

# Methodological guidance for the development of animal welfare mandates in the context of the Farm To Fork Strategy

EFSA Panel on Animal Health and Welfare (AHAW),

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## Abstract

This document provides a methodological guidance developed by the EFSA Panel on Animal Health and Welfare (AHAW Panel) to produce Scientific Opinions in response to mandates received from the European Commission in the context of the Farm to Fork Strategy. The mandates relate to the welfare of i. animals during transport, ii. calves, iii. laying hens, iv. broilers, v. pigs, vi. ducks, geese and quails and vii. dairy cows. This guidance was developed in order to define the methods and strategy to be applied for responding to the Terms of Reference (ToRs) of the mandates. The mandates consist in a set of General ToRs– referring to the husbandry systems or transport scenarios used in the production cycle of each animal species - and a set of well-defined ToRs, namely scenarios specific of each livestock category (e.g., farrowing sows and piglets for swine) for which quantitative recommendations related to specific hazards are requested. Part I of the guidance includes a list of known welfare consequences that can impair the welfare of the animals along with their descriptions. Part II includes a new methodology for providing quantitative recommendations in animal welfare. The model follows the assumption that the expression of an Animal-Based Measure (ABM, a measure for welfare) under “unexposed conditions” (e.g., unlimited space) reflects the natural situation an animal may experience, which is considered the optimum in terms of animal welfare. The level of welfare as assessed through this ABM can be quantified for different degrees of the exposure variable (e.g. how the amount of locomotor behaviour increases at increasing space allowances different amount of space) and quantitative recommendations can thus be provided. The final version of the methodological guidance was endorsed by the AHAW Panel on 19 January 2022.

38 **Keywords**

39 Animal welfare assessment, Farm To Fork Strategy, husbandry systems, welfare  
 40 consequences, Animal-Based Measures

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## 98 1 Introduction

99 The purpose of this document is to present a methodological guidance to develop several  
100 Scientific Opinions on welfare and protection of animals in response to seven mandates  
101 received from the European Commission (EC) in the context of the Farm to Fork Strategy  
102 (F2F) revision.

103 The EC requested EFSA with seven mandates and EFSA will respond with 11 opinions because  
104 the original mandate on transport was split in four opinions.

105 The list of 11 Scientific Opinions to which this methodological guidance refers to is therefore:

- 106 1. Protection of animals during transport (free-moving animals-cattle)
- 107 2. Protection of animals during transport (free-moving animals- pigs)
- 108 3. Protection of animals during transport (free-moving animals- horses)
- 109 4. Protection of animals during transport (free-moving animals- sheep and goats)
- 110 5. Protection of animals during transport (animals transported in containers)
- 111 6. Protection of pigs
- 112 7. Protection of calves
- 113 8. Protection of domestic fowl kept for production of eggs (laying hens)
- 114 9. Protection of domestic fowl kept for meat production (broilers)
- 115 10. Protection of ducks, geese and quail
- 116 11. Protection of dairy cows

117  
118 The opinions will be published between June 2022 and March 2023. Eight working groups are  
119 set up to develop the opinions, namely two working groups for all transport opinions and one  
120 per each of the other animal categories.

121 The development of this common methodology is executed by a working group called "Welfare  
122 task force F2F" that involves EFSA staff (including an elicitation specialist), members of the  
123 different WGs and AHAW Panel members (including experts familiar with the guidance  
124 documents on uncertainty analysis in scientific risk assessments) (EFSA, 2018).

125 The methodological guidance was developed following the recommendations of the EFSA  
126 guidance protocol development (EFSA, 2020). It is developed as a 'generic' guidance that  
127 allows the different WGs to flexibly adapt it for the specific situations of their mandates (e.g.  
128 species-specific scenarios).

129

### 130 1.1 Background and Terms of Reference as provided by the requestor

131 The mandates and their ToRs are reported in the next chapters.

132 In order to develop the methodology for the eleven F2F scientific opinions, a summary of the  
133 Terms of Reference (ToRs) is described here. In general, the ToRs of all mandates can be  
134 divided into two parts:

- 135 - Part I consists of general and descriptive ToRs (e.g. description of current husbandry  
136 systems and associated relevant welfare consequences; description of transport  
137 scenarios and associated relevant welfare consequences).

138 - Part II consists of specific ToRs and refers to specific scenarios (e.g. specific animal  
139 category, specific transport situation), for which the EC has found difficulties in  
140 ensuring animal welfare and for which a quantitative approach is envisaged. Specific  
141 ToRs are reported for each mandate.

#### 142 1.1.1 Mandate on Animal Transport

143 The following groups and categories of farmed animals have to be considered.

- 144 - Group 1: free moving animals including equids, bovines, small ruminants and pigs;
- 145 - Group 2: animals in containers such as domestic birds (chickens for meat, end of lay  
146 hens, turkeys, ducks, geese, quails, etc.) and rabbits.

##### 148 1.1.1.1 Part I Transport - General ToRs

149  
150 Describe based on existing literature reports and available data on the current practices  
151 regarding: a) the preparation for transport, loading (including catching and crating of poultry  
152 and rabbits), unloading and handling of animals at all stages of the journey, including at  
153 destination; b) the means of transport by road, roll-on-roll-off vessels, livestock vessels, the  
154 means of transport by air; c) the conditions within the means of transport: space,  
155 microclimatic conditions, watering and feeding; d) the journey duration and its circumstances  
156 as well as the resting of animals in the vehicle being stationary or being unloaded; e. the  
157 conditions for areas where animals are unloaded and/or grouped as part of the journey.  
158 Legally a journey is considered as short (<8h), long (>8h) and very long (> 24h, long journeys  
159 that need unloading and/or feeding).

160 For each of the phases i) describe the relevant welfare consequences for each category of  
161 animals during each step of the process; ii) define qualitative or quantitative measures to  
162 assess the welfare consequences during transport (animal-based measures); iii) identify the  
163 hazards leading to these welfare consequences and, iv) provide recommendations to prevent,  
164 mitigate or correct the welfare consequences (resource and management based measures).

165

##### 166 1.1.1.2 Part II Transport - Specific ToRs

167

168 For the following scenarios, the Commission has identified practical difficulties or insufficient  
169 information in ensuring the welfare of animals. For these, EFSA should propose detailed  
170 animal-based measures and preventive and corrective measures with, where possible, either  
171 qualitative (yes/no question) or quantitative (minimum/maximum) criteria (i.e., requirements  
172 to prevent and/or mitigate the welfare consequences):

173 1. "Export by livestock vessels" - Transport of adult cattle, weaned calves and sheep over long  
174 journeys involving the combination road/livestock vessels;

175 2. "Export by road" - Transport of adult cattle, weaned calves and sheep over long journeys  
176 by road involving the use of facilities where animals are unloaded and reloaded (control posts,  
177 livestock markets) or when animals are kept in stationary vehicles for hours (exit points)  
178 including in third countries;

179 3. "Roll-on-roll off" - Transport of adult cattle, calves and sheep over long journeys involving  
180 the combination road/roll-on-roll-off vessels;

181 4. "End-of-career animals" - Transport of end of career animals to slaughterhouses of dairy  
182 cows, breeding sows, and laying hens;

183 5. "Unweaned calves" - Transport of unweaned calves over long journeys; this scenario will  
184 particularly consider the risks regarding fitness for transport, watering, feeding and thermal  
185 comfort, inappropriate drinkers and liquid feed for unweaned calves;

186 6. "Horses" - Transport of horses on long journeys to slaughterhouses;

187 7. "Special health status animals" - Transport of ruminants and pigs where unloading them  
188 before the final destination might jeopardize their health status.

189 For all of these specific scenarios, the risks should be assessed regarding microclimatic  
190 conditions under the current practices associated with extremely high or low temperatures  
191 including the difficulty of measuring of temperature, humidity and gas concentration within  
192 animals' compartment.

193

#### 194 1.1.2 Mandate on protection of pigs

##### 195 1.1.2.1 Part I- General ToRs

196

197 For each specified category of animals (age, production, etc.) EFSA should i) describe, based  
198 on existing literature and reports, the current husbandry systems and practices of keeping  
199 them, ii) describe the relevant welfare consequences, iii) define qualitative or quantitative  
200 measures to assess the welfare consequences (animal-based measures), iv) identify the  
201 hazards leading to these welfare consequences and v) provide recommendations to prevent,  
202 mitigate or correct the welfare consequences (resource and management based measures).

##### 203 1.1.2.2 Part II- Specific ToRs

204

205 For the following specific scenarios, the Commission has identified practical difficulties or  
206 insufficient information in ensuring the welfare of animals. For these, EFSA should propose  
207 detailed animal-based measures and preventive and corrective measures with, where  
208 possible, either qualitative (yes/no question) or quantitative (minimum/maximum) criteria  
209 (i.e., requirements to prevent and/or mitigate the welfare consequences).

- 210 • Specific Scenario 1: The welfare of gilts and dry pregnant sows after weaning in  
211 individual and group housing systems, during the first four weeks of pregnancy;
- 212 • Specific Scenario 2: The welfare of gilts and dry pregnant sows one week before  
213 farrowing in different housing systems offering different degrees of behavioural  
214 freedom;
- 215 • Specific Scenario 3: The welfare of sows and piglets from farrowing to weaning in  
216 different housing systems offering different degrees of behavioural freedom;
- 217 • Specific scenario 4: The welfare of weaners and rearing pigs, in particular with the  
218 risks associated with weaning, space allowance, including competition for space, types  
219 of flooring, including poor cleanliness and comfort, enrichment material, air quality,

220 health status, diet, including competition for food and the practice of mutilations (tail  
221 docking, tooth clipping, castration);  
222 • Specific Scenario 5: The assessment of Animal-Based Measures collected in  
223 slaughterhouses to monitor the level of welfare on pig farms (such as tail damage,  
224 stomach ulcers, lung lesions)  
225

### 226 1.1.3 Mandate on protection of calves

#### 227 1.1.3.1 Part I- General TORs 228

229 Same as for the mandate on pigs (see details in 1.1.2.1.).  
230

#### 231 1.1.3.2 Part II- Specific TORs 232

233 For the following scenarios, the Commission has identified practical difficulties or insufficient  
234 information in ensuring the welfare of animals. For these, EFSA should propose detailed  
235 animal-based measures and preventive and corrective measures with, where possible, either  
236 qualitative (yes/no question) or quantitative (minimum/maximum) criteria (i.e. requirements  
237 to prevent and/or mitigate the welfare consequences).

- 238 • Specific scenario 1: The welfare of male dairy calves raised for producing “white” veal  
239 meat and the risks associated with individual housing, insufficient space and feed  
240 restriction (such as deprivation of iron and fibres);
- 241 • Specific scenario 2: The assessment of Animal Based Measures collected in  
242 slaughterhouses to monitor the level of on farm welfare of male dairy calves raised for  
243 producing “white” veal meat;
- 244 • Specific scenario 3: The welfare of dairy calves and the risks associated with limited  
245 cow-calf bond-

246

### 247 1.1.4 Mandate on protection of laying hens

248

#### 249 1.1.4.1 Part I- General TORs 250

251 Same as for the mandate on pigs (see details in 1.1.2.1.).  
252

253

#### 253 1.1.4.2 Part II- Specific TORs 254

255 For the following scenarios, the Commission has identified practical difficulties or insufficient  
256 information in ensuring the welfare of animals. For these, EFSA should propose detailed  
257 animal-based measures and preventive and corrective measures with, where possible, either  
258 qualitative (yes/no question) or quantitative (minimum/maximum) criteria (i.e. requirements  
259 to prevent and/or mitigate the welfare consequences).

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- Specific scenario 1: The welfare of laying hens and the risks associated with alternative systems (organic, free range and barn) compared to the cage system currently allowed;
  - Specific scenario 2: Welfare of hens in furnished cages, and risks associated with rearing of animals non beak trimmed;
  - Specific scenario 3: The assessment of Animal-Based Measures collected in slaughterhouses to monitor the level of welfare on laying hen farms.

267

## 268 1.1.5 Mandate on protection of broilers

### 269 1.1.5.1 Part I- General TORs

270

271 Same as for the mandate on pigs (see details in 1.1.2.1.).

272

### 273 1.1.5.2 Part II- Specific TORs

274

275 For the following scenarios, the Commission has identified practical difficulties or insufficient  
276 information in ensuring the welfare of animals. For these, EFSA should propose detailed  
277 animal-based measures and preventive and corrective measures with, where possible, either  
278 qualitative (yes/no question) or quantitative (minimum/maximum) criteria (i.e. requirements  
279 to prevent and/or mitigate the welfare consequences).

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- Specific scenario 1: The welfare of fast-growing chickens in barns and the risks associated with air and floor temperature, access to feed and water, space allowance, air quality
  - Specific scenario 2: The assessment of Animal Based Measures collected in slaughterhouses (such as footpad dermatitis) to monitor the level of welfare on broiler farms.
  - Specific scenario 3: The welfare of broiler breeders and the risks associated with housing in (individual) cages, the practice of routine mutilation (beak trimming, de-toeing, de-combing, de-clawing), the feed restriction;
  - Specific scenario 4: The welfare of day-old chick until they reach the rearing or breeding farms: hatchery conditions, transport conditions.

291

## 292 1.1.6 Mandate on protection of ducks, geese and quails

### 293 1.1.6.1 Part I- General TORs

294

295 EFSA is requested to provide a scientific opinion on the impact of caged-systems on the  
296 welfare of:

297 - domestic ducks (*Anas platyrhynchos*), muscovy ducks (*Cairina moschata*) and hybrids  
298 between domestic and muscovy ducks,

299 - geese (*Anser anser* f. *domesticus*, *Anser cygnoides* f. *domesticus*) and their crossbreeds,



300 - commonly farmed quail (family Phasianidae, e.g. species Common quail (*Coturnix coturnix*)  
301 and Japanese quail (*Coturnix japonica*), and family Odontophoridae),

302 related to the production of meat (including foie gras), to the production of eggs and to  
303 breeding .

304 The request refers to:

- 305 – The keeping of breeders;
- 306 – The keeping of ducklings/ chicks and pullets before they start laying eggs;
- 307 – The keeping of layers, including breeders, during the production of eggs;
- 308 – The keeping of animals for meat production.

309 The process of collecting feathers and downs, the process of force-feeding for fatty liver  
310 production, the transport and the killing of the animals are not part of this request.

311 For this purpose, the EFSA is asked, for each species (or group of species where comparable  
312 in view of their welfare) and category of animals as listed above, to describe the welfare of  
313 the animals and the associated risks by:

314 a. Describing the main husbandry systems with a focus on the accommodation currently used  
315 in the EU for keeping these animals;

316 b. Describing the relevant welfare consequences concerning restriction of movement, injuries,  
317 group stress and inability to perform comfort behaviour related to these husbandry systems.  
318 Relevance will not need to be based on a comprehensive risk assessment, but on EFSA's  
319 expert opinion regarding the severity, duration and occurrence of each welfare consequence;

320

#### 321 1.1.6.2 Part II- Specific TORs

322

323 EFSA should provide recommendations on qualitative or quantitative criteria to prevent the  
324 negative welfare consequences listed in point b for the concerned species in relation to:

- 325 • Specific scenario 1: space allowance (three-dimensional) per animal,
- 326 • Specific scenario 2: maximum size of the group,
- 327 • Specific scenario 3: floor quality,
- 328 • Specific scenario 4: availability, design and size of nesting facilities,
- 329 • Specific scenario 5: enrichment provided (including access to water to fulfil biological  
330 needs)

331

#### 332 1.1.7 Mandate on protection of dairy cows

333

##### 334 1.1.7.1 Part I- General TORs

335

336 This request refers to cows which have had a calf and are kept for milk production and to  
337 pregnant heifers in the last third of gestation. These include dual purpose breeds used for  
338 milk production.

339 For this request, the EFSA will:

- 340 a. Describe, based on existing literature and reports, the most prevalent housing systems  
341 and practices of keeping them in the EU, including tie-stalls, cubicle housing and  
342 systems with free lying area, combined or not with certain outdoor access with grazing.  
343 b. Describe the following welfare consequences for the housing systems and practices  
344 specified above:
- 345 ▪ inability to perform comfort behaviour,
  - 346 ▪ restriction of movement,
  - 347 ▪ locomotor disorders,
  - 348 ▪ metabolic disorders,
  - 349 ▪ mastitis.
- 350 c. Define the most feasible animal-based measures to assess the welfare consequences  
351 above;
- 352 d. Identify the most relevant hazards, leading to the welfare consequences above  
353 mentioned
- 354 e. Provide recommendations to prevent or correct the welfare consequences above  
355 mentioned (resource and management-based measures).

356 1.1.7.2 Part II- Specific TORs

357

358 Specific scenario 1: The recommendations to prevent the negative welfare consequences listed  
359 in point b for the concerned species should be based on key risk factors that may increase the  
360 likelihood of welfare consequences to occur.

361 Specific scenario 2: In addition, EFSA should identify the specific relevant hazards, leading to  
362 the welfare consequences above-mentioned and which can be used to classify the level of risk  
363 for animal welfare based on data currently collected (e.g. milk production, herd size, housing  
364 system etc.).

## 365 2 Data and Methodologies

### 366 2.1 Methodologies

367 This methodological guidance was developed following the steps detailed in the draft  
368 framework for protocol development for EFSA's scientific assessments  
369 (<https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/sp.efsa.2020.EN-1843>).

370 The described TORs and F2F mandates (see Section 1.1) are considered as a "generic  
371 mandate" or a non-application scientific assessment and considered to be classified as  
372 Scientific Risk Assessment (E2.1) according to EFSA's Process Architecture.

373 Due to the wide scope of the Scientific opinions, the methodologies developed here allow  
374 flexibility in the 'extent of planning', i.e., the degree of detail provided in the guidance for the  
375 methods that will be applied. It can be tailored to species-specific scenarios that accommodate  
376 the characteristics of the mandate (e.g., the requestor's needs – including the deadline, and  
377 the available resources). For this reason, it was agreed to develop the methodological

378 guidance according to “low extent of protocol planning” modality. Therefore, the following  
379 steps were taken (Box 1 in the EFSA guidance for protocol development; EFSA, 2020):

- 380 • Step 1: Formulate the problem (the ‘What’)
  - 381 ○ Step 1.1. Translation of the mandate into assessment questions
  - 382 ○ Step 1.2. Definition of the sub-questions of each assessment question and their  
383 relationship
  - 384 ○ Step 1.3. Selection of the approach to be taken to tackle the sub-questions
- 385 • Step 2. Plan the methods for conducting the assessment (the ‘How’)
  - 386 ○ Step 2.1. Definition of evidence needs and methods for answering each sub-  
387 question including uncertainty analysis
  - 388 ○ Step 2.2. Definition of methods for integration of evidence across sub-questions  
389 and addressing remaining and overall uncertainty

390 These steps are developed in the following sections.

391

## 392 3 Assessment

393 The Terms of Reference of the mandates (ToRs) were first divided into those “General ToRs”  
394 – referring to the husbandry systems or transport practices used in the production cycle of  
395 each species - and referred to as “Part I - general ToRs” in Sections 1.1.1.1, 1.1.2.1, 1.1.3.1,  
396 1.1.4.1, 1.1.5.1 (respectively for the mandates on transport, pigs, calves, laying hens,  
397 broilers).

398 Those ToRs referring to specific scenarios (e.g., farrowing sows and piglets for swine, chicks  
399 and pullets before they become laying hens, or e.g. export by vessels) were categorized as  
400 “specific ToRs” and referred to as “Part II - Specific ToRs” in section 1.1.1.2, 1.1.2.2, 1.1.3.2,  
401 1.1.4.2, 1.1.5.2 (respectively for the mandates on transport, pigs, calves, laying hens,  
402 broilers).

403 The methodology is therefore divided accordingly into a methodology for Part I - General ToRs  
404 – addressed in the following section 3.1.- and a methodology for Part II – Specific ToRs –  
405 addressed in the following section 3.2.

406 For both methodologies the decision was taken to implement the EFSA guidance on protocol  
407 development to the low extent. The low extent implies case-specific simplifications that allow  
408 a high level of flexibility since the scope of the opinions is broad and heterogeneous in relation  
409 to the specific species (pigs, laying hens, broilers, calves) as well as to the different topics to  
410 be assessed (different husbandry systems, different transport scenarios, WCs, ABMs, ...).

### 411 3.1 Methodology for Part I - General Terms of Reference

412

#### 413 3.1.1 Step 1: Formulate the problem (the ‘What’)

##### 414 3.1.1.1 Step 1.1. Translation of the mandate into assessment questions

415

416 The general ToRs requested EFSA to answer the following five questions:

- 417 i) describe the current husbandry systems or transport practices,  
418 ii) describe the relevant welfare consequences that may occur in these systems or due to the  
419 practices described under the above point,  
420 iii) define animal-based measures (ABMs) to assess these welfare consequences,  
421 iv) identify hazards leading to these welfare consequences and  
422 v) provide recommendations to prevent, mitigate or correct the hazards.

423

424 3.1.1.2 Step 1.2 & Step 1.3. Definition of the sub-questions of each assessment  
425 question and their relationship & Selection of the approach to be taken to  
426 tackle the sub-questions  
427

428 To address the general ToRs of the mandates, EFSA will translate the assessment questions  
429 into more specific sub-questions. These are interrelated, meaning that the outcome of each  
430 sub-question is necessary to proceed to the next sub-question. The approach to develop the  
431 sub-questions is based on using both evidence from the scientific literature and expert opinion.  
432 The translation of the assessment questions into sub-questions is mapped in Table 1.

DRAFT

433 **Table 1. Mapping of the translation of the mandate assessment questions into sub-questions**

434

Assessment Questions		Sub-questions	
<b>i.</b>	<b>Describe the current husbandry systems and transport practices</b>	<b>1. Identify and select all relevant husbandry systems or animal transport practices per species and animal category</b>	<b>2. Describe the husbandry systems and transport practices</b>
		<p>Aim: Husbandry systems to be considered in the assessment are identified and selected to be representative of the currently used systems in the EU.</p> <p>Approach: expert opinion via group discussion.</p> <p>Relationship with assessment question: This sub-question is necessary for the overall assessment question requiring the description of the systems.</p>	<p>Aim: All the husbandry systems or animal transport practices per animal category identified and selected from sub-question 1 are described narratively</p> <p>Approach: literature review.</p> <p>Relationship with assessment question: this corresponds to the assessment question and is necessary for the next assessment question</p>
<b>ii.</b>	<b>Describe the relevant welfare consequences that may occur in these systems or due to the practices</b>	<b>3. Identify the welfare consequences common for all mandates and provide their definitions</b>	<b>4. Select the most relevant welfare consequences for each husbandry systems or animal transport practices</b>
		<p>Aim: to identify the welfare consequences that may impair the welfare of animals, and to provide a definition for them. EFSA generates a list of welfare consequences common for all mandates.</p> <p>Approach: expert opinion via group discussion (see focus and full resulting list in 3.1.1.3)</p> <p>Relationship with assessment question: the list of all possible welfare consequences is necessary for the next</p>	<p>Aim: To select the most relevant welfare consequences for each of the previously defined husbandry systems or animal transport scenarios per species and animal category</p> <p>Approach: expert opinion via EKE (see focus on this in 3.1.1.4)</p> <p>Relationship with assessment question: this corresponds to the assessment question, is related to sub-question 1 in which relevant welfare consequences are identified only for current husbandry systems/transport scenarios</p>

		assessment question asking to identify the most relevant ones per each system	
iii.	<b>Define qualitative or quantitative animal-based measures (ABMs) to assess these welfare consequences</b>	<i>5. Identify the feasible ABMs for the assessment of the most relevant welfare consequences</i>	<i>6. Describe the feasible ABMs for the assessment of the most relevant welfare consequences</i>
		<p>Aim: The ABMs for the assessment of the welfare consequences previously identified as relevant are selected (only for feasible ABMs).</p> <p>Approach: expert opinion via group discussion</p> <p>Relationship with assessment question: this corresponds to the assessment question and is related to sub-question 4 in which ABMs are identified only for the most relevant welfare consequences</p>	<p>Aim: The ABMs for the assessment of the welfare consequences previously identified as the most relevant are described</p> <p>Approach: literature review</p> <p>Relationship with assessment question: related to sub-question 5</p>
iv.	<b>Identify the hazards leading to these welfare consequences</b>	<i>7. Identify the hazards leading to the most relevant welfare consequences</i>	<i>8. Describe the hazards leading to the most relevant welfare consequences</i>
		<p>Aim: The hazards leading to the most relevant welfare consequences are identified</p> <p>Approach: expert opinion via group discussion</p> <p>Relationship with assessment question: this corresponds to the assessment question and is related to sub-question 4 in which hazards are identified only for the most relevant welfare consequences</p>	<p>Aim: The hazards are described</p> <p>Approach: literature review</p> <p>Relationship with assessment question: related to sub-question 6</p>
v.	<b>Provide recommendations to prevent, mitigate or correct the hazards</b>	<i>9. Identify the preventive and corrective measures for the most relevant welfare consequences</i>	<i>10. Describe the preventive and corrective measures for the most relevant welfare consequences</i>

	<p>Aim: preventive and corrective measures for the most relevant welfare consequences for the previously defined husbandry systems and transport scenarios per animal category are identified</p> <p>Approach: expert opinion via group discussion</p> <p>Relationship with assessment question: this corresponds to the assessment question and is related to sub-question 4 in which preventive and corrective measures are identified only for the most relevant welfare consequences</p>	<p>Aim: preventive and corrective measures are described</p> <p>Approach: literature review</p> <p>Relationship with assessment question: related to sub- question 8</p>
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437 3.1.1.3 Focus on Sub-question 3: Identification of welfare consequences

438

439 The objective of this sub-question is to generate a draft list of known welfare consequences  
 440 (WCs) that can impair the welfare of the animals along with their descriptions. The draft list  
 441 consists of 33 WCs created via working group expert discussions and provides a common  
 442 starting point for all animal species. Although some differences relating to species or context  
 443 exist, it can be used consistently in all mandates (Table 2).

444 The description of each welfare consequence reported in the draft list refers to either one or  
 445 more negative affective states (e.g. pain, fear, fatigue etc). These are the high-level states  
 446 that derive from the occurrence of the welfare consequence and that can lead to animal  
 447 suffering. A draft list and description of the negative affective states as derived from literature  
 448 is reported in Table 3.

449 **Table 2. List and description of 33 welfare consequences used for all animal species as produced via**  
 450 **expert discussion**

Welfare consequence	Description
<b>Restriction of movement</b>	The animal experiences stress and/or negative affective states such as pain, fear, discomfort and/or frustration due to the fact that it is unable to move freely, or is unable to walk comfortably (e.g. due to overcrowding, unsuitable floors, gates, barriers).
<b>Resting problems</b>	The animal experiences stress and/or negative affective states such as discomfort, and/or frustration due to the inability to lie, rest comfortably or sleep (e.g. due to hard flooring, inability to perch or vibration during transport). This may eventually lead to fatigue.
<b>Group stress</b>	The animal experiences stress and/or negative affective states such as pain, fear and/or frustration resulting from a high incidence of aggressive and other types of negative social interactions, often due to hierarchy formation and competition for resources or mates.
<b>Sensorial under- and/or overstimulation</b>	The animal experiences stress and/or negative affective states such as fear, discomfort due to visual, auditory or olfactory under/overstimulation by the physical environment.
<b>Handling stress</b>	The animal experiences stress and/or negative affective states such as pain and/or fear resulting from human or mechanical handling (e.g. sorting and vaccination of newly hatched chicks, loading/unloading, catching and crating of animals to be transported, inversion).
<b>Motion stress</b>	The animal(s) experience motion sickness, stress and/or fatigue due to the forces exerted as a result of acceleration, braking, stopping, cornering, gear changing, vibrations and uneven road surfaces during transport.
<b>Isolation stress</b>	The animal experiences stress and/or negative affective states such as frustration and/or fear resulting from the absence of or from limited social contact with conspecifics.
<b>Separation stress</b>	The animal experiences stress and/or negative affective states such as fear and/or frustration resulting from separation from conspecifics.
<b>Inability to perform comfort behaviour</b>	The animal experiences stress and/or negative affective states such as discomfort and/or frustration resulting from the thwarting of the motivation to maintain the function and integrity of the integument (e.g. cannot keep clean, scratch, dust bathe).
<b>Inability to perform sexual behaviour</b>	The animal experiences stress and/or negative affective states such as frustration resulting from the thwarting of the motivation to engage in sexual activities.



<b>Inability to avoid unwanted sexual behaviour</b>	The animal experiences stress and/or negative affective states such as pain and/or fear resulting from inability to avoid forced mating.
<b>Inability to perform exploratory or foraging behaviour</b>	The animal experiences stress and/or negative affective states such as frustration and/or boredom resulting from the thwarting of the motivation to investigate the environment or to seek for food (i.e. extrinsically and intrinsically motivated exploration).
<b>Inability to express maternal behaviour</b>	The animal experiences stress and/or negative affective states such as frustration resulting from the thwarting of the motivation to care for offspring, including during the pre-partum/pre-laying phase.
<b>Inability to perform sucking behaviour</b>	The animal experiences stress and/or negative affective states such as frustration resulting from the thwarting of the motivation to suck from an udder.
<b>Inability to chew and/or ruminate</b>	The animal experiences stress and/or negative affective states such as frustration resulting from the thwarting of the motivation to ingest sufficient amounts of fibrous feed or the inhibition of rumination.
<b>Inability to perform play behaviour</b>	The animal experiences stress and/or negative affective states such as frustration resulting from the thwarting of the motivation to engage in social/locomotor or object play.
<b>Predation stress</b>	The animal experiences stress and/or negative affective states such as fear and/or pain resulting from being attacked or perceiving a high predation risk
<b>Prolonged hunger</b>	The animal experiences craving or urgent need for food or a specific nutrient, accompanied by a negative affective state, and eventually leading to a weakened condition as metabolic requirements are not met
<b>Prolonged thirst</b>	The animal experiences craving or urgent need for water, accompanied by an uneasy sensation (a negative affective state), and eventually leading to dehydration as metabolic requirements are not met.
<b>Heat stress</b>	The animal experiences stress and/or negative affective states such as discomfort and/or distress when exposed to high effective temperature.
<b>Cold stress</b>	The animal experiences stress and/or negative affective states such as discomfort and/or distress when exposed to low effective temperature.
<b>Locomotor disorders (including lameness)</b>	The animal experiences negative affective states such as pain, discomfort and/or due to impaired locomotion induced by e.g. bone, joint, skin or muscle damage.
<b>Soft tissue lesions and integument damage</b>	The animal experiences negative affective states such as pain, discomfort and/or distress due to physical damage to the integument or underlying tissues, e.g. multiple scratches, open or scabbed wounds, bruises, ulcers, abscesses and feather or hair loss. This welfare consequence may result from negative social interactions such as aggression, tail-biting or feather pecking, from handling or from damaging environmental features, or from mutilation practices (e.g. beak trimming, de-toeing, de-horning, tail docking).
<b>Bone lesions (incl. fractures and dislocations)</b>	The animal experiences negative affective states such as pain, discomfort and/or distress due to fractures or dislocations of the bones (excluding those fractures leading to locomotor disorders).
<b>Skin disorders (other than soft tissue lesions and integument damage)</b>	The animal experiences negative affective states such as pain, discomfort and/or distress due to e.g. infections (e.g. dermatophytosis/ringworm, pseudomonosis, staphylococcosis, viral diseases), ectoparasites (e.g. mange or red mites), inflammation of the skin or sunburn.
<b>Respiratory disorders</b>	The animal experiences negative affective states such as discomfort, pain, air hunger and/or distress due to impaired function or lesion of the lungs or airways.

<b>Eye disorders</b>	The animal experiences negative affective states such as discomfort, pain and/or distress due irritation or lesion or lack of function of at least one eye.
<b>Gastro-enteric disorders</b>	The animal experiences negative affective states such as discomfort, pain and/or distress due to impaired function or lesion of the gastro-intestinal tract resulting from for example nutritional deficiency, infectious, parasitic, or toxigenic agents.
<b>Reproductive disorders</b>	The animal experiences negative affective states such as pain and/or discomfort due to a disorder of the reproductive system resulting from physical injury or infection (including dystocia and metritis).
<b>Mastitis</b>	The animal experiences negative affective states such as pain and/or discomfort due to the inflammation of at least one of the mammary glands.
<b>Metabolic disorders</b>	The animal experiences negative affective states such as inappetence, weakness, fatigue, discomfort, pain and/or distress due to disturbed metabolism (e.g. acidosis and ketosis), deficiencies in several nutrients (e.g. anaemia) or induced by ectoparasites affecting metabolism (anaemia due to red mites) or poisoning
<b>Muscle disorders</b>	The animal experiences negative affective states such as discomfort and/or pain due to a disorder or lack of function of the muscles (e.g. myopathy in broilers).
<b>Umbilical disorders and hernias</b>	The animal experiences negative affective states such as discomfort and/or pain due to inflammation of the navel or any type of hernias

451

452 **Table 3. List and description of negative affective states**

<b>Negative affective state</b>	<b>Description</b>
<b>Fear</b>	The animal experiences an unpleasant emotional affective state induced by the perception of a danger or a potential danger, that threaten the integrity of the animal (Boissy, 1995).
<b>Discomfort</b>	Discomfort can be physical or psychological and is characterized by an unpleasant feeling resulting in a natural response of avoidance or reduction of the source of the discomfort. Pain is one of the causes for discomfort, but not every discomfort can be attributed to pain. Discomfort in non-communicative patients is assessed and measured via behavioral expression, also used to describe pain and agitation, leading to discomfort being interpreted as pain in some conditions (Ashkenazy and DeKeyser Ganz, 2019).
<b>Pain</b>	An unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage (Raja et al 2020).
<b>Fatigue</b>	Physiological state representing extreme tiredness and exhaustion of an animal (EFSA AHAW Panel, 2020).
<b>Distress (and stress)</b>	STRESS: Stressors are events, internal or external to the body involving real or potential threats to the maintenance of homeostasis. When stressors are present, the body will show stress responses (biological defence to re-establish homeostasis – for example behavioural, physiological, immunological, cognitive, emotional). Stress is a state of the body when stress responses are present (Sapolsky, 2002).

	DISTRESS: Distress is a conscious, negatively valenced, intensified affective motivational state that occurs in response to a perception that current coping mechanisms (involving physiological stress responses) are at risk of failing to alleviate the aversiveness of the current situation in a sufficient and timely manner.
<b>Frustration</b>	Negatively valenced emotional state consecutive to the impossibility to obtain what is expected or needed. Frustration is very often triggered by restriction of natural behaviours thus resulting in thwarted motivation to perform these behaviours.
<b>Boredom</b>	Boredom is an unpleasant emotion including suboptimal arousal levels and a thwarted motivation to experience almost anything different or more arousing than the behaviours and sensations currently possible (adapted from Mason and Burn, 2011).

453

454

455 3.1.1.4 Focus on Sub-question 4: selection of most relevant welfare consequences

456

457 As explained above (Sub-question 4), the mandates request the identification of the most  
 458 relevant welfare consequences for each of the defined husbandry systems or animal transport  
 459 scenarios per animal category. This identification of the most relevant WCs is executed via  
 460 expert opinion. Hereto, the opinion of the WG experts is elicited through an exercise of  
 461 individual classification of welfare consequences in terms of relevance followed by group  
 462 discussion to identify the most relevant ones by consensus.

463 The starting point is the list of 33 specific WCs identified under Sub-question 3 (for details see  
 464 section 3.1.1.3.) The exercise is carried out separately for each of the husbandry systems or  
 465 animal transport stages per species or animal category resulting from Sub-question 1.

466 The exercise consists in selecting the most relevant WCs out of these 33 per each of these  
 467 combinations.

468 For each combination, WG experts classify, based on an estimate of their magnitude, the 33  
 469 WCs into four categories of relevance: i) non-applicable, ii) less relevant, iii) moderately  
 470 relevant and iv) most relevant. The magnitude of a WC is defined as the product of three  
 471 parameters (severity, duration and frequency of occurrence) (EFSA AHAW Panel, 2012).  
 472 Duration refers to the time an animal spends within a certain production stage (combination  
 473 animal category and husbandry system) while the occurrence refers to the prevalence of  
 474 animals experiencing the welfare consequence in that production stage. Owing to the lack of  
 475 published data on these three parameters, the experts express their qualitative expert opinion  
 476 on the magnitude of WCs.

477 Expert opinion is elicited in 3 phases:

- 478 1. First phase: the experts go individually through the list of welfare consequences and  
 479 identify those that would fall in the "non-applicable" or "less relevant" categories. Their  
 480 individual judgements are then be collated, and those WCs unanimously identified as  
 481 belonging to these two categories are removed and not considered for further  
 482 assessment. Those WCs for which there is no consensus whether they are considered  
 483 "non-applicable" or "less relevant" remain for further assessment and require an open  
 484 group discussion to find a consensus.

- 485 2. Second phase: the experts go individually through the list of remaining welfare  
486 consequences and identify those that would fall in the category of “most relevant” in  
487 order to identify the most relevant WCS that are kept for further assessment procedure  
488 (Sub-question 5 section 3.1.1.2). Similarly, as during the first phase in case discrepant  
489 opinions emerge, consensus is sought through group discussion.
- 490 3. Third phase: the experts are asked to rank individually all the remaining WCs in the  
491 list that are not already identified as most relevant (and thus kept) or non-applicable  
492 or less relevant (and thus removed) from the highest to the least relevant. Their  
493 individual rankings are then discussed again in an open group discussion with the aim  
494 to assign the remaining WCs into the category ‘most relevant’ or in the category  
495 ‘moderately relevant’.

496

497 The scientific opinions only report, for each of the defined husbandry systems or animal  
498 transport scenario(s) per animal category, those WCs that are selected to be most relevant  
499 from this exercise (since the mandates ask for the “most relevant” welfare consequences in  
500 each identified husbandry system).

501

502

503 3.1.2 Step 2. Plan the methods for conducting the assessment (the  
504 'How')

505 3.1.2.1 Step 2.1. Definition of evidence needs and methods for answering each  
506 sub-question including uncertainty analysis

507

508 Tables 4 and 5 present the specific assessment of each of the sub-questions listed above  
509 along with the evidence needs and methods used for answering each of them depending on  
510 whether they are based on expert opinion (Table 4) or data extracted from literature reviews  
511 (Table 5).

**Table 4: Methodology for sub-questions for Part I -General TORs that will be addressed using expert opinion using the LOW extent of planning (according Table 3 of <https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/sp.efsa.2020.EN-1843>).**

	Sub-question					
	Identification of relevant husbandry systems or animal transport scenarios per animal categories (Sub-question 1)	Identification of welfare consequences (Sub-question 3)	Selection of most relevant welfare consequences (Sub-question 4)	Identification of ABMs for relevant WC (Sub-question 5)	Identification of hazards for relevant WC (Sub-question 7)	Identification of preventive and corrective measures (Sub-question 9)
Formulation of sub-question	<p>For the on-farm welfare mandates: to generate a list of husbandry systems per animal category.</p> <p>For transport mandate: to generate a list of main animal transport scenarios per animal category.</p>	<p>To generate a list of all welfare consequences that can impair the welfare of animals along with their definition.</p>	<p>For the on-farm welfare mandates: to identify the most relevant WCs considering the severity, duration and frequency of occurrence for each of the previously defined husbandry systems per animal category.</p> <p>For transport mandate: to identify the most relevant WCs considering the severity, duration and frequency of occurrence for each of the previously defined animal transport scenarios per animal category.</p>	<p>To generate a list of ABMs for the most relevant WC.</p> <p>For the on-farm welfare mandates: Only those ABMs that are feasible on-farm and at the slaughterhouse will be taken up.</p> <p>For transport mandate: Only those ABMs that are feasible in transport will be included.</p>	<p>For all mandates: to generate a list of hazards leading to each identified welfare consequence.</p>	<p>For all mandates: to generate a list of measures to prevent or correct the identified hazards.</p>

<p><b>Definition of the approach</b></p>	<p>For all mandates: A group discussion within the WG and hearing experts selected for each of the specific species and agreed in the Welfare Task Force.</p> <p>The Welfare Task Force is the steering group consisting of EFSA staff (including internal/external elicitation specialist) and members of the selected WGs and AHAW Panel members (including specialists on uncertainty assessment).</p>	<p>A group discussion within the WG and hearing experts selected for each of the mandates and agreed in the Welfare Task Force.</p>	<p>Individual classification of WCs in terms of relevance and group discussion to identify the most relevant ones by consensus.</p>	<p>A group discussion within the WG and hearing experts selected for each of the mandates and agreed in the Welfare Task Force.</p>	<p>A group discussion within the WG and hearing experts selected for each of the mandates and agreed in the Welfare Task Force.</p>	<p>A group discussion within the WG and hearing experts selected for each of the mandates and agreed in the Welfare Task Force.</p>
<p><b>Identification of experts</b></p>	<p>Expert profile: researchers specialized in animal husbandry systems, transport scenarios, welfare consequences, animal-based and resource-based measures.</p>	<p>See expert profile Sub-question 1.</p>	<p>See expert profile Sub-question 1.</p>	<p>See expert profile Sub-question 1.</p>	<p>See expert profile Sub-question 1.</p>	<p>See expert profile Sub-question 1.</p>
<p><b>Preparation of the evidence dossier</b></p>	<p>No specific evidence dossier needed for common TORs. Consulted experts provide the evidence.</p>	<p>No evidence dossier is needed, and judgement is based on the expertise of the consulted experts.</p>	<p>No evidence dossier is needed, and judgement is based on the expertise of the consulted experts.</p>	<p>No evidence dossier is needed, and judgement is based on the expertise of the consulted experts.</p>	<p>No evidence dossier is needed, and judgement is based on the expertise of the consulted experts.</p>	<p>No evidence dossier is needed, and judgement is based on the expertise of the consulted experts.</p>
<p><b>Methods of synthesis of individual expert estimates and</b></p>	<p>Only the agreed final list of defined husbandry systems or animal transport scenarios per animal category is kept.</p>	<p>Only the agreed list of all identified welfare consequences is</p>	<p>Use of plots summarizing individual classifications and variations of classification among</p>	<p>Only the agreed list of ABMs is kept. No uncertainty assessment is</p>	<p>Only the agreed list of hazards kept. No uncertainty assessment is</p>	<p>Only the agreed list of measures is kept. No uncertainty assessment is performed at this point.</p>

<p><b>their uncertainty</b></p>	<p>No uncertainty assessment is performed at this point.</p>	<p>kept. No uncertainty assessment is performed at this point.</p>	<p>the group. Classification of WCs into four categories (most relevant – the target, moderately relevant, less relevant and non-applicable), and use of the number of “moderately relevant” WCs as a quantification of uncertainty.</p>	<p>performed at this point.</p>	<p>performed at this point.</p>	
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**Table 5: Methodology for sub-questions for Part I -General TORs that will be addressed using evidence from the scientific literature.**

	Sub-question			
	Description of current practices and housing systems (Sub-question 2)	Description of ABMs for relevant WC (Sub-question 6)	Description of hazards per relevant WC (Sub-question 8)	Description of preventive and corrective measures (Sub-question 10)
<p><b>Formulation of sub-question</b></p>	<p>For the on-farm welfare mandates: to provide a description of housing systems (divided when appropriate into different animal categories, e.g. sows, weaners, boars, etc.) and management routines most commonly found associated with the respective housing systems.</p> <p>For transport mandate: to provide a description of transport scenarios per species and transport stages divided when appropriate into different categories (e.g., vehicle, vessel) and management routines (e.g. duration of transport)</p>	<p>For all mandates: To describe the ABMs for the most relevant WC.</p>	<p>For all mandates: To describe all hazards leading to the identified most relevant welfare consequences.</p>	<p>For all mandates: To describe preventive and corrective measures to prevent the identified hazards</p>
<p><b>Eligibility criteria for study selection</b></p>	<p>For the on-farm welfare mandates: literature describing current practices and housing systems in the European</p>	<p>For all mandates: literature describing ABMs for the most relevant welfare consequences</p>	<p>For all mandates: literature describing hazards and their relationship with the most relevant welfare consequences.</p>	<p>For all mandates: literature describing preventive and corrective measures for the identified hazards</p>

	<p>Union for the husbandry systems identified in Sub-question 1.</p> <p>For transport mandate: literature describing current transport scenarios from the EU and beyond EU for the scenarios identified in Sub-question 1.</p>			
<b>Search strategy</b>	<p>For all mandates: Previous EFSA scientific outputs complemented with recent studies published in peer-reviewed and grey literature describing housing systems and transport scenarios. The screening is performed by one reviewer.</p>	<p>For all mandates: Previous EFSA scientific outputs complemented with recent studies published in peer-reviewed and grey literature describing the ABM related to the most relevant WC. The screening is performed by one reviewer.</p>	<p>For all mandates: Previous EFSA scientific outputs complemented with recent studies published in peer-reviewed and grey literature describing the hazards related to the most relevant WC. The screening is performed by one reviewer.</p>	<p>For all mandates: Previous EFSA scientific outputs complemented with recent studies published in peer-reviewed and grey literature describing preventive and corrective measures. The screening is performed by one reviewer.</p>
<b>Methods for inclusion/exclusion for study</b>	<p>Publications that are not considered relevant nor providing any additional value to address the question will be removed</p>	<p>Same as in Sub-question 2</p>	<p>Same as in Sub-question 2</p>	<p>Same as in Sub-question 2</p>
<b>Methods for extracting data from included studies</b>	<p>Qualitative information related to the main characteristics of the housing systems and current management and transport scenarios will be extracted by one expert (one reviewer).</p>	<p>Information on the use of the ABM to assess the welfare consequence, including, when possible, qualitative information on sensitivity, specificity and feasibility of the ABM.</p>	<p>Qualitative information on the relevant hazards related with the selected welfare consequences will be extracted by one reviewer.</p>	<p>Qualitative information on the preventive and corrective measures for the identified hazards will be extracted by one reviewer.</p>
<b>Methods for appraising evidence</b>	<p>Relevance of the evidence will be assessed qualitatively after reading of abstracts and, if a paper is selected, the full text document is taken into account for the assessment, if the application of a correct methodology used to describe WCs (using ABMs) and hazards related to WCs is reported.</p>	<p>Same as in Sub-question 2</p>	<p>Same as in Sub-question 2</p>	<p>Same as in Sub-question 2</p>
<b>Preliminary identification and prioritization of sources and uncertainty</b>	<p>Main sources of uncertainty will be identified based on the appraisal of the scientific literature and the working groups experts' knowledge</p>	<p>Same as in Sub-question 2</p>	<p>Same as in Sub-question 2</p>	<p>Same as in Sub-question 2</p>



	<p>on the housing systems, or transport scenarios, ABMs and hazards.</p> <p>For the selection of housing systems, WCs, ABMs and hazards there is still a risk of missing important issues. This is excluded as much as possible by selecting wide range of Welfare experts in working groups and task force welfare, but a full quantification of the uncertainty is not be carried out at this stage.</p>			
<b>Methods for synthesizing the evidence</b>	Evidence is synthesized qualitatively through a narrative text	Same as in Sub-question 2	Same as in Sub-question 2	Same as in Sub-question 2
<b>Methods for analyzing uncertainties individually and combined</b>	Not applicable	Not applicable	Not applicable	Not applicable

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1 3.2 Methodology for Part II – Specific TORs

2 3.2.1 Step 1: Formulate the problem (the 'What')

3 3.2.1.1 Step 1.1. Translation of the mandate into assessment questions

4

5 For these specific TORs, EFSA is requested to provide scientific information regarding risks  
6 and benefits of possible alternative housing/husbandry systems (other than cages) or  
7 requirements for existing systems or transport scenario (e.g. space allowance for calves or  
8 e.g. export by vessels). In addition, if possible, it should propose detailed animal-based  
9 measures (ABMs) of the welfare consequences and preventive and corrective measures with,  
10 where possible, either qualitative (categorical description) or quantitative (continuous or  
11 discrete description) criteria (i.e. requirements to prevent and/or mitigate the welfare  
12 consequences).

13 Each specific scenario can include one or more sub-questions. For instance, one scenario  
14 requires to assess "The welfare of weaners and rearing pigs, in particular with the risks  
15 associated with: a. weaning; b. space allowance, including competition for space; c. types of  
16 flooring, including poor cleanliness and comfort; d. enrichment material; e. air quality; f. health  
17 status; g. diet, including competition for food; and h. the practice of mutilations (tail docking,  
18 tooth clipping, castration)." In this example, the question includes eight sub-questions to be  
19 dealt with separately (points a-h in section 3.2.1.2), and leading up to general conclusions if  
20 possible.

21 Quantitative assessment is carried out where a clear and unconfounded question can be  
22 identified and where sufficient quantitative data can be sourced from literature to address this  
23 question. However, in cases where insufficient quantitative data exist, or where the inter-  
24 relationship of many different factors makes it impossible to set up an acceptable model which  
25 can address an unconfounded question, a qualitative approach is adopted. For example, due  
26 to the framing of the specific scenarios for transport, making them very broad, combined with  
27 the complex nature of transport scenarios with many interacting hazards, simple quantitative  
28 models are not considered feasible.

29

30 3.2.1.2 Step 1.2. Definition of the sub-questions of each assessment question and  
31 their relationship

32

33 Per each sub-question, the following queries are answered in order to provide the context of  
34 the sub-question. These elements are included in a specific scenario factsheet and are needed  
35 to prepare the questions for the EKE method (see next section 3.2.1.3.). The following  
36 **example** from the mandate on the protection of pigs illustrates this process:

37 a) Exact wording of the specific scenario:

38 "The welfare of sows and piglets from farrowing to weaning in different housing  
39 systems offering different degrees of behavioural freedom"

40

41 b) Interpretation of the scenario to give a specific question which was agreed with the  
42 Commission:

43 "How does the amount of space offered to sows and piglets in different farrowing  
44 systems affect their welfare?"

45

46 c) Selection of the animal category considered:  
47 Farrowing and lactating sows, suckling piglets

48

49 d) Selection of the housing/husbandry system to be considered:  
50 Crates, indoor pens

51

52 e) Selection of the exposure variable at stake for the EKE:  
53 Space allowance

54

55 f) Identification of the most relevant welfare consequence at stake for the EKE influenced  
56 by the exposure variable:  
57 Sows: Restriction of movement, Piglets: soft tissue lesions, bone lesions

58

59 g) Definition of the Animal based measure at stake for the EKE with clear relationship  
60 between exposure and ABM:  
61 Sows: Proportion of time sows spent in locomotor activity, Piglets: pre-weaning mortality

62

63 To facilitate the assessment one specific ABM will be defined as reference. Similar ABMs  
64 should be converted to the reference, if possible. ABMs with strong relationship to the  
65 exposure are preferred as well as validated ones for the selected welfare consequence.  
66 If the welfare consequence can't be sufficiently described by one ABM, additional ABMs  
67 will be defined. The ABMs should cover independent aspects of the welfare  
68 consequence. If more ABM are applicable, ABMs which are feasible for surveillance at  
69 the farms are preferred.

70

71 h) Identification of other influencing factors to be considered as strata or within an  
72 appropriate context

73

74 i) Interpretation of the exposure variable within the context: The amount of m<sup>2</sup> available  
75 to the sow in these systems

76

77 The definition of an appropriate context is necessary to reduce the complexity of the  
78 assessment (eliminate further influencing factors, e.g. farming practice) and focus on  
79 the assessment on the selected exposure variable. The context should be close to the  
80 current practice in the selected husbandry systems. Important dependencies will be  
81 included by stratification (e.g. by the age of the animals).

82

83 3.2.1.3 Step 1.3. Selection of the approach: a model for welfare risk assessment

84

85 In order to provide quantitative criteria, it was decided to set up a risk assessment model,  
86 which describes the relation between influencing factors and animal welfare. Such a model  
87 enables the evaluation of a specific scenario in order to provide qualitative/quantitative  
88 recommendations for the mandates. Necessary parameters are extracted from literature and  
89 evaluated by a structured Expert Knowledge Elicitation (EKE) as weight of evidence approach.

90  
91 The underlying assumptions of the model are: 1) The ABM considered is a valid indicator of  
92 the welfare of the animals related to the exposure variable. 2) Since there is no gold standard  
93 for animal welfare, the expression of the ABM (i.e., the extent to which a certain behaviour is  
94 shown or the occurrence of a certain health disorder) under unexposed conditions (e.g.,  
95 unlimited space, full cow-calf contact) reflects the natural situation an animal population may  
96 experience, which is considered the optimum in terms of animal welfare. The ABM observed  
97 under these conditions could be seen as not influenced by exposure to the hazard and work  
98 as a control measurement to describe the influence of the exposure. The level of welfare as  
99 assessed through this ABM can thus be quantified in relation to optimal welfare, for different  
100 degrees of the exposure variable (e.g., 'what proportion of play behaviour is shown by a calf  
101 at different space allowances below unrestricted space?'). Therefore, quantitative  
102 recommendations on the exposure variables, as required by the mandates, can be drawn by  
103 associating different levels of ABMs expression to different levels of exposure variables that  
104 are assessed.

105  
106 The idea of the assessment model is the interpolation of the ABM between a highly exposed  
107 population of animals and a non-exposed population. The assessment relates to the European  
108 average situation. For the definition of the highly exposed population extremes exposures are  
109 considered, which are still allowed by law (e.g. minimal allowed space). For the non-exposed  
110 population farming practices are considered, where the conditions are virtually without  
111 exposure, e.g. outdoor farming on wide pasture with virtual no restriction of the space for the  
112 animal. If possible, the variation of the ABM within the non-exposed population is estimated.  
113 This variation between animals may be used to interpret the strength of the exposure effect  
114 on the average animal.

115  
116 The model is based on a structured and formal EKE that aims to provide  
117 qualitative/quantitative recommendations for specific scenarios in the mandates. Thereafter,  
118 a structured EKE exercise within the working group is executed in order to define four  
119 parameters that would allow to describe the relationship between the exposure variable  
120 (hazard) and the animal-based measure (ABM) considered.

121 The model requires four parameters which can be elaborated in a structured and formal Expert  
122 Knowledge Elicitation (EKE) that eventually enables to evaluate a specific scenario in order to  
123 provide qualitative/quantitative recommendations for the mandates.

124

125 The four parameters are:

- 126 1. The median ABM in a population of animals subjected to optimal conditions, namely  
127 a population not exposed to the hazard (e.g., with no space restriction = situation  
128 of reference);
- 129 2. The variation of the Animal Based Measure in the population of animals not  
130 exposed to the hazard (with no restriction of space);
- 131 3. The greatest degree of exposure to the hazard resulting in no change in the  
132 median value of the ABM compared to the value observed in  
133 the unexposed population of animals;
- 134 4. The median value of the ABM in a population of animals under a high exposure to  
135 the hazard (e.g. with substantial restriction of space).

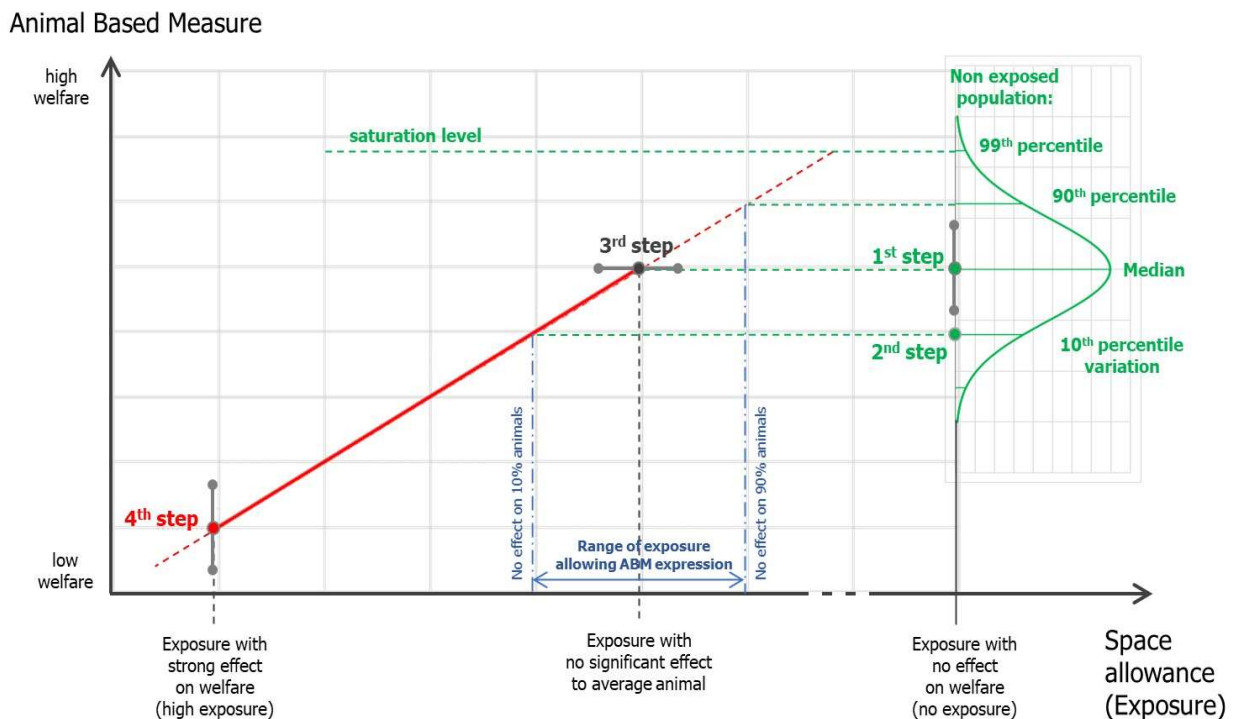
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138 In order to construct the relationship between exposure and ABM, a regression model can be  
139 envisioned according to the complexity. In case of a qualitative assessment the exposure can

140 be described categorical (e.g. different exposure scenarios as crated / non-crated), and the  
 141 ABM can be estimated on an ordinal scale (e.g. by scoring). A linear relationship and an ordinal  
 142 relationship require two questions (ABMs for high and low exposure and eventually “in-  
 143 between” exposure), while categorical relationship requires one question per category.

144 The risk assessment model is graphically represented in Figure 1. The model interpolates the  
 145 (average) Animal Based Measure (ABM) between low and high values of the exposure variable  
 146 (hazard) by a linear trend (red line). The “Range of exposure allowing ABM expression” (blue  
 147 range) is defined by the hazards (exposure values), which results in ABM values comparable  
 148 with the variation (80% confidence interval) within a non-exposed population (green  
 149 distribution in Figure 1).



150

151 **Figure 1:** Graphical representation of the risk assessment model used in F2F welfare  
 152 mandates to express the relationship between exposure and ABMs. This is an illustration of  
 153 one case where a linear relationship was assumed.

154 The EKE follows a 4-step approach that allow to retrieve the four different parameters listed  
 155 above.

156 The first question (step 1) asks for the median ABMs under the assumption of ‘absence of  
 157 exposure’ (e.g. What is the average proportion of time over all days from birth to weaning,  
 158 that a sow is performing locomotor behaviour in pens of unlimited space for a median  
 159 sow (median of the distribution)? The answer estimates the median ABM in the non-exposed  
 160 population. (step 1, median of distribution).

161 The second question assesses the variation of the ABM, e.g. the locomotor behaviour, within  
 162 the non-exposed population (green distribution, Figure 1). It is asking for the ABM values  
 163 limiting the 10% of the sows with lowest respectively highest expression of the ABM, e.g. the

164 proportion of time sows are performing locomotor behaviour in pens of unlimited space (10<sup>th</sup>  
165 and 90<sup>th</sup> percentile of the green distribution, Figure 1).

166 In a third question the experts are asked to estimate the highest level of the exposure variable  
167 (e.g. lowest space allowance) at which the value of the ABM does not significantly differ from  
168 the median ABM value of the non-exposed population (question 1) (e.g. What is the minimal  
169 space allowance with no reduction in performance of time spent in locomotor behaviour,  
170 compared to the unrestricted situation?). It is assumed, that from this level a further reduction  
171 of the exposure (e.g. more space allowance) would significantly change the ABM (e.g. the  
172 locomotor behaviour) of the average animal.

173 In the fourth and final question the expert are asked about the expression of the ABM at high  
174 exposure to the hazard (e.g. what is the average proportion of time over all days from birth  
175 to weaning, that a sow is showing locomotor behaviour in pens of low space (e.g. like in a  
176 crate) for a median sow?).

177 The answers to the first/third and fourth question allow a quantitative estimation of the impact  
178 that increased space allowance has on performance of locomotor behaviour. They also allow  
179 the level of locomotor behaviour to be expressed as a proportion of what would be expressed  
180 in an unrestricted environment (in which welfare is not challenged by limitations in space  
181 allowance).

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183

### 184 3.2.2 Step 2. Plan the methods for conducting the assessment (the 185 'How')

#### 186 3.2.2.1 Step 2.1. Definition of evidence needs and methods for answering each 187 sub-question including uncertainty analysis

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189 **Table 6. Methodology for sub-questions for specific TORs (Part II -Specific TORs) that will be**  
190 **addressed using expert opinion using the LOW extent of planning (according Table 3 of**  
191 **<https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/sp.efsa.2020.EN-1843>**)

Sub-question	Identification of relevant steps
Formulation of sub-question	Generate a list of questions for each species and exposure variables, which can be categorical or continuous, including the most relevant WCs (see General TORs) and the ABMs that should be assessed in a quantitative way by EKE.
Definition of the approach	A structured EKE within the WG and hearing experts selected for each of the specific species and agreed in the Welfare Task Force. The Welfare Task Force is the steering group consisting of EFSA staff (including internal/external elicitation specialist) and members of the selected WGs and AHAW panel members (including specialists on uncertainty assessment).
Identification of experts	Expert profile: Welfare expert for each specific animal species of animals: researchers specialized in animal husbandry systems, WCs and animal-based and resource-based measures.
Preparation of the evidence dossier	For each specific scenario an evidence dossier is compiled (e.g. space allowance in sows). An evidence dossier should consist of all definitions to specify the scenario: the animal category, the different housing systems, the hazard selected for the scenario, the WCs, the ABMs, the identified exposure

	variable for the model; the assessment model and the EKE questions (see above) in order to retrieve the relationship between ABMs and exposure variable, and a summary from literature in relation to hazards/ABMs/other influencing factors/limitations.
Methods of synthesis of individual expert estimates and their uncertainty	Behavioural aggregation (group consensus) are applied regarding the description of uncertainty around the EKE parameters of the questions (step 1 to 4, Figure 1). In case of limited evidence on the variation of the ABM in non-exposed populations (question 2) the corresponding EKE parameter is assessed in a simplified way (e.g. as CV), assuming that the uncertainty in the estimation of the full distribution is described by the uncertainty of its location (median parameter).

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### 3.2.2.2 Step 2.2. Definition of methods for integration of evidence within or across

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#### sub-questions

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As explained in section 3.2.2.1, per each sub-question requiring the provision of quantitative criteria, a welfare consequence, measured by a 'reference ABM' (chosen to be best ABM reflecting the welfare consequence under assessment), is selected to describe the relationship between the exposure variable (hazard) and the welfare consequence. However, one welfare consequence may be assessed by more than one ABM and, similarly, one exposure variable may lead to more than one welfare consequence.

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Therefore, an approach is developed for the integration of the evidence within a sub-question. The findings from the EKE performed for the 'reference ABM' are integrated with the findings from literature about other ABMs for the selected welfare consequence or other welfare consequences that can be expressed at different levels of the exposure variable. The approach for such integration is qualitative/semi-quantitative, leading to the production of tables presenting all findings from the EKE and from literature in order to provide the risk managers with the complete picture around an exposure variable (hazard) and provide them all options explaining the relation between ABMs and the exposure (hazard).

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A similar approach can be used to integrate the evidence across sub-questions within the same specific scenario.

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## 4 Conclusions

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This document outlines the methodologies that can be implemented by the EFSA Panel on Animal Health and Welfare (AHAW Panel) to develop the Scientific Opinions on welfare and protection of animals in response to mandates received from the European Commission (EC) in the context of the Farm to Fork Strategy (F2F). It is developed in order to define as much as possible the strategy to be applied for collecting data, appraising the relevant evidence, and analysing and integrating the evidence in order to draw conclusions in the Scientific Opinions.

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For addressing the general TORs (Part I) of the Scientific Opinions a 'low extent of planning' is selected as methodological approach because it allows the working group to leave a high level of flexibility in the methods to be used (mainly expert opinion and literature review/search). The flexibility is required as the scope of the opinions is broad and

228 heterogeneous in relation to the specific species (pigs, laying hens, broilers, calves) as well as  
229 to the different topics to be assessed (different husbandry systems, different transport  
230 scenarios, WCs, ABMs, ...). Therefore, these methodologies could be implemented for any  
231 animal species and husbandry system, or transport scenario, in place and requested for in  
232 future mandates.

233 Related to the methodology for part II (Section 3.2.1.3), a new model is proposed for the  
234 housing mandates, and may serve as a guidance for risk assessment in animal welfare and,  
235 more precisely, when quantitative recommendations are required. The model starts from the  
236 concept how an important ABM (a measure of animal welfare) is expressed under "unexposed"  
237 (hazard) circumstances. It is followed by the ABM under "highly exposed" circumstances. A  
238 structured EKE exercise is used to elicit the necessary parameters of the model to allow an  
239 interpolation between the extremes (EFSA, 2014). Thus the model provides an agreed  
240 estimation of the relationship between an exposure variable (hazard) and the expression of  
241 an ABM in an animal (e.g. how the amount of locomotor behaviour increases at increasing  
242 space allowances).

243 An additional method is provided to integrate the evidence from EKE with the evidence from  
244 literature explaining the relation between ABMs and the exposure (hazard).

245

246 Based on this relationship, the WG can describe different scientifically based options, taking  
247 into account the related uncertainties, to risk managers as a basis for integration with other  
248 considerations (e.g. economical, societal) and for subsequent risk management decisions.

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DRAFT



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