WelFur

Welfare assessment protocol for foxes

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The consortium of experts, and universities involved are listed in Annex B 'Contributors to WelFur'.
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Foreword

WelFur – Introductory words

Animal welfare is a societal issue which most citizens and consumers are clearly concerned about. For the same reason animal welfare is a key priority in the European fur farming sector. The fur farming sector acknowledges however, that welfare standards on fur farms may not be sufficiently transparent to the general public and other stakeholders, just as the fur farming sector acknowledges that animal welfare standards are not fixed objectives, but the results of dynamic process in which new knowledge and technology must be considered as they appear.

In the preparation of the WelFur protocols for fur-farmed species (mink and foxes), all existing scientific knowledge has been reviewed. Scientific research on animal welfare in farmed mink and fox have been conducted in a number of countries for more than 30 years. Consequently the WelFur protocols can be considered as the latest scientific reference with regard to animal welfare for fur-farmed species.

The overall aims of the WelFur project rest on three principles. 1) WelFur is a reliable and feasible system for animal welfare assessment based on scientifically proven measurements. 2) WelFur is designed to create transparency around the animal welfare standards. 3) WelFur works as a strategic tool for the individual fur farmer to indentify and improve any areas on the fur farm where the welfare standards can potentially be improved.

Background

To promote a more objective and transparent view on the state of animal welfare on European fur farms, the European Fur Breeders' Association (EFBA) currently European Fur Information Center (Fur Europe) initiated the WelFur project in 2009. WelFur is largely inspired by the Welfare Quality® project that the European Commission initiated in 2004 covering pigs, poultry and cattle. Welfare assessment relies on a sequential evaluation process, in which measurements are collected on farms to assess the welfare status of the farm within 12 criteria. Those welfare criteria are then aggregated into four main welfare principles and finally an overall welfare classification is produced.

The objectives of WelFur

The main objective of WelFur is to check the level of animal welfare on European fur farms.

This can form the basis for a solid certification program to cover all European fur farms. Assessments will be carried by third-parties and results will be communicated to the fur farmer in order to encourage the farmer to take the most appropriate steps to improve animal welfare. It must be underlined that the welfare assessment protocols evaluate the actual welfare of the fur animals and not primarily compliance with any national and/or EU legislation.

At present, national authorities carry out controls of fur farms with the objective of insuring compliance with existing legislation on animal welfare. However, the levels of control and the basic legislation differ considerably from one member state to the other. Another potential benefit of the WelFur project is consequently to influence the reform of current controls and legislation on both national and EU levels. The industry proposes that WelFur could serve as an EU-based scientific reference for regulation and control.

WelFur structure and timeline

In 2009, EFBA (currently Fur Europe) appointed a consortium of 7 European universities and institutes (see Annex B 'Contributors to WelFur') to gather existing research in two protocols – one for mink and one for foxes. The senior scientist Dr. Steen Henrik Møller from Aarhus University and Prof. Jaakko Mononen from the University of Eastern Finland, were appointed project co-ordinators for mink and fox species, respectively. To secure the validity and the independence of the research on the protocols, three external reviewers were appointed: Prof. Georgia Mason from Guelph University, Prof. Harry Blokhuis from Swedish

University of Agricultural Sciences and Prof. David Morton from University of Birmingham. The reviewers participated in all the review meetings of the project and have issued a report at the end of the development process.

The scientists identified and evaluated the possible welfare indicators and measurements to be included in the protocols following an in-depth review of the existing welfare research on fur animals. They selected a number of these on the basis of their scientific validity, reliability and feasibility. The description of the selected welfare measurements was finished in early 2011. The researchers decided on 23 measurements to assess the welfare of foxes and 22 measurements for mink. About half of the measurements are animal-based. The goal has never been to have 100% animal-based indicators but instead, to have an overall picture of the farm which includes a combination of animal-based, management-based and resource-based indicators.

With the support of INRA (French National Institute of Agronomic Research) and various consultations with scientists, the scoring of the welfare measurements was accomplished by the end of 2011. WelFur is designed to be implemented directly at the farm. That is why the protocols were then tested in a number of commercial fur farms in Denmark, Finland, The Netherlands, Norway and Sweden during 2011 and 2012, in order to get a first set of farm data covering the 3 periods of the annual production cycle. From these tests, the scientific teams could conclude that the assessments can be performed within one day (approx. 5-7 hours). The tests also showed that the measurements are sensitive enough to demonstrate variation between farms.

Transparency paper

The 22 and 23 specific measurements for mink and foxes respectively, have been chosen by the scientist for their scientific validity, reliability and feasibility. During the development of WelFur several hundred measurements have been considered, and, on completion of the WelFur protocols, the scientist will produce a transparency paper explaining in detail the reason for the final choice of measurements.

WelFur implementation

The WelFur implementation consists of 4 procedures:

- Publishing the WelFur assessment protocols presenting both the measurements and the way calculations are performed up to the final overall classification of farms (present document).

- Development of a software tool to calculate the scores and store the data. This work by INRA started in parallel with the development of the protocols. This tool will be available to both the assessors (for the assessments) and the farmers (for information and improvement purposes).

- Development of the training material for the assessors were started in parallel with the development of the protocols. Training material (e.g. videos, written material, pictures) will be consolidated by the same scientific teams. It should be ready in 2015.

- National implementation action plans will be developed in the course of 2016 with the support of each Fur Europe member association, including the third-party selection to perform the assessments. There will not be a pan-European solution. Instead, each member country will have to develop a solution suited for national circumstances. The implementation of WelFur will be started at the beginning of 2017.

Ethical and societal aspects

WelFur differs from the Welfare Quality® project in that no social scientists were involved when setting the consolidation rules from the welfare criteria to principles and the overall assessment. Therefore, in WelFur, these two steps were extrapolated from the consolidated Welfare Quality® data. This situation is particular and mainly due to the fact that there is a polarisation of views when addressing the welfare of fur animals. Despite this there is general agreement within the scientific community about what represents good animal welfare. This consensus was expressed in the 'Five Freedoms' that Welfare Quality® is based on.

In order to address citizens' concerns regarding the fur farming sector, EFBA (currently Fur Europe) has also launched a number of key initiatives in parallel with WelFur:

- In September 2010, Fur Europe undertook a public survey (conducted by independent market research company Ipsos) regarding fur animals in Belgium, Germany and the Netherlands in order to get a clear understanding of the public's concerns.

- Following this survey, Fur Europe appointed a consortium of three scientists from the fields of bioethics and animal welfare with the purpose of having the consortium reflect on the subject of ethics in fur production. A first scientific publication, framing the ethical debate around animal use and fur farming in particular, is due to be released in the course of 2015.

- Responding to this first paper the future scope of the Ethical Committee is to analyse the ethics in the European fur farming sector. Considering areas like animal welfare, sustainability, the value of animals and various moral views, the Ethical Committee can point out ethical gaps in fur production. Ultimately the European fur farming sector will introduce an Ethical Charter in order to assure the public that consistent ethical consideration is integrated with European fur production.

- Further analysis of public attitude towards animal use and fur production were undertaken with a second public survey in December 2012 (by independent market research company Ipsos) in Denmark, France, The Netherlands, Poland, Spain and the UK. The outcomes of this survey will be used to further articulate the WelFur implementation plan in member countries.

Future developments

WelFur is a dynamic programme and the welfare assessment protocols for mink and foxes should be considered a first version. We will strive for a 5 year revision cycle, with a view to improving its scientific basis and providing more efficient tests. The revisions will be based on the experiences gained from its implementation process and will include recommendations from external reviewers and ethical experts as well as new research.

Given that WelFur is a farm level certification programme with the objective of demonstrating transparency, Fur Europe will gather and publish annual reports with data from the assessment when the implementation is under way.

Conclusion

The European fur farmers associated with Fur Europe have the same objectives as the general public. The implementation of WelFur, the testing and the controls may well reveal room for some future changes. This is in accordance with the purpose of the programme as Fur Europe recognises the need and the demand for constant improvement. WelFur is scientifically valid and reliable programme that will further develop the welfare of our fur animals, and demonstrate transparency in the European fur farming sector.

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Terms and definitions

Adult: Individual older than 7-8 months. In WelFur terms adult foxes can be present in Periods 1, 2 and 3.

Animal-based measurement: Measurement that is taken directly from the animal.

Assessor: Person collecting data using the WelFur protocol on a farm in order to assess the welfare of foxes.

Cubs: Young foxes from birth to weaning. In WelFur terms cubs are present only in Period 2.

Farm: In this protocol, "farm" is used to designate the animal unit that means the whole or section of a farm that deals with a certain type of animal (*i.e.* foxes).

Farm manager: Person responsible for the farm.

Juvenile: Young fox older than 7-8 weeks and younger than 7-8 months. Consequently, juveniles are found on farms in between the time of weaning and pelting. In WelFur terms, juveniles are present only in Period 3.

Killing method: Techniques that lead to the death of the animal.

Management-based measurement: Measurement that refers to how the farm and the foxes are managed.

Overall assessment of welfare: Synthesis of welfare information, which will then be used to allocate a farm to a welfare category.

Pelting: The humane killing of animals to harvest mature winter pelts. In the northern hemisphere, pelting takes place from November to early January, and defines the end of Period 3.

Resource-based measurement: Measurement that is taken from the environment in which the animals are kept.

Weaning: Mother is removed from her cubs or the cubs are removed from their mother. Usually at 7-8 weeks after the birth of the cubs.

Welfare category: Final categorisation given to a farm that indicates the overall welfare of animals in that particular farm.

Welfare criterion: Represents a specific area of welfare concern that has to be addressed to satisfy good animal welfare.

Welfare measurement: Measurement taken on a farm for assessing a welfare criterion. A welfare measurement may be animal-, resource- or management-based.

Welfare principle: Collection of welfare criteria associated with: feeding, housing, health or behaviour.

Welfare score: Score that indicates the welfare state under a criterion or principle.

WelFur protocol: Description of the measurements that are used to calculate the overall assessment of welfare. The protocol also specifies how the data will be collected.

Photo: © Leena Ahola

1 Scope

This protocol deals with measurements related to the on-farm welfare assessment of foxes. Interpretation of these in terms of fox welfare and their aggregation to produce an overall judgment on the level of welfare on a given farm was performed by experts and calculations deriving from their opinions.

A similar objective of producing on overall score of animal welfare at farm level was dealt with for cattle, pigs and poultry within a European project called Welfare Quality®[1]. In WelFur, even if the general construction procedure is the same as in Welfare Quality®, several characteristics, listed below, have to be taken into consideration in the model construction for farmed fur animals.

Contrary to many other farm animal production systems, the whole production cycle (including breeding, lactation, weaning, growing and finally humane killing for pelting) occurs on the same farm in fur production. As a consequence, it is necessary to take into account, all types of animals (adult males, adult females, cubs and juveniles). In addition, two different species of foxes and their crossbreeds are to be considered: the blue fox (*Vulpes lagopus*) and the silver fox (*Vulpes vulpes*). Consequently, when appropriate, the construction of each criterion needed to be adjusted according to the different animal types so that their differences can be taken into account for the interpretation of the related measurements in terms of welfare.

Moreover, to have an overall view of the whole fur farm, the entire production cycle has to be evaluated. As a consequence, three periods (from pelting to mating / from mating to weaning / from weaning to pelting) were defined and have to be assessed (Figure 1). Depending on the period, the number and types of animals (adult males, adult females, cubs and juveniles) and the resources used differ. This has a direct impact on the time of the visit and on the construction of the criteria. Moreover, at criterion level the data collected in several periods have to be integrated and this requires specific arrangements for the calculation of scores. Consequently, to build a model for the overall assessment of welfare on a fox farm, it is necessary to combine the results from the three periods.

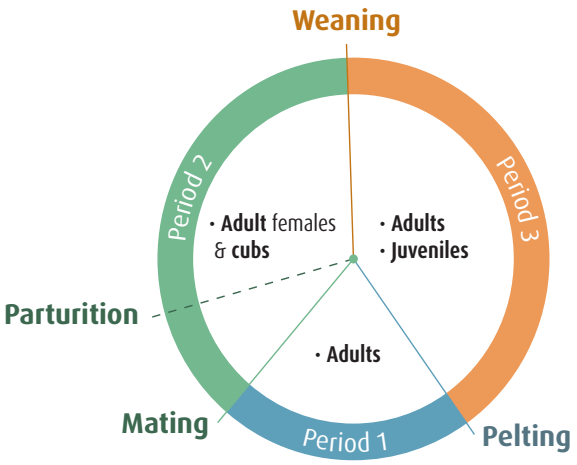


Figure 1 The three periods of the production cycle considered for foxes

Furthermore, the assessment system developed in WelFur should be applicable to all the production systems present in Europe, including variability in regulations (*e.g.* minimum size of cages) and climatic conditions (from Iceland to Greece).

Even if the general procedures presented here might be applicable to other fur animals, such as the Finnraccoon (*Nyctereutes procyonoides ussuriensis*), this protocol cannot be used, before a revision of the procedures for other species than foxes.

1 Welfare Quality® Assessment Protocol for Cattle, 2009, ISBN/EAN 978-90-78240-04-4, 180 pages.
Welfare Quality® Assessment Protocol for Poultry, 2009, ISBN/EAN 978-90-78240-06-8, 119 pages.
Welfare Quality® Assessment Protocol for Pigs, 2009, ISBN/EAN 978-90-78240-05-1, 119 pages.

With regard to the implementation procedure - it is suggested by Fur Europe to not run the whole protocol each year but to follow this proposal: the first year a farm is assessed, three visits on the farm are required (one per period); then, one visit per year is necessary, with a different period being assessed each year (Figure 2).

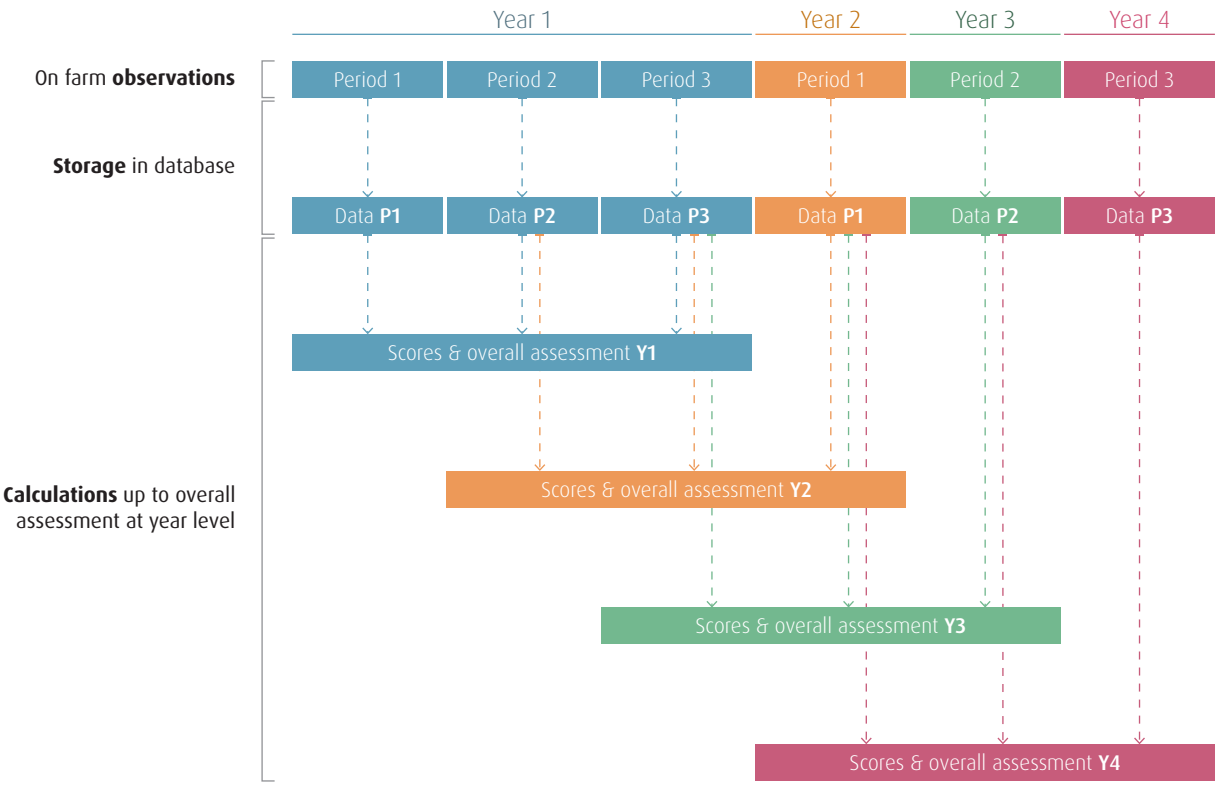


Figure 2 Suggested implementation procedure over several consecutive years

Photo: © Katja Lösönen

2 Background of WelFur protocols

2.1 Overall structure of the WelFur assessment

The objective of the WelFur project was to develop farm-level welfare assessment protocols for the three main fur animal species farmed in Europe (the mink, blue fox and silver fox). As in the Welfare Quality® project, the aim was to build an overall assessment of welfare. Therefore, the results obtained from measurements are synthesised to form such an overall assessment.

The welfare assessment related to a given farm is based on the calculation of welfare scores from the information collected on that farm (Figure 3). An advisor can use the welfare assessment to highlight points requiring the farm manager's attention. The information can also be used to inform consumers about the welfare status of the animals whose fur they buy.

This document contains the protocol for fox. It presents all the measurements relevant for the farm fox and an explanation of what data should be collected and what way.

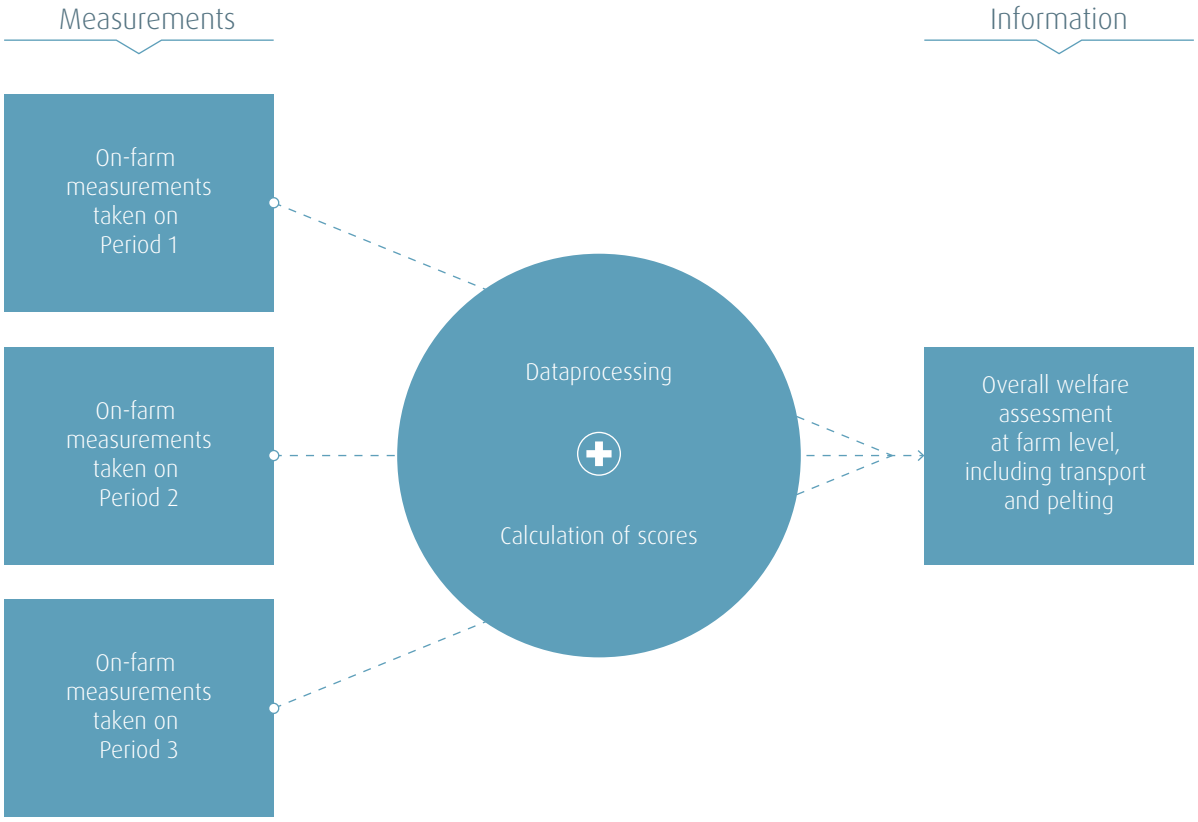


Figure 3 Structure of the WelFur assessment including the different sources of information.

2.2 Basic principles

2.2.1 Defining welfare principles and criteria

The WelFur project used the welfare principles and criteria defined in Welfare Quality® (Table 1).

Table 1 The principles and criteria that are the basis for the Welfare Quality® and WelFur assessment protocols

Welfare principles	**Criterion number**	**Welfare criteria**
Good feeding	1	Absence of prolonged hunger
	2	Absence of prolonged thirst
Good housing	3	Comfort around resting
	4	Thermal comfort
	5	Ease of movement
Good health	6	Absence of injuries
	7	Absence of disease
	8	Absence of pain induced by management procedures
Appropriate behaviour	9	Expression of social behaviours
	10	Expression of other behaviours
	11	Good human-animal relationship
	12	Positive emotional state

The criteria are detailed as follows in the Welfare Quality® protocols:

1. Animals should not suffer from prolonged hunger, *i.e.* they should have a suitable and appropriate diet.
2. Animals should not suffer from prolonged thirst, *i.e.* they should have a sufficient and accessible water supply.
3. Animals should have comfort when they are resting.
4. Animals should have thermal comfort, *i.e.* they should neither be too hot nor too cold.
5. Animals should have enough space to be able to move around freely.
6. Animals should be free of injuries, e.g. skin damage and locomotory disorders.
7. Animals should be free from diseases, *i.e.* farm managers should maintain high standards of hygiene and care.
8. Animals should not suffer from pain induced by inappropriate management, handling, killing or surgical procedures (e.g. castration).
9. Animals should be able to express normal, non-harmful, social behaviours (e.g. grooming).
10. Animals should be able to express other normal behaviours, *i.e.* it should be possible to express species-specific natural behaviours such as observing surroundings.
11. Animals should be handled well in all situations, *i.e.* handlers should promote good human-animal relationships.
12. Negative emotions such as fear, distress, frustration or apathy should be avoided whereas positive emotions such as security or contentment should be promoted.Calculation of scores and consultation process

2.2.2 Calculation of scores and consultation process

As in Welfare Quality®, once all the measurements have been recorded on a farm, a bottom-up approach is followed to produce an overall assessment of animal welfare on that particular farm. First the data collected (*i.e.* the values obtained for the different measurements) on the farm are combined to calculate criterion-scores; then criterion-scores are combined to calculate principle-scores and finally the farm is assigned to one welfare category according to the principle-scores it attained (Figure 4). A mathematical model has been designed to obtain the criteria and principles scores.

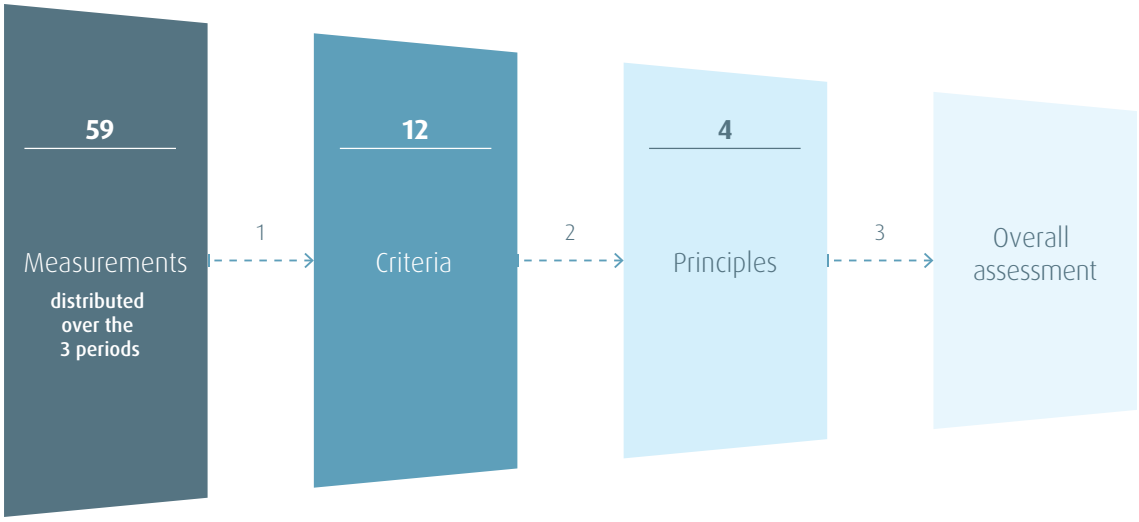


Figure 4 Approach defined in Welfare Quality® and therefore in WelFur, to produce an overall assessment of animal welfare

As in Welfare Quality®, animal scientists, including those who developed the measurements were consulted to define formulae to compute data from measurements into criterion-scores (Step 1 in Figure 4).
In Welfare Quality®, these consultations helped to define principle-scores from criterion-scores and to decide of a procedure to synthesise principle-scores into an overall assessment (Steps 2 and 3 in Figure 4). Therefore, in WelFur, these two steps were extrapolated from Welfare Quality® with no further consultation.

Calculation of criterion-scores

The data produced by the measurements relevant to a given criterion are interpreted and synthesised to produce a criterion-score that reflects the compliance of the farm to this criterion. As in Welfare Quality® assessment protocols, this compliance is expressed on a 0 to 100 value scale, in which:

- '0' corresponds to the worst situation one can find on a farm (*i.e.* the situation below which it is considered there cannot be further decrements in welfare).
- '50' corresponds to a neutral situation, the level of welfare is not too bad but not too good.
- '100' corresponds to the best situation one can find on a farm (*i.e.* the situation above which it is considered there cannot be further improvements in welfare).

As in Welfare Quality®, several methods were used to compute data from measurements into criterion-scores[2]:

- When all measurements used to check a criterion are taken at farm level and are expressed in a limited number of categories or when there are more than 4 possible situations at animal level, a decision-tree is produced. An example is provided in Explanation box 1.

- When a criterion is checked by only one or two measurements taken at individual level expressed on an ordinal scale (less than 4 possible situations), this scale generally represents the severity of a problem and, at farm level, the proportion of animals observed in each possible situation can be calculated (e.g. percentage of foxes= with no moving difficulties, percentage of foxes with some moving difficulties, percentage of foxes with major moving difficulties and percentage of foxes that do not move even when disturbed). In that case, a weighted sum is calculated, with weights increasing with the severity of the problem and a non-linear function is then applied. An example is provided in Explanation box 2.
- When the measurements used to check a criterion lead to data expressed on different scales (e.g. percentage of foxes with bent feet, ocular inflammation, with impaired mouth and teeth health in Period 3 and total mortality taking into account the percentage of humanely killed foxes during the last 12 months), data are compared to alarm and warning thresholds defined by field vets. These thresholds represent the limit between what is a serious problem, a moderate problem and an acceptable situation. Then the number of alarms and warnings is used as the measurement value at farm level. This measurement is then processed in a similar way as in the case described just above. An example is provided in Explanation box 3.

Experts from animal sciences were consulted to interpret the data from farms in terms of welfare. Then experts were asked to score virtual farms. In the situations where weighted sums were to be calculated, this consultation was used to define weights that produce the same ranking of farms as the one given by experts.
Experts do not in general follow linear reasoning, I-spline functions were therefore chosen to produce criterion-score. I-spline functions allow calculation of portions of curves (expressed as cubic functions) so as to obtain a smooth increasing representative curve (see Explanation box 2).

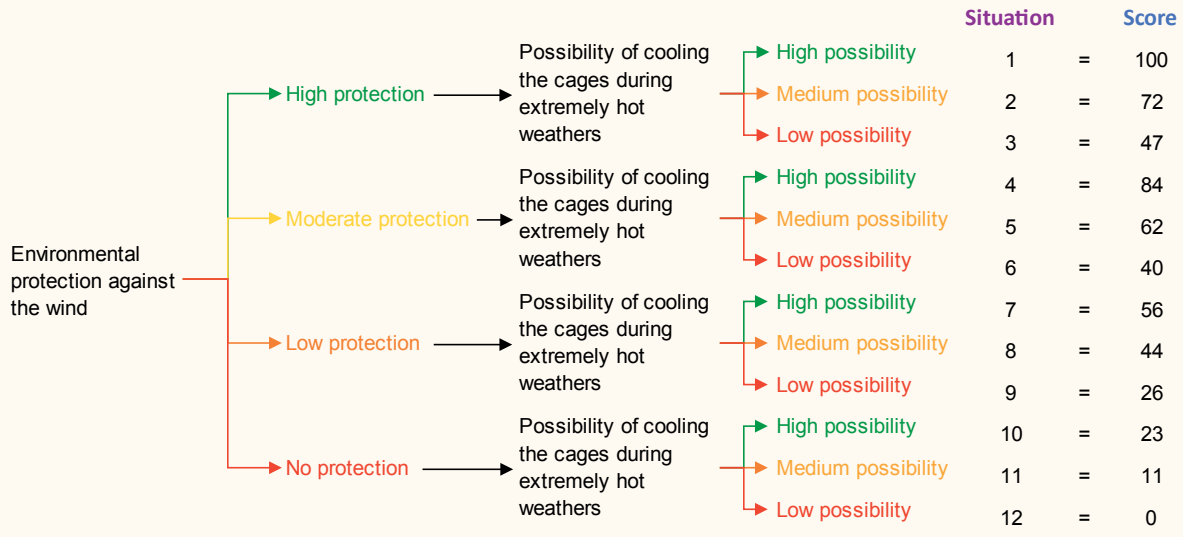
Explanation box 1: Decision-tree as applied to the *Measurement Protection from exceptional weather conditions* in Period 3, as part of the Criterion *Thermal comfort* in foxes.

To assess the Criterion *Thermal comfort* on a fox farm in Period 3, one measurement is considered: *Protection from exceptional weather conditions*. To evaluate this measurement, two questions, based on the protection from wind and the possibility of cooling the cages, are used. Four levels of protection from wind and three levels of Possibilities of cooling the cages are considered at cage level (cf. description of the measurement for more details). This led us to propose the following decision tree defining the twelve possible situations combining the two questions:

In period 3 we have two different questions:

1/ Are the cages in use well protected against the wind?

2/ Are there possibilities of cooling the cages during hot weather?



Situation		Score
1	=	100
2	=	72
3	=	47
4	=	84
5	=	62
6	=	40
7	=	56
8	=	44
9	=	26
10	=	23
11	=	11
12	=	0

Explanation box 2: Weighted sum and I-spline functions as applied to the Measurement *Difficulties in moving* in Period 3, as part of the Criterion *Absence of injuries* in foxes.

The % of foxes with no moving difficulties, some difficulties in moving, major difficulties in moving and the % of foxes that do not move even when disturbed are combined in a weighted sum, with a weight of 0 for no moving difficulties, 5 for some difficulties, 13 for major difficulties and 22 for percentage of foxes that do not move even when disturbed. This sum is then transformed into an index (I) that varies from 0 to 100:

$$I = \left(100 - \frac{0\,(\%\text{ no difficulties}) + 5\,(\%\text{ some difficulties}) + 13\,(\%\text{ major difficulties}) + 22\,(\%\text{ do not move})}{22}\right)$$

This index is then transformed and computed into a score using I-spline functions:

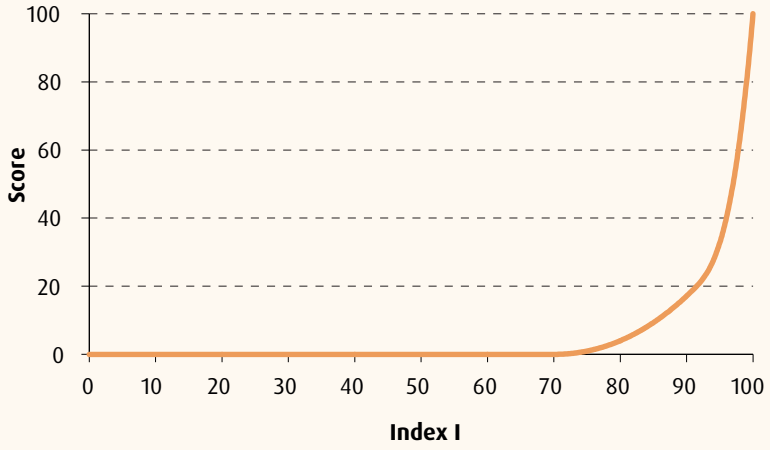
$$J = \frac{I - 70}{100 - 70} \times 100 \text{ if I} \geq 70, \text{ else } J = 0$$

When I ≤ 70

then Score = $(0.000000000002843879699944 9 \times J) + (0.00336885065242255874254 36 \times J^2) + (0.000007312215412839079791 0 \times J^3)$

When I ≥ 70

then Score = $-749.50932392987510866078082 47 + (32.12182833642389567785357 94 \times J) + (-0.45551441335682646416316 29 \times J^2) + (0.00219247062381097050989 82 \times J^3)$



Explanation box 3: Use of alarm and warning thresholds applied to the Criterion *Absence of disease in foxes*:

- during the farm visit: % of foxes with severely bent feet, % of foxes with clear ocular inflammation, % of foxes with impaired mouth and/or teeth health, % of foxes with clear evidence of diarrhoea, % of foxes with clear evidence of reddish/brownish urine, % of obviously sick foxes ;
- from farm records: % of foxes older than 8 weeks recorded dead within the last 12 months, taking into account humanely killed foxes by considering three categories related to the proportion of humanely killed animals out of the total mortality: Mortality when < 25% due to humane killing/Mortality when 25% ≤ mortality < 50% due to humane killing/Mortality when ≥ 50% due to humane killing.

The incidence of each disorder is compared to an alarm and to a warning threshold. The alarm threshold is defined as the incidence above which a health plan is required at farm level. The warning threshold is defined as half the alarm threshold. The number of alarms and warnings detected on a farm are calculated. They are used to calculate a weighted sum finally transformed into a score using *I*-spline functions (as in the example shown in Explanation box 2).

Incidence of each disorder	Alarm threshold
% of foxes with severely bent feet	15.0%
% of foxes with clear ocular inflammation	7.5%
% of foxes with impaired mouth and/or teeth health	3.0%
% of foxes with clear evidence of diarrhoea	15.0%
% of foxes with clear evidence of reddish/brownish urine	2.0%
% of obviously sick foxes	0.5%
% of foxes older than 8 weeks recorded dead within the last 12 months, *taking into account humanely killed animals:*	
Mortality when < 25% due to humane killing	2.75%
Mortality when 25% ≤ mortality < 50% due to humane killing	4.25%
Mortality when ≥ 50% due to humane killing	7.5%

When a criterion was composed of very different measurements which experts found difficult to consider together and/or when a given measurement is assessed at several periods of the production cycle and/or on several animal types (*e.g.* adults *vs.* juveniles), measurement periods or animal types were aggregated using Choquet integrals (see Explanation box 4).

Explanation box 4: Use of the Choquet integral to aggregate sub-scores

Each time sub-scores are to be aggregated (*i.e.* when a measurement is observed during several periods or when several measurements are interpreted independently and need therefore be aggregated to obtain a score at criterion level), we use the Choquet integral. In this explanation box, we will use the Measurement *Body condition score* of the Criterion *Absence of prolonged hunger* as an illustrative example. In that example the three period sub-scores are to be aggregated. The Choquet integral allows fine control of the importance attached to periods in the aggregation but also of the impact of low and high sub-scores on the aggregated one.

Formally, the Choquet integral to aggregate n elements (corresponding here to the sub-scores, noted S_i) writes:

$$C(S_1,\ldots,S_n)=\sum_{i=1}^{n}\left[S_{(i)}-S_{(i-1)}\right]\times\mu\left(A_{(i)}\right)$$

with the convention $S_{(0)}=0\le S_{(1)}\le S_{(2)}\le\ldots\le S_{(n)}$ $\mathbf{X}_{(0)}=0\le\mathbf{X}_{(1)}\le\mathbf{X}_{(2)}\le\ldots\le\mathbf{X}_{(n)}$ (*i.e.* the brackets indicate a reordering of the elements, in that example the three periods, depending on the score they obtained, from the lowest to the highest) and $A_{(i)}=\{(i),\ldots,(n)\}$, $A_{(n+1)}=\varnothing$.

μ is a capacity function defined for any subset of periods entering in the composition of the measure-score at year

level. This capacity is a set function subject to the following constraints: $\mu(\varnothing)=0$, $\mu(\{1,\ldots,n\})=1$ and $A\subseteq B\Rightarrow\mu(A)\leq\mu(B)$.

To be somewhat more operational, here are the explanations on how to calculate the score for our example. The scores obtained by a farm for the 3 periods are sorted in increasing order. The difference between the lowest sub-score and the next sub-score is multiplied by the 'capacity' of the group comprising all periods except the one that has the lowest score. Then, the difference between the last but one sub-score and the next sub-score is multiplied by the 'capacity' of the group comprising all periods except the two that have the lowest sub-scores (here, since that there are only 3 elements to be aggregated, it is the capacity of the period that has the highest sub-score). Finally, the measure-score therefore corresponds to the sum of these three terms. This can be written as follows:

$$\text{Measure-score}=\begin{cases}S_1+(S_2-S_1)\mu_{23}+(S_3-S_2)\mu_3 & \text{if} \quad S_1\leq S_2\leq S_3\\ S_1+(S_3-S_1)\mu_{23}+(S_2-S_3)\mu_2 & \text{if} \quad S_1\leq S_3\leq S_2\\ S_2+(S_1-S_2)\mu_{13}+(S_3-S_1)\mu_3 & \text{if} \quad S_2\leq S_1\leq S_3\\ S_2+(S_3-S_2)\mu_{13}+(S_1-S_3)\mu_1 & \text{if} \quad S_2\leq S_3\leq S_1\\ S_3+(S_1-S_3)\mu_{12}+(S_2-S_1)\mu_2 & \text{if} \quad S_3\leq S_1\leq S_2\\ S_3+(S_2-S_3)\mu_{12}+(S_1-S_2)\mu_1 & \text{if} \quad S_3\leq S_2\leq S_1\end{cases}$$

Where S_1, S_2 and S_3 are the sub-scores assigned to the Measurement *Body condition score* in Periods 1, 2 and 3 respectively.
μ_1, μ_2 and μ_3 are the capacities of Periods 1, 2 and 3 respectively.
μ_{12} is the capacity of the group made of Periods 1 and 2 and so on...

The parameters of the Choquet integral used to calculate the Criterion *Absence of prolonged hunger*-score are:

μ_1	=	0.13	μ_{12}	=	0.14
μ_2	=	0.14	μ_{13}	=	0.49
μ_3	=	0.40	μ_{23}	=	0.46

with 1 = Period 1, 2 = Period 2 and 3 = Period 3.

Thus, with the μ listed above:

$$\text{Absence of prolonged hunger-score}=\begin{cases}S_1+0.46(S_2-S_1)+0.40(S_3-S_2) & \text{if} \quad S_1\leq S_2\leq S_3\\ S_1+0.46(S_3-S_1)+0.14(S_2-S_3) & \text{if} \quad S_1\leq S_3\leq S_2\\ S_2+0.49(S_1-S_2)+0.40(S_3-S_1) & \text{if} \quad S_2\leq S_1\leq S_3\\ S_2+0.49(S_3-S_2)+0.13(S_1-S_3) & \text{if} \quad S_2\leq S_3\leq S_1\\ S_3+0.14(S_1-S_3)+0.14(S_2-S_1) & \text{if} \quad S_3\leq S_1\leq S_2\\ S_3+0.14(S_2-S_3)+0.13(S_1-S_2) & \text{if} \quad S_3\leq S_2\leq S_1\end{cases}$$

The importance of each period is given by the so called Shapley value, which brings for this example:

Period 1 $\Phi(1)=\frac{1}{3}\times(1+\mu_1-\mu_{23})+\frac{1}{6}\times(\mu_{12}-\mu_2+\mu_{13}-\mu_3)=0.24$

Period 2 $\Phi(2)=\frac{1}{3}\times(1+\mu_2-\mu_{13})+\frac{1}{6}\times(\mu_{12}-\mu_1+\mu_{23}-\mu_3)=0.23$

Period 3 $\Phi(3) = \frac{1}{3} \times (1 + \mu_3 - \mu_{12}) + \frac{1}{6} \times (\mu_{13} - \mu_1 + \mu_{23} - \mu_2) = 0.53$

The calculations are derived from the following general formula of the Shapley Value:

$$\Phi(i) = \sum_{A \subseteq N \setminus \{i\}} \frac{(n-a-1)!\,a!}{n!} \times [\mu(A \cup \{i\}) - \mu(A)]$$

The interactions between the scores are given by the interaction indices, higher the index is, more limited are the compensations (*i.e.* one low score is sufficient for the farm to be low):

$I12 = \frac{1}{2} \times (1 - \mu_{13} - \mu_{23} + \mu_3) + \frac{1}{2} \times (\mu_{12} - \mu_1 - \mu_2) = 0.16$

$I13 = \frac{1}{2} \times (1 - \mu_{12} - \mu_{23} + \mu_2) + \frac{1}{2} \times (\mu_{13} - \mu_1 - \mu_3) = 0.25$

$I23 = 1 - \mu_{12} - \mu_{13} - \mu_{23} + \mu_1 + \mu_2 + \mu_3 = 0.21$

$I123 = 1 - \mu_{12} - \mu_{13} - \mu_{23} + \mu_1 + \mu_2 + \mu_3 = 0.58$

The calculations are derived from the following general formula of the Interaction Index:

$$I_{ij} = \sum_{A \subseteq N \setminus \{i,j\}} \frac{(n-a-2)!\,a!}{(n-1)!} \times [\mu(A \cup \{ij\}) - \mu(A \cup \{i\}) - \mu(A \cup \{j\}) + \mu(A)]$$

Calculation of principle-scores from criterion-scores

In WelFur project, we averaged the parameters set in Welfare Quality® for the various species (cattle, pigs and poultry) to determine the parameters to be used for fur animals.

Assignment of farms to the welfare categories

We transposed the rules used in Welfare Quality® to produce an overall welfare assessment of farms.
However, contrary to Welfare Quality®, the names of the classes have been changed because we believe that an animal production can never be excellent and that the key reference point is the best current practice according to the experts.
Briefly, a farm is classified in one welfare category according to its principle-scores (Figure 5):

- A farm is considered to correspond to **'Best current practice'** if it scores more than 55 on all principles and more than 80 on two of them.
- A farm is considered to correspond to '**Good current practice**' if it scores more than 20 on all principles and more than 55 on two of them.
- A farm is considered to correspond to '**Acceptable current practice**' if it scores more than 20 on three principles and more than 10 on the remaining principle.
- Other farms are considered to correspond to '**Unacceptable current practice**'.

In addition, an indifference threshold equal to 5 is applied: For instance, a score of 50 is not considered to be significantly different from one of 55.
Note: The rules to assign a farm to a given welfare category may be subject to modifications once a sufficient number of commercial farms have been inspected.

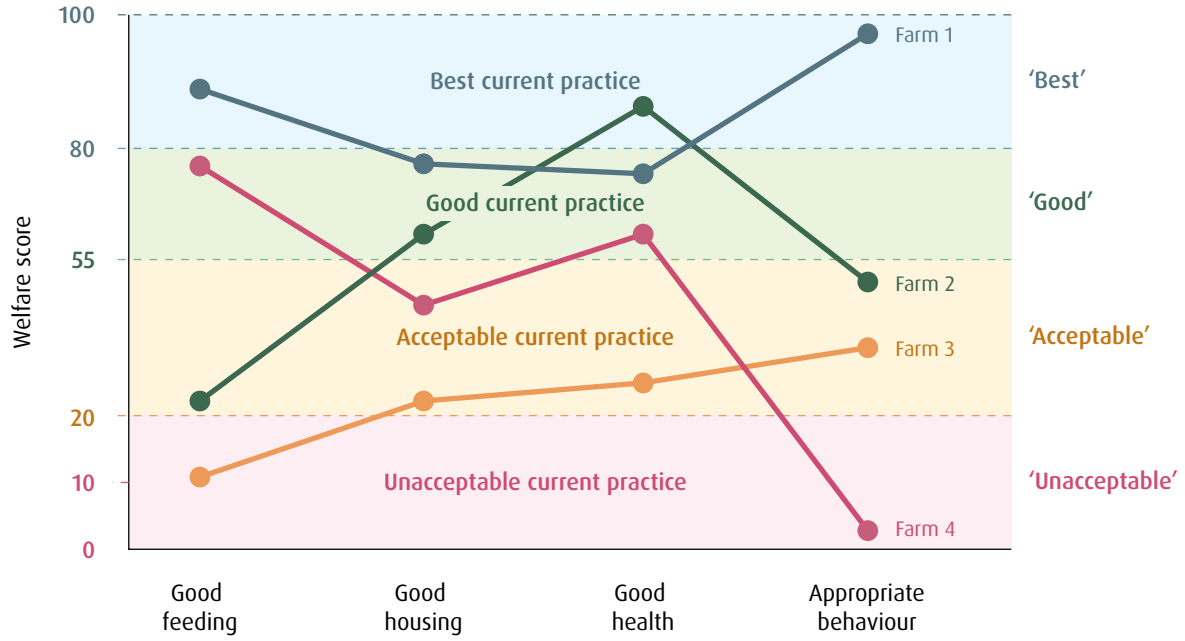


Figure 5 Examples of farms in the four welfare categories

Final comments

In this protocol the reader will find all the necessary information to understand what is made in WelFur to produce an overall welfare assessment of foxes at farm level. However, for the data collection, specific training is required to ensure the relevance and the reliability of the observations. The development of the training material for the assessors started in parallel with the development of the protocol, training material (e.g. videos, pictures, farm visit, etc.) will be consolidated.

A software package has been developed to calculate welfare scores and to produce the overall assessment of farms. For more information, contact the partners of the WelFur project, represented by the Fur Europe office.

The following chapters are specific to the two fox species. They are structured to present firstly the measurements collected on farms and the sampling strategy to be adopted and secondly the calculation of scores needed for the overall assessment.

Photo: © Paula Martiskainen

3 Welfare assessment protocol for foxes

The assessment of welfare should be a multi-disciplinary process since only the assessment of a variety of different parameters can provide a comprehensive assessment of an animal's welfare in any given system. To this end, the WelFur project utilizes physiological, health and behavioural aspects as well as the more traditional input based aspects of housing and management, to assess the welfare of foxes on farms.

In this chapter, a description of each measurement for foxes is given, followed by additional information about the sampling strategy to be adopted and the order in which the different measurements should be carried out during a farm visit.

Before commencing farm visits, assessors need to be fully trained in all the measurements that are to be assessed, by using photographs, video clips and practical 'on-farm' training. For some of the health measurements, this training will involve recognition of certain conditions/diseases; however, it is imperative that this document is not used as a diagnostic tool to identify individual health conditions but rather as a tool to highlight the presence of health problems affecting the welfare of animals. The assessor should not enter into discussions with the farm manager on the prevalence or severity of different diseases on the farm; this is a matter for the farm manager and the herd veterinarian. Additionally, in general, the role of the assessor is to assess and not to advise directly. The farm manager should, however, be advised if serious health problems are observed.

Trained assessors will use animal-based, management-based and resource-based measurements to achieve a representative assessment of foxes' welfare of each farm. In this chapter, the same protocol describes the three periods of the production cycle considered for foxes. However, how each measurement applies to each period is specified in the data collection descriptions while section 3.2.5 *Guidelines for a visit to a farm* and Annex A *Recording sheets for foxes* will have a set of descriptions for each period. Moreover, for the on-farm assessment, it is impossible to evaluate all the animals present on the farm according to the time needed to assess all the measurements. Therefore, stratified samples of foxes are defined at the beginning of the farm visit in order to have a representative number of the different types of animals and species for all measurements.

The majority of the measurements are scored according to either a two-point scale (0/1) or a three-point scale (0/1/2). The assessment scale has been selected so that, as a general rule, score 0 is awarded where welfare is good and a score 1 (and 2 or 3 in case of three and four-point scales) is awarded where welfare is poor or unacceptable. In some cases, a cardinal scale (e.g. cm or m^2) is used.

3.1 An introduction to fox production

3.1.1 The origin of the farmed foxes

Two fox species, the blue fox (*Vulpes lagopus*, formerly *Alopex lagopus*) and the silver fox (*Vulpes vulpes*) and their crossbreeds are farmed for their fur. The blue fox type foxes originate from different colour types of the arctic fox which live in arctic circumpolar areas. The term silver fox refers to several different colour variants that originate from the red fox.

In the wild, arctic foxes live mainly solitary outside the breeding season, whereas red foxes may live solitary or in small family groups throughout the year. Both fox species breed in spring or early summer. The cubs are nursed by the female in a den, which is typically a complex underground structure. Also the male may make some effort to care for and feed the cubs. Juvenile foxes will disperse within the first year of life, though some may remain or return later to the natal area.

In the wild, both fox species eat small mammals, birds, eggs, amphibians and carrion, and they also use some vegetable food sources like berries and seeds. In urban areas both fox species may visit garbage. The diet varies according to the season and availability of various food sources.

3.1.2 Fox farming and the annual cycle of production

Fox farming was first started in Canada in the late 19th century. The first European fox farms were established in the 1910s. The current fox population on today's fox farms originates from those foxes captured for farming approximately 100 years ago and foxes have been domesticated to farming conditions thereafter. In 2014, the worldwide production of fox pelts was 7,3 million, out of which 30 % was produced in Europe.

Under production conditions, European farmed foxes are generally housed in wire mesh cages in outdoor sheds or in unheated barns under natural light conditions. European recommendations as well as national legislations lay the minimum requirements for housing conditions of farmed foxes. These documents stipulate minimum cage dimensions, guidelines for enrichment, as well as other requirements for the care and handling of foxes.

Fox production is characterised by a strict annual cycle. The annual production cycle of a fox farm starts in February-April with the breeding season. At that time, the adult breeding males and females are housed singly. According to current farming practices, the majority of the females are artificially inseminated and natural mating is used less often. The gestation lasts for 52-54 days, thus the cubs are born in April-June. Typically a week or two weeks before expected whelping, the females are provided with a nest box where they are allowed unrestrictive delivery and nursing of the cubs. The cubs weighing 60-110g are born with only poor thermoregulation and without the ability to see or hear. The cubs start to move outside the nest box approximately at the age of four weeks and at that time they also start to eat some solid food. Lactation starts to cease at the cubs' age of five or six weeks. Females nurse their cubs for around eight weeks after which the cubs are separated from their mother, *i.e.* weaned. After weaning of the cubs, the females are once again housed singly whereas the litters are split up and the juvenile foxes are housed in pairs or small groups throughout their growing period, *i.e.* autumn. After maturation of the winter coat, in late autumn-early winter, all foxes, but those selected as breeding animals, are pelted. Consequently, after pelting time, only old breeding animals and younger, future breeding animals are present on the farm. Crossbreed foxes are sterile and therefore, they are not kept as breeding animals.

The foxes are fed once or twice a day with feed consisting mainly on slaughterhouse offal, fish and cereals. Water is provided through an automatic watering system or manually once or twice a day.

The housing conditions allow for efficient daily inspection of health and behaviour of farmed foxes. They are left intact, *i.e.* they are not subjected to physical mutilations of the body or surgical procedures (no identification marking, castration or other management procedures are used) at any stage of their life.

The foxes typically live their entire life on one farm, the one where they were born, *i.e.* they are not systematically transported at any stage of their life. The foxes are also humanely killed on the natal farm at pelting time.

3.1.3 Building the WelFur assessment protocol for foxes

This protocol has been built for the assessment of the welfare of foxes on a farm to be assessed by doing three one-day visits of 6-7 hours each:

- In the winter between the pelting and breeding seasons when there are only breeding males and females on the farm.
- In the spring or summer before weaning when the breeding females nurse their cubs
- In the autumn when there are breeding males and females and juveniles on the farm.

WelFur is built on the available scientific literature and the knowledge within the project group on behaviour, health, management and housing conditions of the farmed foxes. The welfare assessment protocol evaluates the actual welfare of the foxes and not primarily the compliance with legislation. This is partly because there is not necessarily a relationship between the scientific knowledge and

legislation and partly because the actual legislation differs between European countries, although the legal framework for fox production is based on the Council of Europe recommendations.

By reviewing the literature over 200 potential welfare measurements for foxes were identified. Each measurement was evaluated according to:

- Validity: does the measurement reflect some aspect of the actual welfare of the fox relative to the criteria
- Reliability: acceptable inter- and intra-observer reliability and robustness to external factors (e.g. time of day or weather conditions)
- Feasibility: is the measurement possible and practical to apply in practice on a fox farm with reasonable effort and costs

The review for each of the 12 assessment criteria led to an assessment of the validity, reliability and feasibility of the measurements based on a three point scale:

0. High certainty: Solid and complete data available; strong evidence in multiple references with most authors coming to the same conclusion
1. Medium certainty: Some or only incomplete data available; evidence provided in a small number of references; authors' conclusions vary from one to the other; solid and complete data available from other species which can be extrapolated to the species considered
2. Low certainty: Scarce or no data available; evidence provided in unpublished reports or based on personal observations or communications; authors' conclusions vary considerably between the reports

A total of 23 welfare measurements passed this evaluation and are included in the protocol. Consequently, the majority of the recognised measurements were excluded due to lack of scientific knowledge of validity or reliability or due to lack of feasibility. However, on-going scientific research may refine measurements so that the validity and feasibility of new measurements will be high enough for inclusion in the protocol at a later stage.

Another aspect of the WelFur protocol is that it should be applicable in all European countries. Unforeseen situations may appear during application and therefore it is planned that the WelFur protocol will be updated in a 5 year revision cycle in the light of new scientific knowledge as well as a result of the practical experience gained while implementing the WelFur scheme.

3.2 Collection of data for foxes

Categorisation of the foxes:

The instructions on collection of data presented here apply to all colour types of the two farmed fox species, the blue fox (*Vulpes lagopus*) and the silver fox (*Vulpes vulpes*) and their crossbreeds.

Definitions of the periods:

Period 1: Breeding males and females before the breeding season, in winter. Data collection from January 1st to February 28th, after pelting time but before the onset of the breeding season
Period 2: Breeding females during the breeding season, in summer. Data collection from May 1st to July 31st, when the majority of the cubs on the farm are 4-8 weeks old
Period 3: Adult breeding males, and females and juveniles during the growing season, in autumn. Data collection from October 1st to November 30th, before pelting time

3.2.1 Good feeding

3.2.1.1 Absence of prolonged hunger

Title	**Body condition score (BCS)**
Scope	Animal-based measurement: Periods 1, 2 and 3
Sample size	Sample B (80-100 foxes: see 3.2.6 *Sampling and practical information* for details)
Method description	The animal is observed but must not be touched. View the animal from all sides of its body. Pay attention to the flank, abdominal area and face. The animal is scored with regard to its body condition (see photographic illustration). **Body condition scores:** Applied from scoring system by Kempe et al. (2009). **1 = Very thin**: General appearance of the animal is pinched and bony. Ribs, shoulder and pelvic bones are easily visible. Abdomen is tucked up when viewed from the side. **2 = Thin**: General appearance of the animal is slim. Ribs, shoulder and pelvic bones are visible under a thin fat layer. Abdomen is tucked up when viewed from the side. **3 = Ideal**: General appearance of the animal is balanced and normal. Ribs, shoulder and pelvic bones could be felt through a distinctive fat layer. Straight abdominal line. **4 = Heavy**: General appearance of the animal is fat. Heavy fat cover in the shoulder and pelvic areas. Waist and abdominal area distended because of fat pad. **5 = Extremely fat**: General appearance of the animal is extremely fat, massive and round. Massive fat deposits over ribs, shoulders and pelvic area. Noticeable abdominal distension. Fat deposits in face and limbs. This BCS scale is simplified to obtain three WelFur scores at individual level: **0** - The body condition of the animal is balanced **1** - The animal is very lean **2** - The animal is extremely fat The description of these three WelFur scores differ between the periods, both in terms of definition and types of animals concerned:

	Individual level: **In Period 1:** 0 - BCS 3 or 4; 1 - BCS 1 or 2; 2 - BCS 5. **In Period 2:** 0 - BCS 2, 3 or 4; 1 - BCS 1; 2 - BCS 5. **In Period 3:** 0 - BCS 3 or 4; 1 - BCS 1 or 2; 2 - BCS 5.
Classification	**Farm level:** Percentage of very lean animals (Score 1)
Additional information	Information concerning the percentage of extremely fat animals (Score 2) is collected for advisory purposes.

BCS 1
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BCS 1
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BCS 1
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BCS 2
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BCS 2
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BCS 2
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BCS 3
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BCS 3
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BCS 4
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BCS 5
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3.2.1.2 Absence of prolonged thirst

Four sub-measurements are taken at cage level and combined to the Measurement *Continuous water availability* to assess the Criterion of *Absence of prolonged thirst*. Each sub-measurement leads to a classification at cage level. The classification at farm level results from the combination of these four sub-measurements.

Subtitle	**Type of watering system**
Scope	Resource- and management-based measurement: Periods 1, 2 and 3
Sample size	Farm, confirmed with Sample B (80-100 foxes: see 3.2.6 *Sampling and practical information* for details)

Method description	Consult the farm manager whether the animals are provided with potable water through an automatic watering system or manually. If water is provided manually, ask how many times a day water is provided. During all periods, only water supply systems in use are taken into account. If various watering systems are used on the farm, check the watering systems according to Sample B. **Cage level:** **The type of watering system:** **0** – Watering system with automatic water flow throughout the year. The system does not freeze in sub-zero temperatures. **1** – Watering system with automatic water flow. The system freezes, tends to freeze or is not working in subzero temperatures. When the system is not working, then water is supplied manually. **2** – No automatic watering system. Water is provided manually throughout the year. **NB:** in Period 2, since the climatic conditions prevent watering system from freezing, all automatic systems are scored 0. **Then, if 1 (not working system) or 2**: Frequency of water provision: **0 –** Water is provided manually at least twice a day. **1** – Water is provided manually once a day. **2 –** Water is provided manually less than once a day.
Classification	**Cage level**: Seven possible situations result from the combination of watering system and watering frequency: **0 –** 0 **1 –** 1 then 0 **2 –** 1 then 1 **3 –** 1 then 2 **4 –** 2 then 0 **5 –** 2 then 1 **6 –** 2 then 2

Subtitle	**Protection against overheating of drinking water**
Scope	Resource- and management-based measurement: Periods 2 and 3
Sample size	Farm, confirmed with Sample B (80-100 foxes: see 3.2.6 *Sampling and practical information* for details)
Method description	Consult the farm manager to identify whether solutions against overheating of the drinking water are used on the farm in extremely hot weather. For preventing overheating, the farm manager can run water in the water pipes or the pipes can be insulated. During all periods, only water supply systems in use are taken into account. If various watering systems are used on the farm, check the cages for protection against overheating of drinking water according to Sample B. **NB1:** The measurement is not considered in Period 1, since the climatic conditions prevent watering systems from overheating.

	NB2: The measurement is not considered if manual water supply is in use. **Cage level:** **0** – Watering system is protected against overheating. **1 –** Watering system is not protected against overheating.
Classification	**Cage level**: Each cage is scored either 0 or 1.

Subtitle	**Functioning of the water points**
Scope	Resource and management-based measurement: Periods 1, 2 and 3
Sample size	Sample B (80-100 foxes: see 3.2.6 *Sampling and practical information* for details)
Method description	Check the functioning of the water points (cups/nipples). Choose the water points to be assessed from separate sheds and as a representative sample from different water supply systems used on the farm. During all periods, only cups/nipples in use are considered. **NB1:** The measurement is not considered if manual water supply is in use. **NB2:** In Period 1, if the automatic watering system is frozen (*i.e.* Score 1 in the Sub-measurement *Type of watering system*), functioning of the watering system is not considered. **Cage level:** **0** – The water point works properly. **1 –** The water point does not work properly.
Classification	**Cage level:** Each cage is scored either 0 or 1.

Subtitle	**Cleanliness of the water points**
Scope	Resource- and management-based measurement: Periods 1, 2 and 3
Sample size	Sample B (80-100 foxes: see 3.2.6 *Sampling and practical information* for details)
Method description	Check the cleanliness of the water points (cups/nipples). A water point is considered to be dirty if there is organic matter (e.g. algae, feed and/or faeces) in/on it. Choose the water points to be assessed from separate sheds and as a representative sample from different water supply systems used on the farm. During all periods, only cups/nipples in use are considered. **Cage level:** **0** – The water point is clean. **1 –** The water point is dirty.
Classification	**Cage level:** Each cage is scored either 0 or 1.

Score 0
Photos: © H. Huuki UEF

Score 1
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Score 1
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Title	**Continuous water availability**

Classification

Farm level: Percentage of animals in each of the situations resulting from the combination of the four sub-measurements described above: *Type of watering system*, *Protection against overheating of drinking water*, *Functioning of the water points* and *Cleanliness of the water points*. The number of situations differs from one period to another:

Period 1: 16 different situations are relevant

	Continuous	**Overheating**	**Functioning**	**Cleanliness**	**% of animals**
Situation 1	0		0	0	*P1*
Situation 2	0		0	1	*P2*
Situation 3	0		1	0	*P3*
Situation 4	0		1	1	*P4*
Situation 5	1			0	*P5*
Situation 6	1			1	*P6*
Situation 7	2			0	*P7*
Situation 8	2			1	*P8*
Situation 9	3			0	*P9*
Situation 10	3			1	*P10*
Situation 11	4			0	*P11*
Situation 12	4			1	*P12*
Situation 13	5			0	*P13*
Situation 14	5			1	*P14*
Situation 15	6			0	*P15*
Situation 16	6			1	*P16*

Period 2: 14 different situations are relevant

	Continuous	**Overheating**	**Functioning**	**Cleanliness**	**% of animals**
Situation 1	0	0	0	0	*P1*
Situation 2	0	0	0	1	*P2*
Situation 3	0	0	1	0	*P3*
Situation 4	0	0	1	1	*P4*
Situation 5	0	1	0	0	*P5*
Situation 6	0	1	0	1	*P6*
Situation 7	0	1	1	0	*P7*

Situation 8	0	1	1	1	*P8*
Situation 9	4			0	*P9*
Situation 10	4			1	*P10*
Situation 11	5			0	*P11*
Situation 12	5			1	*P12*
Situation 13	6			0	*P13*
Situation 14	6			1	*P14*

Period 3: 38 different situations are relevant

Period 2	Continuous	Overheating	Functioning	Cleanliness	% of animals
Situation 1	0	0	0	0	*P1*
Situation 2	0	0	0	1	*P2*
Situation 3	0	0	1	0	*P3*
Situation 4	0	0	1	1	*P4*
Situation 5	0	1	0	0	*P6*
Situation 6	0	1	0	1	*P6*
Situation 7	0	1	1	0	*P7*
Situation 8	0	1	1	1	*P8*
Situation 9	1	0	0	0	*P9*
Situation 10	1	0	0	1	*P10*
Situation 11	1	0	1	0	*P11*
Situation 12	1	0	1	1	*P12*
Situation 13	1	1	0	0	*P13*
Situation 14	1	1	0	1	*P14*
Situation 15	1	1	1	0	*P15*
Situation 16	1	1	1	1	*P16*
Situation 17	2	0	0	0	*P17*
Situation 18	2	0	0	1	*P18*
Situation 19	2	0	1	0	*P19*
Situation 20	2	0	1	1	*P20*
Situation 21	2	1	0	0	*P21*
Situation 22	2	1	0	1	*P22*

Situation 23	2	1	1	0	*P23*
Situation 24	2	1	1	1	*P24*
Situation 25	3	0	0	0	*P25*
Situation 26	3	0	0	1	*P26*
Situation 27	3	0	1	0	*P27*
Situation 28	3	0	1	1	*P28*
Situation 29	3	1	0	0	*P29*
Situation 30	3	1	0	1	*P30*
Situation 31	3	1	1	0	*P31*
Situation 32	3	1	1	1	*P32*
Situation 33	4			0	*P33*
Situation 34	4			1	*P34*
Situation 35	5			0	*P35*
Situation 36	5			1	*P36*
Situation 37	6			0	*P37*
Situation 38	6			1	*P38*

3.2.2 Good housing

3.2.2.1 Comfort around resting

Title	**Cleanliness of the fur**
Scope	Animal-based measurement: Periods 1, 2 and 3
Sample size	Sample B (80-100 foxes: see 3.2.6 *Sampling and practical information* for details)
Method description	The animal is observed but must not be touched. View the animal from all sides of its body. Pay attention to the abdominal area and rear parts of the animal. The animal is scored with regard to the cleanliness of its fur (see photographic illustration): **Individual level:** **0 – Clean**: The fur of the animal is clean. No urine, faeces or feed stains are observable in any part of the animal. **1 – Slightly dirty**: The fur of the animal is dirty in some parts of the body. **2 – Clearly dirty**: The fur of the animal is entirely dirty, wet and/or tangled.
Classification	**Farm level:** Percentage of clearly dirty animals (Score 2)
Additional information	Information concerning the percentage of slightly dirty animals (Score 1) is collected for advisory purposes.

Score 0
Photos: © T. Koistinen UEF

Score 1
© T. Koistinen UEF

Score 1
© L. Ahola UEF

Score 1
Photos: © T. Koistinen UEF

Score 2
© T. Koistinen UEF

Score 2
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Title	**Availability of a platform**
Scope	Resource-based measurement: Periods 1, 2 and 3
Sample size	Sample B (80 to 100 foxes: see 3.2.6 *Sampling and practical information* for details)
Method description	Check the cage for the availability of a platform. The roof of a nest box can be considered as a platform if the fox can rest on its roof. The animal/s in the cage is/are considered to have access to the platform if the platform is unbroken and usable and the minimum distance from the platform (or from the roof of a year-round nest box) to the ceiling of the cage is at least 20 cm. The platform has, however, to be mounted sufficiently high up that the animal/s is/are able to move and lie under the platform. Measure the distance from the platform (or from the roof of the year-round nest box) to the ceiling of the cage. The cage is scored with regard to the availability of an accessible platform. **Cage level:** **0 –** There is a usable platform in the cage. **1 –** There is no usable platform in the cage.
Classification	**Farm level:** Percentage of animals without a usable platform (Score 1)
Additional information	Information concerning the distance from the platform to the cage ceiling is collected also for advisory purposes.

3.2.2.2 Thermal comfort

Title	**Protection from exceptional weather conditions**
Scope	Management- and resource-based measurement: Periods 1, 2 and 3
Sample size	Sample B (80-100 foxes: see 3.2.6 *Sampling and practical information* for details) and the farm

Method description	Check the farm and cages for environmental and inbuilt protection against wind and extremely hot weather. Consult the farm manager to identify whether sprinkling of the animals or roofs of the sheds is used during ambient temperatures above 30 °C. The cage is scored with regard to protection from wind (Periods 1 and 3) and possibility of cooling the cages during extremely hot weather (Periods 2 and 3). **Cage level**: **Protection from wind (Periods 1 and 3):** **0 –** The animals are housed in solid walled barns or there is a stand of trees or bushes, hills, solid fences or buildings in the immediate vicinity of the outdoor cage, protecting the animal/s from the wind. There is a wind shield in the outer half of the outdoor cage. **1 –** The animals are housed in outdoor sheds and there is a stand of trees or bushes, hills, solid fences or buildings in the immediate vicinity of the cage protecting the animal/s from the wind, but there is no wind shield in the cage. **2 –** The animals are housed in outdoor sheds and the surroundings of the cage are bare, with no trees, bushes, hills, solid fences or buildings in the immediate vicinity of the cage but there is a wind shield in the outer half of the cage. **3 –** The animals are housed in outdoor sheds and the surroundings of the cage are bare, with no trees, bushes, hills, solid fences or buildings in the immediate vicinity of the cage and there is no wind shield in the cage. **NB**: Since blue foxes have excellent thermoregulatory capacity in cold weather conditions, they are scored 0 with regard to protection from wind. **Possibility of cooling the cages during extremely hot (≥ 30 °C) weather (Periods 2 and 3):** **0** – For the animals housed in solid walled barns, there is a possibility to increase ventilation in the barn, *e.g.* by automatic ventilation or by opening windows or other kinds of openings on the roof or on the low parts of the walls of the barn. As regards the animals housed in outdoor sheds, there is some protection, in addition to eaves, against direct sunlight *e.g.* sun blind or applicable wind shield. In general, cages with outer walls facing north do not need any special protection against direct sunlight. The animals or the roofs of the sheds are sprinkled with water during ambient temperatures above 30 °C. **1** – For the animals housed in solid walled barns, there is a possibility to increase ventilation of the cages in the barn, *e.g.* by automatic ventilation or by opening windows or other kinds of openings on the roof or on the low parts of the walls of the barn. As regards the animals housed in outdoor sheds, there is some protection, in addition to the eaves, against direct sunlight *e.g.* sun blind or appropriate wind shield. In general, cages with outer walls facing north do not need any special protection against direct sunlight. The animals and the roofs of the sheds are not sprinkled with water during ambient temperatures above 30°C. **OR** There are no sun blinds or such in cages with direct sunlight but the animals or the roofs of the sheds are sprinkled with water during ambient temperatures above 30°C. **2** – For the animals housed in solid walled barns, there is no possibility to increase ventilation of the cages. As regards the animals housed in outdoor sheds, there are no sun blinds or similar in cages with direct sunlight and the animals and the roofs of the sheds are not sprinkled with water during ambient temperatures above 30°C.

Classification

Farm level:

In Period 1: Protection from wind: percentage of animals with the Score 0, Score 1, Score 2 and Score 3

In Period 2: Possibility of cooling the cages: percentage of animals with the Score 0, Score 1 and Score 2

In Period 3: Percentage of animals in each of the 12 possible situations resulting from the combination of the 4 scores for Protection from the wind and the 3 scores for Possibility of cooling the cages

Period 3	Protection from the wind	Possibility to cool the cages	% of animals
Situation 1	0	0	*P1*
Situation 2	0	1	*P2*
Situation 3	0	2	*P3*
Situation 4	1	0	*P4*
Situation 5	1	1	*P5*
Situation 6	1	2	*P6*
Situation 7	2	0	*P7*
Situation 8	2	1	*P8*
Situation 9	2	2	*P9*
Situation 10	3	0	*P10*
Situation 11	3	1	*P11*
Situation 12	3	2	*P12*

Solid walled barn
Photos: © L. Ahola UEF

Wind shield
© L. Ahola UEF

Protection against sunlight
© L. Ahola UEF

3.2.2.3 Ease of movement

Title	**Floor area**
Scope	Resource- and management-based measurement: Periods 1, 2 and 3
Sample size	Sample B (80-100 foxes: see 3.2.6 *Sampling and practical information* for details)
Method description	During all periods, only cages in use are considered. Measure the cage length and width in separate sheds. If different-sized cages are used on the farm, measure as many cage types as possible. Note that the regular platform and top nest box are not counted in the floor area but if there are two separate floors in the cage, both floors are counted in the total area,. Only a floor area with ≥ 70 cm cage height is included in the floor area. The cages are scored according to the available floor area (width x length) of the cage, taking into account the period, social conditions and the age of the animals in the cage. **Cage level:** **0** – Clearly above the EU recommendation **1** – According to or slightly above the EU recommendation **2** – Below the EU recommendation
Classification	**Farm level:** Percentages of animals with the Score 0, 1 and 2

Title	**Cage height**
Scope	Resource-based measurement: Periods 1, 2 and 3
Sample size	Sample B (80-100 foxes: see 3.2.6 *Sampling and practical information* for details)
Method description	During all periods, only cages in use are considered. Measure the cage height in separate sheds. If different height-cages are used on the farm, measure as many cage types as possible. The cage height is measured from the place where the cage height is the lowest. The cages are scored according to their height. **Cage level:** **0** – Clearly above the EU recommendation, and considering also that the animal can reach the extra height **1** – Clearly above the EU recommendation **2** – According to or slightly above the EU recommendation **3** – Below the EU recommendation
Classification	**Farm level:** Percentages of animals with the Score 0, 1, 2 and 3

3.2.3 Good health

3.2.3.1 Absence of injuries

Title	**Difficulties in moving**
Scope	Animal-based measurement: Period 3
Sample size	Sample B (80-100 foxes: see 3.2.6 *Sampling and practical information* for details)
Method description	The animal is observed to detect difficulties in its moving. If necessary, the animal can be encouraged to move in the cage. The animal is scored with regard to difficulties in its moving:

	Individual level: **0 – No moving difficulties**: The animal moves in the cage actively, jumps onto the platform without difficulty and uses all four feet evenly while moving. **1 – Some difficulty in moving**: The animal moves in the cage but the locomotion is somehow impaired and/or the animal does not use all four feet evenly while moving. **2 – Major difficulty in moving**: The animal remains mainly sitting or lying down in the cage, even when disturbed. The locomotion seems clearly impaired and/or the animal does not use all four feet while moving. **3 – The animal does not move even when disturbed**. **NB:** this does not include animals that refuse to move due to an obvious defensive or withdrawal response.
Classification	**Farm level:** Percentage of animals with the Score 0, 1, 2 or 3

Title	**Skin lesions and/or other observed injuries to the body**
Scope	Animal-based measurement: Period 3
Sample size	Sample B (80-100 foxes: see 3.2.6 *Sampling and practical information* for details)
Method description	Skin lesions are defined as dermatitis, clear bite marks, clear hairless spots or any evident bleeding or infectious damage of the skin. Note that areas with broken hair are not interpreted as skin lesions. The animal is observed but must not be touched. View the animal from all sides of its body. Pay special attention to the tail, neck, chest, legs and ears of the animal. The animal is scored with regard to the skin lesions in its body (see photographic illustration): **Individual level**: **0 –** No evidence of obvious skin lesions or other injuries to the body **1** – Evidence of mild fresh skin lesions or clear hairless spots with a diameter < 3 cm; or evidence of severe old lesions, already healed, *e.g.* notch in the ear or a missing body part, *e.g.* a tail **2** – Evidence of bleeding and/or infectious skin damage with a diameter > 3 cm
Classification	**Farm level:** Percentage of animals with the Score 1 or 2

Score 0
Photos: © T. Koistinen UEF

Score 1
© T. Koistinen UEF

Score 1
© L. Ahola UEF

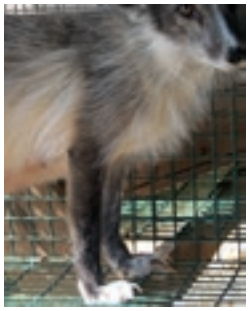
Score 1
Photos: © T. Koistinen UEF

Score 2
© L. Ahola UEF

Score 2
© T. Koistinen UEF

3.2.3.2 Absence of disease

Title	**Bent feet**
Scope	Animal-based measurement: Period 3
Sample size	Sample B (80-100 foxes: see 3.2.6 *Sampling and practical information* for details)
Method description	Bent feet are defined as carpal laxity leading to a changed carpal joint angle. Bent feet are assessed according to the carpal joint angle of the animal's forelegs. The animal is observed but must not be touched. If necessary, the animal is encouraged to stand up and move. The animal is preferably observed while it is moving. The animal is scored with regard to carpal joint angle of its forelegs (see photographic illustration): **Individual level**: **0 –** No bent feet **1 –** Slightly bent feet **2** – Severely bent feet
Classification	**Farm level:** Percentage of animals with severely bent feet (Score 2)
Additional information	Information concerning the percentage of animals with slightly bent feet (Score 1) is collected for advisory purposes.

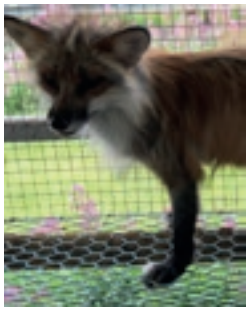


Score 0
Photos: © T. Koistinen UEF

Score 0
© T. Koistinen UEF

Score 1
© T. Koistinen UEF

Score 2
© T. Koistinen UEF



Score 0
Photos: © T. Koistinen UEF

Score 1
© T. Koistinen UEF

Score 2
© T. Koistinen UEF

Score 2
© T. Koistinen UEF

Title	**Ocular inflammation**
Scope	Animal-based measurement: Period 3

Sample size	Sample B (80-100 foxes: see 3.2.6 *Sampling and practical information* for details)
Method description	Ocular inflammation is defined as evident purulent discharge from and/or inflammation in one or both eyes. Minor watery discharge from the eyes is not considered. The animal is observed but must not be touched. The animal is scored with regard to the evidence of ocular discharge and/or ocular inflammation (see photographic illustration): **Individual level**: **0 –** No evidence of ocular discharge or inflammation **1** – Clear evidence of purulent ocular discharge and/or inflammation at least in one of the eyes
Classification	**Farm level:** Percentage of animals with clear evidence of ocular discharge and/or inflammation (Score 1)

Score 0
Photos: © T. Koistinen UEF

Score 0
© T. Koistinen UEF

Score 1
© L. Ahola UEF

Score 1
Photos: © L. Ahola UEF

Score 1
© L. Ahola UEF

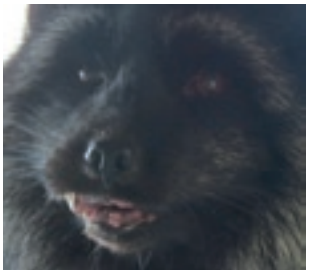
Score 1
© T. Koistinen UEF

Title	**Impaired mouth and teeth health**
Scope	Animal-based measurement: Period 3
Sample size	Sample B (80-100 foxes: see *3.2.6 Sampling and practical information* for details)
Method description	Impaired mouth and teeth health is defined as any bleeding, swelling or abnormalities in the mouth or teeth (*e.g.* abnormal bite). The animal is observed but must not be touched. The animal is scored with regard to impaired mouth and teeth health (see photographic illustration): **Individual level**: **0 –** No evidence of impaired mouth and teeth health **1** – Impaired mouth and teeth health

Classification	**Farm level:** Percentage of animals with impaired mouth and/or teeth health (Score 1)

Score 0
Photos: © L. Ahola UEF

Score 1
© T. Koistinen UEF



Score 1
© T. Koistinen UEF

Title	**Diarrhoea**
Scope	Animal-based measurement: Period 3
Sample size	Sample B (80-100 foxes: see *3.2.6 Sampling and practical information* for details)
Method description	Diarrhoea is defined as soft and watery faeces. Diarrhoea can be observed directly on the animal while defecating or from the cage and under the cage. Assess the cage and the underneath of the cage for the presence of soft and watery faeces. If there is more than one animal in the cage and there is clear evidence of diarrhoea, the number of ill animals in the cage is "0.5 x the number of animals in the cage". If there is one animal in the cage and there is clear evidence of diarrhoea, the number of ill animals in the cage is one. The cage is scored with regard to evidence of diarrhoea (see photographic illustration): **Cage level**: **0 –** No evidence of diarrhoea **1** – Clear evidence of diarrhoea
Classification	**Farm level:** Percentage of animals with clear evidence of diarrhoea (score 1)

Score 0
Photos: © L. Ahola UEF

Score 0
© L. Ahola UEF

Score 1
© L. Ahola UEF

Title	**Urinary tract infection**
Scope	Animal-based measurement: Period 1
Sample size	Sample B (80-100 foxes: see *3.2.6 Sampling and practical information* for details)

Method description	Urinary tract infection is defined as the presence of reddish and/or brownish urine inside and/or under the cage of the animal(s) or while the animal is urinating. Assess fresh urine while the animal is urinating, or urine inside and/or under the cage of the animal/ animals for signs of reddish and/or brownish urine. If there is more than one animal in the cage and there is clear evidence of urinary tract infection, the number of ill animals in the cage is "0.5 x the number of animals in the cage". If there is one animal in the cage and there is clear evidence of urinary tract infection, the number of ill animals in the cage is one. The cage is scored with regard to evidence of urinary tract infection (see photographic illustration): **Cage level**: **0 –** No evidence of reddish and/or brownish urine **1** – Clear evidence of reddish and/or brownish urine
Classification	**Farm level:** Percentage of animals with clear reddish/brownish urine (score 1)

Score 0
Photos: © L. Ahola UEF

Score 1
© L. Ahola UEF

Score 1
© L. Ahola UEF

Title	**Obviously sick fox**
Scope	Animal-based measurement: Period 3
Sample size	Sample B (80-100 foxes: see *3.2.6 Sampling and practical information* for details)
Method description	An obviously sick fox is defined as a fox having obvious signs of poor or reduced health, *i.e.* a fox with signs of disorders not included in the other measurements of the disease criteria, *e.g.* impaired ear health, inflammation in toes/paws, breathing difficulties, unusual head posture or convulsion. The animal is observed but must not be touched. The animal is scored with regard to signs of poor or reduced health: **Individual level**: **0 –** No signs of poor or reduced health **1** – Obvious signs of poor or reduced health **2 –** Obvious signs of stereotypic behaviour during inspection
Classification	**Farm level:** Percentage of animals with obvious signs of poor or reduced health (Score 1)
Additional information	Information concerning the percentage of stereotyping animals during health inspection (Score 2) is collected for advisory purposes

Score 0
Photos: © L. Ahola UEF

Score 1
© L. Ahola UEF

Score 1
© L. Ahola UEF

Score 1
Photos: © L. Ahola UEF

Score 1
© T. Koistinen UEF

Score 1
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Title	**Mortality**
Scope	Animal-based measurement: All periods (recorded from farm records for the past 12 months at each visit)
Sample size	Farm
Method description	Mortality is defined as uncontrolled deaths (animals that are found dead) and animals that are humanely killed by the farmer due to diseases or injuries outside the actual pelting season out of the total number of animals on the farm. Consult the farm manager about the number of animals, older than 8 weeks, which were found dead or were humanely killed outside the actual pelting season due to diseases or injuries during the last 12 months. Those animals that were pelted because they were found dead or humanely killed due to diseases or injuries close to the pelting season must also be taken into account. The farm is scored with regard to mortality and the percentage of humanely killed animals out of total mortality. Three categories are defined at the **farm level:** **0 –** Humanely killed ≥ 50% of total mortality **1 –** 25% ≤ humanely killed < 50% of total mortality **2** – Humanely killed< 25% of total mortality
Classification	**Farm level:** Percentage of animals, older than 8 weeks, which were recorded dead during the past 12 months, taking into account the three categories of the percentage of humanely killed animals out of total mortality

3.2.3.3 Absence of pain induced by management procedures

Farmed foxes are not routinely subjected to any kinds of mutilations of their body or surgical procedures, such as castration, trimming, teeth cutting or tail cutting. Therefore, the Criterion *Absence of pain induced by management procedures* includes only evaluation of the killing methods used for the farmed foxes.

Title	**Killing method**
Scope	Resource- and management-based measurement: Periods 1, 2 and 3
Sample size	Farm
Method description	Consult the farm manager about the killing methods used for the animals on the farm. If the animals are humanely killed with electrocution, consult the farm manager about the type and functionality of the device/devices. Ask the manager to show you the killing devices in use on the farm, and inspect the device/devices. Since different killing devices may be used on the farm, the farm is scored according to the lowest quality device in use. **NB**: Humane killing methods allowed for foxes and their key parameters are available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:303:0001:0030:EN:PDF
Classification	**Farm level:** **0** – Electrocution, the device is in functional state and has a check light or sound **1** – Electrocution, the device is in functional state but has no check light or sound **2** – Other allowed humane killing method than electrocution; the device is in functional state **3** – Absence of a device to kill the animals humanely or the functionality of the device is not acceptable

3.2.4 Appropriate behaviour

3.2.4.1 Expression of social behaviours

Title	**Social housing**
Scope	Management-based measurement: Period 3
Sample size	Sample B (see 3.2.6 *Sampling and practical information* for details)
Method description	Social housing is defined according to the number of foxes housed in a cage. Social housing conditions are scored with regard to the number of animals in the same cage or cage system, taking into account the age of the animals. **Adult animals:** **0** – There is only one adult animal in the cage. **1** – There are two or more adult animals in the cage. **Juvenile animals:** **0** – There are two or more juvenile animals in the cage. **1** – There is only one juvenile animal in the cage.
Classification	**Farm level:** **Adult animals:** Percentage of adult animals housed in pairs or in groups (Score 1) **Juveniles animals:** Percentage of juveniles housed singly (Score 1)

3.2.4.2 Expression of other behaviours

Title	**Opportunity to use enrichment**
Scope	Resource-based measurement: Periods 1, 2 and 3
Sample size	Sample B (80-100 foxes: see *3.2.6 Sampling and practical information* for details)

Method description

Enrichment is defined as an object or material inside the cage, or with regard to straw or such material also outside the cage so that it is available for the animal, which allows species-specific manipulation and/or interaction with it, *e.g.* gnawing, carrying or digging.
Enrichment can be a wooden block, bone, pile of straw, rope, ball, year-round nest box, digging substrate (*e.g.* sand), scratching plate or some other objects or material that are not harmful for the animals. Note that *e.g.* straw and a nest box placed outside the actual cage but accessible for the fox are considered as enrichments.

Check the cage for the availability of any kind of enrichment. The animal is scored with regard to the number of different types of enrichments. Although an item could be interpreted as beneficial to the foxes in several categories, the item is included only in one, *i.e.* the highest possible category.
In the case of a year-round nest box, check that the animal has the access to the nest box.

Categories of enrichment types:
0 – Extremely beneficial: A renewable gnawing object, *i.e.* a bone or wooden block, or a construction with at least one solid wall, increasing environmental complexity, *i.e.* a nest box or concealment screen
1 – Very beneficial: Occupational material for exploration and/or play, *e.g.* a ball, rope, straw or sand
2 – Moderately beneficial: Other types of enrichment, *e.g.* a scratching plate

Classification

Farm level:
Percentage of animals in each of the 27 situations resulting from the combination of the numbers of different types of enrichment in different categories of enrichments.

Period 1, 2 or 3	Number of different enrichments in the category 0	Number of different enrichments in the category 1	Number of different enrichments in the category 2	% of animals
Situation 1	≥ 2	≥ 2	≥ 2	*P1*
Situation 2	≥ 2	≥ 2	1	*P2*
Situation 3	≥ 2	≥ 2	0	*P3*
Situation 4	≥ 2	1	≥ 2	*P4*
Situation 5	≥ 2	1	1	*P5*
Situation 6	≥ 2	1	0	*P6*
Situation 7	≥ 2	0	≥ 2	*P7*
Situation 8	≥ 2	0	1	*P8*
Situation 9	≥ 2	0	0	*P9*
Situation 10	1	≥ 2	≥ 2	*P10*
Situation 11	1	≥ 2	1	*P11*
Situation 12	1	≥ 2	0	*P12*
Situation 13	1	1	≥ 2	*P13*
Situation 14	1	1	1	*P14*
Situation 15	1	1	0	*P15*
Situation 16	1	0	≥ 2	*P16*
Situation 17	1	0	1	*P17*

Situation 18	1	0	0	*P18*
Situation 19	0	≥ 2	≥ 2	*P19*
Situation 20	0	≥ 2	1	*P20*
Situation 21	0	≥ 2	0	*P21*
Situation 22	0	1	≥ 2	*P22*
Situation 23	0	1	1	*P23*
Situation 24	0	1	0	*P24*
Situation 25	0	0	≥ 2	*P25*
Situation 26	0	0	1	*P26*
Situation 27	0	0	0	*P27*

Wooden block (Category 0)

Photos: © EFBA

Wooden block and sand (Category 0, 1)
© P. Martiskainen UEF

Bone, straw and scratching plate (Category 0,1,2)
© T. Koistinen UEF

Title	**Opportunity to observe surroundings**
Scope	Resource-based measurement: Periods 1, 2 and 3
Sample size	Sample B (80-100 foxes: see *3.2.6 Sampling and practical information* for details)
Method description	Check the cage for constructions obstructing the animal's view to its surroundings. The animal is interpreted as not being able to observe its surroundings if at least one of the following conditions is fulfilled: a) One of the walls of its cage is completely opaque b) There is an opaque wall of a barn or such (*e.g.* a fence) nearer than 2 m from its cage The animal is scored with regard to its opportunity to observe its surroundings. **Individual level:** **0 –** The animal has opportunity to observe its surroundings. **1 –** The animal has no opportunity to observe its surroundings.
Classification	**Farm level:** Percentage of animals that have no opportunity to observe their surroundings (Score 1)

Title	**Stereotypic behaviour**
Scope	Animal-based measurement: Periods 1, 2 and 3
Sample size	150 to 200 foxes: see *3.2.6 Sampling and practical information* for details
Method description	Stereotypic behaviour is defined as invariant behaviour that is repeated three or more times in a row. Stereotypic behaviour can be, *for example*: Pacing: invariant, repetitive walking along the side of the cage or circling the cage. Jumping: invariant, repetitive jumping against the wall(s) of the cage. Other: any stereotypic behaviour other than pacing and jumping, *e.g.* repetitive gnawing/licking of the cage or repetitive head twirling. Choose the animals to be assessed for stereotypical behaviour from different sheds/barns, on different ends of the sheds/barns and on different locations on the farm. Place yourself in the middle of the aisle in front of the assessed fox's cage, facing towards either end of the shed. Observe (scan) the animals in front of you on both sides of the aisle for one minute. Observe as many animals as you can reliably observe (2-12 animals). Mark whether the animals are resting, active without performing stereotypic behaviour or active and performing stereotypic behaviour. After one minute's observation time, turn slowly 180 degrees and observe the animals in the other direction of the shed for one minute. With regard to activity and resting, the most long lasting behaviour during the one minute observation time is recorded for the animal. If stereotypic behaviour is observed, it is always recorded, regardless of the duration of the occurrence. The animal is considered to be active in all cases where it has been observed to express stereotypic behaviour. Note that there is no need to observe stereotypic behaviour after every animal that are assessed with the measurements included in the Sample B; just be sure that you observe enough animals from different sheds or barns, on different ends of the sheds or barns and on different locations on the farm. Note also that you take a break in observing stereotypic behaviour during the feeding time, *i.e.* the animals should not hear the sound from the feeding machine and/or be eating during the observation of stereotypic behaviour. Assess the occurrence of the following behaviours: **Resting –** The animal is resting in a lying position. **Active –** The animal is sitting, standing or moving. **Stereotypic behaviour –** The animal is expressing stereotypic behaviour. The animal is scored with regard to its behaviour: **Individual level:** **0 –** The animal is resting. **1 –** The animal is active but not expressing stereotypic behaviour. **2 –** The animal expresses stereotypic behaviour.
Classification	**Farm level:** Percentage of animals expressing stereotypic behaviour (Score 2) out of all active animals (Scores 1 and 2)

Title	**Fur chewing**
Scope	Animal-based measurement: Periods 1 and 3
Sample size	Sample B (80-100 foxes: see 3.2.6 *Sampling and practical information* for details)

Method description	Fur chewing is defined as fur chewed by the fox itself or by the cage mate of the fox. Fur can be chewed from all sides of the body, *e.g.* the flanks and the tail of the animal. The animal is observed but must not be touched. View the animal from all sides of its body. Pay attention especially to the tail of the animal. The animal is scored with regard to the observed clear signs of chewed fur (see photographic illustration): **Individual level**: **0 –** No fur chewing **1 –** Clear signs of fur chewing
Classification	**Farm level:** Percentage of animals with clear signs of fur chewing (score 1)

Score 0
Photos: © L. Ahola UEF

Score 1
© T. Koistinen UEF

Score 1
© L. Ahola UEF

3.2.4.3 Good human-animal relationship

Title	**Feeding test**
Scope	Animal-based measurement: Period 1
Sample size	Sample A (100 foxes: see *3.2.6 Sampling and practical information* for details)
Method description	With the aid of the farm manager, equip yourself with the usual feed used on the farm. Ensure from the farm manager that the chosen animals have not been fed earlier on the testing day. You can test simultaneously four singly housed animals that are housed in cages with floor area ≤ 1.2 m^2. If the cages are substantially larger than 1.2 m^2, test only two animals at the same time.
	During testing, avoid eye contact with the animals. Deliver some (50 - 100 g) feed manually on the feeding tray. If there is no feeding tray in the cage, place the feed where the animals in the cage are usually fed. In the cages with several feeding plates, place the feed on the plate closest to you. Deliver separate feed portions for each animal in the cages. After the delivery of feed, stay in "the middle" of the cages (at a distance of 0.5 - 0.7 m to each cage) and record whether the animals eat or not within 30 sec, *i.e.* mark 0 ("yes") or 1 ("no") separately for each animal. Eating feed is defined as taking a bite of feed; just sniffing or touching feed is not considered as eating feed. The animal is scored with regard to its reaction: **Individual level:** **0** – The animal eats within 30 sec. **1** – The animal does not eat within 30 sec.
Classification	**Farm level:** Percentage of the animals that eat within 30 sec (Score 0)

3.2.4.4 Positive emotional state

Title	**Temperament test**
Scope	Animal-based measurement: Period 1
Sample size	Sample B (80-100 foxes: see *3.2.6 Sampling and practical information* for details)
Method description	Use a stick made of plastic or wood (length 150 cm, maximum 1.5 cm in diameter). During testing, avoid eye contact with the animal. Approach the cage quietly and insert 30 cm of the stick through the front cage wall (near the corner of the cage) towards the animal. If the cage is constructed from two or several smaller cages connected to each other, insert the stick from the corner of the cage where the animal is staying. The stick must be inserted at the eye level of the fox, (*i.e.* 20 - 25 cm high). Stand at least 1 m from the cage but only at a distance where you can see the animal's reaction to the stick. Observe for 10 secs. Then withdraw the stick from the cage. The animal is scored with regard to its reaction to the stick. **Individual level:** **0 – Explorative** : The animal touches the stick in explorative way. **1 – Passive** : The animal does not touch the stick. The animal is motionless, asleep and/or does not react to the stick. **2 – Fearful or aggressive** : The animal attacks the stick and/or bites it aggressively.
Classification	**Farm level:** Percentage of animals with the Score 0, 1 and 2

Title	**Transport of live foxes**
Scope	Management-based measurement: All periods (recorded for the past 12 months at each visit)
Sample size	Farm
Method description	In traditional farming, fur animals are seldom transported because they are usually killed on the same farm where they were born. Transportation of live animals is therefore considered mainly for artificial insemination, exhibitions or for breeding animal business. Consult the farm manager about the vehicle transport of live animals during the last 12 months, e.g. due to purchase of breeding animals or in order to artificially inseminate or raise animals on a remote or separate farm.
Classification	Farm level: **0** – No systematic vehicle transport of live animals **1** – Vehicle transport of few live animals (less than 10% of the animals on the farm) due to purchase of breeding animals or in order to artificially inseminate or raise animals on a remote or separate farm **2** – Systematic vehicle transport of live animals (more than 10% of the animals on the farm) due to purchase of breeding animals or in order to artificially inseminate or raise animals on a remote or separate farm or transport of a few live animals (even less than 10% of the animals on the farm) due to international animal business (long distance transport)

3.2.5 Guidelines for a visit to a fox farm

Before the farm visit, the assessor needs to inform the farm manager about the purpose of the visit, how it is conducted and what preventive measures are taken against spreading of diseases. In order to be able to stratify the sampling, the assessor needs to get the information of the number of different types of foxes on the farm. The farmer should also be informed about the feeding test (only in Period 1) aimed to be conducted before the feeding of the animals.

The assessor must be aware of the points of the compass in advance or at the latest on arrival at the farm. This information is needed for assessing the need for sun blinds in the Criterion *Thermal comfort*.

The equipment needed on the farm
Note that for the assessment of a fox farm you need the following equipment:

- Instructions
- Tablet/PC or recording sheets, pencils and writing-tablet
- Timer
- Folding ruler or measuring tape for measuring cage dimensions and platform height
- Equipment to test the functioning of water nipples
- A bucket for the feeding test (only in Period 1)
- A wooden or plastic stick for the temperament test (only in Period 1)
- Appropriate clothing (protective, disposable clothing, such as shoe covers)
- Disinfection equipment

Bio-security
Adhere to the individual farm's own bio-security requirements and take care to shower, change clothing and clean and disinfect boots and other non-disposable items after each visit. Make sure to comply with national or regional bio-security regulations. If possible, park the car outside the farm area.

On the farm
On the farm, the assessor should repeat the brief explanation of what is about to be done during the course of the visit, since the person hosting the visit may not be familiar with the assessment. Explain to the farm manager that there will be an assessment of animal-based and resource-based measurements and how long it will approximately take to complete these.

At the end of the visit, thank the farm manager for her/his input to the data collection, inform about your observations that may be of special interest, for example, sick or injured foxes. Explain how the data are treated and when the outcome can be expected.

3.2.6 Sampling and practical information

The assessor should become familiar with the number of sheds and barns occupied by foxes and the number of foxes of different types and species. The number of different types of sheds, animals and species needs to be carefully recorded, since this information is needed when choosing the samples A and B to obtain a representative sample of sheds, species and animal types for the assessment.
When choosing sheds, species and animal types for assessment, the assessor must maintain the same ratio of different kinds of sheds and barns, fox species (including crossbreeds) and different types of animals (*i.e.* age) in the sample as they are present on the farm. Furthermore, also the ratio of singly housed and group-housed foxes, the ratio of foxes housed in different-sized cages and the ratio of foxes housed with various watering systems must be maintained in the same level in the sample as they are present on the farm.

Choose the animals to be assessed from different sheds/barns, at different ends of the sheds/barns and at different locations on the farm. A plan must be made in advance for choosing the animals to be assessed: it should be decided to start from the X^{th} cage before entering the shed.

There is a specific order in which the different measurements have to be carried out and also which measurements can be carried out simultaneously.

For some of the measurements, input from the farm manager is required (see Table 2). Time must be reserved for discussion with the farm manager.

Table 2 Measurements to be discussed with the farm manager

Measurement	Period 1	Period 2	Period 3
Type of watering system	yes	yes	yes
Protection against overheating of drinking water		yes	yes
Possibility of cooling the cages (sprinkling of the animals or roofs of the shed)		yes	yes
Mortality	yes	yes	yes
Killing method	yes	yes	yes
Transport of live foxes	yes	yes	yes

The animal-based and resource-based measurements are recorded on the farm in the following order:

Sample A (in Period 1)
With the aid of the farm manager, prepare yourself for the feeding test. Select as many groups of animals as is needed to test at least 100 foxes. Allocate 30-60 min for carrying out the feeding test.

Sample B (all periods)
The measurements to be taken in Sample B differ between the three periods (see Table 3). Select every 7th fox in the chosen sheds. Select 10 foxes at the most from one shed if more than eight sheds are occupied by foxes on the farm. Assess at least 80 foxes for sample B but, if possible, assess 100 foxes on a farm housing thousands of foxes in tens of sheds. Allocate 3-5 hours for carrying out the measurements included in the Sample B.

Stereotypic behaviour
Note that stereotypic behaviour is observed, by turns, with the Sample B. After taking the measurements included in the Sample B, observe stereotypic behaviour from the neighbouring foxes. Take care that you do not observe the same animals twice, e.g. by observing stereotypic behaviour only after every fifth animal in Sample B.

Table 3 Sample B: measurements that can be assessed simultaneously. The temperament test must always be performed first in Period 1, otherwise the presented order of the measurements can be considered as a recommendation.

Measurement	Period 1	Period 2	Period 3
Temperament test	yes		
Body condition scoring	yes	yes	yes
Cleanliness of the fur	yes	yes	yes
Difficulties in moving			yes
Skin lesions or other observed injuries to the body			yes
Bent feet			yes
Ocular inflammation			yes
Impaired mouth and teeth health			yes
Diarrhoea			yes
Urinary tract infection	yes		

Obviously sick fox			yes
Fur chewing	yes		yes
Social housing			yes
Continuous water availability			
Type of watering system	yes	yes	yes
Protection against overheating of drinking water		yes	yes
Functioning of the water points	yes	yes	yes
Cleanliness of the water points	yes	yes	yes
Availability of a platform	yes	yes	yes
Space available for moving	yes	yes	yes
Opportunity to use enhancement	yes	yes	yes
Opportunity to observe surroundings	yes	yes	yes
Protection from exceptional weather conditions			
Protection from wind	yes		yes
Possibility of cooling the cages		yes	yes

Photo: © T. Koistinen

3.3 Calculation of scores for foxes

3.3.1 Criterion-scores

From measurements to criterion-scores, up to 3 steps can be necessary. They are briefly presented in Figure 6.

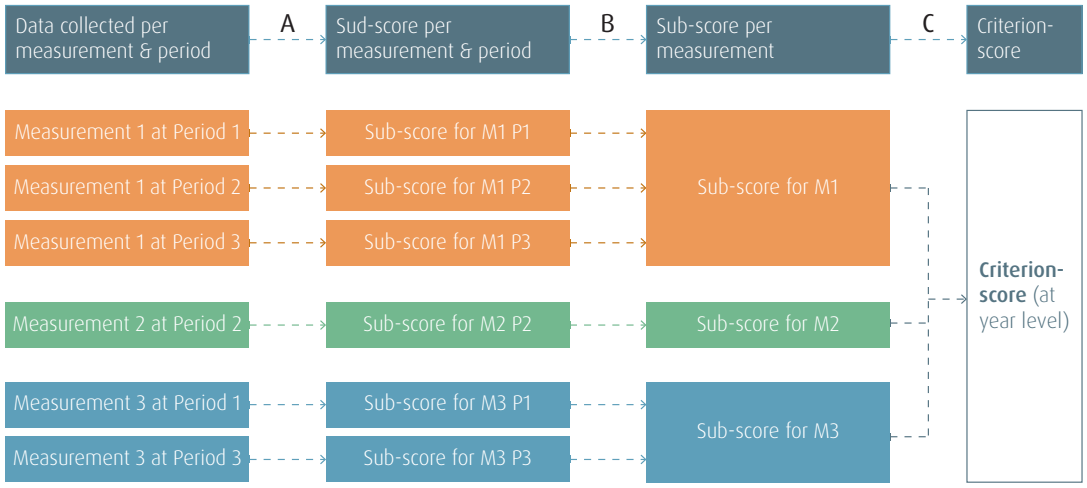

Figure 6 Up to 3 steps (called A, B and C) are necessary to go from raw data collected on the farm to a criterion-score, here presented on a virtual example: A - Interpretation in terms of welfare of data collected for a given measurement at a given period, B - Aggregation of sub-scores obtained for a given measurement on the different periods and C - Aggregation of sub-scores obtained on the different measurements.

To perform those steps, different aggregation tools are used. These are summarised in Table 4.

Table 4 The different types of construction used to assess welfare on fox farms

Spline	% of animals in an impaired welfare state (*e.g.* % of lean foxes) transformed into a score using least-squares spline curve fitting
Decision-tree	Construction of a decision-tree leading to X possible situations, scores directly assigned to each of these X situations
Decision-tree & % Rule	Construction of a decision-tree leading to X possible situations, scores directly assigned to each of these X situations + The worst situation observed on at least Y% of the animals is considered (Y varies with measurements)
Continuous, Index & Spline	Calculation of an index based on a linear combination of the % of animals in the different categories (*e.g.* % of foxes presented cages with an area above/at/below the recommendation), transformed into a score using least-squares spline curve fitting
Ordinal, Index & Spline	Each measurement (*e.g.* % of foxes with diarrhoea) is transformed to an ordinal scale qualifying the severity of the problem at farm level: no/moderate/severe problem; calculation of an index based on a linear combination of the proportions of no, moderate & severe problems, transformed into a score using least-squares spline curve fitting
Choquet	The sub-scores (*e.g.* one per period or one per measurement) are synthesised by using a Choquet integral

More particularly, Table 5 presents the twelve criteria used to assess the welfare of foxes with, for each, the measurements used, the type of measurement (*i.e.* animal or resource-based or taken from farm records), the period(s) concerned and the aggregation tools used.

Table 5 Measurements and construction tools for each criterion
Table 5a Criteria 1 to 6

Criterion number	Measurement	Type of measure-ment*	Period	No. of data	A-Construction at measurement level	B-Aggregation of periods per measurement	C-Aggregation of measurements
C1	Body condition score	A	P1, P2 & P3	1, 1, 1	Spline (% of too lean foxes)	Choquet	no
C2	Continuous water availability	R + M	P1, P2 & P3	3, 4, 4	Decision-tree (27, 14, 38 situations, for P1, P2, P3 respectively) + 2% Rule	Choquet	no
C3	Cleanliness of the fur	A	P1, P2 & P3	1, 1, 1	Spline (% of clearly dirty foxes)	Choquet	Choquet
	Availability of a platform	R	P1, P2 & P3	1, 1, 1	Spline (% of foxes without a platform), different for P1, P2 and P3	Choquet	
C4	Protection from exceptional weather conditions	R + M	P1	1	Index (% of foxes in cages with high/moderate/low/no protection from the wind) & Spline	Choquet	Choquet
			P2	1	Index (% of foxes in cages with high/moderate/low possibility to cool the cages) & Spline		
			P3	2	Decision-tree (12 situations) + 10% Rule		
C5	Space available for moving : Floor area	R + M	P1, P2 & P3	1, 1, 1	Index (% of foxes living in cages with an area above/at/below the recommendation) & Spline, different for P1 & P2 and P3	Choquet	Choquet
	Space available for moving : Cage height	R	P1, P2 & P3	1, 1, 1	Index (% of foxes living in cages with a height largely above/above/at/below the recommendation) & Spline	Choquet	
C6	Difficulties in moving	A	P3	1	Index (% of foxes without injuries / with injuries of category 1 / with injuries of category 2 / with injuries of category 3) & Spline	Choquet	Choquet
	Skin lesions and other injuries to the body	A	P3	1	Index (% of foxes presented cages with no evidence/moderate/severe skin damage) & Spline	Choquet	

* *Type of measurement: observed on the farm may be animal-based (A), resource-based (R) or management-based (M)*

Table 5b Criteria 7 to 12

Criterion number	Measurement	Type of measure-ment*	Period	No. of data	A-Construction at measurement level	B-Aggregation of peri-ods per measurement	C-Aggregation of measurements
C7	Bent feet	A	P3	1	% of animals transformed to ordinal (no/moderate/severe problem), Index & Spline	no	no
	Ocular inflammation	A	P3	1			
	Impaired mouth and teeth health	A	P3	1			
	Diarrhoea	A	P3	1			
	Urinary tract infection	A	P3	1			
	Obviously sick fox	A	P3	1			
	Mortality	A	Year	2			
C8	Killing method	R + M	P1, P2 & P3	1, 1, 1	Decision-tree (4 situations)	Choquet	no
C9	Social housing	M	P3 Adults	1	Spline (% of adults breeding animals housed in pairs or groups)	Choquet (to aggregate the two animal-types)	no
			P3 Juveniles	1	Spline (% of juveniles housed singly)		
C10	Stereotypical behaviours (SB)	A	P1, P2 & P3	1, 1, 1	Spline (% of foxes expressing SB out of active animals), different for P1 & P3 and P2	Choquet	Choquet
	Opportunity to use enrichment	R + M	P1, P2 & P3	1, 1, 1	Decision-tree (27 situations) + 10% Rule, different for P1, P2 and P3	Choquet	
	Opportunity to observe surroundings	R	P1, P2 & P3	1, 1, 1	Spline (% of foxes not able to observe their surroundings)	Choquet	
	Fur chewing	A	P1, P2 & P3	1, 1, 1	Spline (% of animals with clear signs of chewed fur)	Choquet	
C11	Feeding Test	A	P1	1	Spline (% of foxes that eat within 30 sec)	no	no
C12	Temperament Test	A	P1	1	Index (% of exploratory/ passive/aggressive or fearful foxes) & Spline	no	Choquet
	Transport of live foxes	M	All year	1	Decision-tree (3 situations)	no	

** Type of measurement: observed on the farm may be animal-based (A), resource-based (R) or management-based (M)*

3.3.1.1 Absence of prolonged hunger

The score of a farm with regard to the Criterion of *Absence prolonged hunger* is calculated from the % of very lean foxes for the three periods of the production cycle. So the first stage is to calculate one sub-score for each period, then to aggregate the three sub-scores obtained for each period in order to have the criterion-score covering the whole production cycle.

Sub-scores S1, S2 and S3 for Periods 1, 2 and 3
The calculation of the sub-score is the same for each period.
In terms of interpretation, the greater the % of very lean foxes, the lower the criterion-score. As a consequence, the % of very lean foxes is to be transformed into the criterion-score following several calculation steps.

First, the % is, for each period, turned into an intermediate value called index (*I*).

Let I_1 = 100 - % of very lean foxes in Period 1
I_2 = 100 - % of very lean foxes in Period 2
I_3 = 100 - % of very lean foxes in Period 3

$$\text{Let } J_i = \frac{I_i - 50}{100 - 50} \times 100 \quad \text{if } I_i \geq 50$$
$$J_i = 0 \quad \text{if } I_i < 50$$

with *I* = 1, 2 or 3 according to the period considered while assessing the farm.

Finally, J_i is computed into a score using I-spline functions (Figure 7) as follows:

$$\textbf{Score} = a_x + b_x \times J_i + c_x \times J_i^2 + d_x \times J_i^3 \qquad i = 1, 2 \text{ or } 3$$

with $x = 1$ when $J_i < k$ and $x = 2$ when $J_i \geq k$

Criterion 1 - Body condition score - Period 1, 2 or 3			
a_1	0	a_2	-4884.05071613469044677913188 93
b_1	0.06568641401817969238674 52	b_2	183.21759811042591081786667 93
c_1	-0.00082108017537795095069 92	c_2	-2.29022008855073089250709 02
d_1	0.00002532882990190990877 13	d_2	0.00956449178942560436500 48
k	80		

Note: The coefficients are the same for the three periods since the interpretation in terms of welfare is the same whatever the period considered.

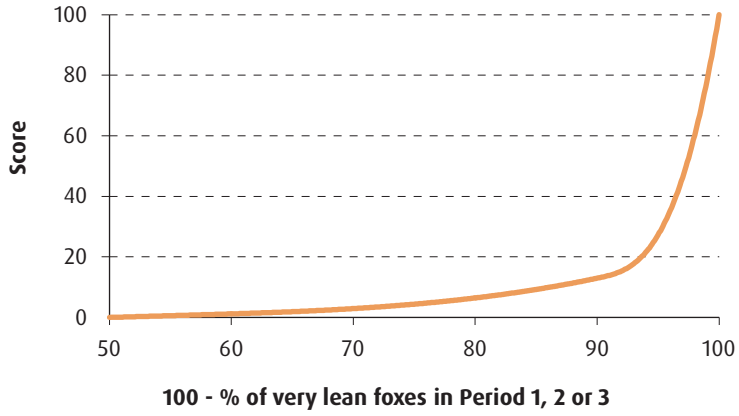

Figure 7 Calculation of the sub-score S_i for the Criterion *Absence of prolonged hunger* according to the percentage of very lean foxes in period *i* (with *i* = 1, 2 or 3 according to the period considered)

Score for absence of prolonged hunger

The three sub-scores are combined to form the overall score for the Criterion *Absence of prolonged hunger* using a Choquet integral:

$$C(a_1,\ldots,a_n)=\sum_{i=1}^{n}\left(a_{(i)}-a_{(i-1)}\right)\mu\left(\{(i),\ldots,(n)\}\right)$$

With the convention $a_{(0)}=0\le a_{(1)}\le\cdots\le a_{(n)}$ *i.e.* a reordering of the periods (or measurements or criteria) depending on the score they obtained, from the worst period (or measurement or criterion) to the best one.
μ(A) is a capacity function defined for any subset A of criteria entering in the composition of the principle. This capacity is subjected to the following constraints:

$$\begin{cases}\mu(\varnothing)=0\\ \mu(\{1,\cdots,n\})=1\\ A\subseteq B\Rightarrow\mu(A)\le\mu(B)\end{cases}$$

The parameters of the Choquet integral used to calculate the Criterion *Absence of prolonged hunger*-score are:

μ_1	=	0.13	μ_{12}	=	0.14
μ_2	=	0.14	μ_{13}	=	0.49
μ_3	=	0.40	μ_{23}	=	0.46

with 1 = Period 1, 2 = Period 2 and 3 = Period 3.

Reminder:

$$\text{Absence of prolonged hunger-score} = \begin{cases} S_1 + (S_2 - S_1)\mu_{23} + (S_3 - S_2)\mu_3 & \text{if} \quad S_1 \le S_2 \le S_3 \\ S_1 + (S_3 - S_1)\mu_{23} + (S_2 - S_3)\mu_2 & \text{if} \quad S_1 \le S_3 \le S_2 \\ S_2 + (S_1 - S_2)\mu_{13} + (S_3 - S_1)\mu_3 & \text{if} \quad S_2 \le S_1 \le S_3 \\ S_2 + (S_3 - S_2)\mu_{13} + (S_1 - S_3)\mu_1 & \text{if} \quad S_2 \le S_3 \le S_1 \\ S_3 + (S_1 - S_3)\mu_{12} + (S_2 - S_1)\mu_2 & \text{if} \quad S_3 \le S_1 \le S_2 \\ S_3 + (S_2 - S_3)\mu_{12} + (S_1 - S_2)\mu_1 & \text{if} \quad S_3 \le S_2 \le S_1 \end{cases}$$

Therefore, with the μ listed above:

$$\text{Absence of prolonged hunger-score} = \begin{cases} S_1 + 0.46(S_2 - S_1) + 0.40(S_3 - S_2) & \text{if} \quad S_1 \le S_2 \le S_3 \\ S_1 + 0.46(S_3 - S_1) + 0.14(S_2 - S_3) & \text{if} \quad S_1 \le S_3 \le S_2 \\ S_2 + 0.49(S_1 - S_2) + 0.40(S_3 - S_1) & \text{if} \quad S_2 \le S_1 \le S_3 \\ S_2 + 0.49(S_3 - S_2) + 0.13(S_1 - S_3) & \text{if} \quad S_2 \le S_3 \le S_1 \\ S_3 + 0.14(S_1 - S_3) + 0.14(S_2 - S_1) & \text{if} \quad S_3 \le S_1 \le S_2 \\ S_3 + 0.14(S_2 - S_3) + 0.13(S_1 - S_2) & \text{if} \quad S_3 \le S_2 \le S_1 \end{cases}$$

Where S_1, S_2 and S_3 are the scores obtained by a given farm during Periods 1, 2 and 3 respectively.
μ_1, μ_2 and μ_3 are the capacities of Periods 1, 2 and 3 respectively.
μ_{12} is the capacity of the group made of Periods 1 and 2 and so on...

3.3.1.2 Absence of prolonged thirst

The Criterion of *Absence of prolonged thirst* is evaluated with the Measurement *Continuous water availability* considering the Sub-measurements *Type of watering system, Protection against overheating of drinking water, Functioning of the water points* and *Cleanliness of the water points*.

As the weather changes according to the period considered, the daily water availability is assessed by evaluating both a risk of freezing or a risk of overheating depending on the period considered.

For each cage the assessor must answer the following questions:

- Is there continuous access to potable water throughout Period i (including type of water supply and special arrangements against freezing)?
- Is the watering system protected against overheating? (not considered in Period 1)
- Does the water point work properly?
- Is the water point clean?

Since the assessment of the first question (the type of watering system) is different from one period to another, sub-scores are first calculated at farm level for each of the three periods and then, these three sub-scores are combined in order to obtain the Criterion-score covering the three periods of the production cycle.

Sub-scores S_1, S_2 and S_3 for Periods 1, 2 and 3
The score S_i (where i = 1, 2 or 3 according to the period considered) for the Criterion *Absence of prolonged thirst* is assigned to foxes (observed at cage level) according to the answers to the four questions (Figure 8, Figure 9 and Figure 10) as follows:

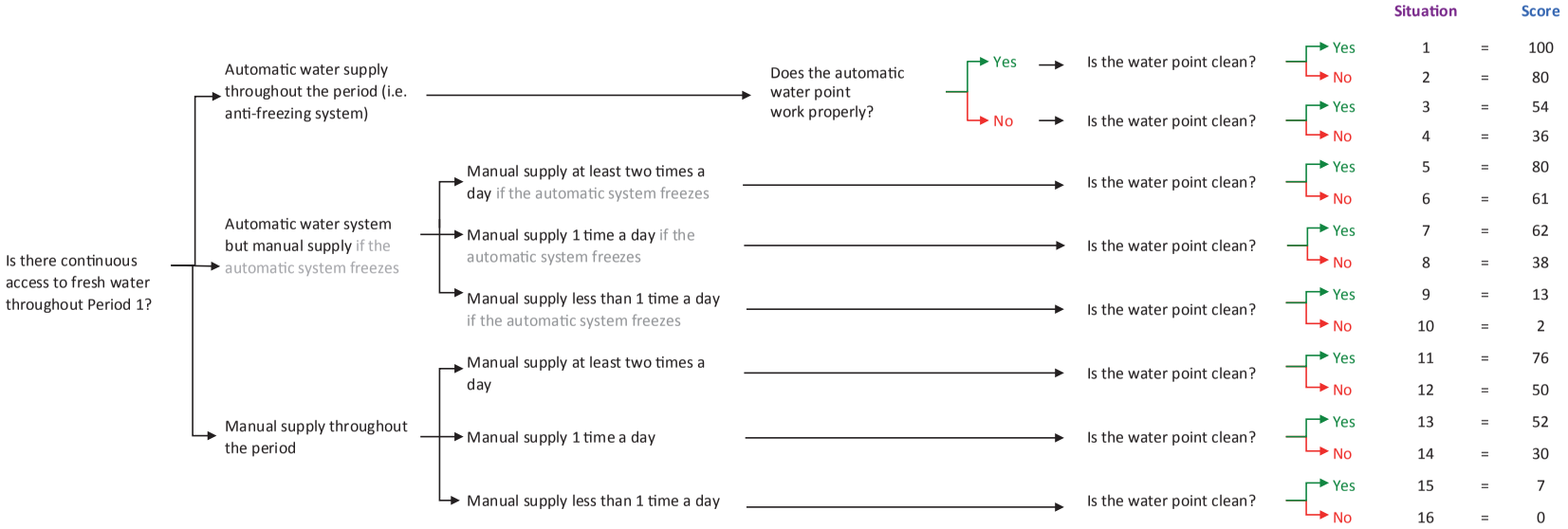

Figure 8 Sub-scores S_1 assigned to combinations of answers to questions on the Measurement of *Continuous water availability* in Period 1

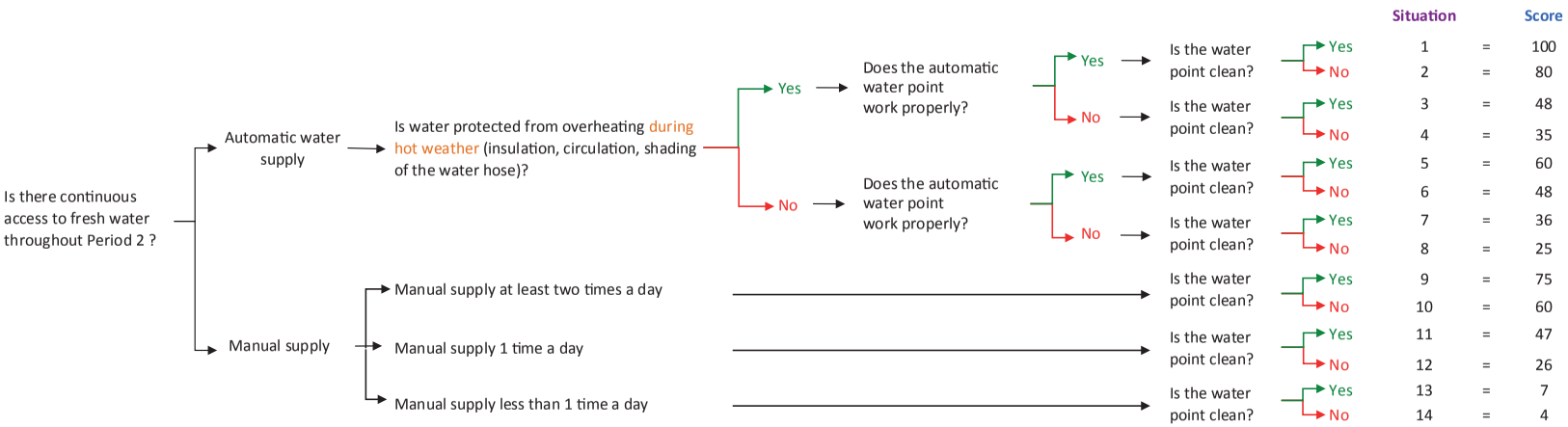

Figure 9 Sub-scores S_2 assigned to combinations of answers to questions on the Measurement of *Continuous water availability* in Period 2

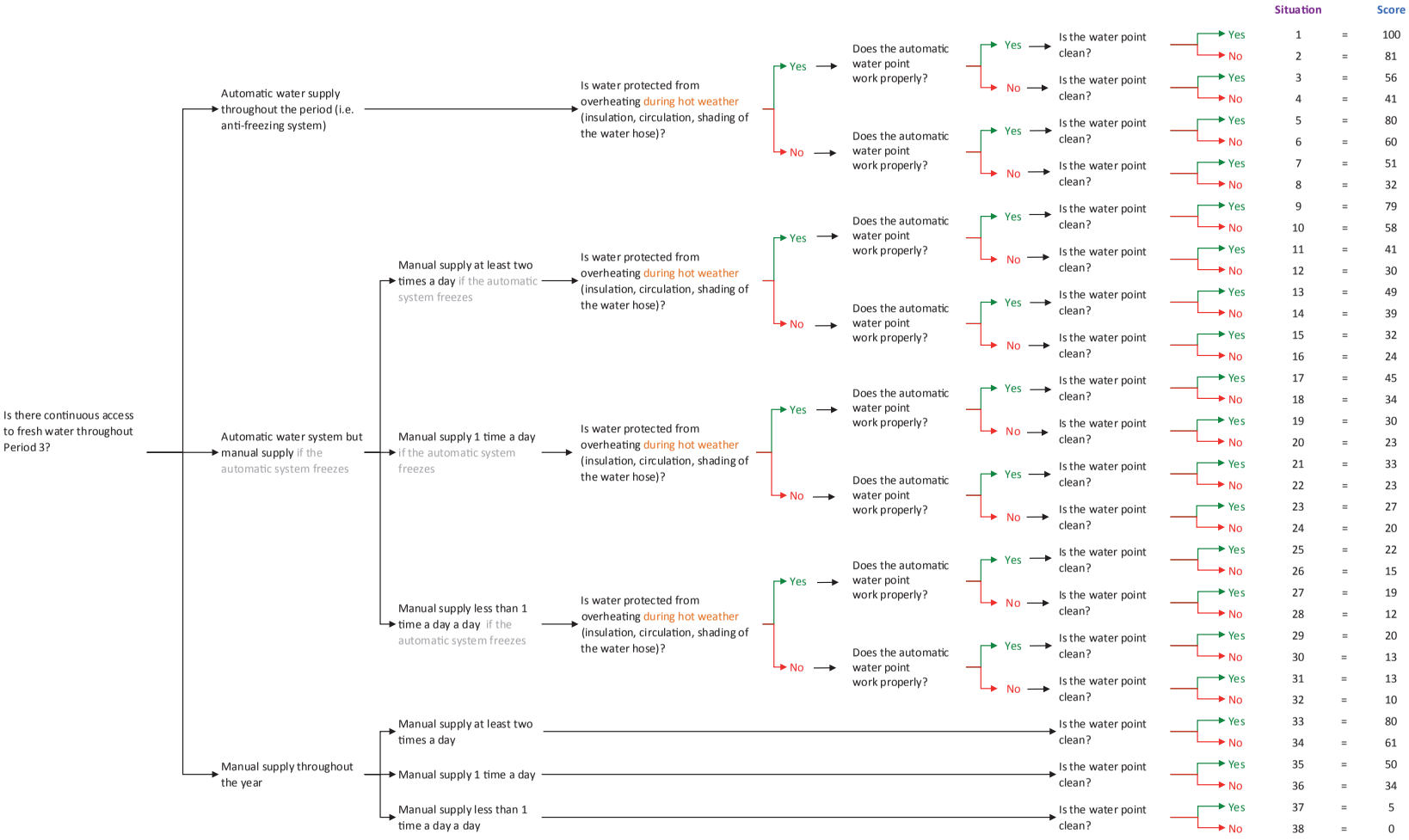

Figure 10 Sub-scores S_3 assigned to combinations of answers to questions on the Measurement of *Continuous water availability* in Period 3

Since animals may be housed with different water provision conditions, we consider the % of animals in each situation defined by the decision-tree. The final score to be assigned to the farm is the worst score (= the one corresponding to the worst situation found on the farm) observed in at least 2% of the animals.

Score for the Criterion *Absence of prolonged thirst*

The three sub-scores are combined to form the overall score for the Criterion *Absence of prolonged thirst* using a Choquet integral. The parameters of the Choquet integral are:

μ_1	=	0.12	μ_{12}	=	0.30
μ_2	=	0.30	μ_{13}	=	0.33
μ_3	=	0.27	μ_{23}	=	0.68

with 1 = Period 1, 2 = Period 2 and 3 = Period 3.

Reminder:

$$\text{Absence of prolonged thirst-score} = \begin{cases} S_1 + (S_2 - S_1)\mu_{23} + (S_3 - S_2)\mu_3 & \text{if} \quad S_1 \le S_2 \le S_3 \\ S_1 + (S_3 - S_1)\mu_{23} + (S_2 - S_3)\mu_2 & \text{if} \quad S_1 \le S_3 \le S_2 \\ S_2 + (S_1 - S_2)\mu_{13} + (S_3 - S_1)\mu_3 & \text{if} \quad S_2 \le S_1 \le S_3 \\ S_2 + (S_3 - S_2)\mu_{13} + (S_1 - S_3)\mu_1 & \text{if} \quad S_2 \le S_3 \le S_1 \\ S_3 + (S_1 - S_3)\mu_{12} + (S_2 - S_1)\mu_2 & \text{if} \quad S_3 \le S_1 \le S_2 \\ S_3 + (S_2 - S_3)\mu_{12} + (S_1 - S_2)\mu_1 & \text{if} \quad S_3 \le S_2 \le S_1 \end{cases}$$

Therefore, with the μ listed above:

$$\text{Absence of prolonged thirst-score} = \begin{cases} S_1 + 0.68(S_2 - S_1) + 0.27(S_3 - S_2) & \text{if} \quad S_1 \le S_2 \le S_3 \\ S_1 + 0.68(S_3 - S_1) + 0.30(S_2 - S_3) & \text{if} \quad S_1 \le S_3 \le S_2 \\ S_2 + 0.33(S_1 - S_2) + 0.27(S_3 - S_1) & \text{if} \quad S_2 \le S_1 \le S_3 \\ S_2 + 0.33(S_3 - S_2) + 0.12(S_1 - S_3) & \text{if} \quad S_2 \le S_3 \le S_1 \\ S_3 + 0.30(S_1 - S_3) + 0.30(S_2 - S_1) & \text{if} \quad S_3 \le S_1 \le S_2 \\ S_3 + 0.30(S_2 - S_3) + 0.12(S_1 - S_2) & \text{if} \quad S_3 \le S_2 \le S_1 \end{cases}$$

Where S_1, S_2 and S_3 are the scores obtained by a given farm for Periods 1, 2 and 3 respectively.
μ_1, μ_2 and μ_3 are the capacities of Periods 1, 2 and 3 respectively.
μ_{12} is the capacity of the group made of Periods 1 and 2 and so on...

3.3.1.3 Comfort around resting

For the Criterion *Comfort around resting,* two partial scores are calculated, one for the Measurement *Cleanliness of the fur* and one for the Measurement *Availability of a platform*, before being combined into a criterion-score for the Criterion *Comfort around resting*.
Moreover, these two measurements are assessed for the three periods of the production cycle. So the first stage, for each measurement, is to calculate the sub-score for each period, then to aggregate the three sub-scores obtained for each period in order to have the score covering the production cycle for each of these two measurements.

Sub-scores S_1^f, S_2^f and S_3^f for Periods 1, 2 and 3 for the Measurement *Cleanliness of the fur*

The score of a farm with regard to the Measurement *Cleanliness of the fur* is calculated from the % of foxes which are considered as clearly dirty, observed during the three periods of the production cycle.

Since the interpretation of the Measurement *Cleanliness of the fur* is different in terms of welfare for each period, the interpretation of this measurement is made for each period separately:

Period 1:
Let I_1 = 100 - % of clearly dirty foxes in Period 1

$$\text{Let } J_1 = \frac{I_1 - 95}{100 - 95} \times 100 \quad \text{if } I_1 \geq 95$$
$$J_1 = 0 \quad \text{if } I_1 < 95$$

J_1 is computed into a score using *I*-spline functions (Figure 11) as follows:

Score = $a_x + b_x \times J_1 + c_x \times J_1^2 + d_x \times J_1^3$

with $x = 1$ when $J_1 < k$ and $x = 2$ when $J_1 \geq k$

Criterion 3 - Cleanliness of the fur - Period 1			
a_1	0	a_2	-719.70269818056294752750545 74
b_1	0.16968820530753261910383 86	b_2	31.92127786917394516308377 21
c_1	-0.00249541478390045328231 15	c_2	-0.46943055737447286768215 80
d_1	0.00003298272525373231099 61	d_2	0.00232188048499675859029 37
k	68		

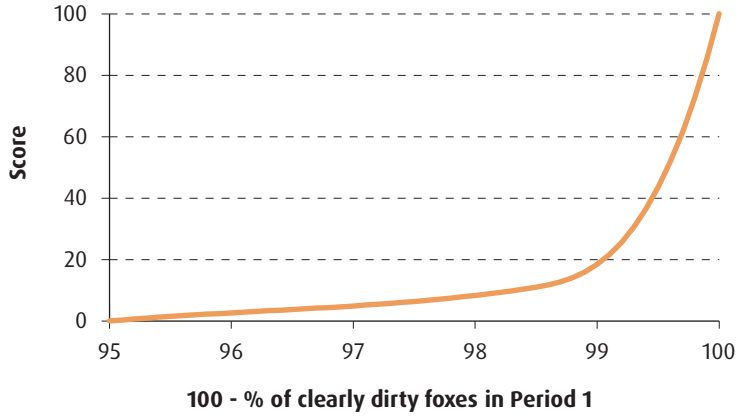

Figure 11 Calculation of the sub-score S_1^f for the Measurement *Cleanliness of the fur according* to the percentage of clearly dirty foxes in Period 1

Period 2:
Let I_2 = 100 - % of clearly dirty foxes in Period 2

$$\text{Let } J_2 = \frac{I_2 - 95}{100 - 95} \times 100 \quad \text{if } I_2 \geq 95$$
$$J_2 = 0 \quad \text{if } I_2 < 95$$

J_2 is computed into a score using *I*-spline functions (Figure 12) as follows:

Score = $a_x + b_x \times J_2 + c_x \times J_2^2 + d_x \times J_2^3$

with $x = 1$ when $J_2 < k$ and $x = 2$ when $J_2 \geq k$

Criterion 3 - Cleanliness of the fur - Period 2			
a_1	0	a_2	-80.143407310878018279254320 1
b_1	0.326148545561470493137079 5	b_2	5.134752983040913321133302 8
c_1	0.003579137173538922845478 2	c_2	-0.092592951558816166679477 5
d_1	-0.000048549633537617527831 5	d_2	0.000592597624595814567727 3
k	50		

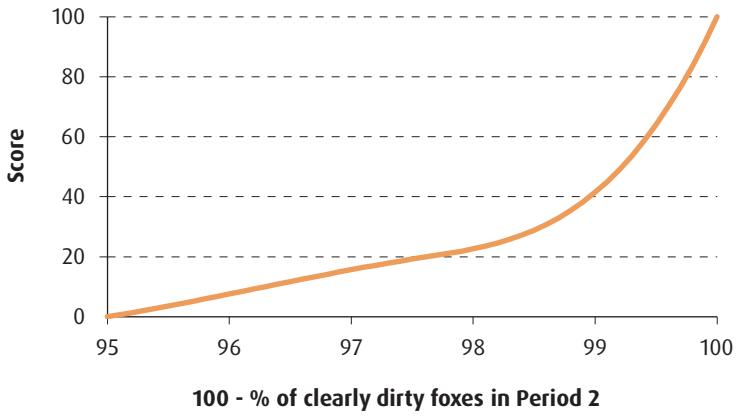

Figure 12 Calculation of the sub-score S_2^f for the Measurement *Cleanliness of the fur* according to the percentage of clearly dirty foxes in Period 2

Period 3:
Let I_3 = 100 - % of clearly dirty foxes in Period 3

$$\text{Let } J_3 = \frac{I_3 - 95}{100 - 95} \times 100 \quad \text{if } I_3 \geq 95$$
$$J_3 = 0 \quad \text{if } I_3 < 95$$

J_3 is computed into a score using *I*-spline functions (Figure 13) as follows:

Score = $a_x + b_x \times J_3 + c_x \times J_3^2 + d_x \times J_3^3$

with $x = 1$ when $J_3 < k$ and $x = 2$ when $J_3 \geq k$

Criterion 3 - Cleanliness of the fur - Period 3			
a_1	0	a_2	-557.18359655200481483916519 21
b_1	0.10624549782449366208680 89	b_2	25.82241145482810651401450 74
c_1	0.00142900833296591986756 87	c_2	-0.39420431360180019364491 95
d_1	-0.00001190324131592280498 53	d_2	0.00201698558710101732635 58
k	65		

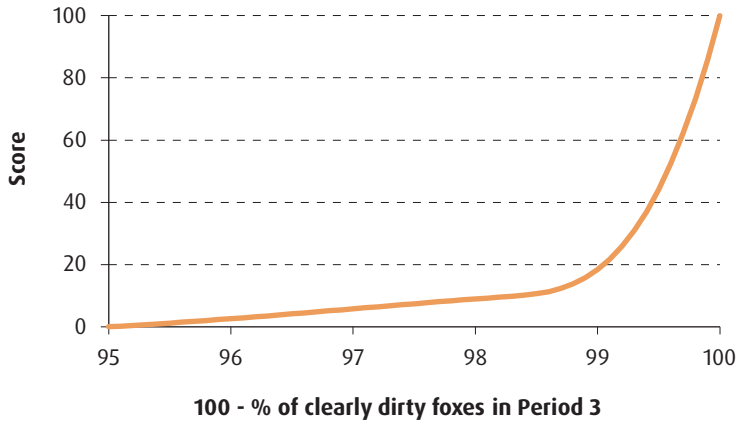

Figure 13 Calculation of the sub-score S_3^f for the Measurement *Cleanliness of the fur according* to the percentage of clearly dirty foxes in Period 3

Score S^f for the Measurement of *Cleanliness of the fur*

The three sub-scores are combined to form the partial score S^f for the Measurement *Cleanliness of the fur* using a Choquet integral. The parameters of the Choquet integral are:

μ_1	=	0.20	μ_{12}	=	0.24
μ_2	=	0.24	μ_{13}	=	0.55
μ_3	=	0.47	μ_{23}	=	0.53

with 1 = Period 1, 2 = Period 2 and 3 = Period 3.

Reminder:

$$S^f\text{-score} = \begin{cases} S_1^f + \left(S_2^f - S_1^f\right)\mu_{23} + \left(S_3^f - S_2^f\right)\mu_3 & \text{if} \quad S_1^f \le S_2^f \le S_3^f \\ S_1^f + \left(S_3^f - S_1^f\right)\mu_{23} + \left(S_2^f - S_3^f\right)\mu_2 & \text{if} \quad S_1^f \le S_3^f \le S_2^f \\ S_2^f + \left(S_1^f - S_2^f\right)\mu_{13} + \left(S_3^f - S_1^f\right)\mu_3 & \text{if} \quad S_2^f \le S_1^f \le S_3^f \\ S_2^f + \left(S_3^f - S_2^f\right)\mu_{13} + \left(S_1^f - S_3^f\right)\mu_1 & \text{if} \quad S_2^f \le S_3^f \le S_1^f \\ S_3^f + \left(S_1^f - S_3^f\right)\mu_{12} + \left(S_2^f - S_1^f\right)\mu_2 & \text{if} \quad S_3^f \le S_1^f \le S_2^f \\ S_3^f + \left(S_2^f - S_3^f\right)\mu_{12} + \left(S_1^f - S_2^f\right)\mu_1 & \text{if} \quad S_3^f \le S_2^f \le S_1^f \end{cases}$$

Therefore, with the μ listed above:

$$S^f\text{-score} = \begin{cases} S_1^f + 0.53\left(S_2^f - S_1^f\right) + 0.47\left(S_3^f - S_2^f\right) & \text{if} \quad S_1^f \le S_2^f \le S_3^f \\ S_1^f + 0.53\left(S_3^f - S_1^f\right) + 0.24\left(S_2^f - S_3^f\right) & \text{if} \quad S_1^f \le S_3^f \le S_2^f \\ S_2^f + 0.55\left(S_1^f - S_2^f\right) + 0.47\left(S_3^f - S_1^f\right) & \text{if} \quad S_2^f \le S_1^f \le S_3^f \\ S_2^f + 0.55\left(S_3^f - S_2^f\right) + 0.20\left(S_1^f - S_3^f\right) & \text{if} \quad S_2^f \le S_3^f \le S_1^f \\ S_3^f + 0.24\left(S_1^f - S_3^f\right) + 0.24\left(S_2^f - S_1^f\right) & \text{if} \quad S_3^f \le S_1^f \le S_2^f \\ S_3^f + 0.24\left(S_2^f - S_3^f\right) + 0.20\left(S_1^f - S_2^f\right) & \text{if} \quad S_3^f \le S_2^f \le S_1^f \end{cases}$$

Where S^f_1, S^f_2 and S^f_3 are the scores obtained by a given farm for the partial score S^f in Periods 1, 2 and 3 respectively.
μ_1, μ_2 and μ_3 are the capacities of Periods 1, 2 and 3 respectively.
μ_{12} is the capacity of the group made of Periods 1 and 2 and so on...

Sub-scores S_2^p, S_2^p and S_3^p for Periods 1, 2 and 3 for the Measurement *Availability of a platform*
The score of a farm with regard to the Measurement *Availability of a platform* is calculated from the % of foxes without a platform for the three periods of the production cycle.

The calculation of the sub-score is the same for each period:
Let I_i = 100 - % of foxes without a platform in period i with i =1, 2 or 3 according to the period considered

$$\text{Let } J_i = \frac{I_i - 50}{100 - 50} \times 100 \quad \text{if } I_i \ge 50$$
$$J_i = 0 \quad \text{if } I_i < 50$$

J_i is computed into a score using *I*-spline functions (Figure 14) as follows:

Score = $a_x + b_x \times J_i + c_x \times J_i^2 + d_x \times J_i^3$ i = 1, 2 or 3

with x = 1 when $J_i < k$ and x = 2 when $J_i \ge k$

Criterion 3 - Availability of a platform - Period 1, 2 or 3			
a_1	0	a_2	-5928.4783289651613813475705683
b_1	0.00000000002723554973612 48	b_2	216.89552775886696167617628 82
c_1	-0.00000000000106010324676 82	c_2	-2.64506717806183200281111 57
d_1	0.00003729260350151766850 07	d_2	0.01078959733553392849603 19
k	82		

Note: The coefficients are the same for the three periods since the interpretation in terms of welfare is the same whatever the period considered.

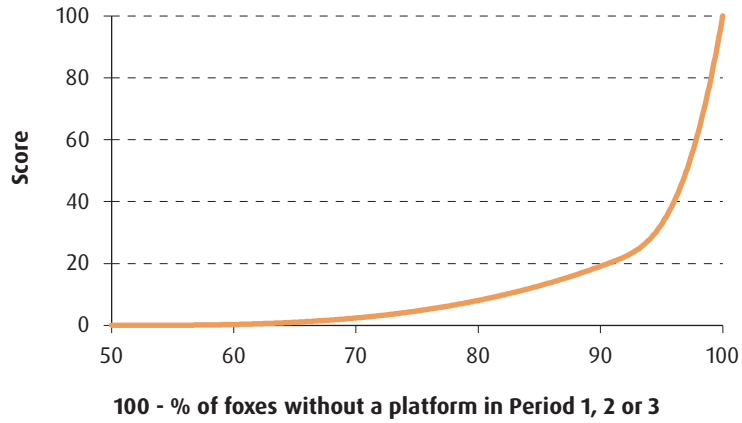

Figure 14 Calculation of the sub-score S_i^p for the Measurement *Availability of a platform* according to the percentage of foxes without a platform (with i = 1, 2 or 3 according to the period considered)

Score S^p for the Measurement *Availability of a platform*

The three sub-scores are combined to form the partial score S^p for the Measurement *Availability of a platform* using a Choquet integral. The parameters of the Choquet integral are:

μ_1	=	0.10	μ_{12}	=	0.26
μ_2	=	0.19	μ_{13}	=	0.39
μ_3	=	0.39	μ_{23}	=	0.46

with 1 = Period 1, 2 = Period 2 and 3 = Period 3.

Reminder:

$$S^p\text{-score} = \begin{cases} S_1^p + \left(S_2^p - S_1^p\right)\mu_{23} + \left(S_3^p - S_2^p\right)\mu_3 & \text{if} \quad S_1^p \le S_2^p \le S_3^p \\ S_1^p + \left(S_3^p - S_1^p\right)\mu_{23} + \left(S_2^p - S_3^p\right)\mu_2 & \text{if} \quad S_1^p \le S_3^p \le S_2^p \\ S_2^p + \left(S_1^p - S_2^p\right)\mu_{13} + \left(S_3^p - S_1^p\right)\mu_3 & \text{if} \quad S_2^p \le S_1^p \le S_3^p \\ S_2^p + \left(S_3^p - S_2^p\right)\mu_{13} + \left(S_1^p - S_3^p\right)\mu_1 & \text{if} \quad S_2^p \le S_3^p \le S_1^p \\ S_3^p + \left(S_1^p - S_3^p\right)\mu_{12} + \left(S_2^p - S_1^p\right)\mu_2 & \text{if} \quad S_3^p \le S_1^p \le S_2^p \\ S_3^p + \left(S_2^p - S_3^p\right)\mu_{12} + \left(S_1^p - S_2^p\right)\mu_1 & \text{if} \quad S_3^p \le S_2^p \le S_1^p \end{cases}$$

Therefore, with the μ listed above:

$$S^p\text{-score} = \begin{cases} S_1^p + 0.46\left(S_2^p - S_1^p\right) + 0.39\left(S_3^p - S_2^p\right) & \textit{if} \quad S_1^p \le S_2^p \le S_3^p \\ S_1^p + 0.46\left(S_3^p - S_1^p\right) + 0.19\left(S_2^p - S_3^p\right) & \textit{if} \quad S_1^p \le S_3^p \le S_2^p \\ S_2^p + 0.39\left(S_1^p - S_2^p\right) + 0.39\left(S_3^p - S_1^p\right) & \textit{if} \quad S_2^p \le S_1^p \le S_3^p \\ S_2^p + 0.39\left(S_3^p - S_2^p\right) + 0.10\left(S_1^p - S_3^p\right) & \textit{if} \quad S_2^p \le S_3^p \le S_1^p \\ S_3^p + 0.26\left(S_1^p - S_3^p\right) + 0.19\left(S_2^p - S_1^p\right) & \textit{if} \quad S_3^p \le S_1^p \le S_2^p \\ S_3^p + 0.26\left(S_2^p - S_3^p\right) + 0.10\left(S_1^p - S_2^p\right) & \textit{if} \quad S_3^p \le S_2^p \le S_1^p \end{cases}$$

Where S^p_1, S^p_2 and S^p_3 are the sub-scores obtained by a given farm for Periods 1, 2 and 3 respectively.
μ_1, μ_2 and μ_3 are the capacities of Periods 1, 2 and 3 respectively.
μ_{12} is the capacity of the group made of Periods 1 and 2 and so on...

Score for the Criterion of *Comfort around resting*
The two partial scores are combined to form the overall score for the Criterion of *Comfort around resting* using a Choquet integral. The parameters of the Choquet integral are:

$$\mu_f = 0.13 \qquad \mu_p = 0.47$$

with *f*, cleanliness of the fur and *p*, availability of a platform.

Reminder:

$$\text{Comfort around resting-score} = \begin{cases} S^f + \left(S^p - S^f\right)\mu_p & \text{if} \quad S^f \le S^p \\ S^p + \left(S^f - S^p\right)\mu_f & \text{if} \quad S^p \le S^f \end{cases}$$

Therefore, with the μ listed above:

$$\text{Comfort around resting-score} = \begin{cases} S^f + 0.47\left(S^p - S^f\right) & \text{if} \quad S^f \le S^p \\ S^p + 0.13\left(S^f - S^p\right) & \text{if} \quad S^p \le S^f \end{cases}$$

Where S^f and S^p are the partial scores obtained by a given farm for the Sub-measurements '*f*' and '*p*' respectively.
μ_f and μ_p are the capacities of the Sub-measurements 'f' and 'p' respectively.

3.3.1.4 Thermal comfort

For the Criterion *Thermal comfort*, it is assessed if there is any protection from exceptional weather conditions for foxes on the farm. This is considered separately for Periods 1, 2 and 3 due to the changes in weather between the periods. In Period 1, only the Sub-measurement *Protection from wind* is assessed, in Period 2, only the Sub-measurement *Possibility of cooling the cages during extremely hot weather* is assessed and in Period 3 both sub-measurements are assessed.

Since the Measurement *Protection from exceptional weather conditions* is assessed in different ways for the three periods of the production cycle, the first stage is to calculate the sub-score for each period, then to aggregate the three sub-scores obtained for each period in order to have the score covering the production cycle *i.e.* the criterion-score.

Sub-scores S_1, S_2 and S_3 for Periods 1, 2 and 3 for the Measurement *Protection from exceptional weather conditions*

In period 1:
The score of a farm with regard to the Measurement *Protection from exceptional weather conditions* is calculated from the % of foxes within each level of the scale used to assess the Sub-measurement of *Protection from wind* (4 levels here):

Level	0	1	2	3
% of foxes	P^1_0	P^1_1	P^1_2	P^1_3
$\text{Let } I_1 = \left(100 - \frac{\sum_{j=0}^{3} w^1_j \; p^1_j}{w^1_3}\right)$		NB: As Blue foxes are by nature well protected from the wind, they are systematically assigned to the category "high protection from the wind".		
Weights	$w^1_0 = 0$	$w^1_1 = 6$	$w^1_2 = 10$	$w^1_3 = 13$

I_1 is computed into a score using *I*-spline functions (Figure 15) as follows:

Score = $a_x + b_x \times I_1 + c_x \times I_1^2 + d_x \times I_1^3$

with $x = 1$ when $I_1 < k$ and $x = 2$ when $I_1 \geq k$

Criterion 4 - Protection from wind - Period 1			
a_1	0	a_2	-12.126750454832093240042922 8
b_1	0.74391317116248512064657 92	b_2	1.47151819841624975637728 31
c_1	0.01158211759466817522556 96	c_2	-0.00296998294986133880637 99
d_1	-0.00010233924351560765941 91	d_2	-0.00000532523988815089650 63
k	50		

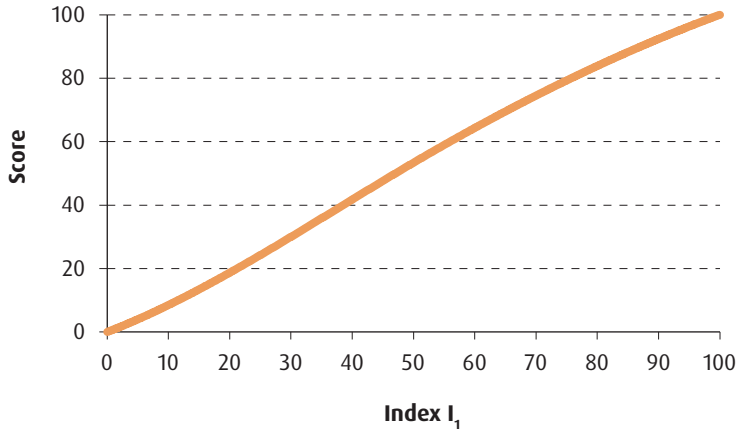

Figure 15 Calculation of the sub-score S1 for the Sub-measurement *Protection from wind* according to the percentage of foxes in each category of protection in Period 1

In Period 2:

The score of a farm with regard to the Measurement *Protection from exceptional weather conditions* is calculated from the % of foxes within each level of the scale used to assess the Sub-measurement *Possibility of cooling the cages during extremely hot weather* (3 levels here):

Level	**0**	**1**	**2**
% of foxes	P_0^2	P_1^2	P_2^2
	$\text{Let } I_2 = \left(100 - \frac{\sum_{j=0}^{2} w_j^2 \; p_j^2}{w_2^2} \right)$		
Weights	$w_0^2 = 0$	$w_1^2 = 1$	$w_2^2 = 4$

I_2 is computed into a score using *I*-spline functions (Figure 16) as follows:

Score = $a_x + b_x \times I_2 + c_x \times I_2^2 + d_x \times I_2^3$

with $x = 1$ when $I_2 < k$ and $x = 2$ when $I_2 \geq k$

Criterion 4 - Possibility of cooling the cages - Period 2			
a_1	0	a_2	-237.06033879009703468909719 96
b_1	0.795484624244607529952588 7	b_2	10.955213397638921435373049 5
c_1	-0.004785070279974056733918 2	c_2	-0.149924052366616378240138 4
d_1	0.000049641514344323047533 0	d_2	0.000740779522700793675860 1
k	70		

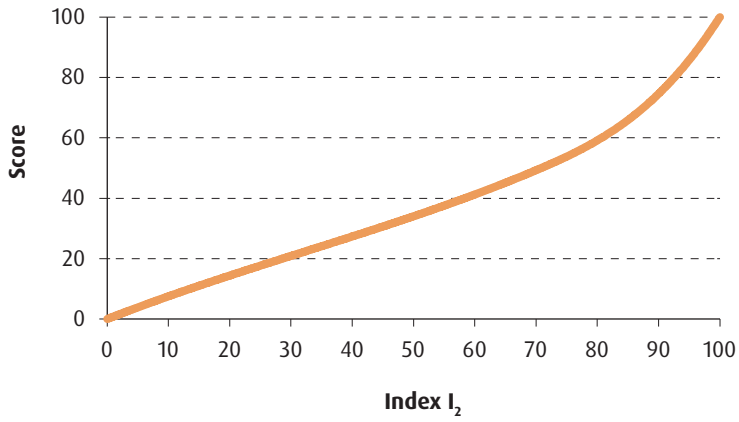

Figure 16 Calculation of the sub-score S_2 for the Sub-measurement *Possibility of cooling the cages during extremely hot* weather according to the percentage of foxes in each category of possibility of cooling the cage in Period 2

In Period 3:
In Period 3, a decision-tree combining the two ordinal sub-measurements leading to 12 possible situations allows to calculate the score for the Measurement *Protection from exceptional weather conditions*. The sub-score S_3 is assigned to foxes submitted to a given combination and is calculated as the mean score assigned by experts to this combination (Figure 17).

NB: As blue foxes are by nature well protected from the wind, they are systematically assigned to the category "high protection from the wind".

The following scores are assigned to each of the situations:

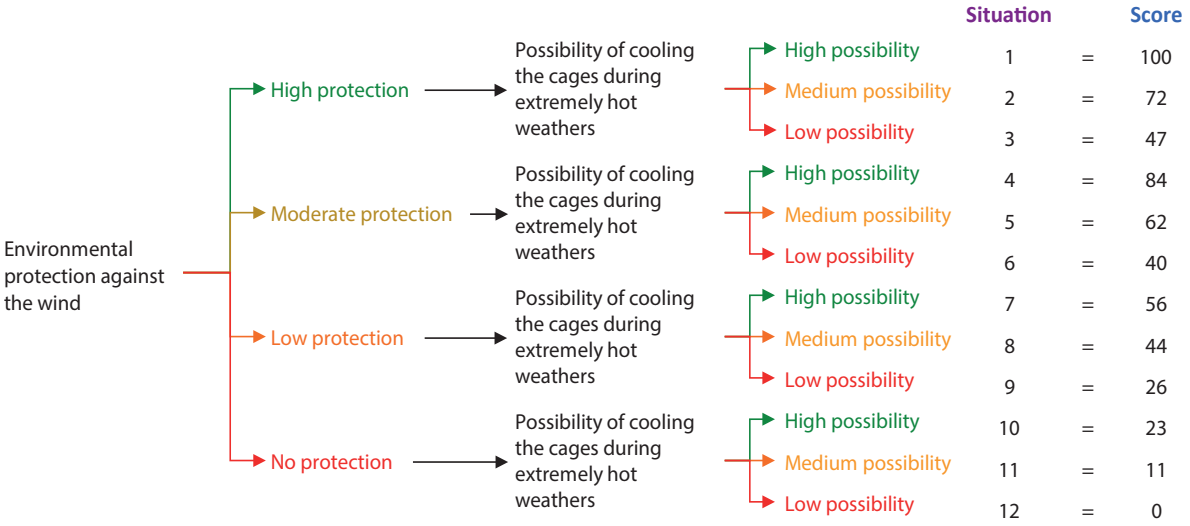

Figure 17 Sub-scores S_3 assigned to combinations of observations on possibility to protect the foxes from the wind and possibility of cooling the cages in Period 3

Since animals may be housed with different environmental protection conditions, we consider, in Period 3, the % of animals in each situation defined by the decision-tree (see Figure 17) and the final score to be assigned to the farm is the worst score (= the one corresponding to the worst situation found on the farm) observed in at least 10% of the animals.

Score for the Criterion *Thermal comfort*

The three sub-scores are combined to form the overall score for the Criterion *Thermal comfort* using a Choquet integral. The parameters of the Choquet integral are:

μ_1	=	0.28	μ_{12}	=	0.28
μ_2	=	0.21	μ_{13}	=	0.46
μ_3	=	0.43	μ_{23}	=	0.44

with 1 = Period 1, 2 = Period 2 and 3 = Period 3.

Reminder:

$$\text{Thermal comfort-score} = \begin{cases} S_1 + (S_2 - S_1)\mu_{23} + (S_3 - S_2)\mu_3 & \text{if} \quad S_1 \le S_2 \le S_3 \\ S_1 + (S_3 - S_1)\mu_{23} + (S_2 - S_3)\mu_2 & \text{if} \quad S_1 \le S_3 \le S_2 \\ S_2 + (S_1 - S_2)\mu_{13} + (S_3 - S_1)\mu_3 & \text{if} \quad S_2 \le S_1 \le S_3 \\ S_2 + (S_3 - S_2)\mu_{13} + (S_1 - S_3)\mu_1 & \text{if} \quad S_2 \le S_3 \le S_1 \\ S_3 + (S_1 - S_3)\mu_{12} + (S_2 - S_1)\mu_2 & \text{if} \quad S_3 \le S_1 \le S_2 \\ S_3 + (S_2 - S_3)\mu_{12} + (S_1 - S_2)\mu_1 & \text{if} \quad S_3 \le S_2 \le S_1 \end{cases}$$

Therefore, with the μ listed above:

$$\text{Thermal comfort-score} = \begin{cases} S_1 + 0.44(S_2 - S_1) + 0.43(S_3 - S_2) & \text{if} \quad S_1 \le S_2 \le S_3 \\ S_1 + 0.44(S_3 - S_1) + 0.21(S_2 - S_3) & \text{if} \quad S_1 \le S_3 \le S_2 \\ S_2 + 0.46(S_1 - S_2) + 0.43(S_3 - S_1) & \text{if} \quad S_2 \le S_1 \le S_3 \\ S_2 + 0.46(S_3 - S_2) + 0.28(S_1 - S_3) & \text{if} \quad S_2 \le S_3 \le S_1 \\ S_3 + 0.28(S_1 - S_3) + 0.21(S_2 - S_1) & \text{if} \quad S_3 \le S_1 \le S_2 \\ S_3 + 0.28(S_2 - S_3) + 0.28(S_1 - S_2) & \text{if} \quad S_3 \le S_2 \le S_1 \end{cases}$$

Where S_1, S_2 and S_3 are the scores obtained by a given farm for the Criterion *Thermal comfort* in Periods 1, 2 and 3 respectively.
μ_1, μ_2 and μ_3 are the capacities of Periods 1, 2 and 3 respectively.
μ_{12} is the capacity of the group made of Periods 1 and 2 and so on...

3.3.1.5 Ease of movement

For the Criterion *Ease of movement* two partial scores are calculated, one for the *Floor area* and one for the *Cage height*, before being combined into a criterion-score.

Moreover, these two measurements are assessed for the three periods of the production cycle. So the first stage is to calculate the sub-score for each period, then to aggregate the three sub-scores obtained (*i.e.* one sub-score per period for each measurement separately) in order to have the score covering the production cycle for each of these two measurements.

Sub-scores S_1^a, S_2^a and S_3^a for Periods 1, 2 and 3 for the measurement *Floor area*
The score of a farm with regard to the measurement *Floor area* is calculated from the % of foxes within each level of the scale used to assess floor area (3 levels here), whatever the period considered:

Level	**0**	**1**	**2**
% of foxes	$P^a_{i,0}$	$P^a_{i,1}$	$P^a_{i,2}$
Let $I_i = \left(100 - \frac{\sum_{j=0}^{2} w^a_{i,j} \; p^a_{i,j}(x)}{w^a_{i,2}} \right)$	with i = 1, 2 or 3 according to the Period and j = 0, 1 or 2 according to the level.		
In Period 1 or 2:			
Weights	$w^a_{i,0} = 0$	$w^a_{i,1} = 1$	$w^a_{i,2} = 9$

I_i is computed into a score using *I*-spline functions (Figure 18) as follows:

Score = $a_x + b_x \times I_i + c_x \times I_i^2 + d_x \times I_i^3$ $\quad i = 1$ or 2

with $x = 1$ when $I_i < k$ and $x = 2$ when $I_i \ge k$

Criterion 5 - Floor area - Period 1 or 2			
a_1	0	a_2	-20.172775955191980301606236 0
b_1	-0.00000000000008962766555362	b_2	1.729095081887538132292547 7
c_1	0.01986224851774773952906 02	c_2	-0.02954046810793907809622 46
d_1	-0.00022783411425824422430 30	d_2	0.00024266794884580876706 49
k	35		

Note: The coefficients are the same for the two periods (i.e. Periods 1 and 2) since the interpretation in terms of welfare is the same whatever the period considered.

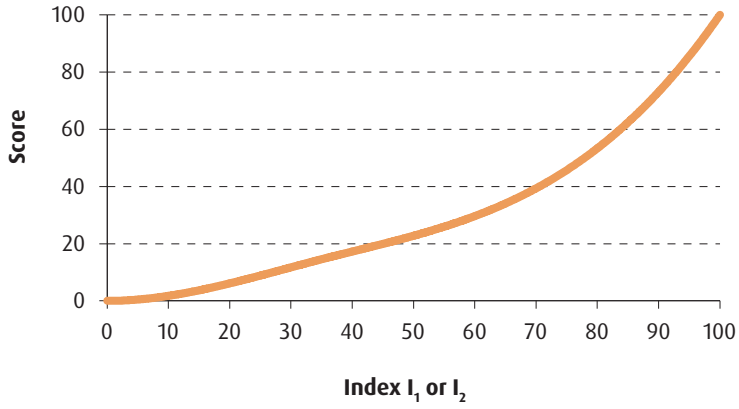

Figure 18 Calculation of the sub-scores S_2^a and S_2^a for the measurement *Floor area* according to the percentage of foxes in each category of floor area in their cages in Period 1 or 2

In Period 3:

Weights	$w^a_{i,0} = 0$	$w^a_{i,1} = 1$	$w^a_{i,2} = 9$

I_3 is computed into a score using *I*-spline functions (Figure 19) as follows:

Score = $a_x + b_x \times I_3 + c_x \times I_3^2 + d_x \times I_3^3$

with $x = 1$ when $I_3 < k$ and $x = 2$ when $I_3 \geq k$

Criterion 5 - Floor area - Period 3			
a_1	0	a_2	-11.030338635467302310644299 7
b_1	0.20582980260516195447628 72	b_2	0.71492235405939819070653 13
c_1	0.00104567327983321909853 91	c_2	-0.00678651980732883006175 45
d_1	0.00006723820859943795735 8	d_2	0.00010740330130316301721 68
k	65		

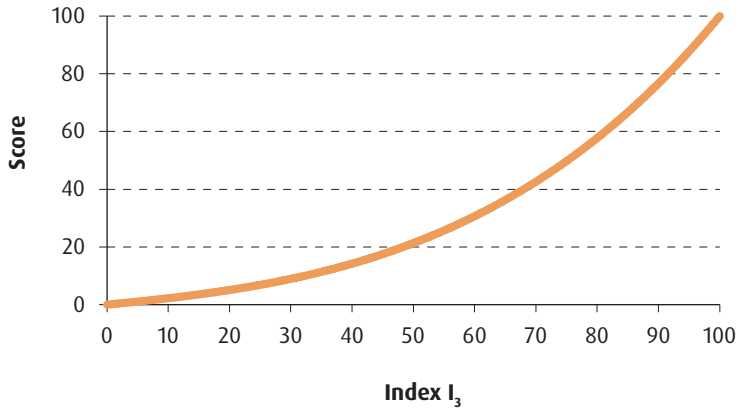

Figure 19 Calculation of the sub-score S_3^a for the measurement *Floor area* according to the percentage of foxes in each category of floor area in their cages in Period 3

NB: The calculation is similar for the three periods but, as the interpretation is different in terms of welfare in Period 3, the measurement was interpreted separately for this period and therefore the coefficients of the curve are different from the ones used for Periods 1 and 2.

Score S^a for the Sub-measurement *Floor area*

The three sub-scores are combined to form the partial score S^a for the measurement *Floor area* using a Choquet integral. The parameters of the Choquet integral are:

μ_1	=	0.21	μ_{12}	=	0.21
μ_2	=	0.13	μ_{13}	=	0.50
μ_3	=	0.35	μ_{23}	=	0.67

with 1 = Period 1, 2 = Period 2 and 3 = Period 3.

Reminder:

$$S^a\text{-score} = \begin{cases} S_1^a + \left(S_2^a - S_1^a\right)\mu_{23} + \left(S_3^a - S_2^a\right)\mu_3 & \text{if} \quad S_1^a \le S_2^a \le S_3^a \\ S_1^a + \left(S_3^a - S_1^a\right)\mu_{23} + \left(S_2^a - S_3^a\right)\mu_2 & \text{if} \quad S_1^a \le S_3^a \le S_2^a \\ S_2^a + \left(S_1^a - S_2^a\right)\mu_{13} + \left(S_3^a - S_1^a\right)\mu_3 & \text{if} \quad S_2^a \le S_1^a \le S_3^a \\ S_2^a + \left(S_3^a - S_2^a\right)\mu_{13} + \left(S_1^a - S_3^a\right)\mu_1 & \text{if} \quad S_2^a \le S_3^a \le S_1^a \\ S_3^a + \left(S_1^a - S_3^a\right)\mu_{12} + \left(S_2^a - S_1^a\right)\mu_2 & \text{if} \quad S_3^a \le S_1^a \le S_2^a \\ S_3^a + \left(S_2^a - S_3^a\right)\mu_{12} + \left(S_1^a - S_2^a\right)\mu_1 & \text{if} \quad S_3^a \le S_2^a \le S_1^a \end{cases}$$

Therefore, with the μ listed above:

$$S^a\text{-score} = \begin{cases} S_1^a + 0.67\left(S_2^a - S_1^a\right) + 0.35\left(S_3^a - S_2^a\right) & \text{if} \quad S_1^a \le S_2^a \le S_3^a \\ S_1^a + 0.67\left(S_3^a - S_1^a\right) + 0.13\left(S_2^a - S_3^a\right) & \text{if} \quad S_1^a \le S_3^a \le S_2^a \\ S_2^a + 0.50\left(S_1^a - S_2^a\right) + 0.35\left(S_3^a - S_1^a\right) & \text{if} \quad S_2^a \le S_1^a \le S_3^a \\ S_2^a + 0.50\left(S_3^a - S_2^a\right) + 0.21\left(S_1^a - S_3^a\right) & \text{if} \quad S_2^a \le S_3^a \le S_1^a \\ S_3^a + 0.21\left(S_1^a - S_3^a\right) + 0.13\left(S_2^a - S_1^a\right) & \text{if} \quad S_3^a \le S_1^a \le S_2^a \\ S_3^a + 0.21\left(S_2^a - S_3^a\right) + 0.21\left(S_1^a - S_2^a\right) & \text{if} \quad S_3^a \le S_2^a \le S_1^a \end{cases}$$

Where S_1^a, S_2^a and S_3^a are the sub-scores obtained by a given farm for the measurement Floor area in Periods 1, 2 and 3 respectively.
μ1, μ2 and μ3 are the capacities of the measurement Floor area in Periods 1, 2 and 3 respectively.
μ12 is the capacity of the group made of the measurements in period 1 and 2 and so on...

Sub-scores S_2^h, S_2^h and S_3^h for Periods 1, 2 and 3 for the measurement *Cage height*

The score of a farm with regard to the measurement *Cage height* is calculated from the % of foxes within each level of the scale used to assess cage height (4 levels here), whatever the period considered:

Level	**0**	**1**	**2**	**3**
% of foxes	$P^h_{i,0}$	$P^h_{i,1}$	$P^h_{i,2}$	$P^h_{i,3}$
$\text{Let } I_i = \left(100 - \frac{\sum_{k=0}^{3} w^h_{i,j}\ p^h_{i,j}(x)}{w^h_{i,3}}\right)$	with i = 1, 2 or 3 according to the period and j = 0, 1, 2 or 3 according to the level			
Weights	$w^h_{i,0} = 0$	$w^h_{i,1} = 3$	$w^h_{i,2} = 10$	$w^h_{i,3} = 64$

I_i is computed into a score using *I*-spline functions (Figure 20) as follows:

Score = $a_x + b_x \times I_i + c_x \times I_i^2 + d_x \times I_i^3$ i = 1, 2 or 3

with $x = 1$ when $I_i < k$ and $x = 2$ when $I_i \ge k$

Criterion 5 - Cage height - Period 1, 2 or 3			
a_1	0	a_2	1633.86929822146521473769098 52
b_1	0.16427432312251419310733 52	b_2	-57.50169233549267744365351 97
c_1	-0.00193263909569928063296 45	c_2	0.67649040399718418647978 52
d_1	0.00011187807328270981766 05	d_2	-0.00254860410517742264763 23
k	85		

Note: The coefficients are the same for the three periods since the interpretation in terms of welfare is the same whatever the period considered.

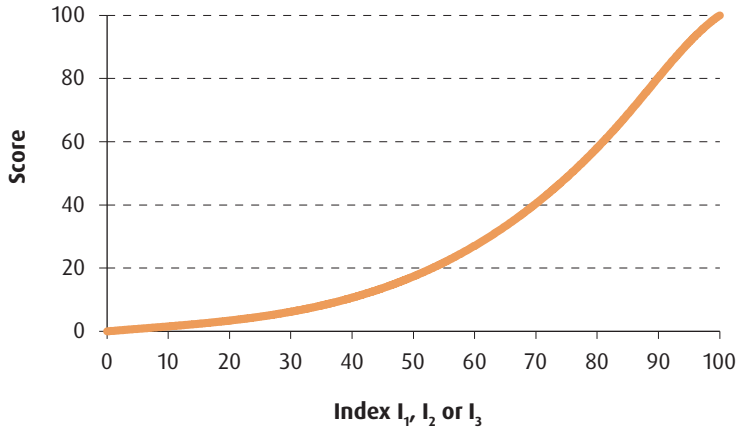

Figure 20 Calculation of the sub-score S_i^h measurement *Cage height* according to the percentage of foxes in each category of cage height (with i =1, 2 or 3 according to the period considered)

Score S^h for the measurement *Cage height*

The three sub-scores are combined to form the partial score S^h for the measurement *Cage height* using a Choquet integral. The parameters of the Choquet integral are:

μ_1	=	0.16	μ_{12}	=	0.22
μ_2	=	0.21	μ_{13}	=	0.53
μ_3	=	0.53	μ_{23}	=	0.57

with 1 = Period 1, 2 = Period 2 and 3 = Period 3.

Reminder:

$$S^h\text{-score} = \begin{cases} S_1^h + \left(S_2^h - S_1^h\right)\mu_{23} + \left(S_3^h - S_2^h\right)\mu_3 & \text{if} \quad S_1^h \le S_2^h \le S_3^h \\ S_1^h + \left(S_3^h - S_1^h\right)\mu_{23} + \left(S_2^h - S_3^h\right)\mu_2 & \text{if} \quad S_1^h \le S_3^h \le S_2^h \\ S_2^h + \left(S_1^h - S_2^h\right)\mu_{13} + \left(S_3^h - S_1^h\right)\mu_3 & \text{if} \quad S_2^h \le S_1^h \le S_3^h \\ S_2^h + \left(S_3^h - S_2^h\right)\mu_{13} + \left(S_1^h - S_3^h\right)\mu_1 & \text{if} \quad S_2^h \le S_3^h \le S_1^h \\ S_3^h + \left(S_1^h - S_3^h\right)\mu_{12} + \left(S_2^h - S_1^h\right)\mu_2 & \text{if} \quad S_3^h \le S_1^h \le S_2^h \\ S_3^h + \left(S_2^h - S_3^h\right)\mu_{12} + \left(S_1^h - S_2^h\right)\mu_1 & \text{if} \quad S_3^h \le S_2^h \le S_1^h \end{cases}$$

Therefore, with the μ listed above:

$$S^h\text{-score} = \begin{cases} S_1^h + 0.57\left(S_2^h - S_1^h\right) + 0.53\left(S_3^h - S_2^h\right) & \text{if} \quad S_1^h \le S_2^h \le S_3^h \\ S_1^h + 0.57\left(S_3^h - S_1^h\right) + 0.21\left(S_2^h - S_3^h\right) & \text{if} \quad S_1^h \le S_3^h \le S_2^h \\ S_2^h + 0.53\left(S_1^h - S_2^h\right) + 0.53\left(S_3^h - S_1^h\right) & \text{if} \quad S_2^h \le S_1^h \le S_3^h \\ S_2^h + 0.53\left(S_3^h - S_2^h\right) + 0.16\left(S_1^h - S_3^h\right) & \text{if} \quad S_2^h \le S_3^h \le S_1^h \\ S_3^h + 0.22\left(S_1^h - S_3^h\right) + 0.21\left(S_2^h - S_1^h\right) & \text{if} \quad S_3^h \le S_1^h \le S_2^h \\ S_3^h + 0.22\left(S_2^h - S_3^h\right) + 0.16\left(S_1^h - S_2^h\right) & \text{if} \quad S_3^h \le S_2^h \le S_1^h \end{cases}$$

Where S^h_1, S^h_2 and S^h_3 are the sub-scores obtained by a given farm for the measurement *Cage height* in Periods 1, 2 and 3 respectively.
μ_1, μ_2 and μ_3 are the capacities of the measurement *Cage height* in Periods 1, 2 and 3 respectively.
μ_{12} is the capacity of the group made of the measurements in period 1 and 2 and so on...

Score for the Criterion of *Ease movement*

The two partial scores are combined to form the overall score for the Criterion *Ease of movement* using a Choquet integral. The parameters of the Choquet integral are:

μ_a = 0.39 μ_h = 0.31

with *a*, floor area and *h*, cage height.

Reminder:

$$\text{Ease of movement-score} = \begin{cases} S^a + \left(S^h - S^a\right)\mu_h & \text{if} \quad S^a \le S^h \\ S^h + \left(S^a - S^h\right)\mu_a & \text{if} \quad S^h \le S^a \end{cases}$$

Therefore, with the μ listed above:

$$\text{Ease of movement-score} = \begin{cases} S^a + 0.31\left(S^h - S^a\right) & \text{if} \quad S^a \le S^h \\ S^h + 0.39\left(S^a - S^h\right) & \text{if} \quad S^h \le S^a \end{cases}$$

Where S^a and S^b are the partial scores obtained by a given farm for the measurements *Floor area* and *of Cage height* respectively.
μ_a and μ_b are the capacities of the measurements *Floor area* and *of Cage height* respectively.

3.3.1.6 Absence of injuries

For the Criterion Absence of injuries, two partial scores are calculated, both in Period 3 of the production cycle, one for the Measurement *Difficulties in moving* and one for the Measurement *Skin lesions and/or other observed injuries to the body*, before being combined into a criterion-score.

Score S_3^m for Period 3 for the Measurement *Difficulties in moving*

The score of a farm in regard to the Measurement *Difficulties in moving* is calculated from the % of foxes within each level of the scale used to assess difficulties in moving (4 levels here) in Period 3:

Level	0	1	2	3
% of foxes	P^m_0	P^m_1	P^m_2	P^m_3
$\text{Let } I_3 = \left(100 - \frac{\sum_{j=0}^{3} w_j^m \; p_j^m(x)}{w_3^m}\right)$	with j = 0, 1, 2 or 3 according to the level.			
Weights	$w^m_0 = 0$	$w^m_1 = 5$	$w^m_2 = 13$	$w^m_3 = 22$

$$\text{Let } J_3 = \frac{I_3 - 70}{100 - 70} \times 100 \quad \text{if } I_3 \geq 70$$

$$J_3 = 0 \quad \text{if } I_3 < 70$$

J_3 is computed into a score using *I*-spline functions (Figure 21) as follows:

Score = $a_x + b_x \times J_3 + c_x \times J_3^2 + d_x \times J_3^3$

with $x = 1$ when $J_3 < k$ and $x = 2$ when $J_3 \geq k$

Criterion 6 - Difficulties in moving - Period 3			
a_1	0	a_2	-749.50932392987510866078082 47
b_1	0.00000000000028438796999449	b_2	32.12182833642389567785357 94
c_1	0.00336885065242255874254 36	c_2	-0.45551441335682646416316 29
d_1	0.00000731221541283907979 10	d_2	0.00219247062381097050989 82
k	70		

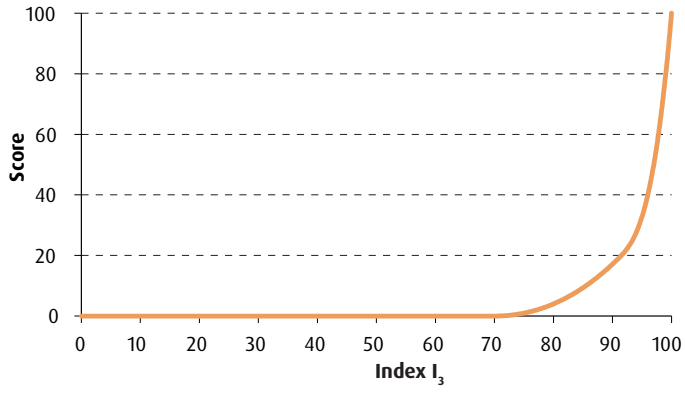

Figure 21 Calculation of the score S_3^m for the Measurement *Difficulties in moving* according to the percentage of foxes in each category of difficulties in moving in Period 3

Score S_3^I for Period 3 for the Measurement *Skin lesions and/or other observed injuries to the body*

The score of a farm in regard to the Measurement *Skin lesions and/or other observed injuries to the body* is calculated from the % of foxes within each level of the scale used to assess skin lesions (3 levels here) in Period 3:

Level	0	1	2
% of foxes	P_0^I	P_1^I	P_2^I
Let $I_3 = \left(100 - \frac{\sum_{j=0}^{2} w_j^I \; p_j^I(x)}{w_2^I}\right)$		with j = 0, 1 or 2 according to the level	
Weights	$w_0^I = 0$	$w_1^I = 3$	$w_2^I = 8$

Let $J_3 = \frac{I_3 - 40}{100 - 40} \times 100$ if $I_3 \geq 40$

$J_3 = 0$ if $I_3 < 40$

J_3 is computed into a score using I-spline functions (Figure 22) as follows:

Score = $a_x + b_x \times J_3 + c_x \times J_3^2 + d_x \times J_3^3$

with $x = 1$ when $I_3 < k$ and $x = 2$ when $I_3 \geq k$

Criterion 6 - Skin lesions - Period 3			
a_1	0	a_2	-697.0868830093527321878354996
b_1	0.000000000007158778043750 4	b_2	30.753833130163389597555578 8
c_1	-0.000000000000335548778455 9	c_2	-0.452262252617075477534314 1
d_1	0.000027354266695316485370 2	d_2	0.002244326096145967969902 6
k	68		

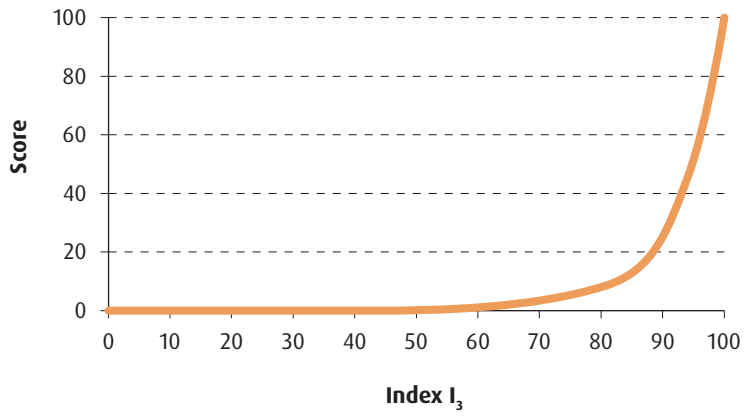

Figure 22 Calculation of the score S_3^I for the Measurement *Skin lesions and/or other observed injuries to the body* according to the percentage of foxes in each category of skin lesions in Period 3

Score for the Criterion *Absence of injuries*

The two partial scores are combined to form the overall score for the Criterion of *Absence of injuries* using a Choquet integral. The parameters of the Choquet integral are:

$\mu_m = 0.39$ $\mu_l = 0.19$

with *m*, difficulties in moving and *l*, skin lesions

Reminder:

$$\text{Absence of injuries-score} = \begin{cases} S^m + \left(S^l - S^m\right)\mu_l & \text{if} \quad S^m \le S^l \\ S^l + \left(S^m - S^l\right)\mu_m & \text{if} \quad S^l \le S^m \end{cases}$$

Therefore, with the μ listed above:

$$\text{Absence of injuries-score} = \begin{cases} S^m + 0.39\left(S^l - S^m\right) & \text{if} \quad S^m \le S^l \\ S^l + 0.19\left(S^m - S^l\right) & \text{if} \quad S^l \le S^m \end{cases}$$

Where S^m and S^l are the partial scores obtained by a given farm for the Measurements *of Difficulties in moving* and *Skin lesions, and/or other observed injuries to the body* respectively.
μ_m and μ_l are the capacities of the Measurements *Difficulties in moving* and *Skin lesions and/or other observed injuries to the body*, respectively.

3.3.1.7 Absence of disease

For the Criterion *Absence of disease,* the incidence of health disorders is compared to warning and alarm thresholds. The alarm threshold is the minimum value (percentage of animals) for a decision to set up a health plan at farm level. The warning threshold is half of the alarm threshold. The values chosen for alarm thresholds appear in Table 6.

Table 6 Warning and alarm thresholds for each health disorder and for mortality

Incidence of each disorder	**Warning threshold**	**Alarm threshold**
% of foxes with severely bent feet	7.50%	15.00 %
% of foxes with ocular inflammation	3.75%	7.50 %
% of foxes with impaired mouth and teeth health	1.50%	3.00 %
% of foxes with evidence of diarrhoea	7.50%	15.00 %
% of foxes with clear reddish/brownish urine	1.00%	2.00 %
% of obviously sick fox	0.25%	0.50 %

% of foxes older than 8 weeks recorded dead within 12 months, *taking into account humanely killed animals*:

- Mortality when < 25% due to humane killing 1.375% 2.75%
- Mortality when 25% ≤ mortality < 50%% due to humane killing 2.125% 4.25%
- Mortality when ≥ 50% due to humane killing 3.75% 7.5%

The two predefined thresholds, define three categories for each health disorder:

- Acceptable situation: the result of the farm is below the warning threshold

- Moderate problem: the result of the farm is above the warning threshold but below the alarm threshold and therefore a health plan at farm level *could* be undertaken by the farmer

- Serious problem: the result of the farm is above the alarm threshold and therefore a health plan at farm level is highly recommended

According to the period considered, the health disorders taken into account are not the same: In Period 1, measurements *Urinary tract infection* and *Mortality* are considered; in Period 2, only the measurement *Mortality* is considered; whereas in Period 3, all measurements except *Urinary tract infection* are considered.

Once each disorder of the period considered has been categorised, we can calculate the number of disorders in each of the three categories:

- N_0 = number of measurements in the category "Acceptable" (*i.e.* < warning threshold)

- N_1 = number of measurements in the category "Moderate problem" (*i.e.* < alarm threshold and ≥ warning threshold)

- N_2 = number of measurements in the category "Serious problem" (*i.e.* ≥ alarm threshold)

Then, we calculate the criterion-score with a calculation based on the weighted sum of the number of measurements in each category, assigning more weight to more serious problem (and no weight for the category acceptable): $\mathbf{w_0 = 0 < w_1 < w_2}$.

$$\text{Let } I = \frac{100}{N_{tot}} \times \left(N_{tot} - \frac{\sum_{j=0}^{2} w_j N_j}{w_2} \right)$$

with j, the level considered

Weights	$w_0 = 0$	$w_1 = 1$	$w_2 = 2$

I is computed into a score using *I*-spline functions (Figure 23) as follows:

$$\textbf{Score} = a_x + b_x \times I + c_x \times I^2 + d_x \times I^3$$

with $x = 1$ when $I < k$ and $x = 2$ when $I \geq k$

Criterion 7 - Absence of disease - Periods 1, 2 and 3			
a_1	0	a_2	-85.05377106485723004425381 08
b_1	0.90939517268994507492863 02	b_2	5.16208373112817753280978 65
c_1	-0.00441554366230250718017 29	c_2	-0.07529368637219907567370 57
d_1	0.00002801480186953413787 20	d_2	0.00042178226167148135262 31
k	60		

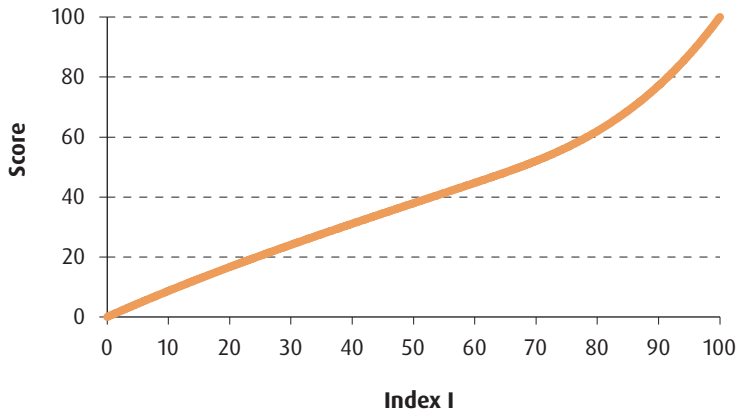

Figure 23 Calculation of the score for the Criterion *Absence of disease* according to the number of measurements in each category of disorders situation

3.3.1.8 Absence of pain induced by management procedures

For the Criterion *Absence of pain induced by management procedures*, the score is calculated, from the Measurement *Killing method*. This measurement is assessed for the three periods of the production cycle. So the first stage is to calculate the sub-score for each period, then to aggregate the three sub-scores obtained for each period in order to have the score covering the production cycle for the Measurement *Killing method*.

Sub-scores S_1^n, S_3^n and S_3^n for Periods 1, 2 and 3 for the Measurement *Killing method*
One score is assigned to the Measurement *Killing method* according to a decision-tree based on the type and functioning of the device (Figure 24).

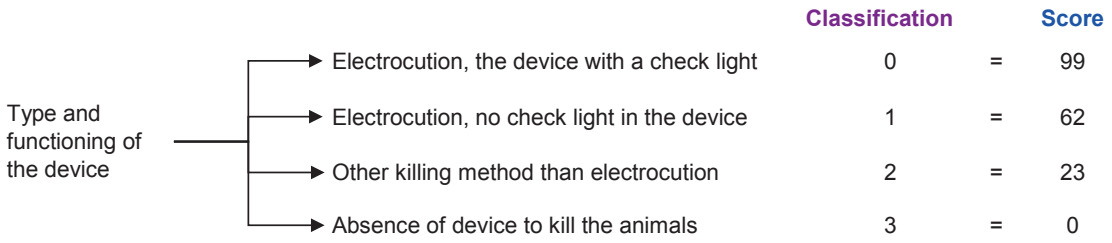

Figure 24 Sub-scores S_i^k assigned to combinations of answers to questions on killing method (with I = 1, 2 or 3 according to the period considered)

Since different killing devices may be present on the farm, we consider the killing device in the worst situation defined by the decision-tree and the final score to be assigned to the farm is the worst score observed (= the one corresponding to the worst situation found on the farm).

Score for the Criterion *Absence of pain induced by management procedures*
The three sub-scores are combined to form the overall score for the Criterion *Absence of pain due to management procedures* using a Choquet integral. The parameters of the Choquet integral are:

μ_1	=	0.01	μ_{12}	=	0.13
μ_2	=	0.07	μ_{13}	=	0.43
μ_3	=	0.43	μ_{23}	=	0.50

with 1 = Period 1, 2 = Period 2 and 3 = Period 3.

Reminder:

$$S^k\text{-score} = \begin{cases} S_1^k + \left(S_2^k - S_1^k\right)\mu_{23} + \left(S_3^k - S_2^k\right)\mu_3 & \text{if} \quad S_1^k \le S_2^k \le S_3^k \\ S_1^k + \left(S_3^k - S_1^k\right)\mu_{23} + \left(S_2^k - S_3^k\right)\mu_2 & \text{if} \quad S_1^k \le S_3^k \le S_2^k \\ S_2^k + \left(S_1^k - S_2^k\right)\mu_{13} + \left(S_3^k - S_1^k\right)\mu_3 & \text{if} \quad S_2^k \le S_1^k \le S_3^k \\ S_2^k + \left(S_3^k - S_2^k\right)\mu_{13} + \left(S_1^k - S_3^k\right)\mu_1 & \text{if} \quad S_2^k \le S_3^k \le S_1^k \\ S_3^k + \left(S_1^k - S_3^k\right)\mu_{12} + \left(S_2^k - S_1^k\right)\mu_2 & \text{if} \quad S_3^k \le S_1^k \le S_2^k \\ S_3^k + \left(S_2^k - S_3^k\right)\mu_{12} + \left(S_1^k - S_2^k\right)\mu_1 & \text{if} \quad S_3^k \le S_2^k \le S_1^k \end{cases}$$

Therefore, with the μ listed above:

$$S^k\text{-score} = \begin{cases} S_1^k + 0.50\left(S_2^k - S_1^k\right) + 0.43\left(S_3^k - S_2^k\right) & \text{if} \quad S_1^k \le S_2^k \le S_3^k \\ S_1^k + 0.50\left(S_3^k - S_1^k\right) + 0.07\left(S_2^k - S_3^k\right) & \text{if} \quad S_1^k \le S_3^k \le S_2^k \\ S_2^k + 0.43\left(S_1^k - S_2^k\right) + 0.43\left(S_3^k - S_1^k\right) & \text{if} \quad S_2^k \le S_1^k \le S_3^k \\ S_2^k + 0.43\left(S_3^k - S_2^k\right) + 0.01\left(S_1^k - S_3^k\right) & \text{if} \quad S_2^k \le S_3^k \le S_1^k \\ S_3^k + 0.13\left(S_1^k - S_3^k\right) + 0.07\left(S_2^k - S_1^k\right) & \text{if} \quad S_3^k \le S_1^k \le S_2^k \\ S_3^k + 0.13\left(S_2^k - S_3^k\right) + 0.01\left(S_1^k - S_2^k\right) & \text{if} \quad S_3^k \le S_2^k \le S_1^k \end{cases}$$

Where S^k_1, S^k_2 and S^k_3 are the sub-scores obtained by a given farm for the Measurement *Killing method* in Periods 1, 2 and 3 respectively.
μ_1, μ_2 and μ_3 are the capacities of the Measurement of *Killing method* in Periods 1, 2 and 3 respectively.
μ_{12} is the capacity of the group made of the measurements in Periods 1 and 2 and so on...

3.3.1.9 Expression of social behaviours

For the Criterion of Expression of social behaviours, *two* partial scores are calculated, both in Period 3 of the production cycle, one for the Sub-measurement *Social housing of adults* and one for the Sub-measurement of *Social housing of juveniles*, before being combined into a criterion-score.

Sub-score S_3^a for Period 3 for the Sub-measurement *Social housing of adults*
The score of a farm with regard to the Sub-measurement *Social housing of adults* is calculated from the % of adults housed in pairs or in groups in Period 3.

Let I_3 = 100 - % of adults housed in pairs or in groups in Period 3

$$\text{Let } J_3 = \frac{I_3 - 40}{100 - 40} \times 100 \quad \text{if } I_3 \ge 40$$
$$J_3 = 0 \quad \text{if } I_i < 40$$

J_3 is computed into a score using *I*-spline functions (Figure 25) as follows:

Score = $a_x + b_x \times J_3 + c_x \times J_3^2 + d_x \times J_3^3$

with $x = 1$ when $J_3 < k$ and $x = 2$ when $J_3 \geq k$

Criterion 9 - Social housing of adults - Period 3			
a_1	0	a_2	-814.55359060616979149926919 49
b_1	0.044591875564799751674449 6	b_2	35.980779654236108910936309 3
c_1	-0.000220763568615574398614 6	c_2	-0.528694112730252352427839 9
d_1	0.000012861121507651711144 4	d_2	0.002603416752498215972627 7
k	68		

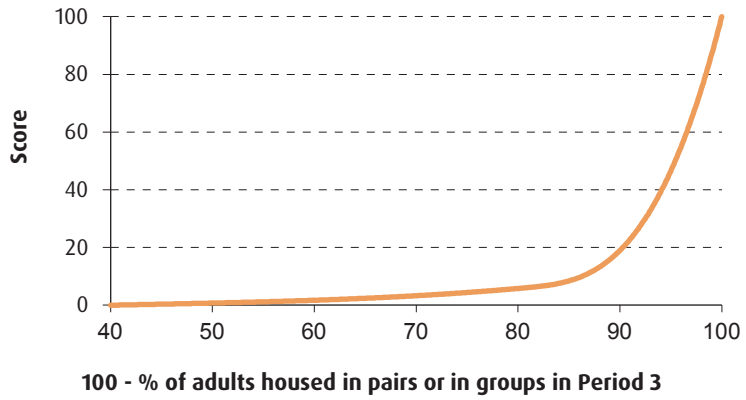

Figure 25 Calculation of the sub-score S_3^a for the Sub-measurement *Social housing of adults* according to the percentage of adults housed in pairs or in groups in Period 3

Sub-score S_3^j for Period 3 for the Sub-measurement *Social housing of juveniles*

The score of a farm with regard to the Sub-measurement *Social housing of juveniles* is calculated from the % of juvenile foxes housed singly in Period 3.

Let I_3 = 100 - % of juvenile foxes housed singly in Period 3

I_3 is computed into a score using *I*-spline functions (Figure 26) as follows:

Score = $a_x + b_x \times I_3 + c_x \times I_3^2 + d_x \times I_3^3$

with $x = 1$ when $I_3 < k$ and $x = 2$ when $I_3 \geq k$

Criterion 9 - Social housing of adults - Period 3			
a_1	0	a_2	-3.368021908469025049726042 2
b_1	0.000000000000003944183779 05	b_2	0.404162629016068142284723 3
c_1	0.001294791394167603285417 2	c_2	-0.014871713766466282749534 3
d_1	-0.000003884505470197837646 4	d_2	0.000211668896671525610985 2
k	25		

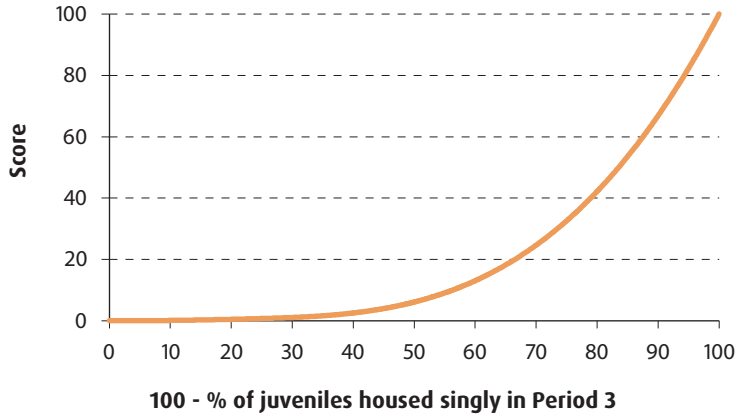

Figure 26 Calculation of the sub-score S_3^j for the Sub-measurement *Social housing of juveniles* according to the percentage of juveniles housed singly in Period 3

Score for the Criterion *Expression of social behaviours*

The two partial scores are combined to form the overall score for the Criterion *Expression of social behaviours* using a Choquet integral. The parameters of the Choquet integral are:

$\mu_j = 0.25$ $\mu_a = 0.32$

with *j*, juveniles and *a*, adults.

Reminder:

$$\text{Expression of social behaviours-score} = \begin{cases} S^j + \left(S^a - S^j\right)\mu_a & \text{if} \quad S^j \le S^a \\ S^a + \left(S^j - S^a\right)\mu_j & \text{if} \quad S^a \le S^j \end{cases}$$

Therefore, with the μ listed above:

$$\text{Expression of social behaviours-score} = \begin{cases} S^j + 0.32\left(S^a - S^j\right) & \text{if} \quad S^j \le S^a \\ S^a + 0.25\left(S^j - S^a\right) & \text{if} \quad S^a \le S^j \end{cases}$$

Where S^j and S^a are the partial scores obtained by a given farm for the Measurement *Social housing* in juveniles and in adults respectively.

μ_a and μ_b are the capacities of the Measurement *Social housing* in juveniles and in adults respectively.

3.3.1.10 Expression of other behaviours

For the Criterion *Expression of other behaviours*, four partial scores are calculated, one for the Measurement of *Opportunity to use enrichment*, one for the Measurement *Opportunity to observe surroundings*, one for the Measurement *Stereotypic behaviours* and one for the Measurement *Fur chewing*, before being combined into a criterion-score.
Moreover, except for the Measurement *Fur chewing which* is assessed only in Periods 1 and 3, the remaining three measurements are assessed at different levels for three periods of the production cycle. So the first stage is to calculate, for each measurement, the sub-score for each period considered, then to aggregate the sub-scores obtained for each period in order to have the score covering the production cycle for each of these four measurements.

Sub-scores S_1^e , S_3^e and S_3^e for Periods 1, 2 and 3 for Measurement *Opportunity to use enrichments*
One score is assigned to the Measurement *Opportunity to use enrichments* according to a decision-tree based on different types and number of enrichments with regard to the number of extremely beneficial enrichments as "≥2", "1" and "0" different enrichments (Figure 27 and Figure 28).

In period 1 and 3:

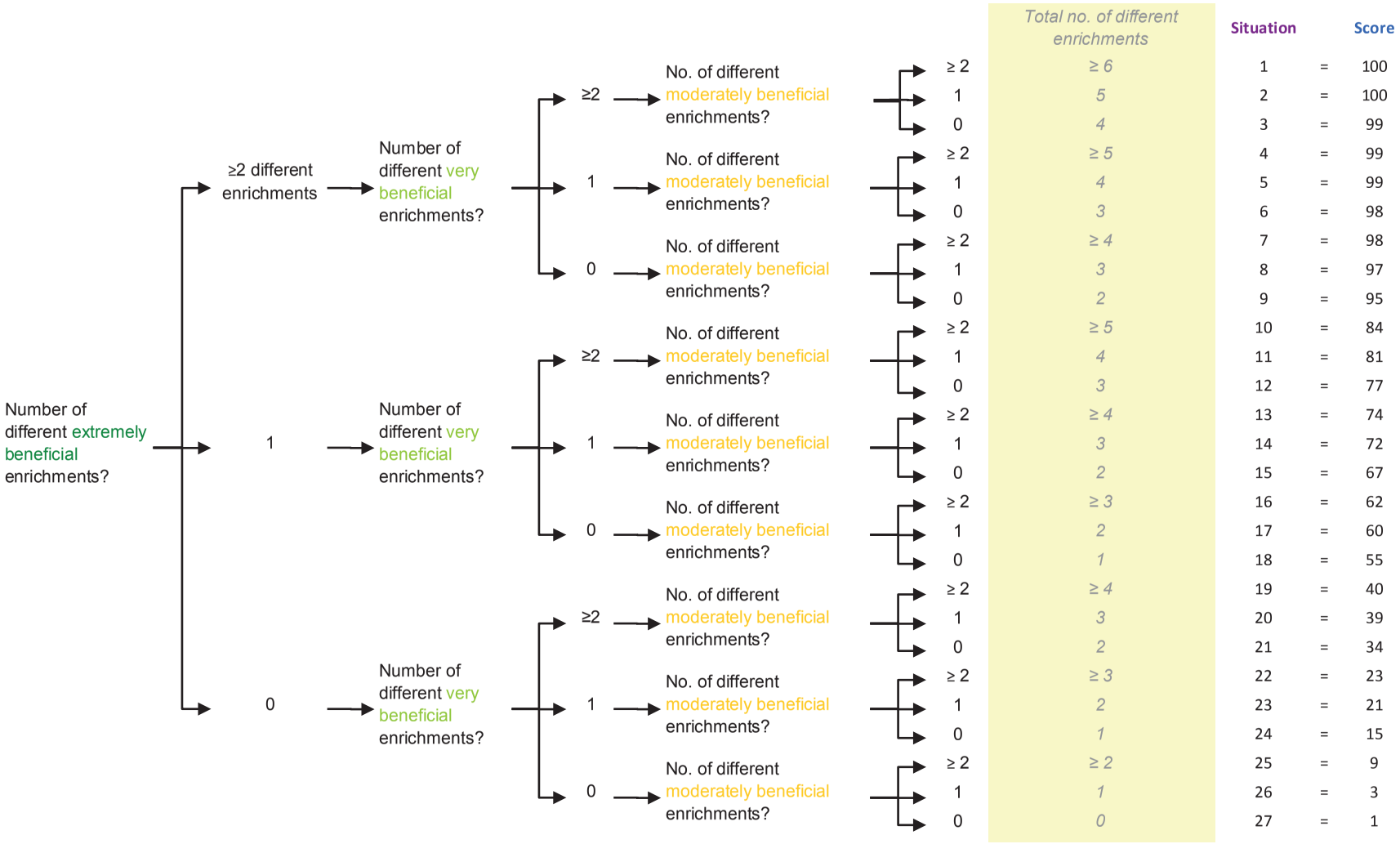

Figure 27 Sub-scores S_3^e and S_3^e assigned to the Measurements *Opportunity to use enrichment* in Periods 1 and 3

In period 2:

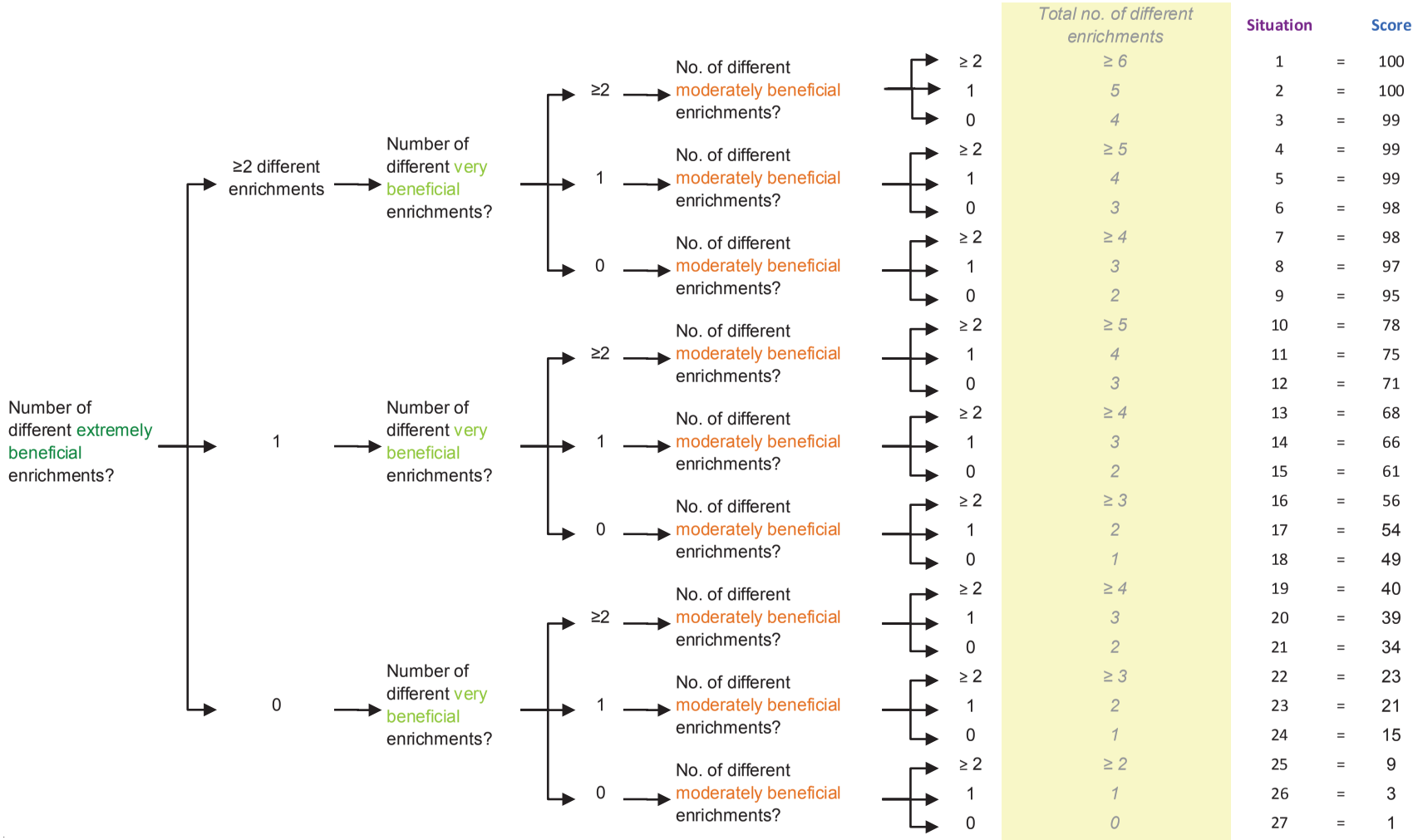

Figure 28 Sub-scores S_2^e assigned to the Measurement *Opportunity to use enrichment* in Period 2

Since animals may be housed with different types and numbers of enrichments, we consider the % of animals in each situation defined by the decision-tree and the final score to be assigned to the farm is the worst score (= the one corresponding to the worst situation found on the farm) observed in at least 10% of the animals.

Score S^e for the Measurement *Opportunity to use enrichments*

The three sub-scores are combined to form the partial score S^e for the Measurement *Opportunity to use enrichments* using a Choquet integral. The parameters of the Choquet integral are:

μ_1	=	0.19	μ_{12}	=	0.19
μ_2	=	0.12	μ_{13}	=	0.45
μ_3	=	0.31	μ_{23}	=	0.39

with 1 = Period 1, 2 = Period 2 and 3 = Period 3.

Reminder:

$$S^e\text{-score} = \begin{cases} S_1^e + \left(S_2^e - S_1^e\right)\mu_{23} + \left(S_3^e - S_2^e\right)\mu_3 & \text{if} \quad S_1^e \le S_2^e \le S_3^e \\ S_1^e + \left(S_3^e - S_2^e\right)\mu_{23} + \left(S_2^e - S_3^e\right)\mu_2 & \text{if} \quad S_1^e \le S_3^e \le S_2^e \\ S_2^e + \left(S_1^e - S_2^e\right)\mu_{13} + \left(S_3^e - S_1^e\right)\mu_3 & \text{if} \quad S_2^e \le S_1^e \le S_3^e \\ S_2^e + \left(S_3^e - S_2^e\right)\mu_{13} + \left(S_1^e - S_3^e\right)\mu_1 & \text{if} \quad S_2^e \le S_3^e \le S_1^e \\ S_3^e + \left(S_1^e - S_3^e\right)\mu_{12} + \left(S_2^e - S_1^e\right)\mu_2 & \text{if} \quad S_3^e \le S_1^e \le S_2^e \\ S_3^e + \left(S_2^e - S_3^e\right)\mu_{12} + \left(S_1^e - S_2^e\right)\mu_1 & \text{if} \quad S_3^e \le S_2^e \le S_1^e \end{cases}$$

Therefore, with the μ listed above:

$$S^e\text{-score} = \begin{cases} S_1^e + 0.39\left(S_2^e - S_1^e\right) + 0.31\left(S_3^e - S_2^e\right) & \text{if} \quad S_1^e \le S_2^e \le S_3^e \\ S_1^e + 0.39\left(S_3^e - S_1^e\right) + 0.12\left(S_2^e - S_3^e\right) & \text{if} \quad S_1^e \le S_3^e \le S_2^e \\ S_2^e + 0.45\left(S_1^e - S_2^e\right) + 0.31\left(S_3^e - S_1^e\right) & \text{if} \quad S_2^e \le S_1^e \le S_3^e \\ S_2^e + 0.45\left(S_3^e - S_2^e\right) + 0.19\left(S_1^e - S_3^e\right) & \text{if} \quad S_2^e \le S_3^e \le S_1^e \\ S_3^e + 0.19\left(S_1^e - S_3^e\right) + 0.12\left(S_2^e - S_1^e\right) & \text{if} \quad S_3^e \le S_1^e \le S_2^e \\ S_3^e + 0.19\left(S_2^e - S_3^e\right) + 0.19\left(S_1^e - S_2^e\right) & \text{if} \quad S_3^e \le S_2^e \le S_1^e \end{cases}$$

Where S^e_1, S^e_2 and S^e_3 are the sub-scores obtained by a given farm for the Measurement *Opportunity to use enrichments* in Period 1, in Period 2 and in Period 3 respectively.
μ_1, μ_2 and μ_3 are the capacities of the Measurement *Opportunity to use enrichments* in Periods 1, 2 and 3 respectively.

μ_{12} is the capacity of the group made of the measurements in Periods 1 and 2 and so on...

Sub-scores S_1^s, S_3^s and S_3^s for Periods 1, 2 and 3 for the Measurement *Opportunity to observe surroundings*

The score of a farm with regard to the Measurement *Opportunity to observe surroundings* is calculated from the % of animals not able to observe their surroundings in Periods 1, 2 and 3.

The calculation of the sub-score is the same for each period:
Let I_i = 100 - % of animals not able to observe their surroundings in period *i* with *i* = 1, 2 or 3 according to the period considered

I_i is computed into a score using *I*-spline functions (Figure 29) as follows:

Score $= a_x + b_x \times I_i + c_x \times I_i^2 + d_x \times I_i^3$ $\quad i = 1, 2 \text{ or } 3$

with $x = 1$ when $I_i < k$ and $x = 2$ when $I_i \geq k$

Criterion 10 - Opportunity to observe surroundings - Period 1, 2 and 3			
a_1	0	a_2	-1.290641858519698814689036 2
b_1	-0.000000000001321654181 2676	b_2	0.203785556620329655341 8056
c_1	0.000000000000224398122 7914	c_2	-0.010725555611864149088 6967
d_1	-0.000000000000008674046 2362	d_2	0.000188167642315109509 6410
k	19		

Note: The coefficients are the same for the three periods since the interpretation in terms of welfare is the same whatever the period considered.

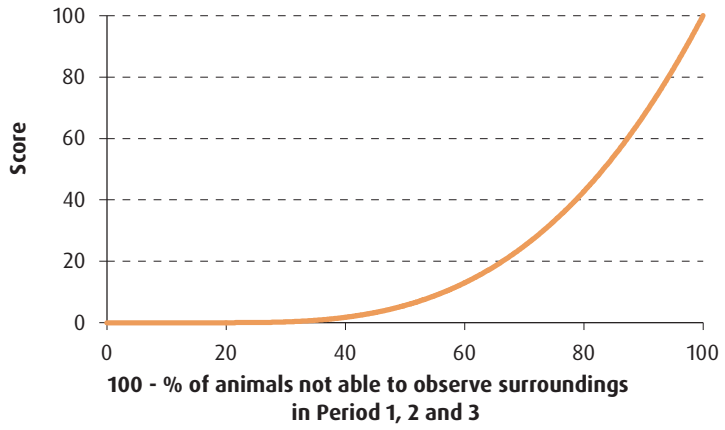

Figure 29 Calculation of the sub-score S_i^s for the Measurement *Opportunity to observe surroundings* according to the percentage of animals not able to observe their surroundings (with $i = 1, 2$ or 3 according to the period considered)

Score S^s for the Measurement *Opportunity to observe surroundings*

The three sub-scores are combined to form the partial score S^s for the Measurement *Opportunity to observe surroundings* using a Choquet integral. The parameters of the Choquet integral are:

μ_1	=	0.26	μ_{12}	=	0.30
μ_2	=	0.27	μ_{13}	=	0.45
μ_3	=	0.45	μ_{23}	=	0.46

with 1 = Period 1, 2 = Period 2 and 3 = Period 3.

Reminder:

$$S^s\text{-score} = \begin{cases} S_1^s + \left(S_2^s - S_1^s\right)\mu_{23} + \left(S_3^s - S_2^s\right)\mu_3 & \text{if} \quad S_1^s \le S_2^s \le S_3^s \\ S_1^s + \left(S_3^s - S_1^s\right)\mu_{23} + \left(S_2^s - S_3^s\right)\mu_2 & \text{if} \quad S_1^s \le S_3^s \le S_2^s \\ S_2^s + \left(S_1^s - S_2^s\right)\mu_{13} + \left(S_3^s - S_1^s\right)\mu_3 & \text{if} \quad S_2^s \le S_1^s \le S_3^s \\ S_2^s + \left(S_3^s - S_2^s\right)\mu_{13} + \left(S_1^s - S_3^s\right)\mu_1 & \text{if} \quad S_2^s \le S_3^s \le S_1^s \\ S_3^s + \left(S_1^s - S_3^s\right)\mu_{12} + \left(S_2^s - S_1^s\right)\mu_2 & \text{if} \quad S_3^s \le S_1^s \le S_2^s \\ S_3^s + \left(S_2^s - S_3^s\right)\mu_{12} + \left(S_1^s - S_2^s\right)\mu_1 & \text{if} \quad S_3^s \le S_2^s \le S_1^s \end{cases}$$

Therefore, with the μ listed above:

$$S^s\text{-score} = \begin{cases} S_1^s + 0.46\left(S_2^s - S_1^s\right) + 0.45\left(S_3^s - S_2^s\right) & \text{if} \quad S_1^s \le S_2^s \le S_3^s \\ S_1^s + 0.46\left(S_3^s - S_1^s\right) + 0.27\left(S_2^s - S_3^s\right) & \text{if} \quad S_1^s \le S_3^s \le S_2^s \\ S_2^s + 0.45\left(S_1^s - S_2^s\right) + 0.45\left(S_3^s - S_1^s\right) & \text{if} \quad S_2^s \le S_1^s \le S_3^s \\ S_2^s + 0.45\left(S_3^s - S_2^s\right) + 0.26\left(S_1^s - S_3^s\right) & \text{if} \quad S_2^s \le S_3^s \le S_1^s \\ S_3^s + 0.30\left(S_1^s - S_3^s\right) + 0.27\left(S_2^s - S_1^s\right) & \text{if} \quad S_3^s \le S_1^s \le S_2^s \\ S_3^s + 0.30\left(S_2^s - S_3^s\right) + 0.26\left(S_1^s - S_2^s\right) & \text{if} \quad S_3^s \le S_2^s \le S_1^s \end{cases}$$

Where S^s_1, S^s_2 and S^s_3 are the sub-scores obtained by a given farm for the Measurement *Opportunity to observe surroundings* in Period 1, in Period 2 and in Period 3 respectively.
μ_1, μ_2 and μ_3 are the capacities of the Measurement *Opportunity to observe surroundings* in Periods 1, 2 and 3 respectively.
μ_{12} is the capacity of the group made of the measurements in Periods 1 and 2 and so on...

Sub-scores S_1^b, S_3^b and S_3^b for Periods 1, 2 and 3 for the Measurement *Stereotypic Behaviour (SB)*
The score of a farm with regard to the Measurement *SB* is calculated from the % of foxes expressing SB out of active animals in Periods 1, 2 and 3.

NB: The calculation is the same for the three periods but as the interpretation is different in terms of welfare in Period 2, the measurement is interpreted separately for this period and therefore the coefficients of the curve are different from Periods 1 and 3.

For Periods 1 and 3:
Let I_i = 100 - % of animals behaving stereotypically in period *i* with *i* = 1 or 3 according to the period considered

$$\text{Let } J_i = \frac{I_i - 50}{100 - 50} \times 100 \quad \text{if } I_i \ge 50$$
$$J_i = 0 \quad \text{if } I_i < 50$$

where *i* = 1 or 3 according to the period considered

J_i is computed into a score using *I*-spline functions (Figure 30) as follows:

Score = $a_x + b_x \times J_i + c_x \times J_i^2 + d_x \times J_i^3$ *i* = 1 or 3

with $x = 1$ when $J_i < k$ and $x = 2$ when $J_i \ge k$

Criterion 10 - SB - Periods 1 and 3			
a_1	0	a_2	-1393.71474085144473065156489 61
b_1	0.000000000003756919671109 9	b_2	55.74858974050357574014924 47
c_1	-0.000000000000016231062997 21	c_2	-0.74331453112607204225525 95
d_1	0.000048380934819556197163 4	d_2	0.00335200107804330431002 24
k	75		

Note: The coefficients are the same for the two periods (Periods 1 and 3) since the interpretation in terms of welfare is the same whatever the period considered.

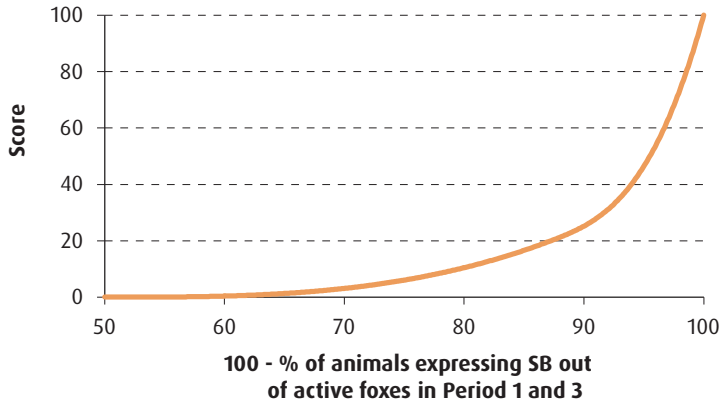

Figure 30 Calculation of the sub-score S_i^b for the Measurement *SB* according to the percentage of foxes expressing SB out of active animals (with i = 1 or 3 according to the period considered)

For Period 2:
Let I_2 = 100 - % of foxes expressing SB out of active animals in Period 2

$$\text{Let } J_2 = \frac{I_2 - 70}{100 - 70} \times 100 \quad \text{if } I_2 \geq 70$$
$$J_2 = 0 \quad \text{if } I_2 < 70$$

J_2 is computed into a score using *I*-spline functions (Figure 31) as follows:

$$\textbf{Score} = a_x + b_x \times J_2 + c_x \times J_2^2 + d_x \times J_2^3$$

with x = 1 when $J_2 < k$ and x = 2 when $J_2 \geq k$

Criterion 10 - SB - Period 2			
a_1	0	a_2	-188.94315148169005169620504 60
b_1	-0.000000000001524259862386 3	b_2	9.94437638937767331981376 63
c_1	0.000000000000090403963239 5	c_2	-0.17446274361334257463340 69
d_1	0.000018882986294266537475 6	d_2	0.00103913294867972560812 93
k	57		

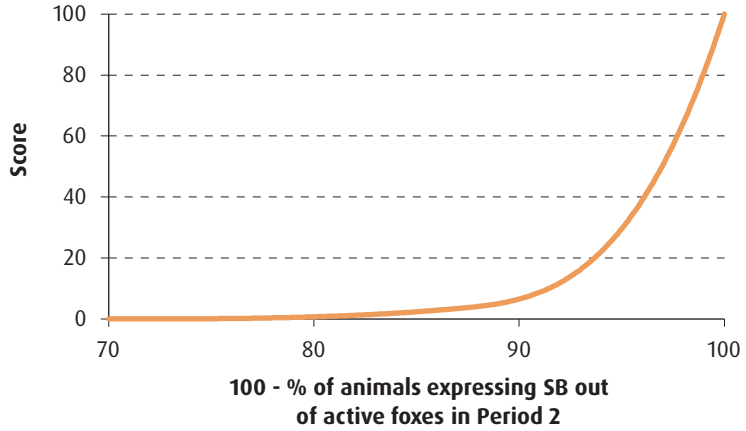

Figure 31 Calculation of the sub-score S_2^b for the Measurement *SB* according to the percentage of foxes expressing SB out of active animals in Period 2

Score S^b for the Measurement *Stereotypic behaviour*

The three sub-scores are combined to form the partial score S^b for the Measurement *Stereotypic behaviour* using a Choquet integral. The parameters of the Choquet integral are:

μ_1	=	0.16	μ_{12}	=	0.32
μ_2	=	0.16	μ_{13}	=	0.37
μ_3	=	0.37	μ_{23}	=	0.47

with 1 = Period 1, 2 = Period 2 and 3 = Period 3.

Reminder:

$$S^b\text{-score} = \begin{cases} S_1^b + \left(S_2^b - S_1^b\right)\mu_{23} + \left(S_3^b - S_2^b\right)\mu_3 & \text{if} \quad S_1^b \le S_2^b \le S_3^b \\ S_1^b + \left(S_3^b - S_1^b\right)\mu_{23} + \left(S_2^b - S_3^b\right)\mu_2 & \text{if} \quad S_1^b \le S_3^b \le S_2^b \\ S_2^b + \left(S_1^b - S_2^b\right)\mu_{13} + \left(S_3^b - S_1^b\right)\mu_3 & \text{if} \quad S_2^b \le S_1^b \le S_3^b \\ S_2^b + \left(S_3^b - S_2^b\right)\mu_{13} + \left(S_1^b - S_3^b\right)\mu_1 & \text{if} \quad S_2^b \le S_3^b \le S_1^b \\ S_3^b + \left(S_1^b - S_3^b\right)\mu_{12} + \left(S_2^b - S_1^b\right)\mu_2 & \text{if} \quad S_3^b \le S_1^b \le S_2^b \\ S_3^b + \left(S_2^b - S_3^b\right)\mu_{12} + \left(S_1^b - S_2^b\right)\mu_1 & \text{if} \quad S_3^b \le S_2^b \le S_1^b \end{cases}$$

Therefore, with the μ listed above:

$$S^b\text{-score} = \begin{cases} S_1^b + 0.47\left(S_2^b - S_1^b\right) + 0.37\left(S_3^b - S_2^b\right) & \text{if} \quad S_1^b \le S_2^b \le S_3^b \\ S_1^b + 0.47\left(S_3^b - S_1^b\right) + 0.16\left(S_2^b - S_3^b\right) & \text{if} \quad S_1^b \le S_3^b \le S_2^b \\ S_2^b + 0.37\left(S_1^b - S_2^b\right) + 0.37\left(S_3^b - S_1^b\right) & \text{if} \quad S_2^b \le S_1^b \le S_3^b \\ S_2^b + 0.37\left(S_3^b - S_2^b\right) + 0.16\left(S_1^b - S_3^b\right) & \text{if} \quad S_2^b \le S_3^b \le S_1^b \\ S_3^b + 0.32\left(S_1^b - S_3^b\right) + 0.16\left(S_2^b - S_1^b\right) & \text{if} \quad S_3^b \le S_1^b \le S_2^b \\ S_3^b + 0.32\left(S_2^b - S_3^b\right) + 0.16\left(S_1^b - S_2^b\right) & \text{if} \quad S_3^b \le S_2^b \le S_1^b \end{cases}$$

Where S^b_1, S^b_2 and S^b_3 are the sub-scores obtained by a given farm for the Measurement *Stereotypic behaviour* in Period 1, in Period 2 and in Period 3 respectively.
μ_1, μ_2 and μ_3 are the capacities of the Measurement *Stereotypic behaviour* in Periods 1, 2 and 3 respectively.
μ_{12} is the capacity of the group made of the measurements in Periods 1 and 2 and so on...

Sub-scores S_1^f and S_3^f for Periods 1 and 3 for the Measurement *Fur chewing*
The score of a farm with regard to Measurement *Fur chewing* is calculated from the % of foxes with clear signs of chewed fur in Periods 1 and 3.

Let I_1 = 100 - % of foxes with clear signs of chewed fur in Period 1
Let I_3 = 100 - % of foxes with clear signs of chewed fur in Period 3

$$\text{Let } J_i = \frac{I_i - 60}{100 - 60} \times 100 \quad \text{if } I_i \ge 60$$
$$J_i = 0 \quad \text{if } I_i < 60$$

with i = 1 or 3 according to the period considered.
J_i is computed into a score using *I*-spline functions (Figure 32) as follows:

Score = $a_x + b_x \times J_i + c_x \times J_i^2 + d_x \times J_i^3$ i = 1 or 3

with x = 1 when $J_i < k$ and x = 2 when $J_i \ge k$

Criterion 10 - Fur chewing - Periods 1 and 3			
a_1	0	a_2	-190.63158238166818136960500 85
b_1	0.20731979918462237200138 53	b_2	10.24056097867711301319104 68
c_1	-0.00363718945939361546979 00	c_2	-0.17965896455894822536514 25
d_1	0.00003379802416424492953 05	d_2	0.00106316513010251733131 75
k	57		

Note: The coefficients are the same for the two periods (Periods 1 and 3) since the interpretation in terms of welfare is the same whatever the period considered.

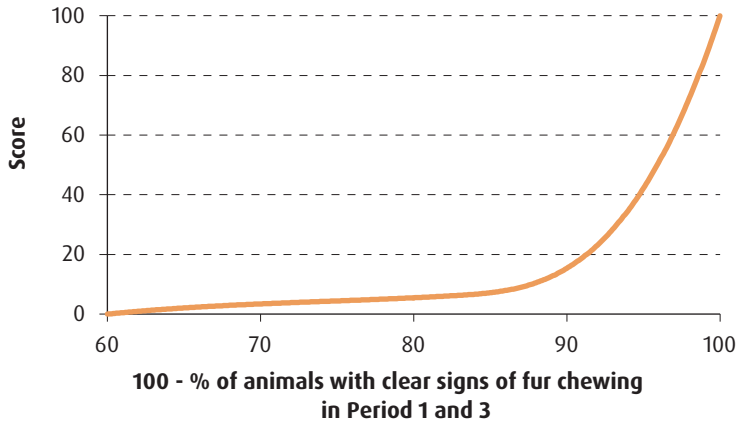

Figure 32 Calculation of the sub-score S_i^f for the Measurement *Fur chewing* according to the percentage of foxes with clear signs of chewed fur (with i = 1 or 3 according to the period considered)

Score S^f for the Measurement *Fur chewing*

The two sub-scores are combined to form the partial score S^f for the Measurement *Fur chewing* using a Choquet integral. The parameters of the Choquet integral are:

μ_1	=	0.24	μ_3	=	0.31

with 1, Period 1 and 3, Period 3.

Reminder:

$$S^f\text{-score} = \begin{cases} S_1^f + \left(S_3^f - S_1^f\right)\mu_3 & \text{if} \quad S_1^f \le S_3^f \\ S_3^f + \left(S_1^f - S_3^f\right)\mu_1 & \text{if} \quad S_3^f \le S_1^f \end{cases}$$

Therefore, with the μ listed above:

$$S^f\text{-score} = \begin{cases} S_1^f + 0.31\left(S_3^f - S_1^f\right) & \text{if} \quad S_1^f \le S_3^f \\ S_3^f + 0.24\left(S_1^f - S_3^f\right) & \text{if} \quad S_3^f \le S_1^f \end{cases}$$

Where S^f_1 and S^f_3 are the scores obtained by a given farm for the Measurement *Fur chewing* in Period 1 and in Period 3 respectively.
μ_1 and μ_3 are the capacities of the Measurement *Fur chewing* in Periods 1 and 3 respectively.

Score for the Criterion *Expression of other behaviours*

The four partial scores are combined to form the overall score for the Criterion *Expression of other behaviours* using a Choquet integral. The parameters of the Choquet integral are:

μ_e	=	0.18	μ_f	=	0.19
μ_s	=	0.25	μ_{es}	=	0.36
μ_b	=	0.19	μ_{eb}	=	0.34

μ_{ef}	=	0.31	μ_{esb}	=	0.60
μ_{sb}	=	0.31	μ_{esf}	=	0.54
μ_{sf}	=	0.25	μ_{ebf}	=	0.53
μ_{bf}	=	0.19	μ_{sbf}	=	0.43

With *e*, enrichement; *s*, surroundings; *b*, SB and *f*, fur chewing.

$$\text{Exp. of other behaviours-score} = \begin{cases}
S_e + (S_s - S_e)\mu_{sbf} + (S_b - S_s)\mu_{fb} + (S_f - S_b)\mu_f & \text{if} \quad S_e \le S_s \le S_b \le S_f \\
S_e + (S_s - S_e)\mu_{sbf} + (S_f - S_s)\mu_{bf} + (S_b - S_f)\mu_b & \text{if} \quad S_e \le S_s \le S_f \le S_b \\
S_e + (S_b - S_e)\mu_{sbf} + (S_s - S_b)\mu_{sf} + (S_f - S_s)\mu_f & \text{if} \quad S_e \le S_b \le S_s \le S_f \\
S_e + (S_b - S_e)\mu_{sbf} + (S_f - S_b)\mu_{sf} + (S_s - S_f)\mu_s & \text{if} \quad S_e \le S_b \le S_f \le S_s \\
S_e + (S_f - S_e)\mu_{sbf} + (S_s - S_f)\mu_{sb} + (S_b - S_s)\mu_b & \text{if} \quad S_e \le S_f \le S_s \le S_b \\
S_e + (S_f - S_e)\mu_{sbf} + (S_b - S_f)\mu_{sb} + (S_s - S_b)\mu_s & \text{if} \quad S_e \le S_f \le S_b \le S_s \\
S_s + (S_e - S_s)\mu_{ebf} + (S_b - S_e)\mu_{bf} + (S_f - S_b)\mu_f & \text{if} \quad S_s \le S_e \le S_b \le S_f \\
S_s + (S_e - S_s)\mu_{ebf} + (S_f - S_e)\mu_{bf} + (S_b - S_f)\mu_b & \text{if} \quad S_s \le S_e \le S_f \le S_b \\
S_s + (S_b - S_s)\mu_{ebf} + (S_e - S_b)\mu_{ef} + (S_f - S_e)\mu_f & \text{if} \quad S_s \le S_b \le S_e \le S_f \\
S_s + (S_b - S_s)\mu_{ebf} + (S_f - S_b)\mu_{ef} + (S_e - S_f)\mu_e & \text{if} \quad S_s \le S_b \le S_f \le S_e \\
S_s + (S_f - S_s)\mu_{ebf} + (S_b - S_f)\mu_{eb} + (S_e - S_b)\mu_e & \text{if} \quad S_s \le S_f \le S_b \le S_e \\
S_s + (S_f - S_s)\mu_{ebf} + (S_e - S_f)\mu_{eb} + (S_b - S_e)\mu_b & \text{if} \quad S_s \le S_f \le S_e \le S_b \\
S_b + (S_s - S_b)\mu_{esf} + (S_e - S_s)\mu_{ef} + (S_f - S_e)\mu_f & \text{if} \quad S_b \le S_s \le S_e \le S_f \\
S_b + (S_s - S_b)\mu_{esf} + (S_f - S_s)\mu_{ef} + (S_e - S_f)\mu_e & \text{if} \quad S_b \le S_s \le S_f \le S_e \\
S_b + (S_f - S_b)\mu_{esf} + (S_s - S_f)\mu_{es} + (S_e - S_s)\mu_e & \text{if} \quad S_b \le S_f \le S_s \le S_e \\
S_b + (S_f - S_b)\mu_{esf} + (S_e - S_f)\mu_{es} + (S_s - S_e)\mu_s & \text{if} \quad S_b \le S_f \le S_e \le S_s \\
S_b + (S_e - S_b)\mu_{esf} + (S_f - S_e)\mu_{sf} + (S_s - S_f)\mu_s & \text{if} \quad S_b \le S_e \le S_f \le S_s \\
S_b + (S_e - S_b)\mu_{esf} + (S_s - S_e)\mu_{sf} + (S_f - S_s)\mu_f & \text{if} \quad S_b \le S_e \le S_s \le S_f \\
S_f + (S_e - S_f)\mu_{esb} + (S_s - S_e)\mu_{sb} + (S_b - S_s)\mu_b & \text{if} \quad S_f \le S_e \le S_s \le S_b \\
S_f + (S_e - S_f)\mu_{esb} + (S_b - S_e)\mu_{sb} + (S_s - S_b)\mu_s & \text{if} \quad S_f \le S_e \le S_b \le S_s \\
S_f + (S_s - S_f)\mu_{esb} + (S_b - S_s)\mu_{eb} + (S_e - S_b)\mu_e & \text{if} \quad S_f \le S_s \le S_b \le S_e \\
S_f + (S_s - S_f)\mu_{esb} + (S_e - S_s)\mu_{eb} + (S_b - S_e)\mu_b & \text{if} \quad S_f \le S_s \le S_e \le S_b \\
S_f + (S_b - S_f)\mu_{esb} + (S_e - S_b)\mu_{es} + (S_s - S_e)\mu_s & \text{if} \quad S_f \le S_b \le S_e \le S_s \\
S_f + (S_b - S_f)\mu_{esb} + (S_s - S_b)\mu_{es} + (S_e - S_s)\mu_e & \text{if} \quad S_f \le S_b \le S_s \le S_e
\end{cases}$$

Therefore, with the μ listed above:

$$\text{Exp. of other behaviours-score} = \begin{cases} S_e + 0.43(S_s - S_e) + 0.19(S_b - S_s) + 0.19(S_f - S_b) & \text{if} \quad S_e \le S_s \le S_b \le S_f \\ S_e + 0.43(S_s - S_e) + 0.19(S_f - S_s) + 0.19(S_b - S_f) & \text{if} \quad S_e \le S_s \le S_f \le S_b \\ S_e + 0.43(S_b - S_e) + 0.25(S_s - S_b) + 0.19(S_f - S_s) & \text{if} \quad S_e \le S_b \le S_s \le S_f \\ S_e + 0.43(S_b - S_e) + 0.25(S_f - S_b) + 0.25(S_s - S_f) & \text{if} \quad S_e \le S_b \le S_f \le S_s \\ S_e + 0.43(S_f - S_e) + 0.31(S_s - S_f) + 0.19(S_b - S_s) & \text{if} \quad S_e \le S_f \le S_s \le S_b \\ S_e + 0.43(S_f - S_e) + 0.31(S_b - S_f) + 0.25(S_s - S_b) & \text{if} \quad S_e \le S_f \le S_b \le S_s \\ S_s + 0.53(S_e - S_s) + 0.19(S_b - S_e) + 0.19(S_f - S_b) & \text{if} \quad S_s \le S_e \le S_b \le S_f \\ S_s + 0.53(S_e - S_s) + 0.19(S_f - S_e) + 0.19(S_b - S_f) & \text{if} \quad S_s \le S_e \le S_f \le S_b \\ S_s + 0.53(S_b - S_s) + 0.31(S_e - S_b) + 0.19(S_f - S_e) & \text{if} \quad S_s \le S_b \le S_e \le S_f \\ S_s + 0.53(S_b - S_s) + 0.31(S_f - S_b) + 0.18(S_e - S_f) & \text{if} \quad S_s \le S_b \le S_f \le S_e \\ S_s + 0.53(S_f - S_s) + 0.34(S_b - S_f) + 0.18(S_e - S_b) & \text{if} \quad S_s \le S_f \le S_b \le S_e \\ S_s + 0.53(S_f - S_s) + 0.34(S_e - S_f) + 0.19(S_b - S_e) & \text{if} \quad S_s \le S_f \le S_e \le S_b \\ S_b + 0.54(S_s - S_b) + 0.31(S_e - S_s) + 0.19(S_f - S_e) & \text{if} \quad S_b \le S_s \le S_e \le S_f \\ S_b + 0.54(S_s - S_b) + 0.31(S_f - S_s) + 0.18(S_e - S_f) & \text{if} \quad S_b \le S_s \le S_f \le S_e \\ S_b + 0.54(S_f - S_b) + 0.36(S_s - S_f) + 0.18(S_e - S_s) & \text{if} \quad S_b \le S_f \le S_s \le S_e \\ S_b + 0.54(S_f - S_b) + 0.36(S_e - S_f) + 0.25(S_s - S_e) & \text{if} \quad S_b \le S_f \le S_e \le S_s \\ S_b + 0.54(S_e - S_b) + 0.25(S_f - S_e) + 0.25(S_s - S_f) & \text{if} \quad S_b \le S_e \le S_f \le S_s \\ S_b + 0.54(S_e - S_b) + 0.25(S_s - S_e) + 0.19(S_f - S_s) & \text{if} \quad S_b \le S_e \le S_s \le S_f \\ S_f + 0.60(S_e - S_f) + 0.31(S_s - S_e) + 0.19(S_b - S_s) & \text{if} \quad S_f \le S_e \le S_s \le S_b \\ S_f + 0.60(S_e - S_f) + 0.31(S_b - S_e) + 0.25(S_s - S_b) & \text{if} \quad S_f \le S_e \le S_b \le S_s \\ S_f + 0.60(S_s - S_f) + 0.34(S_b - S_s) + 0.18(S_e - S_b) & \text{if} \quad S_f \le S_s \le S_b \le S_e \\ S_f + 0.60(S_s - S_f) + 0.34(S_e - S_s) + 0.19(S_b - S_e) & \text{if} \quad S_f \le S_s \le S_e \le S_b \\ S_f + 0.60(S_b - S_f) + 0.36(S_e - S_b) + 0.25(S_s - S_e) & \text{if} \quad S_f \le S_b \le S_e \le S_s \\ S_f + 0.60(S_b - S_f) + 0.36(S_s - S_b) + 0.18(S_e - S_s) & \text{if} \quad S_f \le S_b \le S_s \le S_e \end{cases}$$

Where S_e, S_s, S_b and S_f are the scores obtained by a given farm for the Measurement *Opportunity to use enrichments*, Measurement *Opportunity to observe surroundings*, Measurement *Stereotypical behaviour* and Measurement *Fur chewing* respectively.

μ_e, μ_s, μ_b and μ_f are the capacities of the Measurements *Opportunity to use enrichments*, *Opportunity to observe surroundings, Stereotypic behaviour* and *Fur chewing* respectively.

μ_{es} is the capacity of the group made of the Measurements *Opportunity to use enrichments* and *Opportunity to observe surroundings* and so on...

3.3.1.11 Good human-animal relationship

The score of a farm with regard to the Criterion *Good human-animal relationship* is calculated from the % of foxes that eat within 30 seconds in the feeding test.

Score for Period 1 for the Criterion *Good human-animal relationship*
Let P_1 = % of foxes that eat within 30 seconds in Period 1

P_1 is computed into a score using *I*-spline functions (Figure 33) as follows:

$$\textbf{Score} = a_x + b_x \times P_1 + c_x \times P_1^2 + d_x \times P_1^3$$

with $x = 1$ when $P_1 < k$ and $x = 2$ when $P_1 \geq k$

Criterion 11 - Good human-animal relationship - Period 1			
a_1	0	a_2	9.3508426513496516463419539
b_1	0.85425472373954880467294 97	b_2	0.2932041645700709797672801
c_1	0.0037532100667375858232822	c_2	0.0149742212514415596463779
d_1	-0.0000136067303849671403048	d_2	-0.0000884134716227054839530
k	50		

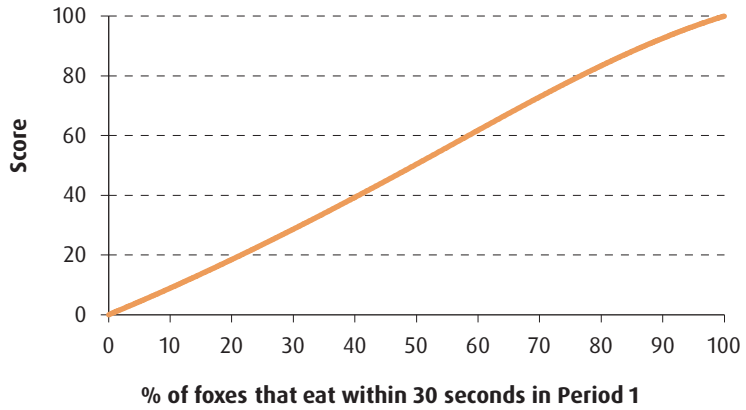

Figure 33 Calculation of the score for the Criterion *Good human-animal relationship* according to the percentage of foxes that eat within 30 seconds in the feeding test in Period 1

3.3.1.12 Positive emotional state

For the Criterion *Positive emotional state*, two partial scores are calculated, one for the Measurement *Temperament test* and one for the Measurement *Transport of live foxes*, before being combined into a criterion-score.
The Measurement *Temperament test* is assessed only in Period 1. So the first stage is to calculate the sub-score for Period 1 and consequently the sub-score at this period is evaluated as the measure-score.
Transportation is assessed at year level, *i.e.* covering the last 12 months.

Sub-score S_1^{tp} for Period 1 for the Measurement *Temperament test*

The score of a farm with regard to the Measurement *Temperament test* is calculated from the % of animals within each category used in the temperament test (3 categories here) in Period 1:

Level	0	1	2
% of foxes	P_0^{TP}	P_1^{TP}	P_2^{TP}
	$\text{Let } I_1 = \left(100 - \frac{\sum_{j=0}^{2} w_j^{tp} \; p_j^{tp}}{w_2^{tp}} \right)$		
Weights	$w_0^{TP} = 0$	$w_1^{TP} = 5$	$w_2^{TP} = 9$

I_1 is computed into a score using *I*-spline functions (Figure 34) as follows:

Score = $a_x + b_x \times I_1 + c_x \times I_1^2 + d_x \times I_1^3$

with $x = 1$ when $I_1 < k$ and $x = 2$ when $I_1 \geq k$

Criterion 12 - Temperament test - Period 1			
a_1	0	a_2	41.299124686249655269421055 0
b_1	0.722350897577570982832639 9	b_2	-1.342605336962170659020898 7
c_1	-0.006214070316572858562742 5	c_2	0.028201866928791560068523 5
d_1	0.000102142391098573948938 5	d_2	-0.000089057260277834154730 6
k	60		

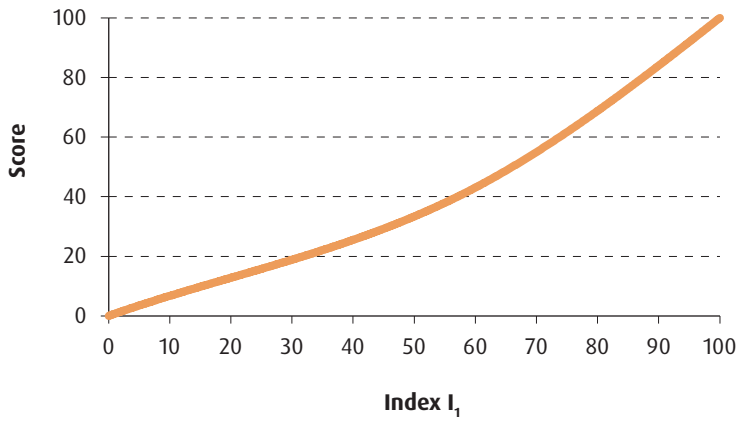

Figure 34 Calculation of the score S_1^{tp} for the Measurement *Temperament test* according to the percentage of foxes in each category of the temperament test in Period 1

Sub-score S^t for the Measurement *Transport of live foxes,* covering the last 12 months

One score is assigned to the Measurement *Transport of live foxes* according to a decision-tree (Figure 35) for the last 12 months.

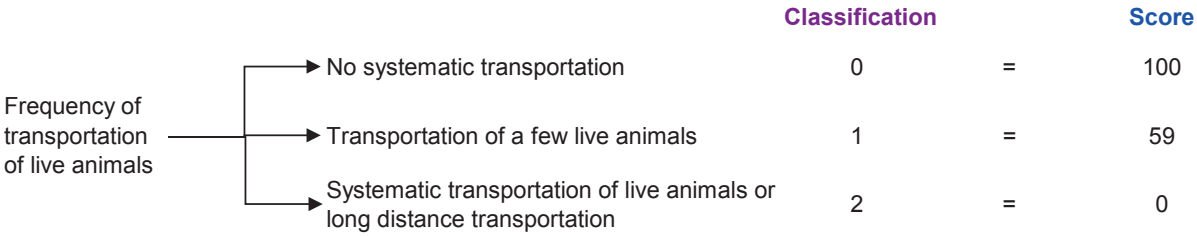

Figure 35 Sub-scores S^t assigned to situations concerning Measurement *Transport of live foxes*

Score for the Criterion *Positive emotional state*

The two partial scores are combined to form the overall score for the Criterion *Positive emotional state* using a Choquet integral. The parameters of the Choquet integral are:

μ_{tp} = 0.13 μ_t = 0.47

with *tp*, temperament and *t*, transport.

Reminder:

$$\text{Positive emotional state-score} = \begin{cases} S^{tp} + \left(S^t - S^{tp}\right)\mu_t & \text{if} \quad S^{tp} \le S^t \\ S^t + \left(S^{tp} - S^t\right)\mu_{tp} & \text{if} \quad S^t \le S^{tp} \end{cases}$$

Therefore, with the μ listed above:

$$\text{Positive emotional state-score} = \begin{cases} S^{tp} + 0.47\left(S^t - S^{tp}\right) & \text{if} \quad S^{tp} \le S^t \\ S^t + 0.13\left(S^{tp} - S^t\right) & \text{if} \quad S^t \le S^{tp} \end{cases}$$

Where S^{tp} and S^t are the partial scores obtained by a given farm for the Measurement *Temperament test* and the Measurement *Transport of live foxes* respectively.
μ_{tp} and μ_t are the capacities of the Measurements *Temperament test* and *Transport of live foxes* respectively.

3.3.2 Principle-scores

To calculate principle-scores in WelFur, we decided to follow the same process as in Welfare Quality®. In Welfare Quality®, parameters of the calculation (using Choquet integrals) to aggregate criterion-scores into principle-scores were defined for each animal type under study (*dairy cows, fattening bulls, veal calves, fattening pigs, sows and piglets, broilers and layers*).

The analysis of the experts' answers obtained in Welfare Quality® for the 8 types of animals cited above showed that there is no significant difference between the principle-scores calculated for each type of animal. We therefore decided to calculate WelFur principle-scores by gathering all animal types experts' answers into only one set of parameters, to be used in WelFur. We performed analytical work by testing and calculating several ways to combine the answers of the experts for all the animal types in order to achieve a common procedure for all livestock species.

Principle-scores are therefore calculated from the data collected on the eight animal types separately. Consequently, we use Choquet integrals in order to form fox principle scores by using the mean of each animal type's principle-scores obtained by the combination of criterion-scores assigned by the Welfare Quality® experts.

The parameters of the integrals are given below for each principle.

The Principle *Good feeding*

μ_1	=	0.11	μ_2	=	0.29

with 1, The Criterion *Absence of prolonged hunger* and 2, the Criterion *Absence of prolonged thirst*.

Reminder:

$$\text{Good feeding-score} = \begin{cases} S_1 + (S_2 - S_1)\,\mu_2 & \text{if} \quad S_1 \le S_2 \\ S_2 + (S_1 - S_2)\,\mu_1 & \text{if} \quad S_2 \le S_1 \end{cases}$$

Therefore, with the μ listed above:

$$\text{Good feeding-score} = \begin{cases} S_1 + 0.29(S_2 - S_1) & \text{if} \quad S_1 \le S_2 \\ S_2 + 0.11(S_1 - S_2) & \text{if} \quad S_2 \le S_1 \end{cases}$$

Where S_1 and S_2 are the criterion-scores obtained by a given farm for the Criterion *Absence of prolonged hunger* and the Criterion *Absence of prolonged thirst,* respectively.
μ_1 and μ_2 are the capacities of Criteria *Absence of prolonged hunger* and *Absence of prolonged thirst,* respectively.

The Principle *Good housing*

μ_3	=	0.15	μ_{34}	=	0.34
μ_4	=	0.10	μ_{35}	=	0.42
μ_5	=	0.13	μ_{45}	=	0.36

with 3, Criterion *Comfort around resting*; 4, the Criterion *Thermal comfort*; and 5, the Criterion *Ease of movement*.

Reminder:

$$\text{Good housing-score} = \begin{cases} S_3 + (S_4 - S_3)\,\mu_{45} + (S_5 - S_4)\,\mu_5 & \text{if} \quad S_3 \le S_4 \le S_5 \\ S_3 + (S_5 - S_3)\,\mu_{45} + (S_4 - S_5)\,\mu_4 & \text{if} \quad S_3 \le S_5 \le S_4 \\ S_4 + (S_3 - S_4)\,\mu_{35} + (S_5 - S_3)\,\mu_5 & \text{if} \quad S_4 \le S_3 \le S_5 \\ S_4 + (S_5 - S_4)\,\mu_{35} + (S_3 - S_5)\,\mu_3 & \text{if} \quad S_4 \le S_5 \le S_3 \\ S_5 + (S_3 - S_5)\,\mu_{34} + (S_4 - S_3)\,\mu_4 & \text{if} \quad S_5 \le S_3 \le S_4 \\ S_5 + (S_4 - S_5)\,\mu_{34} + (S_3 - S_4)\,\mu_3 & \text{if} \quad S_5 \le S_4 \le S_3 \end{cases}$$

Therefore, with the μ listed above:

$$\text{Good housing-score} = \begin{cases} S_3 + 0.36(S_4 - S_3) + 0.13(S_5 - S_4) & \text{if} \quad S_3 \le S_4 \le S_5 \\ S_3 + 0.36(S_5 - S_3) + 0.10(S_4 - S_5) & \text{if} \quad S_3 \le S_5 \le S_4 \\ S_4 + 0.42(S_3 - S_4) + 0.13(S_5 - S_3) & \text{if} \quad S_4 \le S_3 \le S_5 \\ S_4 + 0.42(S_5 - S_4) + 0.15(S_3 - S_5) & \text{if} \quad S_4 \le S_5 \le S_3 \\ S_5 + 0.34(S_3 - S_5) + 0.10(S_4 - S_3) & \text{if} \quad S_5 \le S_3 \le S_4 \\ S_5 + 0.34(S_4 - S_5) + 0.15(S_3 - S_4) & \text{if} \quad S_5 \le S_4 \le S_3 \end{cases}$$

Where S_3, S_4 and S_5 are the criterion-scores obtained by a given farm for the Criterion *Comfort around resting*, the Criterion *Thermal comfort* and the Criterion *Ease of movement,* respectively.
μ_3, μ_4 and μ_5 are the capacities of Criteria *Comfort around resting*, *Thermal comfort* and *Ease of movement,* respectively.
μ_{34} is the capacity of the group made of Criteria *Comfort around resting* and *Thermal comfort* and so on...

The Principle *Good health*

μ_6	=	0.08	μ_{67}	=	0.36
μ_7	=	0.22	μ_{69}	=	0.18
μ_8	=	0.12	μ_{78}	=	0.22

with 6, the Criterion *Absence of injuries*; 7, the Criterion *Absence of disease*; and 8, the Criterion *Absence of pain induced by management procedures*.

Reminder:

$$\text{Good health-score} = \begin{cases} S_6 + (S_7 - S_6)\mu_{78} + (S_8 - S_7)\mu_8 & \text{if} \quad S_6 \le S_7 \le S_8 \\ S_6 + (S_8 - S_6)\mu_{78} + (S_7 - S_8)\mu_7 & \text{if} \quad S_6 \le S_8 \le S_7 \\ S_7 + (S_6 - S_7)\mu_{68} + (S_8 - S_6)\mu_8 & \text{if} \quad S_7 \le S_6 \le S_8 \\ S_7 + (S_8 - S_7)\mu_{68} + (S_6 - S_8)\mu_6 & \text{if} \quad S_7 \le S_8 \le S_6 \\ S_8 + (S_6 - S_8)\mu_{67} + (S_7 - S_6)\mu_7 & \text{if} \quad S_8 \le S_6 \le S_7 \\ S_8 + (S_7 - S_8)\mu_{67} + (S_6 - S_7)\mu_6 & \text{if} \quad S_8 \le S_7 \le S_6 \end{cases}$$

Therefore, with the μ listed above:

$$\text{Good health-score} = \begin{cases} S_6 + 0.22(S_7 - S_6) + 0.12(S_8 - S_7) & \text{if} \quad S_6 \le S_7 \le S_8 \\ S_6 + 0.22(S_8 - S_6) + 0.22(S_7 - S_8) & \text{if} \quad S_6 \le S_8 \le S_7 \\ S_7 + 0.18(S_6 - S_7) + 0.12(S_8 - S_6) & \text{if} \quad S_7 \le S_6 \le S_8 \\ S_7 + 0.18(S_8 - S_7) + 0.08(S_6 - S_8) & \text{if} \quad S_7 \le S_8 \le S_6 \\ S_8 + 0.36(S_6 - S_8) + 0.22(S_7 - S_6) & \text{if} \quad S_8 \le S_6 \le S_7 \\ S_8 + 0.36(S_7 - S_8) + 0.08(S_6 - S_7) & \text{if} \quad S_8 \le S_7 \le S_6 \end{cases}$$

Where S_6, S_7 and S_8 are the scores obtained by a given farm for the Criterion *Absence of injuries*, the Criterion *Absence of disease* and the Criterion *Absence of pain induced by management procedures,* respectively.
μ_6, μ_7 and μ_8 are the capacities of the Criteria *Absence of injuries*, *Absence of disease* and *Absence of pain induced by management procedures,* respectively.
μ_{67} is the capacity of the group made of the Criteria *Absence of injuries* and *Absence of disease* and so on...

The Principle of *Appropriate behaviour*

μ_9	=	0.14	μ_{12}	=	0.16
μ_{10}	=	0.07	μ_{910}	=	0.16
μ_{11}	=	0.09	μ_{911}	=	0.14

μ_{912}	=	0.23	μ_{91011}	=	0.48
μ_{1011}	=	0.16	μ_{91012}	=	0.56
μ_{1012}	=	0.20	μ_{91112}	=	0.53
μ_{1112}	=	0.27	μ_{101112}	=	0.51

with 9, the Criterion *Expression of social behaviours*; 10, the Criterion *Expression of other behaviours*; 11, the Criterion *Good human-animal relationship*; 12, the Criterion *Positive emotional state*.

Reminder:

$$\text{Appropr. behaviour-score} = \begin{cases}
S_9 + (S_{10} - S_9)\,\mu_{101112} + (S_{11} - S_{10})\,\mu_{1211} + (S_{12} - S_{11})\,\mu_{12} & \text{if} \quad S_9 \le S_{10} \le S_{11} \le S_{12} \\
S_9 + (S_{10} - S_9)\,\mu_{101112} + (S_{12} - S_{10})\,\mu_{1112} + (S_{11} - S_{12})\,\mu_{11} & \text{if} \quad S_9 \le S_{10} \le S_{12} \le S_{11} \\
S_9 + (S_{11} - S_9)\,\mu_{101112} + (S_{10} - S_{11})\,\mu_{1012} + (S_{12} - S_{10})\,\mu_{12} & \text{if} \quad S_9 \le S_{11} \le S_{10} \le S_{12} \\
S_9 + (S_{11} - S_9)\,\mu_{101112} + (S_{12} - S_{11})\,\mu_{1012} + (S_{10} - S_{12})\,\mu_{10} & \text{if} \quad S_9 \le S_{11} \le S_{12} \le S_{10} \\
S_9 + (S_{12} - S_9)\,\mu_{101112} + (S_{10} - S_{12})\,\mu_{1011} + (S_{11} - S_{10})\,\mu_{11} & \text{if} \quad S_9 \le S_{12} \le S_{10} \le S_{11} \\
S_9 + (S_{12} - S_9)\,\mu_{101112} + (S_{11} - S_{12})\,\mu_{1011} + (S_{10} - S_{11})\,\mu_{10} & \text{if} \quad S_9 \le S_{12} \le S_{11} \le S_{10} \\
S_{10} + (S_9 - S_{10})\,\mu_{91112} + (S_{11} - S_9)\,\mu_{1112} + (S_{12} - S_{11})\,\mu_{12} & \text{if} \quad S_{10} \le S_9 \le S_{11} \le S_{12} \\
S_{10} + (S_9 - S_{10})\,\mu_{91112} + (S_{12} - S_9)\,\mu_{1112} + (S_{11} - S_{12})\,\mu_{11} & \text{if} \quad S_{10} \le S_9 \le S_{12} \le S_{11} \\
S_{10} + (S_{11} - S_{10})\,\mu_{91112} + (S_9 - S_{11})\,\mu_{912} + (S_{12} - S_9)\,\mu_{12} & \text{if} \quad S_{10} \le S_{11} \le S_9 \le S_{12} \\
S_{10} + (S_{11} - S_{10})\,\mu_{91112} + (S_{12} - S_{11})\,\mu_{912} + (S_9 - S_{12})\,\mu_9 & \text{if} \quad S_{10} \le S_{11} \le S_{12} \le S_9 \\
S_{10} + (S_{12} - S_{10})\,\mu_{91112} + (S_{11} - S_{12})\,\mu_{911} + (S_9 - S_{11})\,\mu_9 & \text{if} \quad S_{10} \le S_{12} \le S_{11} \le S_9 \\
S_{10} + (S_{12} - S_{10})\,\mu_{91112} + (S_9 - S_{12})\,\mu_{911} + (S_{11} - S_9)\,\mu_{11} & \text{if} \quad S_{10} \le S_{12} \le S_9 \le S_{11} \\
S_{11} + (S_{10} - S_{11})\,\mu_{91012} + (S_9 - S_{10})\,\mu_{912} + (S_{12} - S_9)\,\mu_{12} & \text{if} \quad S_{11} \le S_{10} \le S_9 \le S_{12} \\
S_{11} + (S_{10} - S_{11})\,\mu_{91012} + (S_{12} - S_{10})\,\mu_{912} + (S_9 - S_{12})\,\mu_9 & \text{if} \quad S_{11} \le S_{10} \le S_{12} \le S_9 \\
S_{11} + (S_{12} - S_{11})\,\mu_{91012} + (S_{10} - S_{12})\,\mu_{910} + (S_9 - S_{10})\,\mu_9 & \text{if} \quad S_{11} \le S_{12} \le S_{10} \le S_9 \\
S_{11} + (S_{12} - S_{11})\,\mu_{91012} + (S_{10} - S_{12})\,\mu_{910} + (S_{10} - S_9)\,\mu_{10} & \text{if} \quad S_{11} \le S_{12} \le S_9 \le S_{10} \\
S_{11} + (S_9 - S_{11})\,\mu_{91012} + (S_{12} - S_9)\,\mu_{1012} + (S_{10} - S_{12})\,\mu_{10} & \text{if} \quad S_{11} \le S_9 \le S_{12} \le S_{10} \\
S_{11} + (S_9 - S_{11})\,\mu_{91012} + (S_{10} - S_9)\,\mu_{1012} + (S_{12} - S_{10})\,\mu_{12} & \text{if} \quad S_{11} \le S_9 \le S_{10} \le S_{12} \\
S_{12} + (S_9 - S_{12})\,\mu_{91011} + (S_{10} - S_9)\,\mu_{1011} + (S_{11} - S_{10})\,\mu_{11} & \text{if} \quad S_{12} \le S_9 \le S_{10} \le S_{11} \\
S_{12} + (S_9 - S_{12})\,\mu_{91011} + (S_{11} - S_9)\,\mu_{1011} + (S_{10} - S_{11})\,\mu_{10} & \text{if} \quad S_{12} \le S_9 \le S_{11} \le S_{10} \\
S_{12} + (S_{10} - S_{12})\,\mu_{91011} + (S_{11} - S_{10})\,\mu_{911} + (S_9 - S_{11})\,\mu_9 & \text{if} \quad S_{12} \le S_{10} \le S_{11} \le S_9 \\
S_{12} + (S_{10} - S_{12})\,\mu_{91011} + (S_9 - S_{10})\,\mu_{911} + (S_{11} - S_9)\,\mu_{11} & \text{if} \quad S_{12} \le S_{10} \le S_9 \le S_{11} \\
S_{12} + (S_{11} - S_{12})\,\mu_{91011} + (S_9 - S_{11})\,\mu_{910} + (S_{10} - S_9)\,\mu_{10} & \text{if} \quad S_{12} \le S_{11} \le S_9 \le S_{10} \\
S_{12} + (S_{11} - S_{12})\,\mu_{91011} + (S_{10} - S_{11})\,\mu_{910} + (S_9 - S_{10})\,\mu_9 & \text{if} \quad S_{12} \le S_{11} \le S_{10} \le S_9
\end{cases}$$

Therefore, with the μ listed above:

$$\text{Appropr. behaviour-score} = \begin{cases}
S_9 + 0.51(S_{10} - S_9) + 0.27(S_{11} - S_{10}) + 0.16(S_{12} - S_{11}) & \text{if} \quad S_9 \le S_{10} \le S_{11} \le S_{12} \\
S_9 + 0.51(S_{10} - S_9) + 0.27(S_{12} - S_{10}) + 0.09(S_{11} - S_{12}) & \text{if} \quad S_9 \le S_{10} \le S_{12} \le S_{11} \\
S_9 + 0.51(S_{11} - S_9) + 0.20(S_{10} - S_{11}) + 0.16(S_{12} - S_{10}) & \text{if} \quad S_9 \le S_{11} \le S_{10} \le S_{12} \\
S_9 + 0.51(S_{11} - S_9) + 0.20(S_{12} - S_{11}) + 0.07(S_{10} - S_{12}) & \text{if} \quad S_9 \le S_{11} \le S_{12} \le S_{10} \\
S_9 + 0.51(S_{12} - S_9) + 0.16(S_{10} - S_{12}) + 0.09(S_{11} - S_{10}) & \text{if} \quad S_9 \le S_{12} \le S_{10} \le S_{11} \\
S_9 + 0.51(S_{12} - S_9) + 0.16(S_{11} - S_{12}) + 0.07(S_{10} - S_{11}) & \text{if} \quad S_9 \le S_{12} \le S_{11} \le S_{10} \\
S_{10} + 0.53(S_9 - S_{10}) + 0.27(S_{11} - S_9) + 0.16(S_{12} - S_{11}) & \text{if} \quad S_{10} \le S_9 \le S_{11} \le S_{12} \\
S_{10} + 0.53(S_9 - S_{10}) + 0.27(S_{12} - S_9) + 0.09(S_{11} - S_{12}) & \text{if} \quad S_{10} \le S_9 \le S_{12} \le S_{11} \\
S_{10} + 0.53(S_{11} - S_{10}) + 0.23(S_9 - S_{11}) + 0.16(S_{12} - S_9) & \text{if} \quad S_{10} \le S_{11} \le S_9 \le S_{12} \\
S_{10} + 0.53(S_{11} - S_{10}) + 0.23(S_{12} - S_{11}) + 0.14(S_9 - S_{12}) & \text{if} \quad S_{10} \le S_{11} \le S_{12} \le S_9 \\
S_{10} + 0.53(S_{12} - S_{10}) + 0.14(S_{11} - S_{12}) + 0.14(S_9 - S_{11}) & \text{if} \quad S_{10} \le S_{12} \le S_{11} \le S_9 \\
S_{10} + 0.53(S_{12} - S_{10}) + 0.14(S_9 - S_{12}) + 0.09(S_{11} - S_9) & \text{if} \quad S_{10} \le S_{12} \le S_9 \le S_{11} \\
S_{11} + 0.56(S_{10} - S_{11}) + 0.23(S_9 - S_{10}) + 0.16(S_{12} - S_9) & \text{if} \quad S_{11} \le S_{10} \le S_9 \le S_{12} \\
S_{11} + 0.56(S_{10} - S_{11}) + 0.23(S_{12} - S_{10}) + 0.14(S_9 - S_{12}) & \text{if} \quad S_{11} \le S_{10} \le S_{12} \le S_9 \\
S_{11} + 0.56(S_{12} - S_{11}) + 0.16(S_{10} - S_{12}) + 0.14(S_9 - S_{10}) & \text{if} \quad S_{11} \le S_{12} \le S_{10} \le S_9 \\
S_{11} + 0.56(S_{12} - S_{11}) + 0.16(S_9 - S_{12}) + 0.07(S_{10} - S_9) & \text{if} \quad S_{11} \le S_{12} \le S_9 \le S_{10} \\
S_{11} + 0.56(S_9 - S_{11}) + 0.20(S_{12} - S_9) + 0.07(S_{10} - S_{12}) & \text{if} \quad S_{11} \le S_9 \le S_{12} \le S_{10} \\
S_{11} + 0.56(S_9 - S_{11}) + 0.20(S_{10} - S_9) + 0.16(S_{12} - S_{10}) & \text{if} \quad S_{11} \le S_9 \le S_{10} \le S_{12} \\
S_{12} + 0.48(S_9 - S_{12}) + 0.16(S_{10} - S_9) + 0.09(S_{11} - S_{10}) & \text{if} \quad S_{12} \le S_9 \le S_{10} \le S_{11} \\
S_{12} + 0.48(S_9 - S_{12}) + 0.16(S_{11} - S_9) + 0.07(S_{10} - S_{11}) & \text{if} \quad S_{12} \le S_9 \le S_{11} \le S_{10} \\
S_{12} + 0.48(S_{10} - S_{12}) + 0.14(S_{11} - S_{10}) + 0.14(S_9 - S_{11}) & \text{if} \quad S_{12} \le S_{10} \le S_{11} \le S_9 \\
S_{12} + 0.48(S_{10} - S_{12}) + 0.14(S_9 - S_{10}) + 0.09(S_{11} - S_9) & \text{if} \quad S_{12} \le S_{10} \le S_9 \le S_{11} \\
S_{12} + 0.48(S_{11} - S_{12}) + 0.16(S_9 - S_{11}) + 0.07(S_{10} - S_9) & \text{if} \quad S_{12} \le S_{11} \le S_9 \le S_{10} \\
S_{12} + 0.48(S_{11} - S_{12}) + 0.16(S_{10} - S_{11}) + 0.14(S_9 - S_{10}) & \text{if} \quad S_{12} \le S_{11} \le S_{10} \le S_9
\end{cases}$$

Where S_9, S_{10}, S_{11} and S_{12} are the scores obtained by a given farm for the Criterion *Expression of social behaviours*, the Criterion *Expression of other behaviours*, the Criterion *Good human-animal relationship* and the Criterion *Positive emotional state,* respectively.
μ_9, μ_{10}, μ_{11} and μ_{12} are the capacities of the Criteria *Expression of social behaviours*, *Expression of other behaviours*, *Good human-animal relationship* and *Positive emotional state,* respectively.
μ_{910} is the capacity of the group made of the Criteria *Expression of social behaviours* and *Expression of other behaviours* and so on...

Due to the positive values of the interactions between criterion-scores, the principle-scores are always intermediate between the lowest and the highest values obtained at criterion level and always closer to the minimum value.

Within each principle, some criteria are considered more important than others (and will contribute to a large extent to the principle-score):

- Within the Principle *Good feeding*, the Criterion *Absence of prolonged thirst* is considered more important than the Criterion *Absence of prolonged hunger*.

- Within the Principle *Good housing*, the Criterion *Comfort around resting* is considered more important than the Criterion *Ease of movement* which in turn is considered more important than the Criterion *Thermal comfort*.

- Within the Principle *Good health*, the Criterion *Absence of disease* is considered more important than the Criterion *Absence of injuries* which in turn is considered more important than the Criterion *Absence of pain induced by management procedures*.

- Within the Principle *Appropriate behaviour*, the Criterion *Positive emotional state* is considered more important than the Criterion *Expression of social behaviours* which in turn is considered more important than the Criterion *Good human-animal relationship* which in turn is considered more important than the Criterion *Expression of other behaviours*.

Examples of principle-scores resulting from Criterion-scores are provided in Table 7, Table 8, Table 9 and Table 10

Table 7 Examples of scores for Principle *Good feeding* according to combinations of criterion-scores for the Criteria *Absence of prolonged hunger* and *Absence of prolonged thirst*

Absence of prolonged hunger	Absence of prolonged thirst	Principle Good feeding
25	75	**39**
40	60	**46**
50	50	**50**
60	40	**42**
75	25	**30**

Table 8 Examples of scores for the Principle Good housing according to combinations of criterion-scores for the Criteria *Comfort around resting, Thermal comfort* and *Ease of movement*

Comfort around resting	Thermal comfort	Ease of movement	Principle Good housing
25	50	75	**37**
25	75	50	**37**
40	50	60	**45**
40	60	50	**45**
50	25	75	**39**
50	40	60	**46**
50	50	50	**50**
50	60	40	**44**
50	75	25	**36**
60	40	50	**46**
60	50	40	**45**
75	25	50	**39**
75	50	25	**37**

Table 9 Examples of scores for the Principle *Good health* according to combinations of criterion-scores for the Criteria *Absence of injuries, Absence of disease* and *Absence of pain induced by management procedures*

Absence of injuries	Absence of disease	Absence of pain induced by management procedures	Principle Good health
25	50	75	**34**
25	75	50	**36**
40	50	60	**43**
40	60	50	**44**
50	25	75	**33**
50	40	60	**43**
50	50	50	**50**
50	60	40	**46**
50	75	25	**40**
60	40	50	**43**
60	50	40	**44**
75	25	50	**32**
75	50	25	**36**

Table 10 Examples of scores for the Principle *Appropriate behaviour* according to combinations of criterion-scores for the Criteria *Expression of social behaviours, Expression of other behaviours, Good human-animal relationship* and *Positive emotional state*

Expression of social behaviours	Expression of other behaviours	Good human-animal relationships	Positive emotional state	Principle Appropriate behaviour
35	35	65	65	**43**
35	50	50	65	**45**
35	50	65	50	**44**
35	65	35	65	**41**
35	65	50	50	**44**
35	65	65	35	**40**
50	35	50	65	**45**
50	35	65	50	**44**
50	50	35	65	**46**
50	50	50	50	**50**
50	50	65	35	**44**
50	65	35	50	**44**
50	65	50	35	**43**
65	35	35	65	**42**
65	35	50	50	**45**
65	35	65	35	**39**
65	50	35	50	**45**
65	50	50	35	**44**
65	65	35	35	**40**

3.3.3 Overall assessment

The synthesis of the four principle-scores into an overall assessment is carried out in a similar way for all animal types in WelFur as well as in Welfare Quality®.
The scores obtained by a farm on all welfare principles are used to assign that farm to a welfare category. How many and what welfare categories are necessary depends on the purposes for which the welfare assessment will be used. According to the range of potential uses of the assessment, four welfare categories are to be identified:

Best current practice: the welfare of animals is of the best current practice.
Good current practice: the welfare of animals is of good current practice.
Acceptable current practice: the welfare of animals is above minimal requirements for current practice.
Unacceptable current practice: the welfare of animals is below current practice and considered unacceptable.

'Aspiration values' are defined for each category. They represent the goal that the farm should try to achieve to be assigned to a given category. The 'Best' threshold is set at 80, the one for 'Good' at 55 and that for acceptability at 20. However, just as criteria do not compensate for each other within a principle (see earlier), high scores in one principle do not offset low scores in another, so categories cannot be based on average scores. At the same time, it is important that the final classification reflects not only the theoretical acknowledgement of what can be considered as best, good, *etc.*, but also what can realistically be achieved in practice.
A farm is considered 'Best current practice' if it scores more than 55 on all principles and more than 80 on at least two, while it is considered 'Good current practice' if it scores more than 20 on all principles and more than 55 on at least two. Farms with 'Acceptable current practice' levels of animal welfare score more than 10 on all principles and more than 20 on at least three. Farms that do not reach these minimum standards are classified as 'Unacceptable current practice' (Figure 36). Due to the variability of experts' answers during the various consultations, some uncertainty of the evaluation is to be taken into account. As a consequence, an indifference threshold equal to 5 is applied: for instance, 50 is not considered significantly lower than 55.

Note: The rules to assign a farm to a given welfare category may be subject to modifications once a sufficient number of commercial farms have been inspected.

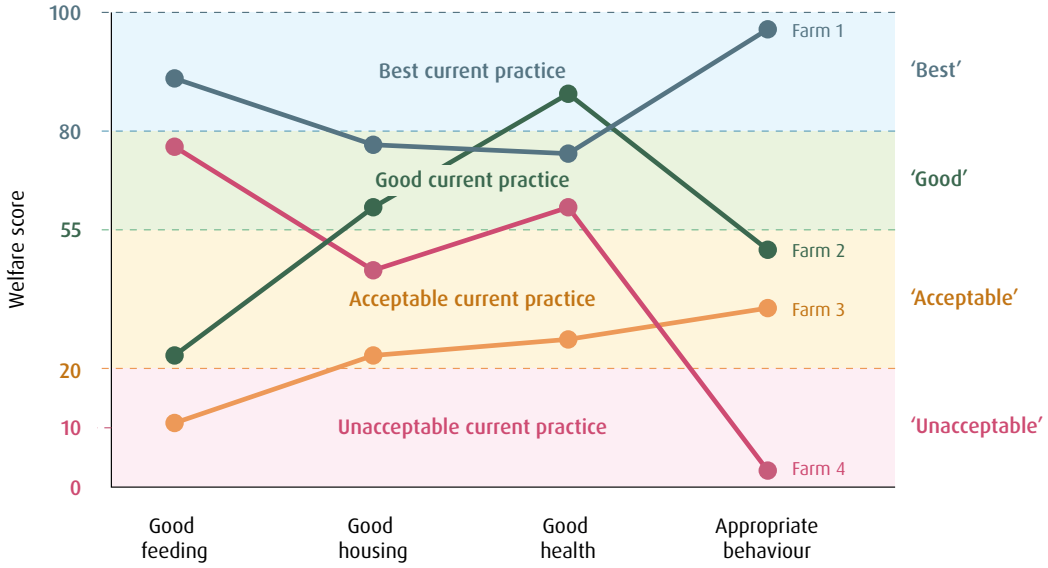

Figure 36 Examples of farms in the four welfare categories

3.4 Annex A: Recording sheets for foxes

Farm:	Page: /
Assessor:	Date:

Data recording sheets for foxes for Period 1

Arrival time:	Leaving time:

ONLY for sheds holding foxes			Number of	Location	Foxes in sample A (~100)	B (80-100)	ST (150-200)
SHEDS	Type	Two row					
		Multi row					
FOXES	Blue foxes	Females					
		Males					
	Silver foxes	Females					
		Males					
CAGES	Singly housing	~ 0.8m^2					
		~ 1.2m^2					
		~ 2.4m^2					
	Pair/group housing	~ 1.2m^2					
		~ 2.4m^2					
WATERING SYSTEM	Quality control	Yes					
		No					
	Automatic	Frost protection					
		No frost protection					
	Manual			Water: times a day			
HEALTH	Section for sick and injured animals						
	Are there contagious diseases on the farm?		Yes				
			No				

Farm:	Page: /
Assessor:	Date:

Coding instructions (Period 1)

Animal codes:
Species: 1= Blue fox, 2 = Silver fox
Sex: 1 = Male, 2 = Female

Feeding test:
Score: 0 = eats within 30 sec, 1 = does not eat within 30 sec

Stereotypic behaviour:

Score	Behaviour	Short description
0	Resting	Laying down, head on the floor or up
1	Activity	Active, *e.g.* sitting, walking, drinking or playing
2	Stereotypy	Repetitive pacing and/or jumping; other stereotypy, *e.g.* licking or biting the cage.

Temperament test:
0 = touches the stick in exploratory way
1 = does not touch the stick
2 = attacks the stick and/or bites the stick aggressively

BCS:
1 = very thin
2 = thin
3 = ideal
4 = heavy
5 = extremely fat

Cleanliness:
0 = clean
1 = slightly dirty
2 = clearly dirty

Urinary tract infection:
0 = no evidence of urinary tract infection
1 = clear signs of urinary tract infection

Fur chewing:
0 = no fur chewing
1 = clear signs of fur chewing

Type of watering system:
0 = watering system with automatic water flow, protected from freezing
1 = watering system with automatic water flow, not protected from freezing
2 = water is provided manually

Water function:
0 = water point works properly
1 = water point does not work properly

Water cleanliness:
0 = water point is clean
1 = water point is dirty

Platform:
0 = usable platform
1 = no usable platform

Platform (cm):
Measure the distance (cm) from the ceiling to the platform

Cage length (cm):
Measure the cage length (cm) for calculation of cage area

Cage width (cm):
Measure the cage width (cm) for calculation of cage area

Cage height (cm): Measure the cage height (cm)

Number of foxes in the cage:
Mark the number of foxes in the cage for determining cage area score

Enrichment:
Mark the number of different enrichments in the cage in each enrichment type category:

Category 0 = renewable gnawing object (*i.e.* bone or wooden block) or a construction with at least one solid wall, increasing environmental complexity (*i.e.* nest box or concealment screen)

Category 1 = occupational material for exploration and/or play (*e.g.* ball, rope, straw or sand)

Category 2 = other types of enrichment (*e.g.* scratching plate)

Observing:
0 = opportunity to observe surroundings
1 = no opportunity to observe surroundings

Wind shield:
0 = wind shield in the cage,
1= no wind shield in the cage

Buildings/stand of trees:
0 = buildings, solid fences, hills or a stand of trees in the immediate vicinity of the cage,
1 = no buildings, solid fences, hills or a stand of trees in the immediate vicinity of the cage

Farm:	Page: /
Assessor:	Date:

Management questionnaire

MORTALITY (ONLY FOXES OLDER THAN 8 WEEKS ARE CONSIDERED)		
Number of foxes found dead during the last 12 months		individuals
Number of foxes humanely killed during the last 12 months		individuals
Total number of foxes on the farm during the last 12 months		individuals
KILLING METHOD		
What killing method(s) is/are used?		
Check light or sound for verifying the functioning of the device?		YES / NO
Does the killing device work properly?		YES / NO
OPPORTUNITY TO USE ENRICHMENTS		
How often enrichments are renewed		times a year
TRANSPORT OF LIVE FOXES		
Have foxes been bought during the last 12 months?		YES / NO
How many individuals		individuals
How far		distance (km)
Are foxes transported from one farm area to another?		YES / NO
How many individuals		individuals
How far		distance (km)

Comments and observations

Farm:	Page: /
Assessor:	Date:

Feeding test (Scores: 0 = eats within 30 sec, 1 = does not eat within 30 sec), Sample A (~100 foxes)

Species										
Score										

Species										
Score										

Species										
Score										

Species										
Score										

Species										
Score										

Species										
Score										

Species										
Score										

Total number of foxes tested ________________

Total number of foxes eating in the feeding test ________________

Percentage of foxes eating ________________ %

Farm:	Page: /
Assessor:	Date:

Animal-based and resource-based measurements, Sample B (80-100 foxes)

Cage or ID										
Species/Sex										
Temperament test 0/1/2										
BCS 1/2/3/4/5										
Cleanliness 0/1/2										
Urinary tract infection 0/1										
Fur chewing 0/1										
Type of watering system 0/1/2										
Water function 0/1										
Water cleanliness 0/1										
Platform 0/1										
Platform (cm)										
Cage length (cm)										
Cage width (cm)										
Cage height (cm)										
No. of foxes in cage										
Number of different enrichments in categories	Cat. 0									
	Cat. 1									
	Cat. 2									
Observing 0/1										
Wind shield 0/1										
Build./stand of trees 0/1										

Farm:	Page: /
Assessor:	Date:

Stereotypic behaviour: Scores 0 = resting, 1 = active, 2 = stereotypy (100-150 foxes)

Species										
Score										

Species										
Score										

Species										
Score										

Species										
Score										

Species										
Score										

Species										
Score										

Species										
Score										

Species										
Score										

Species										
Score										

Species										
Score										

Total number of foxes tested _________________

Number of foxes with Score 0 _________________

Number of foxes with Score 1 _________________

Number of foxes with Score 2 _________________

Number of active foxes (Score 1+2) _________________

Stereotyping foxes out of all active foxes _________________ %

Farm:	Page: /
Assessor:	Date:

Data recording sheets for foxes for Period 2

Arrival time:	Leaving time:

					Foxes in sample	
ONLY for sheds holding foxes			**Number of**	**Location**	**B (80-100)**	**ST (150-200)**
SHEDS	Type	Two row				
		Multi row				
FOXES	Blue foxes	Females				
		Males				
		Cubs				
	Silver foxes	Females				
		Males				
		Cubs				
	Crossbreeds	Cubs				
CAGES	Singly housing of adults (including vixen with cubs)	~ 0.8m²				
		~ 1.2m²				
		~ 2.4m²				
	Pair/group housing	~ 1.2m²				
		~ 2.4m²				
WATERING SYSTEM	Quality control	Yes				
		No				
	Automatic	Overheating protection				
		No overheating protection				
	Manual			Water: times a day		
HEALTH	Section for sick and injured animals					
	Are there contagious diseases on the farm?		Yes			
			No			

Farm:	Page: /
Assessor:	Date:

Coding instructions (Period 2)

Animal codes:
Species: 1= Blue fox, 2 = Silver fox, 3 = Crossbreed
Age: 1 = Cub, 2 = Adult

Sex: 1 = Male, 2 = Female

Stereotypic behaviour:

Score	Behaviour	Short description
0	Resting	laying down, head on the floor or up
1	Activity	Active, *e.g.* sitting, walking, drinking or playing
2	Stereotypy	Repetitive pacing and/or jumping; other stereotypy, e.g. licking or biting the cage

BCS:
1 = very thin
2 = thin
3 = ideal
4 = heavy
5 = extremely fat

Cleanliness:
0 = clean
1 = slightly dirty
2 = clearly dirty

Type of watering system:
0 = watering system with automatic water flow
2 = water is provided manually

Overheating:
0 = watering system is protected against overheating
1 = watering system is not protected against overheating

Water function:
0 = water point works properly
1 = water point does not work properly

Water cleanliness:
0 = water point is clean
1 = water point is dirty

Platform:
0 = usable platform
1 = no usable platform

Platform (cm):
Measure the distance (cm) from the ceiling to the platform

Cage length (cm):
Measure the cage length (cm) for calculation of cage area

Cage width (cm):
Measure the cage width (cm) for calculation of cage area

Cage height (cm): Measure the cage height (cm)

Number of foxes in the cage:
Mark the number of foxes (adults and cubs) in the cage for determining cage area score

Enrichment:
Mark the number of different enrichments in the cage in each enrichment type category:
Category 0 = renewable gnawing object (*i.e.* bone or wooden block) or a construction with at least one solid wall, increasing environmental complexity (*i.e.* nest box or concealment screen)
Category 1 = occupational material for exploration and/or play (*e.g.* ball, rope, straw or sand)
Category 2 = other types of enrichment (*e.g.* scratching plate)

Observing:
0 = opportunity to observe surroundings
1 = no opportunity to observe surroundings

Sun blinds:
0 = there is some protection, in addition to eaves, against direct sunlight
1 = no protection against direct sunlight

Ventilation (concerns only barns):
0 = ventilation can be increased by an automated ventilation system or by openings *e.g.* windows in the barn
1 = no possibility to increase ventilation.

Farm:	Page: /
Assessor:	Date:

Management questionnaire

PROTECTION FROM EXCEPTIONAL WEATHER CONDITIONS		
Are the foxes or the roofs of the sheds sprinkled in warm (> 30 °C) weather		YES / NO
MORTALITY (ONLY FOXES OLDER THAN 8 WEEKS ARE CONSIDERED)		
Number of foxes found dead during the last 12 months		individuals
Number of foxes humanely killed during the last 12 months		individuals
Total number of foxes on the farm during the last 12 months		individuals
KILLING METHOD		
What killing method(s) is/are used?		
Check light or sound for verifying the functioning of the device?		YES / NO
Does the killing device work properly?		YES / NO
OPPORTUNITY TO USE ENRICHMENTS		
How often enrichments are renewed		times a year
TRANSPORT OF LIVE FOXES		
Have foxes been bought during the last 12 months?		YES / NO
How many individuals		individuals
How far		distance (km)
Are foxes transported from one farm area to another?		YES / NO
How many individuals		individuals
How far		distance (km)

Comments and observations

Farm:	Page: /
Assessor:	Date:

Animal-based and resource-based measurements, Sample B (80-100 foxes)

Cage or ID										
Species/Sex										
BCS 1/2/3/4/5										
Cleanliness 0/1/2										
Type of watering system 0/1/2										
Water overheating 0/1										
Water function 0/1										
Water cleanliness 0/1										
Platform 0/1										
Platform (cm)										
Cage length (cm)										
Cage width (cm)										
Cage height (cm)										
No. of adults and cubs (x + x) in cage										
Number of different enrichments in categories – Cat. 0										
Number of different enrichments in categories – Cat. 1										
Number of different enrichments in categories – Cat. 2										
Observing 0/1										
Sun blinds 0/1										
Ventilation * 0/1										

* Concerns only barns

Farm:	Page: /
Assessor:	Date:

Stereotypic behaviour: Scores 0 = resting, 1 = active, 2 = stereotypy (100-150 foxes)

Species										
Score										

Species										
Score										

Species										
Score										

Species										
Score										

Species										
Score										

Species										
Score										

Species										
Score										

Species										
Score										

Species										
Score										

Species										
Score										

Total number of foxes tested ________________

Number of foxes with Score 0 ________________

Number of foxes with Score 1 ________________

Number of foxes with Score 2 ________________

Number of active foxes (Score 1+2) ________________

Stereotyping foxes out of all active foxes ________________ %

Farm:	Page: /
Assessor:	Date:

Data recording sheets for foxes for Period 3

Arrival time:	Leaving time:

					Foxes in sample	
ONLY for sheds holding foxes			**Number of**	**Location**	**B (80-100)**	**ST (150-200)**
SHEDS	Type	Two row				
		Multi row				
FOXES	Blue foxes	Females				
		Males				
		Juveniles				
	Silver foxes	Females				
		Males				
		Juveniles				
	Crossbreeds	Juveniles				
CAGES	Singly housing	~ 0.8m²				
		~ 1.2m²				
		~ 2.4m²				
	Pair/group housing	~ 1.2m²				
		~ 2.4m²				
WATERING SYSTEM	Quality control	Yes				
		No				
	Automatic	Frost protection				
		No frost protection				
	Manual			Water: times a day		
HEALTH	Section for sick and injured animals					
	Are there contagious diseases on the farm?		Yes			
			No			

Farm:	Page: /
Assessor:	Date:

Coding instructions (Period 3)

Animal codes:
Species: 1= Blue fox, 2 = Silver fox, 3 = Crossbreed
Age: 1 = Juvenile, 2 = Adult

Sex: 1 = Male, 2 = Female

Stereotypic behaviour:

Score	Behaviour	Short description
0	Resting	laying down, head on the floor or up
1	Activity	Active, e.g. sitting, walking, drinking or playing
2	Stereotypy	Repetitive pacing and/or jumping; other stereotypy, *e.g.* licking or biting the cage

BCS: 1 = very thin, 2 = thin, 3 = ideal, 4 = heavy, 5 = extremely fat

Cleanliness: 0 = clean, 1 = slightly dirty, 2 = clearly dirty

Moving: 0 = no moving difficulty, 1 = some difficulties in moving, 2 = major difficulties in moving, 3 = does not move even when disturbed

Skin lesions: 0 = no lesions, 1 = mild lesions, 2 = severe lesions

Bent feet: 0 = normal feet, 1 = slightly bent feet, 2= severely bent feet

Eyes: 0 = no ocular discharge or inflammation, 1 = clear evidence of ocular discharge or inflammation

Mouth: 0 = no evidence of impaired mouth and/or teeth health 1 = impaired mouth and/or teeth health

Diarrhoea: 0 = no evidence of diarrhoea, 1 = clear signs of diarrhoea

Obviously sick: 0 = no signs of poor/reduced health, 1= obvious signs of poor/ reduced health, 2 = obvious signs of stereotypic behaviour. Note that score 2 can be recorded simultaneously with 0 or 1

Fur chewing: 0 = no fur chewing, 1 = clear signs of fur chewing

Type of watering system: 0 = watering system with automatic water flow, protected from freezing 1 = watering system with automatic water flow, not protected from freezing 2 = water is provided manually

Overheating: 0 = watering system is protected against overheating, 1 = watering system is not protected against overheating

Water function: 0 = water point works properly, 1 = water point does not work properly

Water cleanliness: 0 = water point is clean, 1 = water point is dirty

Platform: 0 = usable platform, 1 = no usable platform

Platform (cm): Measure the distance (cm) from the ceiling to the platform

Cage height (cm): Measure the cage height (cm)

Number of foxes in the cage: Mark the number of foxes (adults and juveniles) in the cage for determining cage area and social housing scores

Enrichment: Mark the number of different enrichments in the cage in each enrichment type category:

> **Category 0 =** renewable gnawing object (*i.e.* bone or wooden block) or a construction with at least one solid wall, increasing environmental complexity (*i.e.* nest box or concealment screen)
>
> **Category 1 =** occupational material for exploration and/or play (*e.g.* ball, rope, straw or sand)
>
> **Category 2 =** other types of enrichment (*e.g.* scratching plate)

Observing: 0 = opportunity to observe surroundings, 1 = no opportunity to observe surroundings

Wind shield: 0 = wind shield in the cage, 1= no wind shield in the cage

Buildings/stand of trees: 0 = buildings, solid fences, hills or a stand of trees in the immediate vicinity of the cage, 1= no buildings, solid fences, hills or a stand of trees in the immediate vicinity of the cage

Sun blinds: 0 = some protection, in addition to eaves, against direct sunlight, 1= no protection against direct sunlight

Ventilation (concerns only barns): 0 = ventilation can be increased by an automated ventilation system, or by opening e.g. windows in the barn, 1= no possibility to increase ventilation.

Farm:	Page: /
Assessor:	Date:

Management questionnaire

PROTECTION FROM EXCEPTIONAL WEATHER CONDITIONS		
Are the foxes or the roofs of the sheds sprinkled in warm (> 30 º C) weather		YES / NO
MORTALITY (ONLY FOXES OLDER THAN 8 WEEKS ARE CONSIDERED)		
Number of foxes found dead during the last 12 months		individuals
Number of foxes humanely killed during the last 12 months		individuals
Total number of foxes on the farm during the last 12 months		individuals
KILLING METHOD		
What killing method(s) is/are used?		
Check light or sound for verifying the functioning of the device?		YES / NO
Does the killing device work properly?		YES / NO
OPPORTUNITY TO USE ENRICHMENTS		
How often enrichments are renewed		times a year
TRANSPORT OF LIVE FOXES		
Have foxes been bought during the last 12 months?		YES / NO
How many individuals		individuals
How far		distance (km)
Are foxes transported from one farm area to another?		YES / NO
How many individuals		individuals
How far		distance (km)

Comments and observations

Farm:	Page: /
Assessor:	Date:

Animal-based and resource-based measurements, Sample B (80-100 foxes)

Cage or ID											
Species/Age/Sex											
BCS 1/2/3/4/5											
Cleanliness 0/1/2											
Moving 0/1/2/3											
Skin lesions 0/1/2											
Bent feet 0/1/2											
Ocular inflammation 0/1											
Mouth/teeth health 0/1											
Diarrhoea 0/1											
Obviously sick 0/1*/2											
Fur chewing 0/1											
Type of watering system 0/1/2											
Water overheating 0/1											
Water function 0/1											
Water cleanliness 0/1											
Platform 0/1											
Platform (cm)											
Cage length (cm)											
Cage width (cm)											
Cage height (cm)											
No. of foxes in cage											
Number of different enrichments in categories – Cat. 0											
Number of different enrichments in categories – Cat. 1											
Number of different enrichments in categories – Cat. 2											
Observing 0/1											
Wind shield 0/1											
Build./stand of trees 0/1											
Sun blinds 0/1											
Ventilation** 0/1											

* Please fill the observed symptoms

** Concerns only barns

Cage/ID	

Notes :

Farm:	Page: /
Assessor:	Date:

Stereotypic behaviour: Scores 0 = resting, 1 = active, 2 = stereotypy (100-150 foxes)

Species/age										
Score										

Species/age										
Score										

Species/age										
Score										

Species/age										
Score										

Species/age										
Score										

Species/age										
Score										

Species/age										
Score										

Species/age										
Score										

Species/age										
Score										

Species/age										
Score										

Total number of foxes tested ________________

Number of foxes with Score 0 ________________ %

Number of foxes with Score 1 ________________ %

Number of foxes with Score 2 ________________ %

Number of active foxes (Score 1+2) ________________

Stereotyping foxes out of all active foxes ________________ %

3.5 Annex B: Contributors to WelFur

WelFur partners	Country
European Fur Information Center (Fur Europe), Brussels	Belgium
INRA (National Institute of Agronomic Research), UMR1213 Herbivores, Clermont-Ferrand	France
University of Eastern Finland (UEF, Department of Biology)	Finland
MTT Agrifood Research Finland (MTT, Animal Production Research)	Finland
Aarhus University (AU, Department of Animal Science)	Denmark
Norwegian University of Life Sciences (NMBU, Department of Animal and Aquacultural Sciences)	Norway
Swedish University of Agricultural Sciences (SLU, Department of Animal Environment and Health)	Sweden
University of Utrecht (UU, Faculty of Veterinary Medicine, Department of Animals in Science & Society)	The Netherlands
University of Guelph (Animal and Poultry Department of Science)	Canada
University of Birmingham (School of Biosciences)	United-Kingdom
Experts from the original Welfare Quality® project	

The authors of the fox protocol (in alphabetical order):
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