Table I
The BPRACTICES project

Consortium partners
Research Institutes
Istituto Zooprofilattico Sperimentale del Lazio e della Toscana (IZSLT), Italy
Namik Kemal University, Turkey
Agricultural Institute of Slovenia, Slovenia
Centro de Investigación Apícola y Agroambiental de Marchámalo (CIAPA), Spain
Austrian Agency for Health and Food Safety (AGES), Austria
Istituto Zooprofilattico Sperimentale delle Venezie (IZSVE), Italy
University of Genoa, Italy
European Union Reference Laboratory (EURL) for Bee Health, French Agency for Food, Environmental and Occupational Health and Safety (ANSES), France
Food and Agriculture Organization of the United Nations (FAO)
Beekeeping Exchange Group, Technologies and Practices for Small Agricultural Producers (TECA), FAO, Italy
Beekeepers' associations involved in the project
International Federation of Beekeepers' Associations (APIMONDIA), Italy
European Professional Beekeepers Association (EPBA), Germany

Materials and methods

Classification of good beekeeping practices

Good beekeeping practices were classified by taking into consideration the most relevant 'headings' of the OIE–FAO guidelines (18). In addition, GBPs were classified in 'categories' similar to those used by Formato and Smulders (19), adapted to consider productivity and the One Health approach: human health, animal health and ecosystem health.

Identification of good beekeeping practices

The 11 participant partners identified, listed and ranked GBPs by relevance using a consensus approach. Direct, simple and easily understandable language was used to write the list of GBPs, to ensure easy comprehension by all beekeepers.

Validation of good beekeeping practices

During the process, crucial relevance was attributed to the practical point of view of beekeepers. Some of the most important international beekeepers' associations (the International Federation of Beekeepers' Associations [APIMONDIA] and European Professional Beekeepers Association [EPBA]), together with the members of the BPRACTICES consortium, participated in the identification and evaluation of GBPs according to their importance in daily apiary activities, in order to validate them.

Assessment of good beekeeping practices

The different partners and stakeholders of the BPRACTICES project duly prioritised the GBPs in a transparent manner, using previous attempts at prioritisation conducted in similar fields as a reference (20).

In order to allow the project partners to perform a relevance-based assessment of GBPs, they received a Microsoft Excel (Excel® 2016, Microsoft Corporation, Redmond, WA, United States of America) file for completion, correction, amendment and rating of the GBPs. Partners evaluated each GBP according to its importance through the adoption of a score ranging from 1 to 4 (1 = not important; 2 = slightly important; 3 = important; 4 = very important). A score of 4 was given to those beekeeping practices deemed of crucial relevance according to the legal requirements within individual countries and in accordance with the experience of the participants, based on the magnitude of the impact they can have in the context of the One Health approach (colony health, human health, environmental protection). In order to avoid bias, all scores were provided without allowing individuals to view the scores given by other participants.

Statistical methods

To rate each GBP, the mean result was calculated from the scores received and the answers were sorted according to the 'relevant' and 'mandatory' criteria. All ratings were statistically processed to obtain a final list containing a reasonable number of GBPs to recommend to beekeepers. For the final ranking, only scores with means higher than the 75th percentile threshold were considered.

Results

Definition of good beekeeping practices

As a result of the process mentioned above, GBPs were defined as 'those integrative activities that beekeepers apply for on-apiary production to attain optimal health for humans, honey bees and the environment' (Fig. 2). The implementation of the GBPs, therefore, would have a positive effect on colony health and on society, and at the same time could favour high production standards.

Classification of good beekeeping practices

According to the OIE–FAO classification of GFPs, GBPs were classified by considering the following headings: general apiary management, veterinary medicines, disease management (general), hygiene, animal feeding and watering, record keeping and training (Tables II and III).

Fig. 2
Elements of the One Health approach in beekeeping
Arrow indicates good beekeeping practices

Identification of good beekeeping practices

An overall list of 251 GBPs was identified (www.izslt.it/bpractices/good-beekeeping-guidelines/) (21).

Assessment of good beekeeping practices

The 251 GBPs were arranged according to the average score attributed by the different partners. Then, in order to obtain a smaller, more practical and reasonable list of GBPs to provide to beekeepers, only the GBPs with a mean score within the 75th percentile were considered for each heading and category, reaching a total of 140 GBPs (Tables II and III).

Finally, a list of the 140 most relevant GBPs was obtained, classified as shown in Table III. For each heading, the following categories were considered: honey-bee health (HBH), product safety (PS), human health (HH) and productivity (PR) (Tables II and IV). Some GBPs were included in more than one category (Table IV).

Discussion and conclusions

The aim of this work was to contribute to a first definition of GBPs in accordance with FAO and OIE guidelines (18) in close collaboration among scientists, Technologies and Practices for Small Agricultural Producers (TECA)–FAO and international beekeepers' organisations (APIMONDIA and EPBA).

Good beekeeping practices are intended to be implemented in the primary production of hive products. Moreover, GBPs are prerequisites for the 'biosecurity measures in beekeeping' (BMBs). The latter are those operational activities aimed at limiting the spread of specific honey-bee diseases. Only if GBPs are systematically implemented by the beekeeper can BMBs be properly tackled.

Table II
General good beekeeping practices

1. General apiary management		Mean score (1–4)	Category
1.1. Transportation	Comply with legal obligations concerning restrictions on animal movements in the case of notifiable diseases	4.0	HBH
	Transport/move only healthy colonies	3.8	HBH
	Transport hives avoiding the warmer hours of the day, providing adequate openings for air ventilation in the hives	3.7	HBH
1.2. Hygiene	Respect hygiene rules (e.g. periodically clean suits, gloves, etc.)	3.8	HBH
	Practise good hygiene when dealing with dead colonies (combs, food stores, boxes, etc.)	3.8	HBH
	Disinfect levers and other potentially contaminated equipment (e.g. gloves) after inspection of hives affected by transmissible diseases	3.7	HBH
	Do not place honey supers directly on the ground (avoid contamination with *Clostridium botulinum*)	3.7	PS
	Avoid contact with dust during the transport of the supers from the apiary to the honey house	3.6	PS
	Do not place beehives directly on the ground	3.3	PS
	Use disposable gloves when handling diseased hives	3.3	HBH

1. General apiary management (cont.)		Mean score (1–4)	Category
1.3. Bee health	For nuclei use only bees and brood combs from healthy colonies	3.8	HBH
	Balance colony strength among colonies, transferring frames only in the case of healthy hives	3.7	HBH, PR
	Buy new bee colonies only after thorough inspection for bee diseases, preferably with a health certificate from a veterinarian	3.6	HBH
	Keep only healthy strong colonies in the apiary	3.5	HBH, PR
	Avoid areas with environmental pollutants (e.g. pesticides, heavy metals, etc.) to place apiaries	3.2	HBH, HH, PR
	Do not unbalance the proportion between nurse bees and brood while equalising the hives; preferably use combs with hatching bees to fortify weak colonies	3.2	PR, HBH
	Perform genetic selection in order to have queens that are more resistant to disease and adapted to local climatic conditions	3.0	HBH
	Keep newly introduced colonies separate from the existing stock for an appropriate period (at least one month) in order to monitor them against diseases to prevent transmission	2.9	HBH
	Avoid, as far as possible, the introduction of swarms of unknown origin, or colonies or queens from other apiaries	2.8	HBH
	Keep purchased or weak colonies in a quarantine apiary	2.8	PR
	Reduce bee stress (e.g. avoiding unnecessary winter inspections of the hives; limiting the use of the smoker; feeding the bees properly, etc.)	1.3	PR, HBH
1.4. Apiary management	Evaluate the melliferous and pollen capacity of the area and the availability of water resources	3.3	HBH
	Do not leave beekeeping material in the apiary	3.2	PS
	Keep a good balance between the number of hives and the amount of melliferous plants/pollen sources in the area where the apiary is located	3.1	PR
	Avoid windy areas when placing apiaries	3.0	HBH
	Place apiaries in an accessible area	3.0	HBH
	Adjust the number of hives in the apiary according to season, pollen, nectar, honeydew resources	3.0	HBH, PR
	Adjust the number of hives within a flight range according to season, pollen, nectar, honeydew resources	3.0	HBH, PR
	Place apiaries on a firm area	2.8	HBH
	Prevent drift occurrence: avoid keeping too many colonies in a single row	2.7	HBH
	Place apiaries in an area accessible to vehicles	2.7	HBH
	Avoid having broken hives with openings or poorly maintained hives, to prevent robbing	2.6	HBH
1.5. Wintering	Before winter, reduce the empty space in the hive	3.0	PR
	Wintering: reduce the size of the hive entrance	3.0	HBH
	Wintering: perform beehive box maintenance (replacing parts or painting; verify the integrity of hive boxes, if needed)	2.8	PR
	Wintering: verify the external position of the frames with stores in the hive	2.5	PR
	Wintering: reduce the number of frames in the hive box	2.3	PR
	Wintering: insert a divider board to reduce the volume for the hive nest	2.3	PR
	Wintering: wrap the hive in black tar paper, if needed	1.3	PR
1.6. Human health	Have the support of an expert (e.g. veterinarian, technician, etc.) to provide assistance in case of need	3.3	PR, HBH, PS
	Use personal protective clothing and equipment when visiting honey bee colonies	2.8	HH
	Avoid areas where toxic (e.g. with pyrrolizidine alkaloids) plants (e.g. *Echium* spp., *Eupatorium* spp. and *Senecio* spp.) can be found in significant quantity	2.5	PR, HH
	Keep corticosteroids or other appropriate medicines ready to use during apiary inspections to guarantee health of operators (for example, in case of anaphylaxis)	2.4	HH
	Limit the weight lift (e.g. when harvesting supers or when moving hives) and, if needed, use back protector devices	2.3	HH
	Avoid areas where allergenic plants (e.g. *Ambrosia trifida* and *Artemisia vulgaris*) can be found in significant quantity	2.0	HH, PS

1. General apiary management (cont.)		Mean score (1–4)	Category
1.7. Colony management	Practise hive management according to region, season, strength of colony	3.7	PR
	Replace the queens at least every two or three years except those of high genetic value	3.6	HBH, PR
	Prevent swarming by insertion of new wax foundations	3.1	HBH
	Prevent swarming by colony splitting	3.0	PR
	Comply with the planned schedule for beehive inspection	3.0	PR
	Prevent swarming by placing of supers	2.8	PR
	Prevent swarming by taking off the entrance reducer	2.8	HBH, PR
	Prevent swarming by adopting genetic selection of the queens	2.8	PR
	Use a queen excluder	2.8	HBH
	Reduce the opening of the hive entrance during robbing and cold periods and increase the opening of the hive entrance during the hot season	2.8	HBH
	Mark the queen bee according to the date of birth	2.7	PR, HBH
	Orientate hive entrance so that the sun can reach the bees in the early morning hours	2.5	PS
	Prevent swarming by insertion of drawn combs	2.2	PR
	Prevent drift occurrence: paint/draw numbers or identification signs on the front and entrance of the hive	2.2	HBH
	Indicate the age of the combs on the top bar of the frame (e.g. the year of placement of the frame with foundation)	1.6	HBH
	Prevent swarming by removal of the beehive's bottom board	1.2	PR
	Provide adequate openings in the hive for air circulation, if needed	1.2	PR, HBH

2. Veterinary medicines	Mean score (1–4)	Category
Use only veterinary medicines for honey bees registered in your country or legally imported medicines	4.0	HH, HBH, PS
Ensure that all treatments or procedures are carried out correctly as described in the instructions (respecting dosage and method of application)	4.0	HH, HBH, PS
Do not carry out illegal treatments	4.0	HH, HBH, PS
Use only pharmacological products registered for beekeeping use, follow the usage instructions and record the treatments	4.0	HH, HBH, PS
Observe the withdrawal period of veterinary products and ensure that products from treated hives are not used for human consumption until the withdrawal periods have elapsed	4.0	PS, HH
If using instruments for the application (formic acid dispenser, sublimators for oxalic acid treatment), ensure that they are appropriate and correctly calibrated for administration	3.7	HH, HBH, PS
Respect the required storage conditions for veterinary medicines and feeds	3.6	PS, HBH
Dispose of used instruments and devices in a biosecure manner	3.5	HH, HBH

3. Disease management	Mean score (1–4)	Category
In the case of notifiable diseases, follow the instructions from the veterinary regulations and competent authorities	4.0	HBH
In the case of infectious diseases, clean all beekeeping material between uses (e.g. hive bodies, hive bottom boards, feeders, hive tools)	4.0	HBH, PR
Clean or disinfect (in the case of infectious diseases) the hive box before installing new colonies	4.0	HBH, PR
Carry out thorough inspections for clinical signs of bee diseases and the presence of the queen in spring	3.8	HBH, PR
Carry out thorough inspections for clinical signs of bee diseases and the presence of the queen at the end of the beekeeping season	3.8	HBH, PR
Quickly remove beehives with dead colonies	3.8	HBH

3. Disease management (cont.)	Mean score (1–4)	Category
Take samples for laboratory analyses when sick or dead bees are found, if needed	3.8	HBH (Subcategory PCI)
Clean equipment, scrape off wax and propolis, on a regular basis	3.8	HBH
Remove and process wax of all combs from dead, affected colonies	3.7	HBH, PR
Record the health status of the colonies: diseased/infected colonies (dates, diagnoses, ID of colonies affected, treatments and results)	3.6	PS, HBH
Renew 30% of the hive combs every year	3.5	HBH, PR
Record the health status of the colonies: mortality (dates, diagnoses, ID of colonies affected)	3.4	HBH
Verify promptly any signs of disease, asking a veterinarian (or a specialist)	3.3	HBH (Subcategory PCI)
Do not move frames or any kind of biological material (for example, to balance hives) from one hive to another if their health status is not well known	3.3	HBH, PR
Inspect diseased hives only after inspections of healthy hives are ended	3.3	HBH
Select the best-performing stocks of honey bees	3.2	HBH, PR
Burn dead colonies	3.2	HBH
Remove queens from colonies with clinical history of AFB disease	3.0	HBH, PR
Remove queens from colonies with clinical history of EFB disease	3.0	HBH, PR
Try to select and breed colonies that are more disease tolerant/resistant	3.0	HBH, PR
Record the origin and use of all disinfectants and consumable items used, keep all the records relating to the cleaning and disinfection procedures used on equipment or honey house (including data sheets for each detergent or disinfectant used), as well as all the records showing that these procedures have been effectively implemented (task sheets, self-inspection checks on the effectiveness of the operations)	3.0	PS, HBH, HH
Disinfect equipment (for example, with NaOH, hypochlorite) on a regular basis	2.8	HBH, PR
Carry out thorough inspections for clinical signs of bee diseases and the presence of the queen before supering the hives	2.7	HBH, PR

4. Hygiene	Mean score (1–4)	Category
Torching (blue flame) used as a disinfection method for hives and beekeeping tools in the case of transmissible diseases	3.3	HBH
Bleaching (soda, NaOH, etc.) used as a disinfection method for hives and beekeeping tools in the case of transmissible diseases	3.2	HBH
Incineration of affected colony, if needed in the case of transmissible diseases	2.3	HBH
Always incinerate affected colony in the case of transmissible diseases	1.8	HBH
Water under high pressure and heated (90°C) used as a disinfection method for hives and beekeeping tools in the case of transmissible diseases	1.6	HBH
Autoclaving used as a method of disinfection of hives and beekeeping tools in the case of transmissible diseases	1.6	HBH
Gamma irradiation as a method of disinfection of beekeeping tools in the case of transmissible diseases	1.5	HBH

5. Animal feeding and watering	Mean score (1–4)	Category
Do not feed the bees with honey, pollen or supplements, unless the absence of pathogens (spores of AFB, chalkbrood, *Nosema*, EFB, etc.) is certified	4.0	HBH
Provide artificial feeding during times of shortage or to build up winter stores, when needed	3.7	HBH, PR
Wintering: verify that there are a sufficient number of stores in the hive	3.7	HBH
Provide nucleus and swarms with adequate food supply when needed	3.6	HBH, PR
Ensure the bees have access to safe water sources	3.3	HBH, PR
Do not feed bees openly in the field to prevent robbing and spread of diseases	3.3	HBH, PR
During transport provide adequate watering if needed	3.0	HBH

6. Record keeping	Mean score (1–4)	Category
Keep records of veterinary medicine treatments	4.0	PS, HBH
Registration of the beekeeper in the National Beekeeping Registry	3.8	PS, HBH
Record the exact position of the bee yards	3.8	PS, HBH
Identify with numbers/letters all the hives in each apiary	3.6	PS, HBH
Keep records of honey-bee diseases and colony mortality or depopulation	3.5	PS, HBH
Set up a data-recording system that can be used to trace exactly which batches of commercial feed the colonies were fed with	3.5	PS, HBH
Keep all documents/certificates about the commercial feed used	3.5	PS, HBH
For each colony or group of colonies, require and keep all commercial and health documents, enabling their exact itinerary to be traced from their farm or establishment of origin to their final destination	3.4	PS, HBH
Record all reared colonies	3.4	PS, HBH
Record all colony arrivals, with origin and date of arrival, to ensure that movements of incoming colonies are traceable to their source	3.4	PS, HBH
Keep records of movements of hives, swarms, queen bees	3.4	PS, HBH
Record period of collection of hive products from each apiary	3.4	PS
Keep detailed records of the origin and use of all medicines, including batch numbers, dates of administration, doses, treated hives and withdrawal times; treated hives or apiaries should be clearly identified	3.3	PS, HBH, HH
Keep all documents/certificates that indicate the raw materials used in feed manufactured by the beekeeper and given to the colonies	3.3	PS, HBH
Create a unique identification number for the apiary to easily trace the location of the hive (for stationary apiaries)	3.2	PS, HBH
Keep records of breeding activities (e.g. all breeding stock, queens' birth dates, their origin and arrival, the breeding dates and outcomes in cases of instrumental insemination, etc.)	3.2	HBH
Establish a data-recording system to ascertain the exact origin (batch) of bee products produced	3.2	PS, HBH
Keep all documents regarding self-checks and official controls on the proper management of the colonies and the sanitary and hygienic quality of the bee products	3.1	PS
Keep all documents proving that the bacteriological and physicochemical quality of the water used in the honey house, given to the colonies or used in feed preparation, meets official national standards for tap water	3.0	PS
Record the origin and use of all feeds used, keep all records of any feed manufacturing procedures and records for each batch of feed	2.9	PS, HBH
Keep a list of certified suppliers	2.8	HBH
Record any other management changes that may occur	2.5	HBH
Record any change in feeding	2.4	PS, HBH
Keep all laboratory reports, including bacteriological tests and sensitivity tests	2.4	PS
Keep reference samples (–20°C) of all feeds administered to the bees	2.3	PS, HBH

7. Training	Mean score (1–4)	Category
Training/knowledge on honey-bee diseases and clinical signs	3.5	PS
Follow a training programme in beekeeping and honey-bee diseases	3.5	HBH
Attend personal training in beekeeping	3.1	HBH, PS, HH, PR
Record datasheets for each detergent/disinfectant used	3.0	HBH, PS, HH
Record disinfection procedures used	3.0	HBH, PS, HH
Record that disinfection procedures have been implemented	3.0	HBH, PS, HH
Keep the documents certifying qualification and training of persons working with bees	1.9	PS

AFB: American foulbrood
EFB: European foulbrood
HBH: honey-bee health
HH: human health
ID: identification number
NaOH: sodium hydroxide
PCI: preclinical indicators
PR: productivity
PS: product safety

Table III
Headings for good beekeeping practices and number of most relevant good beekeeping practices identified

Headings	Number of GBPs identified in each heading
General apiary management	63
Veterinary medicines	8
Disease management (general)	23
Hygiene	7
Animal feeding and watering	7
Record keeping	25
Training	7

GBPs: good beekeeping practices

Table IV
Categories of good beekeeping practices with their abbreviations and number of most relevant identified good beekeeping practices

Categories for GBPs and abbreviations	Number of GBPs identified in each category
Honey-bee health (HBH)*	109*
Product safety (PS)	44
Human health (HH)	16
Productivity (PR)	45

*including the subcategory 'Preclinical indicators' (PCI)
GBPs: good beekeeping practices

A clear definition of GBPs will assist the development of guidelines or recommendations to the beekeeping sector from international institutions involved in animal production, animal health and food safety (e.g. Codex Alimentarius, Joint FAO/World Health Organization [WHO] Expert Committee on Food Additives (JECFA), OIE, FAO, International Organization for Standardization [ISO]). Furthermore, this definition and the methodologies should be valuable for legislative bodies (e.g. EU Regulation 2016/429) (3), producers, Veterinary Services, capacity-building activities, progressive management pathways in beekeeping, etc.

Daily implementation of GBPs in apiary management should result in multiple beneficial impacts:

– for honey-bee health, due to generally better management of hives (e.g. proper wintering, apiary position, feeding) and appropriate control of honey bee diseases (e.g. adopting preventive measures and integrated pest management with proper use of acaricides);

– for human health, due to appropriate use of antimicrobials and food safety of hive products;

– for environmental protection, by preferring the use of organic compounds and avoiding the use of antibiotics;

– from the economical point of view (22, 23, 24), healthier animals reduce the need for medicines (and the subsequent costs) and are able to increase the production (and the income) per hive.

The GBPs were classified by adapting the FAO and OIE guidelines *Guide to Good Farming Practices for Animal Production Food Safety* (18) to the beekeeping sector. In this study, the collaboration and the involvement of international associations of beekeepers (e.g. APIMONDIA and EPBA) represented an important, innovative approach that allowed consideration of the feasibility of applying the GBPs in everyday apiary activities.

Following the FAO and OIE guidelines for GFPs (18), the same headings were adopted when collecting GBPs: general apiary management, veterinary medicines, disease management (general), hygiene, animal feeding and watering, record keeping and training (Table III).

Record keeping, in particular, has the potential to improve the other best practices through monitoring recorded practices. This can be useful for beekeepers on both small and commercial scales. Maintaining consistent and accurate records is an ongoing challenge for all sectors of the beekeeping community; however, various practical solutions have been devised to facilitate record keeping, including markings or indicators in the apiary, notebooks and spreadsheets, as well as recently introduced specialised apiary management and monitoring technology.

Of course, in order to extend the value of record keeping beyond the individual beekeeper to the global beekeeping community, it will be necessary to use standardised data (25, 26) and promote the sharing of relevant data to a common database for analysis. At the same time, guidelines and policies that protect the beekeeper will also be needed to encourage data sharing. New technologies and best practices could not only be recommended, but also built into software systems. Educational objectives could be enhanced through the application of smart software, which will also collect the data needed to finely tune and adapt current best practices to a customised solution.

The use of advanced analytical techniques will help beekeepers to recognise not only threats to the hive, but also what particular GBPs are best for that hive, with the help of a recorded history that will ensure the best outcome for that colony.

The list of 140 GBPs identified will allow more effective and harmonised training of beekeepers, veterinarians and para-professional technicians, as well as the application of effective biosecurity measures in beekeeping.

In conclusion, the authors have defined and listed those GBPs that, at the international level, represent universally accepted prerequisites that will guarantee the sustainability, competitiveness and resilience of the apiculture sector and enable it to face the current challenges of modern beekeeping.

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Les bonnes pratiques apicoles

J. Rivera-Gomis, J. Bubnic, A. Ribarits, R. Moosbeckhofer, O. Alber, P. Kozmus, R. Jannoni-Sebastianini, W. Haefeker, H. Köglberger, M.I. Smodis Skerl, B. Tiozzo, M. Pietropaoli, J. Lubroth, E. Raizman, C. Lietaer, R. Zilli, R. Eggenhoeffner, M. Higes, M.N. Muz, C. D'Ascenzi, M.P. Riviere, A. Gregorc, J. Cazier, E. Hassler, J. Wilkes & G. Formato

Résumé

L'apiculture moderne européenne est confrontée à de nombreuses difficultés dues à divers facteurs, pour la plupart liés à la mondialisation, à la pollution agrochimique et à la modification de l'environnement. À ces facteurs s'ajoute l'émergence de nouveaux agents pathogènes qui menacent la santé des abeilles mellifères d'Europe. Dans ce contexte, une gestion appropriée des colonies d'abeilles devrait reposer sur une vision plus large, dans laquelle les aspects relevant de la productivité sont examinés suivant une approche « Une seule santé » afin de protéger les abeilles mellifères, les humains et l'environnement. Les auteurs décrivent un nouvel outil destiné à l'apiculture : les bonnes pratiques apicoles. Ils ont évalué et classé par ordre d'importance une liste de bonnes pratiques apicoles validées par une équipe internationale composée de chercheurs, d'autorités nationales de la santé animale et d'associations internationales d'apiculteurs. Ces activités ont été conduites dans le cadre du projet « BPRACTICES », proposition retenue suite à l'appel à projets transnationaux du réseau ERA–NET SusAn (European Research Area Network on Sustainable Animal Production) au sein du Programme Horizon 2020 de l'Union européenne pour la recherche et l'innovation. Conçue sous forme de collaboration internationale, cette étude vise à proposer une approche innovante et pratique, similaire aux applications précédemment adoptées dans d'autres systèmes de production animale.

Mots-clés

Abeille mellifère – Apiculture – Bonnes pratiques apicoles – Bonnes pratiques d'élevage – BPRACTICES.

■

Buenas prácticas de explotación en la apicultura

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Resumen

La apicultura europea hace frente a numerosos problemas resultantes de diversos factores, relacionados principalmente con la mundialización, la contaminación agroquímica y los cambios ambientales, a todo lo cual se suman nuevos patógenos que amenazan la salud de las abejas melíferas europeas. En este contexto, una correcta gestión de las colonias debe traer aparejada una visión más global, en la que las cuestiones de productividad se consideren en clave de «Una sola salud» con objeto de proteger tanto a las abejas melíferas como a las personas y el medio ambiente. En este artículo se describe una novedosa herramienta aplicable a la actividad apícola: las buenas prácticas de apicultura. Los autores jerarquizaron una serie de buenas prácticas de apicultura seleccionadas, validadas y puntuadas según su importancia por un equipo internacional que incluía a investigadores, autoridades nacionales de sanidad animal y asociaciones internacionales de apicultores. Este trabajo formaba parte del proyecto «BPRACTICES», aprobado con ocasión de la convocatoria internacional abierta por la Red del espacio europeo de investigación en sanidad animal sostenible (ERA–NET SusAn), inscrita a su vez en Horizonte 2020, el programa de investigación e innovación de la Unión Europea. El estudio aquí descrito, fruto de la colaboración internacional, tiene por objeto presentar un planteamiento novedoso y viable, parecido a las aplicaciones ya implantadas en otros sistemas de producción animal.

Palabras clave

Abeja melífera – Apicultura – BPRACTICES – Buenas prácticas de apicultura – Buenas prácticas de explotación.

■

References

1. United States Department of Agriculture (USDA) (2019). – Beekeeping. USDA, Beltsville, Maryland, United States of America. Available at: www.nal.usda.gov/afsic/beekeeping (accessed on 11 December 2018).

2. World Organisation for Animal Health (OIE) (2018). – Manual of Diagnostic Tests and Vaccines for Terrestrial Animals: mammals, birds and bees, 8th Ed. OIE, Paris, France. Available at: www.oie.int/standard-setting/terrestrial-manual/access-online/ (accessed on 11 December 2018).

3. European Commission (EC) (2016). – Regulation (EU) 2016/429 of the European Parliament and of the Council of 9 March 2016 on transmissible animal diseases and amending and repealing certain acts in the area of animal health ('Animal Health Law'). *Off. J. Eur. Union*, **L 84**, 208 pp. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2016.084.01.0001.01.ENG (accessed on 11 December 2018).

4. Holden C. (2006). – Report warns of looming pollination crisis in North America. *Science*, **314** (5798), 397. doi:10.1126/science.314.5798.397.

5. Westerkamp C. & Gottsberger G. (2002). – The costly crop pollination crisis. *In* Pollinating bees: the conservation link between agriculture and nature (P. Kevan & V.L. Imperatriz Fonseca, eds). Ministry of Environment, Brasilia, Brazil, 51–56. Available at: www.researchgate.net/profile/Christian_Westerkamp2/publication/265484744_the_costly_crop_pollination_crisis/links/54fadfe90cf23e66f033316d.pdf (accessed on 19 July 2019).

6. Aizen M.A. & Harder L.D. (2009). – The global stock of domesticated honeybees is growing slower than agricultural demand for pollination. *Curr. Biol.*, **19** (11), 915–918. doi:10.1016/j.cub.2009.03.071.

7. Gallai N., Salles J.-M., Settele J. & Vaissière B.E. (2009). – Economic valuation of the vulnerability of world agriculture confronted with pollinator decline. *Ecol. Econ.*, **68** (3), 810–821. doi:10.1016/j.ecolecon.2008.06.014.

8. Potts S.G., Biesmeijer J.C., Kremen C., Neumann P., Schweiger O. & Kunin W.E. (2010). – Global pollinator declines: trends, impacts and drivers. *Trends Ecol. Evol.*, **25** (6), 345–353. doi:10.1016/j.tree.2010.01.007.

9. European Parliament (2010). – European Parliament Resolution of 25 November 2010 on the situation in the beekeeping sector. *Off. J. Eur. Union*, **C 99**, 60–64. Available at: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2012:099E:0060:0064:EN:PDF (accessed on 11 December 2018).

10. VanEngelsdorp D. & Meixner M.D. (2010). – A historical review of managed honeybee populations in Europe and the United States and the factors that may affect them. *J. Invertebr. Pathol.*, **103** (Suppl.), S80–S95. doi:10.1016/j.jip.2009.06.011.

11. Chauzat M.-P., Cauquil L., Roy L., Franco S., Hendrikx P. & Ribière-Chabert M. (2013). – Demographics of the European apicultural industry. *PLoS ONE*, **8** (11), e79018. doi:10.1371/journal.pone.0079018.

12. European Commission (EC) (2014). – 2014/909/EU: Commission implementing decision of 12 December 2014 concerning certain protective measures with regard to confirmed occurrences of the small hive beetle in Italy. *Off. J. Eur. Union*, **L 359**, 161–163. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32014D0909 (accessed on 11 December 2018).

13. Woodcock B.A., Bullock J.M. [...] & Pywell R.F. (2017). – Country-specific effects of neonicotinoid pesticides on honeybees and wild bees. *Science*, **356** (6345), 1393–1395. doi:10.1126/science.aaa1190.

14. European Food Safety Authority (EFSA) (2018). – Evaluation of the data on clothianidin, imidacloprid and thiamethoxam for the updated risk assessment to bees for seed treatments and granules in the EU. *EFSA Support. Publ.*, **15** (2), 31 pp. doi:10.2903/sp.efsa.2018.EN-1378.

15. McMenamin A.J. & Genersch E. (2015). – Honeybee colony losses and associated viruses. *Curr. Opin. Insect Sci.*, **8**, 121–129. doi:10.1016/j.cois.2015.01.015.

16. DeGrandi-Hoffman G. & Chen Y. (2015). – Nutrition, immunity and viral infections in honeybees. *Curr. Opin. Insect Sci.*, **10**, 170–176. doi:10.1016/j.cois.2015.05.007.

17. World Health Organization (WHO) (2017). – One Health. WHO, Geneva, Switzerland. Available at: www.who.int/features/qa/one-health/en (accessed on 11 December 2018).

18. Food and Agriculture Organization of the United Nations (FAO) & World Organisation for Animal Health (OIE) (2009). – Guide to good farming practices for animal production food safety. FAO, Rome, Italy, and OIE, Paris, France, 22 pp. Available at: www.oie.int/fileadmin/Home/eng/Current_Scientific_Issues/docs/pdf/eng_guide.pdf (accessed on 11 December 2018).

19. Formato G. & Smulders F.J.M. (2011). – Risk management in primary apicultural production. Part 1: Bee health and disease prevention and associated best practices. *Vet. Q.*, **31** (1), 29–47. doi:10.1080/01652176.2011.565913.

20. Brioudes A., Warner J., Hedlefs R. & Gummow B. (2015). – Diseases of livestock in the Pacific Islands region: setting priorities for food animal biosecurity. *Acta Trop.*, **143**, 66–76. doi:10.1016/j.actatropica.2014.12.012.

21. Istituto Zooprofilattico Sperimentale del Lazio e della Toscana 'M. Aleandri' (IZSLT) (2018). – BPRACTICES. IZSLT, Rome, Italy. Available at: www.izslt.it/bpractices/en (accessed on 11 December 2018).

22. Dawkins M.S. (2017). – Animal welfare and efficient farming: is conflict inevitable? *Anim. Prod. Sci.*, **57** (2), 201–208. doi:10.1071/AN15383.

23. Appleby M.C. (2005). – The relationship between food prices and animal welfare. *J. Anim. Sci.*, **83** (Suppl. 13), E9–E12. Available at: https://academic.oup.com/jas/article-abstract/83/suppl_13/E9/4790544?redirectedFrom=PDF (accessed on 11 October 2019).

24. Veissier I., Butterworth A., Bock B. & Roe E. (2008). – European approaches to ensure good animal welfare. *Appl. Anim. Behav. Sci.*, **113** (4), 279–297. doi:10.1016/j.applanim.2008.01.008.

25. Cazier J., Haefeker W. & Hassler E. (2018). – Data sharing risks and rewards for hobbyist beekeepers. *Bee Culture*, **12**, 23–30. Available at: www.beeculture.com/data-sharing-risks-and-rewards/ (accessed on 24 May 2019).

26. Cazier J., Haefeker W. & Hassler E. (2018). – BXML Part 2: Achieving the goal of standardized data in search of the genius hive. *Bee Culture*, **10**, 26–33. Available at: www.beeculture.com/bxml-part-2-achieving-the-goal-of-standardized-data/ (accessed on 24 May 2019).

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Determinación del estado de bienestar en perros callejeros de dos centros urbanos de Chile

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Resumen

Los perros callejeros constituyen no solo un problema de salud pública y ético, sino también, medioambiental y económico. Si bien se cree que estos perros no se encuentran en buenas condiciones, en Chile los estudios que abordan y analizan este tema son insuficientes. El objetivo de esta investigación fue evaluar el bienestar en perros callejeros en el centro de las ciudades de Santiago y Valparaíso. La evaluación se realizó a través de un método observacional en un total de 554 perros, y se analizaron las siguientes variables: condición corporal, dificultad motora, estado de la piel, enfermedad respiratoria, reacción hacia el humano y otras variables. Además, se consideró la distribución espacial y se estimó la edad, el sexo y la conducta social. Los resultados fueron analizados en términos de frecuencia, y se observó que en Valparaíso (n = 204), el 37% de los perros presentaba un bienestar comprometido (malo - escaso) mientras que el 63% presentaba un bienestar favorable (bueno u óptimo). En cambio, en Santiago (n = 350), sólo un 21,7% presentaba un estado de bienestar comprometido mientras que el 78,3% presentaba un estado de bienestar favorable. Asimismo, respecto a la conducta social, un 55% de los perros evaluados en Valparaíso y un 68% de los evaluados en Santiago mostraron un estilo de vida solitario. Si bien los individuos en su mayoría se encontraban en buenas condiciones, un alto porcentaje no lograba satisfacer las necesidades para estar en equilibrio con su entorno.

Palabras clave

Bienestar animal – Chile – Perros – Perros callejeros – Perros vagabundos – Salud pública – Santiago – Valparaíso.

Introducción

El perro (*Canis lupus familiaris*) ha marcado el transcurso de la civilización porque es un animal de compañía. Se desconoce cuál es el tamaño de la población canina mundial, sin embargo, se correlaciona positivamente con el de la población humana. Según una serie de observaciones, podría alcanzar una décima parte de la población humana, lo cual significaría que en el mundo hay más de 700 millones de perros. La mayoría de ellos, particularmente en ciertas partes de África, Oriente Medio y América Latina, serían perros callejeros (1). Muchas veces, estos animales padecen hambre y enfermedades, y suelen buscar refugio en las comunidades humanas, donde es común que se les vea como una molestia y un riesgo para la salud.

La tenencia responsable se entiende como la condición por la cual el tutor de un animal acepta y se compromete a procurarle una adecuada provisión de alimento, habitáculo, protección, salud y buen trato durante toda la vida, además de prevenir riesgos como la agresión, lesiones o enfermedades infecciosas que el perro pueda provocar a la comunidad, a otros animales o al medio ambiente (2).

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Bienestar en animales de compañía

En la comunidad científica existe consenso acerca de que el bienestar animal (BA) se logra cuando se satisfacen las necesidades físicas, mentales y naturales. La Organización Mundial de Sanidad Animal (OIE) ha establecido una serie de principios básicos en los cuales se funda este concepto (3). Así, diferentes autores han profundizado en esta línea de trabajo, planteando que, para poder estimar el bienestar en las mascotas, se debe llevar a cabo una evaluación que aborde aspectos mentales, físicos y relativos al bienestar natural (4). El concepto de bienestar mental se basa en la idea de que los animales son seres sintientes, es decir, que tienen capacidad de sentir en forma subjetiva (sentir dolor o placer) (5). Por otra parte, el concepto de bienestar físico se basa en la idea de que el funcionamiento biológico, la condición corporal y la salud pueden ser observados directamente por un evaluador, aunque no se debe olvidar que la buena salud física *per se* no siempre es sinónimo de bienestar (6). El ambiente en el que habita el animal también está relacionado con su bienestar físico, ya que los estímulos ambientales determinarán la adaptabilidad del perro al entorno (7). Finalmente, el bienestar natural se mide en función de la oportunidad que tienen los animales de expresar sus comportamientos naturales (6).

Evaluación del bienestar animal mediante indicadores

El desarrollo de instrumentos de evaluación del bienestar en los animales de compañía ha sido escaso. Se ha propuesto cuantificar el bienestar animal en función de indicadores directos e indirectos. Los indicadores directos, basados en el animal, incluyen aspectos del comportamiento, la postura corporal, la condición corporal, la calidad de la interacción con los humanos y con otros animales, los signos de enfermedad y los signos de salud física o funcional. Por otra parte, los indicadores indirectos se basan en los recursos con los que cuenta el animal: la calidad del hábitat, de la alimentación y el acceso a una atención sanitaria (7). Por lo tanto, la aplicación de protocolos de evaluación requiere conocer las necesidades específicas de una especie, principalmente en lo que respecta a su salud (física y mental), a las condiciones ambientales y a su repertorio conductual. Los indicadores más utilizados para determinar el bienestar de los perros callejeros son la condición corporal y el estado de la piel, la presencia de parásitos externos, la presencia de heridas, la presencia de enfermedades neoplásicas o infecciosas, el nivel de cortisol sérico, la agresividad intraespecífica, la conducta de juego, las interacciones perro-humano y parámetros que permiten evaluar cualitativamente el comportamiento (8).

Situación de los perros callejeros en Chile

Se desconoce la cantidad exacta de perros que hay en Chile. Sin embargo, de acuerdo con el censo poblacional del año 2014, se estimó una proporción número de personas:número de perros de 5:1, y por lo tanto, un total de 3 249 505 perros, 487 425 de los cuales corresponderían a perros callejeros y 207 415 a perros sin dueño (Subsecretaría de Desarrollo Regional y Administrativo, Ministerio del Interior y Salud Pública, Gobierno de Chile, 2017).

Se define como perro callejero a aquel que ha sido abandonado o que, aun teniendo dueño, deambula libremente por las áreas públicas (2, 9). Estos animales son abandonados bajo el supuesto de que buscarán alimento entre la basura, en ocasiones, porque los dueños no se encuentran en condiciones de mantenerlos (10). De hecho, en muchos países, la mayoría de los perros que se definen como callejeros, tienen dueño. El perro comunitario o de vecindario, es aquel que no tiene dueño pero que es alimentado por la comunidad y recibe cuidados básicos de la misma (11). Esta es una manifestación de una serie de factores socioeconómicos y culturales que tienen su origen en la insuficiente educación ciudadana y en una deficiente legislación sobre el impacto de la población canina en el medio ambiente y en la salud pública (12). Los perros de vida libre afrontan altas tasas de mortalidad, malnutrición, hambre, enfermedades y maltrato, y estarían asociados a decenas de enfermedades zoonóticas. Otros problemas relacionados con estos perros son los atropellos, las peleas entre ellos, los ruidos molestos, las mordeduras, la contaminación de la vía pública y una reproducción descontrolada (13). Ciertos estudios indican que en países como Las Bahamas, más del 70% de estos animales sufren enfermedades como la equinococosis, la toxocariasis, la parvovirosis, la leptospirosis o tumores venéreos (13). En un estudio realizado en México, se halló que el 34% de los perros callejeros tenía ácaros (un 23%, *Demodex canis*). En una comunidad rural de Sudáfrica, el 51% de los perros presentaba enfermedad clínica, de los cuales, un 10% estaban gravemente enfermos y la mitad sufría enfermedades crónicas. Asimismo, como resultado de la vida libre, estos perros presentan altas tasas de mortalidad y una esperanza de vida de 1,1 años en ciertas comunidades de países como Zimbabue. La sobrepoblación en sí misma es un problema de bienestar, ya que conduce a la devaluación de estos animales por parte de una sociedad en la cual los perros que pueden obtenerse a un bajo o nulo costo, son los que sufren el mayor riesgo de abandono (14).

Pese a lo anterior, en América Latina, la evaluación del bienestar en poblaciones caninas es un área insuficientemente estudiada, motivo por el cual los autores realizaron esta

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