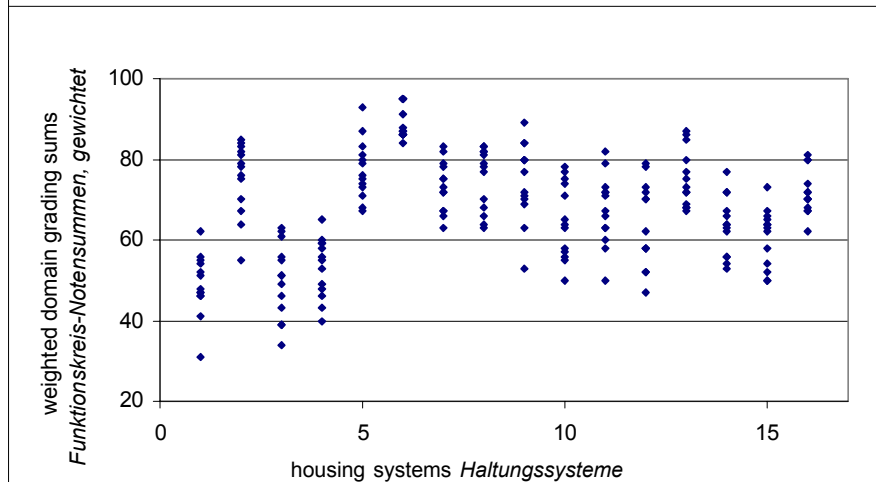*Abbildung 5: Summen der gewichteten Benotungswerte der Funktionskreise für 16 Haltungssysteme (x-Achse)*

*Table 13:* **Mean weighted gradings by 13 assessors for 7 behavioural domains, 22 key words, sums of key word scoring, sums of domain scorings, mean values of lines (∅), and standard deviations s of 16 group housing systems**
*Tabelle 13: Mittelwerte der von 13 Beurteilern vergebenen gewichteten Bewertungsnoten für 7 Funktionskreise, 22 Schlüsselwörter, Summen der Schlüsselwörter-Benotung, Summen der Funktionskreis-Benotungen, sowie Zeilenmittelwerte (∅) und Standardabweichungen für 16 Gruppenhaltungssysteme*

| key words/ behavioural domains *Schlüsselwörter/ Funktionskreise* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | ∅ | s |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| social hierarchy *soziale Rangordnung* | 14,6 | 15,0 | 14,6 | 14,2 | 15,0 | 14,6 | 14,6 | 14,6 | 11,5 | 9,2 | 8,1 | 8,5 | 11,9 | 11,9 | 12,3 | 10,4 | 12,6 | 2,5 |
| stable (sub)group *stabile (Unter)gruppe* | 12,3 | 14,6 | 13,8 | 13,1 | 14,2 | 14,2 | 12,3 | 12,7 | 12,3 | 9,2 | 8,5 | 8,8 | 13,5 | 13,1 | 12,3 | 9,6 | 12,2 | 2,0 |
| physical contact *Körperkontakt* | 14,2 | 15,0 | 8,1 | 14,6 | 15,0 | 15,0 | 15,0 | 15,0 | 15,0 | 15,0 | 15,0 | 15,0 | 15,0 | 15,0 | 15,0 | 15,0 | 14,5 | 1,7 |
| space for bodylanguage *Raum für Körpersprache* | 8,1 | 10,4 | 6,2 | 8,1 | 12,7 | 15,0 | 10,8 | 11,9 | 15,0 | 14,6 | 14,6 | 14,6 | 14,6 | 14,6 | 13,1 | 13,8 | 12,4 | 2,9 |
| **social behaviour *Sozialverhalten*** | **15,4** | **20,4** | **13,1** | **17,3** | **21,2** | **23,8** | **18,8** | **20,4** | **19,2** | **16,2** | **15,4** | **15,4** | **20,0** | **20,0** | **18,8** | **16,5** | **18,2** | **2,8** |
| simultaneous meals *gleichzeitiges Fressen* | 11,1 | 12,0 | 12,0 | 11,4 | 11,4 | 12,0 | 12,0 | 12,0 | 4,9 | 4,3 | 4,6 | 4,6 | 7,7 | 7,7 | 4,9 | 6,2 | 8,7 | 3,3 |
| structured roughage *strukturiertes Rauhfutter* | 5,5 | 11,1 | 5,2 | 4,6 | 11,4 | 10,8 | 9,5 | 9,8 | 11,4 | 9,2 | 9,2 | 8,9 | 10,5 | 9,5 | 4,6 | 12,0 | 9,0 | 2,5 |
| sufficient drinkers (ad lib.) *ausreichende Tränken* | 10,2 | 12,0 | 11,7 | 11,4 | 11,7 | 10,5 | 12,0 | 11,1 | 12,0 | 10,8 | 11,1 | 11,7 | 12,0 | 12,0 | 11,7 | 11,7 | 11,5 | 0,6 |
| adequate individual rations *angemessene individuelle Futterrationen* | 4,6 | 11,4 | 11,7 | 6,5 | 6,5 | 11,4 | 11,4 | 11,1 | 10,5 | 10,5 | 9,8 | 10,2 | 9,2 | 9,8 | 11,1 | 11,1 | 9,8 | 2,1 |
| **feed intake behaviour *Nahrungsaufnahmeverhalten*** | **8,3** | **18,5** | **15,1** | **9,8** | **13,8** | **17,8** | **17,5** | **16,9** | **13,2** | **11,7** | **11,4** | **11,7** | **14,5** | **14,2** | **9,8** | **15,4** | **13,7** | **3,1** |
| survey from lying area *Übersicht vom Liegebereich* | 7,6 | 7,6 | 4,4 | 6,2 | 6,0 | 6,7 | 5,3 | 4,8 | 8,3 | 8,1 | 7,2 | 6,7 | 7,8 | 7,4 | 8,1 | 6,0 | 6,8 | 1,2 |
| protected lying area *geschützte Liegefläche* | 6,5 | 8,5 | 5,8 | 6,5 | 7,2 | 9,0 | 8,5 | 8,8 | 9,0 | 6,5 | 6,2 | 6,2 | 8,5 | 8,8 | 7,8 | 6,9 | 7,5 | 1,2 |
| adequate bedding *ausreichend Einstreu im Liegebereich* | 3,2 | 8,8 | 3,0 | 3,0 | 7,8 | 9,0 | 5,1 | 9,0 | 8,1 | 9,0 | 9,0 | 8,1 | 9,0 | 3,7 | 3,5 | 9,0 | 6,8 | 2,6 |
| adequate space and access to lying area *ausreichendes Platzangebot und Zugänglichkeit im bzw. zum Liegebereich* | 7,2 | 8,5 | 6,7 | 6,7 | 8,3 | 8,8 | 6,5 | 7,2 | 7,6 | 8,5 | 8,1 | 8,3 | 8,5 | 8,1 | 8,1 | 8,3 | 7,8 | 0,8 |
| **resting behaviour *Ausruhverhalten*** | **7,4** | **13,4** | **5,3** | **7,2** | **10,8** | **13,8** | **9,2** | **11,8** | **12,5** | **11,8** | **11,3** | **10,4** | **13,4** | **9,5** | **9,0** | **11,3** | **10,5** | **2,4** |
| separate and adequate elimination area *getrennter und entsprechender Mistplatz* | 4,8 | 4,5 | 4,8 | 4,8 | 5,8 | 6,0 | 5,2 | 5,7 | 5,8 | 5,7 | 5,8 | 5,7 | 6,0 | 5,8 | 5,5 | 5,8 | 5,5 | 0,5 |
| good grip on floor *rutschfester Boden* | 5,2 | 4,9 | 5,2 | 5,3 | 5,2 | 6,0 | 5,2 | 4,9 | 5,2 | 4,9 | 5,4 | 5,1 | 5,4 | 5,4 | 5,2 | 5,4 | 5,2 | 0,3 |
| **eliminative behaviour *Ausscheidungsverhalten*** | **6,9** | **7,4** | **6,9** | **7,2** | **9,1** | **10,0** | **8,3** | **8,2** | **9,2** | **8,6** | **9,4** | **8,8** | **9,2** | **9,2** | **8,8** | **9,2** | **8,5** | **1,0** |
| rubbing brushes or other equivalent devices *Kratzbürsten oder gleichwertige Einrichtungen zur Hautpflege* | 2,3 | 3,5 | 3,2 | 2,5 | 4,0 | 4,9 | 3,4 | 3,4 | 4,3 | 3,4 | 3,5 | 3,8 | 5,5 | 5,5 | 3,5 | 3,5 | 3,8 | 0,9 |
| possibility for warming up *Möglichkeit sich zu wärmen* | 4,6 | 5,8 | 3,1 | 4,8 | 4,8 | 5,2 | 5,5 | 5,7 | 5,2 | 5,8 | 5,7 | 5,5 | 5,7 | 4,8 | 4,9 | 5,7 | 5,2 | 0,7 |
| possibility for cooling down *Möglichkeit sich abzu kühlen* | 3,8 | 4,3 | 4,0 | 4,3 | 5,1 | 6,0 | 5,1 | 4,8 | 5,1 | 4,0 | 4,5 | 3,5 | 4,2 | 3,8 | 4,3 | 4,6 | 4,5 | 0,6 |
| **comfort behaviour and thermoregulation *Komfortverhalten und Thermoregulation*** | **5,1** | **7,2** | **4,2** | **5,5** | **7,1** | **8,9** | **7,4** | **7,1** | **7,5** | **6,5** | **6,9** | **5,8** | **7,4** | **6,5** | **6,0** | **6,8** | **6,6** | **1,1** |
| access to open air *Auslaufmöglichkeit* | 2,0 | 2,0 | 2,0 | 2,0 | 6,0 | 6,0 | 2,0 | 4,8 | 4,6 | 2,0 | 5,7 | 2,0 | 2,0 | 2,0 | 2,0 | 5,4 | 3,3 | 1,7 |
| possibility for exploration . *Erkundungsmöglichkeiten* | 2,5 | 4,8 | 2,5 | 2,3 | 5,7 | 6,0 | 3,8 | 5,2 | 5,7 | 5,1 | 5,5 | 5,1 | 4,9 | 4,3 | 3,5 | 5,4 | 4,5 | 1,2 |
| perception of environment *Wahrnehmung der Umgebung* | 4,0 | 4,2 | 4,0 | 3,8 | 5,1 | 6,0 | 4,6 | 4,9 | 5,5 | 5,5 | 5,7 | 5,1 | 5,7 | 5,4 | 5,1 | 5,4 | 5,0 | 0,7 |
| **exploratory behaviour *Erkundungsverhalten*** | **3,7** | **5,5** | **3,5** | **3,5** | **8,3** | **10,0** | **5,2** | **7,1** | **8,5** | **6,8** | **8,3** | **6,2** | **6,6** | **5,8** | **4,5** | **7,8** | **6,3** | **2,0** |
| adequate space *ausreichend Platz* | 1,46 | 2,08 | 1,38 | 1,69 | 2,77 | 3,00 | 2,00 | 2,46 | 3,00 | 2,85 | 3,00 | 2,62 | 2,85 | 2,85 | 2,46 | 3,00 | 2,47 | 0,57 |
| good grip on floor *rutschfester Boden* | 2,23 | 2,31 | 1,85 | 2,23 | 2,62 | 2,85 | 2,23 | 2,54 | 2,69 | 2,54 | 2,77 | 2,54 | 2,46 | 2,54 | 2,54 | 2,77 | 2,48 | 0,26 |
| **locomotory behaviour *Fortbewegungsverhalten*** | **2,15** | **2,92** | **1,85** | **2,54** | **4,15** | **4,85** | **2,85** | **3,69** | **4,62** | **4,38** | **4,69** | **4,15** | **4,23** | **4,23** | **3,69** | **4,69** | **3,73** | **0,97** |
| **key word sum *Summe Schlüsselwörter*** | **138** | **173** | **135** | **140** | **174** | **189** | **162** | **172** | **173** | **157** | **159** | **153** | **173** | **164** | **152** | **167** | **161** | **15,0** |
| **domain sum *Summe Funktionskreise*** | **48,9** | **75,3** | **49,9** | **53,2** | **74,5** | **89,3** | **69,4** | **75,1** | **74,8** | **65,8** | **67,4** | **62,4** | **75,3** | **69,4** | **60,6** | **71,8** | **68** | **10,7** |

### 4.7. Mean results and standard deviations concerning key words, behavioural domains, deficiencies and management risks of housing systems

*Table 12 (page 12)* shows the mean unweighted assessment results by 13 assessors, as key word grades, behavioural domain grades, grading of management risks, including the sums of key word gradings and, respectively, of behavioural domain gradings and the mean number of deficiencies (gradings = 1) for each of the 16 housing systems, including the means over all housing systems and their standard deviations.

In *figure 2 (page 13)*, the distribution of the sums of the unweighted key word grades for the 16 housing systems are shown. The individual dots of each of the vertical lines represent the summarized grading results of the 13 assessors. In *figure 3 (page 13)*, the respective values are given for the unweighted grading sums of the behavioural domains.

*Table 14:* **Absolute numbers of deficiencies (key word grading = 1 = not satisfactory and domain grading = 1 = not sufficient or bad according grading sheet in annex 2) appointed by 13 assessors for 16 group housing systems and overall sum of deficiencies per housing system**
*Tabelle 14: Absolute Anzahl von Mängeln (Benotung = 1 bei Schlüsselwörtern = unbefriedigend und bei Funktionskreisen = ungenügend oder schlecht gemäß Beurteilungsbogen im Anhang 2) vergeben von 13 Beurteilern für 16 Gruppenhaltungssysteme und Gesamtsumme der Anzahl Mängel pro Haltungssystem*

| key words/ behavioural domains *Schlüsselwörter/ Funktionskreise* | group housing systems *Gruppenhaltungssysteme* | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** |
| social hierarchy *soziale Rangordnung* | | | | | | | | | | 4 | 6 | 5 | | | | 3 |
| stable (sub)group *stabile (Unter)gruppe* | 1 | | | | | | | | | 4 | 6 | 4 | | | | 3 |
| physical contact *Körperkontakt* | | | 7 | | | | | | | | | | | | | |
| space for bodylanguage *Raum für Körpersprache* | 7 | 1 | 10 | 6 | | | | | | | | | | | 1 | |
| **social behaviour *Sozialverhalten*** | | | 2 | | | | | | | | 1 | | | | | |
| simultaneous meals *gleichzeitiges Fressen* | | | | 1 | 1 | | | | 10 | 12 | 11 | 11 | 5 | 5 | 11 | 6 |
| structured roughage *strukturiertes Rauhfutter* | 8 | | 10 | 11 | | | 3 | | 1 | 1 | 1 | 1 | | 2 | 11 | |
| sufficient drinkers (ad lib.) *ausreichende Tränken* | 1 | | | 1 | | | | | | 1 | | | | | | |
| adequate individual rations *angemessene individuelle Futterrationen* | 11 | | | 5 | 6 | | | | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 |
| **feed intake behaviour *Nahrungsaufnahmeverhalten*** | 3 | | | | | | | | | | | | | | 1 | |
| survey from lying area *Übersicht vom Liegebereich* | | 1 | 7 | 2 | 2 | 1 | 3 | 6 | | | 2 | 3 | | 1 | | 3 |
| protected lying area *geschützte Liegefläche* | 2 | | 5 | 2 | 1 | | | | | 4 | 4 | 4 | | | 1 | 2 |
| adequate bedding *ausreichend Einstreu im Liegebereich* | 12 | | 13 | 13 | 1 | | 6 | | 1 | | | | | 11 | 11 | |
| adequate space and access to lying area *ausreichendes Platzangebot und Zugänglichkeit im bzw. zum Liegebereich* | | | 2 | | | | 2 | | | | | | | | 1 | |
| **resting behaviour *Ausruhverhalten*** | 1 | | 4 | | | | | | | | | | | | | |
| separate and adequate elimination area *getrennter und entsprechender Mistplatz* | 1 | 2 | 2 | | | | | | | | | | | | | |
| good grip on floor *rutschfester Boden* | | | | | | | | | | 1 | | | | | | |
| **eliminative behaviour *Ausscheidungsverhalten*** | 1 | | | | | | | | | | | | | | | |
| rubbing brushes or other equivalent devices *Kratzbürsten oder gleichwertige Einrichtungen zur Hautpflege* | 11 | 3 | 5 | 10 | 2 | 1 | 5 | 5 | 2 | 5 | 4 | 4 | 1 | 1 | 4 | 4 |
| possibility for warming up *Möglichkeit sich zu wärmen* | 1 | | 6 | 1 | 2 | | 1 | 1 | | | | | | 2 | 2 | |
| possibility for cooling down *Möglichkeit sich abzu kühlen* | 3 | 2 | 4 | 2 | 1 | | | | | 4 | 1 | 4 | 2 | 2 | 2 | 2 |
| comfort behaviour and thermoregulation *Komfortverhalten und Thermoregulation* | 1 | | 2 | | | | | | | | 1 | 1 | 1 | | 1 | 1 |
| access to open air *Auslaufmöglichkeit* | 13 | 13 | 13 | 13 | | | 13 | 3 | 4 | 13 | | 13 | 13 | 13 | 13 | 2 |
| possibility for exploration *Erkundungsmöglichkeiten* | 11 | 1 | 10 | 11 | | | 3 | | | | | | | 2 | 5 | |
| perception of environment *Wahrnehmung der Umgebung* | 2 | 1 | 3 | 2 | | | | | | | | | | | | 1 |
| **exploratory behaviour *Erkundungsverhalten*** | 3 | | 4 | 4 | | | 1 | | | | | | | | 1 | |
| adequate space *ausreichend Platz* | 7 | 3 | 8 | 4 | | | 1 | | | | | | | | | |
| good grip on floor *rutschfester Boden* | 1 | 1 | 4 | 1 | | | 1 | | | | | | | | | |
| **locomotory behaviour *Fortbewegungsverhalten*** | 2 | 2 | 6 | 1 | | | | | | | | | | | | |
| **number of deficiencies *Anzahl Mängel*** | 103 | 30 | 127 | 90 | 16 | 2 | 38 | 15 | 21 | 52 | 39 | 52 | 23 | 41 | 66 | 28 |

There are clear differences between the 16 housing systems. Also, there is much variance between the assessors in assessing the given housing systems.

*Table 13* (page 14) shows the numbers and results equivalent to *table 12* for weighted grading. Both, key word grades and domain grades were multiplied by the weighting factors according *table 7*. As number of deficiencies and gradings of management risks have not been weighted those respective lines are not included in *table 13*.

F*igures 4* and *5* (page 13) present graphs analogous to *figures 2* and *3*, but based on the weighted grading sums of key words and behavioural domains shown in *table 13*.

In each of the four *figures 2* to *5*, 16*13 = 208 numbers are shown as single dots. In *figures 2* and *3* there seem to be many less dots. This is an effect caused by the multiple coincidences of same key word sum numbers and behavioural domain sum numbers respectively (e.g. the value 54 *in figure 2*. occurs 19 times, the number 55 16 times). As a result of multiplying the key word grades and the behavioural domain grades by different weighting factors, such coincidences occur much less in *figures 4* and *5* showing the weighted grading sums.

*Table 14* (page 15) gives a more close impression of the distribution of system deficiencies. It lists absolute numbers of the deficiencies assessed by the 13 experts for each of the key words and behavioural domains and overall sums of those deficiencies for the 16 housing systems for dry sows. The last line of table 14 corres-ponds with the last but one line of table 12, but in table 12 the corresponding values are mean values per assessor, i.e. values of *table 14* devided by 13.

## 4.8. Ranking of housing systems according mean behavioural assessment, deficiencies and management risks

Six findings per housing system in *tables 12* and *13*, i.e. sums of key word scorings, sums of behavioural domain scorings, both unweighted (*table 12*) and weighted (*table 13*), number of deficiencies and mean grading of management risks (*tables 12* and *14*), were used to establish respective rank orders of the housing systems. Other than in grading, a lower rank number stands for a better housing system in respect to the criteria for which the systems were ranked compared to a housing system with a higher rank value.

In *table 15*, ranking results are compared. Whereas the number of deficiencies relate to the key word sums and to the domain sums (deficiencies are defined by minimum grading = 1 of key words and domains) and therefore the calculation of average behavioural rank numbers seem to be reasonable, the scoring of management risks is completely independent of the behavioural evaluation.

Lines 6 and 7 of *table 15* give mean rank numbers and their standard deviations of the five related rank orders (lines 1 to 5) which show quite good coincidence: 8 housing systems (no. 1, 3, 4, 6, 10, 12, 14, 15) show no or small deviations within all five calculated rank numbers concerning behavioural assessment with standard deviations of 0 % or less than 10 %. The least coincidences of these ranking results (standard deviations 32 - 43 %) occur in 5 housing systems that show low (= good) ranking values where differences in ranking numbers quickly lead to larger deviations (no. 2, 5, 8, 9, 13).

Ranking 16 values between 1 and 16 gives a median value of 8,5. Line 8 of table 13 (management risks) shows a clear distinction between housing systems 1 to 8, all ranging below the median and housing systems 9 to 16 counting above median. The mean rank value of the first

*Table 15:* **Rank numbers according sums of unweighted and weighted key word grading and domain grading of tables 12 and 13, rank numbers according number of deficiencies of table 13, mean rank values and their standard deviations s (absolute and in %) of those 5 rankings refering to behavioural assessment and rank numbers according grading of management risks of table 12 of 16 group housing systems**
*Tabelle 14: Rangwerte gemäß den Summen der ungewichteten und gewichteten Schlüsselwörter- und Funktionskreisnoten aus Tabellen 12 und 13, Rangwerte gemäß der Anzahl von Mängeln aus Tabelle 14, durchschnittliche Rangzahlen und deren Standardabweichungen s (absolut und in %) für diejenigen 5 Rangwerte, die bezüglich der ethologischen Beurteilung ermittelt wurden und Rangwerte gemäß den Managementrisiken aus Tabelle 12 für 16 Gruppenhaltungssysteme*

| line *Zeile* | ranking according.... *Rangfolge entsprechend....* | group housing systems *Gruppenhaltungssysteme* | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 1 | keywords unweighted *ungewichteten Schlüsselwörtern* | 15 | 7 | 16 | 14 | 3 | 1 | 11 | 5 | 2 | 10 | 8 | 12 | 4 | 9 | 13 | 5 |
| 2 | domains unweighted *ungewichteten Funktionskreise* | 15 | 8 | 16 | 14 | 4 | 1 | 11 | 6 | 2 | 10 | 7 | 12 | 3 | 9 | 13 | 5 |
| 3 | keywords weighted *gewichteten Schlüsselwörtern* | 15 | 3 | 16 | 14 | 2 | 1 | 9 | 6 | 5 | 11 | 10 | 12 | 4 | 8 | 13 | 7 |
| 4 | domains weighted *gewichteten Funktionskreisen* | 16 | 3 | 15 | 14 | 6 | 1 | 8 | 4 | 5 | 11 | 10 | 12 | 2 | 9 | 13 | 7 |
| 5 | number of deficiencies *Anzahl Mängel* | 15 | 7 | 16 | 14 | 3 | 1 | 8 | 2 | 4 | 11 | 9 | 11 | 5 | 10 | 13 | 6 |
| 6 | mean rank according lines 1 - 5 *Rangdurchschnitt gemäß Zeilen 1 - 5* | **15,2** | **5,6** | **15,8** | **14,0** | **3,6** | **1,0** | **9,4** | **4,6** | **3,6** | **10,6** | **8,8** | **11,8** | **3,6** | **9,0** | **13,0** | **6,0** |
| 7 | s lines 1 – 5, abs.(%) *s Zeilen 1 - 5, abs. (%)* | 0,45 (3,0) | 2,41 (43) | 0,45 (2,9) | 0,00 (0) | 1,52 (42) | 0,00 (0) | 1,52 (16) | 1,67 (36) | 1,52 (42) | 0,55 (5,2) | 1,30 (15) | 0,45 (3,8) | 1,14 (32) | 0,71 (7,9) | 0,00 (0) | 1,00 (17) |
| 8 | Management risks *Managementrisiken* | **5** | **1** | **2** | **7** | **2** | **8** | **5** | **4** | **12** | **15** | **16** | **13** | **9** | **9** | **14** | **9** |

*Table 16:* **Distribution of average ranking numbers of 5 similar ranking orders concerning behavioural assessment of 16 group housing systems by 13 assessors, according to line 6 of table 15, sorted within 5 ranking classes representing 20 % of the range of ranking numbers each and assignment of the housing system numbers of tables 2 and 3 to the ranking classes**
*Tabelle 15: Verteilung der durchschnittlichen Rangwerte von 5 ähnlichen Rangordnungen bezüglich der ethologischen Beurteilung von 16 Gruppenhaltungssystemen durch 13 Experten gemäß Zeile 6 der Tabelle 15 innerhalb von 5 Rangklassen, die jede jeweils 20 % des gesamten Rangumfanges umfasst sowie Zuordnung der 16 Haltungssysteme gemäß den Nummern in Tabellen 2 und 3 zu den Rangklassen*

| ranking class *Rangklasse* | range of ranking *Rangwertbereich* | number of housing systems *Anzahl von Haltungssystemen* | housing system numbers of tables 2 and 3 *Haltungssystemnummern gemäß Tabellen 2 und 3* |
|---|---|---|---|
| 1 | 1-3,2 | 1 | 6 |
| 2 | 3,3-6,4 | 6 | 2,5,8,9,13,16 |
| 3 | 6,5-9,6 | 3 | 7,11,14 |
| 4 | 9,7-12,8 | 2 | 10,12 |
| 5 | 12,9-16,0 | 4 | 1,3,4,15 |

group is 4,25 (s = 2,49) that of the second group 12,13 (s = 2,85).

This means that the housing systems with larger groups of sows (no 9 to 16, 40 – 500 sows) were considered to be burdened by a higher management risk compared to the systems which house smaller groups (no 1 to 8, 4 – 20 sows). Even housing system no 6 (outdoor production) with the highest management risk grading rank of all the systems with small sow groups does rank below the median value and below each of the 8 housing systems for larger groups (but the difference in rank number is small to systems no 13, 14 and 16, all three ranking 9).

*Table 16* shows the numerical distribution of the mean behavioural rank numbers of *table 15*, line 6, within 5 classes of rank numbers each according 20 % of the range between 1 and 16 and the numbers of housing systems belonging to each of the 5 rank classes.

# 5. Discussion and conclusions

Group housing systems for dry sows have been introduced increasingly in many European countries over the last 20 years. On one hand, new feeding techniques like electronic sow feeders (ESF) have led to the design of new group housing systems. On the other hand, there is growing concern about the welfare of dry sows housed individually in crates or tethered (SCIENTIFIC VETERINARY COMMITTEE, 1997), and several countries have changed their animal welfare legislation to promote group housing systems.

There are many types of group housing systems for dry sows, as such systems are composed of several components that can be combined in different ways. For example, the sows can be fed as a group on the floor/at a trough, individually in stalls, or by the use of ESF. The lying area can be designed as a deep litter system, a kennel housing system, or without any litter on concrete floor. Group size may vary between four and several hundred sows, and group composition may be kept stable over the whole dry period or change several times, as some of the sows are moved to farrowing pens and new sows are introduced after weaning at regular intervals (dynamic groups). Such components may contribute differently to the welfare of the sows (EDWARDS, 2000). As a consequence, it is not possible to make a general statement about the welfare of dry sows in group housing systems. Different types of systems have to be assessed separately.

There are basically three ways of assessing and comparing housing systems. First, specific housing systems can be investigated in detail by collecting data on ethological and physiological parameters that are assumed to be related to the welfare of the sows (e.g. BROOM et al., 1995; JENSEN et al., 1995). Second, housing systems can be assessed on farm during relatively short visits using scoring systems that cover several aspects such as the design of the different areas within a housing system, management practices, animal health, and behaviour (e.g. SANDØE et al., 1997; BARTUSSEK, 1999). Third, housing systems can be ranked based on expert opinion (BRACKE et al., 1999). This last method was used at the IGN Workshop reported here. The participants aimed both at developing and testing a scoring system for the assessment of housing systems for dry sows with regard to animal behaviour and management risks and at assessing and comparing the welfare of sows in 16 specific housing systems.

## 5.1. The assessment tool developed and tested at the IGN Workshop

Although the assessment tool had been partly developed by a steering group and communicated to the participants of the workshop in advance, it took quite some time to discuss and finalise it at the meeting. New elements like the assessment of the management risks, the scoring of the behavioural domains as a whole (not only the keywords) and the weighting of the behavioural domains for the overall assessment score were incorporated in the assessment tool at the workshop. This was done after extensive discussions to reach a consensus.

Furthermore, the keywords and the behavioural domains proposed by the steering group were somewhat modified at the workshop, and it was important but time consuming to discuss the relevant criteria for each of the 22 keywords that were finally included in the assessment tool.

Once the assessment tool was elaborated and all housing systems were introduced in detail, the experts were able to score 16 housing systems for 7 behavioural domains and 22 keywords in about half a day. As the scoring was done within short time, it is likely that a given expert used the same criteria when assessing the different housing systems.

There were some doubts whether the key words chosen would cover all relevant aspects to make a judgement about a given behavioural domain. It was therefore decided to score the behavioural domains as a whole in addition to the keywords. In the analysis, it was found that there was in fact some variation in these two types of assessment (see *figure 1* and

annex 3), but correlation coefficients between the sum of keyword gradings and the behavioural domain gradings were rather high and significant (see *table 10)*. It can thus be concluded that the keywords chosen were judged to be adequate for the assessment of a given behavioural domain.

Weighting of different aspects incorporated in an assessment tool for the calculation of an overall assessment score is difficult and questionable (BARTUS-SEK, 1999; JOHANNESSON et al., 2000). However, when finalising the assessment tool the participants of the workshop found it necessary to consider the fact that some behavioural domains may be more important for the welfare of dry sows than others. It was thus decided to calculate two overall assessment scores for each housing system, one without and one with a weighting factor for each behavioural domain. There was some variation between the experts in their judgements about the relative contribution of the 7 behavioural domains to the welfare of dry sows (see *table 7)*. However, there was also much agreement with regard to the ranking of the domains. For example, most experts judged social behaviour to be the most important behavioural domain. This made it possible to agree on a final weighting factor that was based on the median value of the expert opinions expressed by the 13 participants.

The weighting factors used can not be assumed to represent the real contribution of the 7 defined behavioural domains to the welfare of dry sows. They are based on judgements made by human beings, and they are surely influenced by the scientific background of the experts. The importance of some behavioural domains has been shown by scientific studies using preference tests or operant conditioning techniques whereas the importance of other domains has hardly been addressed in the scientific literature. Most experts participating in the workshop have probably studied the same publications on sow behaviour and welfare. This may have led to a great extent to the high agreement between them with regard to the ranking of the 7 behavioural domains included in the assessment tool.

In the analysis, it was found that the final ranking of the 16 housing systems

did not depend much on the use of the weighting factor. A similar ranking was achieved when weighted or unweighted sums of scores for keywords and behavioural domains were used (see *table 15*). The fact that the rankings based on keyword scores and those based on behavioural domain scores were almost identical is due to the fact that these two types of scores were highly correlated (*see table 10*). It is also not surprising that the ranking according to the average number of deficiencies (grading = 1 for a given keyword or behavioural domain) identified by the 13 experts for each housing system was very similar to the rankings based on the sums of the scores for the keywords and the domains, as these deficiencies had a direct effect on these sums. On the other hand, the ranking of the management risks assessment was clearly different from the ranking of the welfare assessment, and housing systems for small groups of dry sows (4-20 animals) were generally judged to bear lower management risks than housing systems for large groups (40-500 animals).

In conclusion, it was feasible to agree on an assessment tool, to refine it at the workshop and to test the effect of different versions of calculating an overall assessment score on the final ranking of the 16 housing systems for dry sows. The development of the tool, the reasons for the design of the tool and the results obtained by testing the tool with 16 housing systems are described in this report. It is thus possible to use the tool for the assessment of additional housing systems for dry sows and to compare the outcome to that of the housing systems considered at the workshop.

## 5.2. The ranking of the 16 housing systems assessed

For the interpretation of the results obtained regarding the ranking of the 16 housing systems two important points should be kept in mind. First, the experts did not visit the systems they assessed. Each system was introduced by one of the experts in an oral presentation. This was done in a rather systematic way, covering the same components (ground plan, group size, group composition, feeding system, design of the lying area etc.)

for each housing system, and the experts had the possibility to ask questions to increase their knowledge about a given system. Nevertheless, it is likely that there were differences between experts in their perception of the housing systems assessed. Some of them had seen a given system in use before, whereas others had to rely completely on the oral presentation but may have made associations with similar systems they had seen before.

Second, the assessment was not made for certain types of housing systems (e.g. ESF systems), but for specific housing systems with a defined group size, ground plan, floor quality, management etc. As a consequence, the ranking of the 16 housing systems assessed can not be used to make judgements about animal welfare in other housing systems. Each system has to be assessed separately, and the assessment tool described in this report can be used to evaluate other housing systems for dry sows in an identical way.

There was much variance between the 13 experts in the assessment of a given housing system (see *figures 2* to *5*). Part of this variance was certainly due to effective differences between assessors in their judgement of the impact of a given housing system on the welfare of the sows. However, some variance was probably caused by differences between assessors in their interpretation of the keywords, although the relevant criteria for each keyword had been discussed extensively before the assessment of the housing systems.

Given this variance between assessors, the overall rankings presented in *table 15* and the grouping of the 16 housing systems in 5 ranking classes (*table 16*) are to be considered as an average opinion of 13 experts. The rankings of each expert may have been quite different, and the overall ranking could differ if the assessment tool were to be applied to the same 16 housing systems by another group of experts. Nevertheless, it was one of the aims of the workshop to assess a variety of typical housing systems for dry sows used in Europe by means of a concerted action of experts. As a consequence, the ranking of the housing systems elaborated by this group is also an

important result of the workshop, besides the experiences made during the development and testing of the assessment tool.

Generally, it has to be taken into account that all housing systems assessed were assumed to be managed properly (correct nutrition, proper hygiene, climatization, health programs; see chapter 3.2.). Therefore, a housing system ranking high in this assessment can still be very bad for the sows on a given farm if management is not adequate. Management risks were assessed separately by the experts and not considered in the ranking with regard to animal welfare. Furthermore, the distribution of the 16 housing systems over the five ranking classes (*table 16*) takes only the welfare of the sows into account, based on an assessment of their ability to meet behavioural needs within the housing system. Labour conditions, technical, structural, environmental as well as economic advantages and disadvantages of each housing system were not considered. This should be kept in mind in the following discussion.

The outdoor housing system (No. 6) ranked best and is the only system in the first ranking class (*table 16*). However, this does not mean that outdoor housing is generally the best system for the welfare of dry sows. The system assessed here had several specifications that are not fulfilled in many outdoor housing systems. For example, the sows were kept in small and stable groups of 8 sows, they were fed individually in stalls, they had access to shade and a wallowing place, and no nose rings were used. Within the housing systems assessed for small groups (8-20 animals) the outdoor housing system was judged to have the highest management risks.

In the second ranking class there are 6 housing systems, 3 for small groups (No. 2, 5, 8) and 3 for large groups (No. 9, 13, 16). It can thus be concluded that the experts considered good welfare possible both in systems with and without ESF. The systems for small groups are all characterised by a clear separation of the lying and the elimination area, a lying area with straw bedding and a division of the feeding trough in separate feeding places. Two of these systems (No. 5, 8) also include an outside area. The systems

for large groups in this ranking class also have all a lying area with straw bedding and two include an outside area (No. 9, 16). In order to reduce competition for access to the ESF, the sows are either offered roughage ad lib. in racks (No. 9, 16), or fresh straw and pelleted concentrates are distributed daily in the lying area (No. 13). In system No. 16 the number of sows per ESF is quite low as 4 parallel feeders are installed.

The third ranking class contains 3 rather heterogenuous housing systems (No. 7, 11, 14) that are characterised by both positive and negative aspects concerning the welfare of the sows. System No. 7 is a kennel housing system for small groups with individual feeding stalls and additional maize silage offered ad lib. There is only very little straw on the floor in the kennels, and the floor in the activity area is fully slatted. System No. 11 contains several ESF, has straw bedding in the lying area and includes an outside area. However, it is used for a very large group (500 sows). System No. 14 has one ESF and additional floor feeding of maize silage. The floor of the lying area is not littered and the floor in the activity area is fully slatted.

In the fourth ranking class there are two rather similar systems with ESF, straw bedding in the lying area and no access to an outside area (No. 10, 12).

The last ranking class contains 3 systems for small groups (No. 1, 3, 4) and one for large groups with an ESF (No. 15). In all these systems there is no straw bedding in the lying area, and no roughage is offered to the animals. System No. 3 is characterised by combined lying and feeding cubicles. In system No. 1 the animals are fed on the floor.

To summarise, the ranking of the housing systems with regard to animal welfare was not related to group size, despite the clear difference in management risk. Both in the upper and in the lower ranking classes there were systems with small and with large groups, and also systems with and without ESF. In large groups, problems with social behaviour were identified if group size was 100 and more animals. In small groups, on the other hand, space was very limited in some systems, impairing locomotion and not allowing animals to avoid each other. All

ESF systems have the disadvantage that simultaneous feeding of the sows is not possible, and systems without provision of roughage were generally ranked low.

In conclusion, the assessment of 16 housing systems for dry sows used in Europe by means of a concerted action of 13 experts revealed clear differences with regard to animal welfare. It can thus be stated that a transition from individual housing systems (tethers, crates) to group housing systems does probably not lead to a uniform level of animal welfare. There are systems that, based on the experts' opinion, have to be considered more advantageous to the animals than others. It is thus not sufficient to ban individual housing systems to guarantee good welfare. If the behavioural needs of dry sows are taken serious, specific group housing systems that comply well with these needs have to be promoted.

## 6. Summary

There is growing concern about the welfare of dry sows housed individually in crates or tethered, and several European countries have changed their animal welfare legislation to promote group housing systems. Given the variety in the design and the management of group housing systems for dry sows it is, however, questionable whether animal welfare is equal in all group housing systems in use.

To answer this question, the International Society of Livestock Husbandry (Internationale Gesellschaft für Nutztierhaltung; IGN) invited 13 experts on pig housing from Austria, Denmark, Germany, Switzerland, The Netherlands and the United Kingdom to a workshop to assess 16 group housing systems for dry sows with regard to animal behaviour and welfare. The aim of the workshop was to make an overall assessment of each housing system and to identify deficiencies for a given housing system.

In a first part of the workshop, the experts had to develop an assessment tool. It was agreed to assess each housing system for the following 7 behavioural domains: social behaviour, feed intake behaviour, resting behaviour, eliminative behaviour, comfort behaviour & thermoregulation, exploratory behaviour, locomotory behaviour (scores from 1 "not sufficient or bad" to 5 "very good or ex-

cellent"). In addition, the behavioural domains were characterised by a total of 22 keywords that were also assessed for each housing system (scores 1 to 3). Finally, each expert had to assess the weighting of each behavioural domain with regard to the welfare of the sows as well as the management risks of each housing system (low, medium, high).

Before the assessment there was a detailed oral presentation of each housing system by one of the experts. Half of the housing systems were designed for small groups of sows (4-20 sows) without electronic sow feeders (ESF) and the other half for large groups (40-500 sows) with ESF.

To summarise, the ranking of the housing systems with regard to animal welfare was not based on group size. Both in the upper and in the lower ranking classes there were systems with small and with large groups, and also systems with and without ESF. In large groups, problems with social behaviour were identified if group size was 100 and more animals. In small groups, on the other hand, space was in some systems very limited, impairing locomotion and not allowing animals to avoid each other. All ESF systems have the disadvantage that simultaneous feeding of the sows is not possible, and systems without provision of roughage were generally ranked low. Management risks were judged to be increased in group housing systems for large groups compared to systems for small groups.

In conclusion, the assessment of 16 housing systems for dry sows by means of a concerted action of experts revealed clear differences with regard to animal welfare. It can thus be stated that a transition from individual housing systems (tethers, crates) to group housing systems does probably not lead to a uniform level of animal welfare. There are systems that, based on the experts' opinion, have to be considered more advantageous to the animals than others. A general prescription of group housing systems is thus not sufficient to guarantee good animal welfare. If the behavioural needs of dry sows are taken seriously, specific group housing systems that comply well with these needs have to be promoted.

The development of the assessment tool, the reasons for the design of the tool and the results obtained by testing the tool with 16 housing systems are described in this report. It is thus possible to use the tool for the assessment of additional housing systems for dry sows and to compare the outcome to that of the housing systems considered at the IGN workshop.

## 7. Zusammenfassung

Die Einzelhaltung von tragenden Sauen in Kastenständen oder in Anbindehaltung ist aus Gründen des Tierschutzes stark umstritten, und in verschiedenen Staaten Europas wurde die Tierschutzgesetzgebung dahingehend geändert, dass Gruppenhaltungssysteme gefordert werden.

Aufgrund der Unterschiede in der Gestaltung und im Management solcher Systeme ist es jedoch fraglich, ob das Wohlbefinden der Sauen in allen Systemen gleich gut gewährleistet ist. Zur Beantwortung dieser Frage hat die Internationale Gesellschaft für Nutztierhaltung (IGN) im September 1998 an der BAL Gumpenstein einen mehrtägigen Workshop durchgeführt, dessen Ergebnisse in diesem Bericht veröffentlicht werden. Alle wichtigen Daten und Resultate sind in den Tabellen und in den Abbildungen auch auf *Deutsch (kursiv)* dargestellt und beschrieben.

13 Expertinnen und Experten für Schweinehaltung aus Dänemark, Deutschland, Großbritannien, Holland, Österreich und der Schweiz haben am Workshop teilgenommen (*Tabelle 1*), um 16 in Europa praxisübliche Gruppenhaltungssysteme für tragende Sauen aus ethologischer Sicht zu beurteilen. Diese 16 Systeme sind in den *Tabellen 2* und *3* beschrieben und in den Zeichnungen im Anhang 1 dargestellt.

Die verschiedenen Systeme sollten einerseits als Ganzes bewertet werden, und anderseits sollten eventuelle Problempunkte der Systeme herausgearbeitet werden. Vor der Beurteilung wurde jedes Haltungssystem von einem Experten ausführlich vorgestellt. Bei der Hälfte der Systeme handelte es sich um solche für kleinere Gruppen (8-20 Sauen) ohne Abrufütterung (siehe *Tabelle 2* und *Systeme 1* bis *8* im Anhang 1). Die anderen 8 Systeme waren solche mit Abrufütterung für große (40-500) Sauengruppen (*Tabelle 3* und *Systeme 9* bis *16* im Anhang 1).

Vor der Beurteilung ging es in einem ersten Teil des Workshops darum, aufbauend auf einem vorbereiteten und schon vor dem Workshop zirkulierten Vorschlag, gemeinsam die Beurteilungskriterien zu erarbeiten. Man einigte sich, die Haltungssysteme nach den 7 Funktionskreisen (behavioural domains) Sozialverhalten, Nahrungsaufnahmeverhalten, Ausruheverhalten, Ausscheidungsverhalten, Komfort-/Thermoregulationsverhalten, Erkundungsverhalten und Fortbewegung zu beurteilen (Noten von 1 "ungenügend oder schlecht" bis 5 "sehr gut oder ausgezeichnet" – siehe *Tabelle 6*). Darüber hinaus wurden die Funktionskreise in insgesamt 22 Schlüsselwörter (key words) unterteilt, die ebenfalls einzeln benotet wurden (Noten von 1 "ungenügend" bis 3 "befriedigend oder gut" – siehe *Tabelle 6*). Mit der Vergabe der Note 1 (ungenügend) wurde ein Mangel des Haltungssystems in Bezug auf das jeweilige Schlüsselwort oder auf den entsprechenden Funktionskreis des Verhaltens gekennzeichnet. Funktionskreise und zugehörige Schlüsselwörter sind in der *Tabelle 4* zusammengestellt. Mit der Möglichkeit einer unterschiedlichen Benotung eines Funktionskreises und seiner ihm zugeordneten Schlüsselwörter konnten die Experten gemäß ihren Erfahrungen entsprechende Gewichtungen vornehmen. Schließlich wurde noch eine zahlenmäßige Gewichtung der Funktionskreise untereinander aus der Sicht des Tieres vorgenommen (siehe *Tabelle 7*). Jeder Experte sollte darüber hinaus für jedes Haltungssystem abschätzen, ob es mit hohem, mittlerem oder geringem Managementrisiko betrieben werden kann. Die Beurteilung erfolgte mit Hilfe eines Beurteilungsblattes (siehe Anhang 2), in das insgesamt 30 Notenwerte einzutragen waren (für 22 Schlüsselwörter, 7 Funktionskreise und 1 mal für Managementrisiken). Bei 13 Experten und 16 beurteilten Haltungssystemen wurden 208 Beurteilungsblätter mit insgesamt 6240 Daten ausgefüllt, die deskriptiv ausgewertet wurden.

Die *Tabellen 8* und *9* zeigen die Verteilung der Benotungen bei den Schlüsselwörtern, Managementrisiken und bei den Funktionskreisen des Verhaltens, die *Abbildung 1* und die *Tabelle 10* belegen einen engen Zusammenhang zwischen den Benotungen der Schlüsselwörter und

denen der Funktionskreise. Die *Tabelle 12* zeigt die durchschnittlichen Bewertungsergebnisse einschließlich der durchschnittlichen Summen der Schlüsselwörter- und der Funktionskreisnoten und der durchschnittlichen Bewertung der Managementrisiken, die *Abbildungen 2* und *3* verdeutlichen die Benotungssummen für Schlüsselwörter und Funktionskreise für die 16 Haltungssysteme jeweils ohne Berücksichtigung der Wichtungsfaktoren. *Tabelle 13* sowie *Abbildungen 4* und *5* zeigen die entsprechenden gewichteten Ergebnisse dazu. In der *Tabelle 14* ist die absolute Anzahl von Mängeln pro Haltungssystem zusammengestellt, und schließlich werden in *Tabelle 15* die den Ergebnissen aus den *Tabellen 12* bis *14* entsprechenden Rangwerte für die einzelnen Haltungssysteme gezeigt, die in *Tabelle 16* zu 5 Rangklassen zusammengefasst sind. Anders als bei den Benotungen, bei denen eine höhere Zahl eine bessere Bewertung bedeutet, stehen höhere Ränge bzw. Rangklassen für schlechtere Verhältnisse.

Die Ergebnisse zeigen, dass die Tiergerechtheit eines Gruppenhaltungssystems für tragende Sauen nicht durch die Gruppengröße bestimmt wird. Sowohl Systeme mit als auch Systeme ohne Abruffütterung erzielten gute Benotungen.

In Systemen für sehr große Gruppen (100 und mehr Sauen) wurden bedeutende Probleme im Sozialverhalten geortet, während in Systemen für kleine Gruppen das Platzangebot oft sehr beschränkt ist, wodurch die Fortbewegung und die Rückzugsmöglichkeiten beeinträchtigt sind. Bei allen Systemen mit Abruffütterung ist nachteilig, dass die Sauen nicht gleichzeitg fressen können. Haltungssysteme ohne Rauhfuttergabe wurden generell schlecht benotet. Das Managementrisiko wurde bei Systemen für Großgruppen mit Abruffütterung generell höher eingestuft als bei Systemen für Kleingruppen ohne Abruffütterung.

Die Beurteilung der 16 Gruppenhaltungssysteme für tragende Sauen mit Hilfe systematisierter Expertenmeinung machte deutlich, dass es hinsichtlich Tiergerechtheit klare Unterschiede zwischen verschiedenen Haltungssystemen gibt. Es kann daher nicht davon ausgegangen werden, dass durch den Wechsel von der Einzelhaltung zur Gruppenhaltung ein einheitliches Niveau des Wohlbefindens der Sauen erreicht wird. Basierend auf der hier festgehaltenen Expertenmeinung gibt es Gruppenhaltungssysteme, die im Vergleich mit anderen Systemen klar als vorteilhafter für die Sauen einzustufen sind. Eine generelle Vorschrift zur Gruppenhaltung für trächtige Sauen genügt daher nicht, um das Wohlbefinden der Tiere zu gewährleisten. Wenn die Verhaltensbedürfnisse der Sauen ernst genommen werden, müssen Haltungssysteme, die diesen Bedürfnissen besonders Rechnung tragen, gezielt gefördert werden.

Im vorliegenden Bericht werden das Beurteilungsschema, die Begründung für die Inhalte des Schemas und die Ergebnisse bei der Anwendung dieses Schemas auf 16 Gruppenhaltungssysteme beschrieben. Es sollte daher möglich sein, dieses Beurteilungsschema auch auf andere Haltungssysteme für tragende Sauen anzuwenden und die damit erzielten Resultate mit denjenigen zu vergleichen, die an diesem Workshop der IGN erarbeitet wurden.

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# 9. Annexes

Annex 1: Drawings of 16 group housing systems for dry sows assessed

Annex 2: Grading sheet with criteria for assessing group housing systems for dry sows

Annex 3: Relation between grading on key word level and grading on behavioural domain level