Tools and opportunities for African swine fever control in wild boar and feral pigs: a review

Pablo Palencia[1, 2], Sandra Blome[3], Ryan K. Brook[4], Ezio Ferroglio [2], Yeong-Seok Jo[5], Annick Linden[6], Vidal Montoro[1], Mary-Louise Penrith[7], Radim Plhal[8], Joaquín Vicente[1], Arvo Viltrop[9], Christian Gortázar[1*]

1: Grupo Sanidad y Biotecnología (SaBio), Instituto de Investigación en Recursos Cinegéticos (UCLM-CSIC-JCCM), Ronda de Toledo 12, 13071, Ciudad Real, Spain

2: Università Degli Studi di Torino, Dipartimento di Scienze Veterinarie, Largo Paolo Braccini, 2, 10095 Grugliasco Torino, Italy

3: Institute of Diagnostic Virology, Friedrich-Loeffler-Institut, Suedufer 10, 17493 Greifswald-Insel Riems, Germany

4: Department of Animal and Poultry Science, College of Agriculture and Bioresources, University of Saskatchewan, 51 Campus Drive, Saskatoon, Saskatchewan S7N 5A8, Canada.

5: Daegu University, 201, Daegudae-ro, Gyeongsan-si, Gyeongsangbuk-do, 38453 Republic of Korea

6: Department of Infectious Diseases, Faculty of Veterinary Medicine, University of Liege, Place du 20-Août, 7 B- 4000 Liège, Belgium

7: Department of Veterinary Tropical Diseases, Faculty of Veterinary Science, 0110 University of Pretoria, South Africa

8: Mendel University in Brno, Faculty of Forestry and Wood Technology, Zemědělská 3, 613 00 Brno

9: Estonian University of Life Sciences, 51014 Tartu, Estonia

Corresponding author: Grupo Sanidad y Biotecnología (SaBio), Instituto de Investigación en Recursos Cinegéticos, IREC (UCLM-CSIC-JCCM), Ronda de Toledo 12, 13071, Ciudad Real, Spain. Tel: 34 926295300. E-mail: christian.gortazar@uclm.es

Appendix S2: Key Tables

Table 1.- Selected EFSA documents addressing ASF in wild boar, published between 2014 and 2022. Some contain annual epidemiological reports or situation updates, and all contain relevant primary data, modelling insights, or literature review results. Note that some views changed through time (e.g., the correlation between wild boar abundance and ASF risk, or the role of hunting in reducing the risk of ASF introduction and spread).

Reference (Most recent first)	**ASF situation update in EU and neighbouring countries**	**Selected additional relevant content (Often updated over years)**
EFSA et al. 2022	September 2020 to August 2021	• Risk factors for the occurrence of ASF in wild boar • Impact of ASF on wild boar hunting harvest • Romanian hunting grounds: intense hunting is a protective factor for ASF • Preemptive wild boar culling ("white zone") modelling (II)
EFSA et al. 2021d		• Animal Health Law cat A listing • Sampling procedures and guidelines for pig farm outbreaks
EFSA et al. 2021c		• ASF exit strategy, model • Two phases: screening + confirmation
EFSA et al. 2021b		• ASF and outdoor farming of pigs • Farm biosecurity measure (BSM) expert ranking
EFSA et al. 2021a	September 2019 to August 2020	• ASF seasonality: summer peak in pigs, winter in wild boar

		• Preemptive wild boar culling ("white zone") modelling (I) • Modelling predicts faster ASF spread in denser wild boar populations
EFSA et al. 2020	November 2018 to October 2019	• Median speed of natural ASF spread in wild boar 3-12 km/y • Fence use strategy and other interventions in Belgium • Recommendations for wild boar population management at different ASF epidemic stages
EFSA et al. 2019		• Risk assessment for southeastern Europe
EFSA et al. 2018b	November 2017 to November 2018	• Wild boar density is an ASF risk factor • Emergency measures following focal ASF introduction
EFSA et al. 2018a		• Interventions in Czechian focal introduction • No density threshold for ASFV maintenance • Need for better wild boar monitoring • Efficacy of wild boar population control and separation methods • Feeding should be prohibited in unfenced populations • Incentives for finding carcasses
EFSA et al. 2017	September 2016 to September 2017	• ASF case dynamics after entry, with peak at 6 months

		• Consider social context (hunter attitudes) in wild boar control • Potential risk sources: feeding, translocating, offal disposal • Modelling. Combined wild boar control and carcass removal (II)
EFSA 2015		• No correlation between ASF notifications and wild boar density • Expert assessment of wild boar management tools • Modelling. Combined wild boar control and carcass removal (I)
EFSA 2014		• Feasibility of wild boar depopulation • Movement prevention by feeding and barriers • Drastic hunting not a tool to reduce the risk of ASF introduction and spread

Table 2.- Primary research on African swine fever (ASF) monitoring and ASF control in wild boar or feral pigs, detailing field data-based research, experimental laboratory-based research and modelling. See Appendix S1 for the detailed list of references included on this table.

Subject	**Observational**	**Experimental**	**Modelling**
Early ASF detection and effective communication. Information seeking behavior, web monitoring; predator-	Schulz et al. 2020, Klich et al. 2021, Tizzani et al. 2021	Fernández-Carrión et al. 2020	Arsevska et al. 2018, O'Neill et al. 2020

prey changes, changes in wild boar movement rates; RTA sampling;			
ASF monitoring in wild boar	Mačiulskis et al. 2020; Martínez-Avilés et al. 2020, Probst et al. 2020, Vergne et al. 2020, Frant et al. 2020, 2021, Reiner et al. 2021, Schulz et al. 2021, Welz et al. 2021	Blome et al. 2014, de Carvalho Ferreira et al. 2014, Petrov et al. 2014	Guinat et al. 2017, Gervasi et al. 2020
Confirming ASF absence in infected regions and nearby negative regions; strengthened passive surveillance	Schulz et al. 2020, Desvaux et al. 2021		
Wild boar population monitoring	Morelle et al. 2020, Bobek et al. 2021; Bollen et al. 2021		
Tool for evaluating surveillance protocols			Peyre et al. 2019
Risk assessment and mapping prior to ASF entry			Roelandt et al. 2017, Bosch et al. 2017, Fekede et al. 2019, Wormington et al. 2019

Proper hunting waste disposal; carcass cleaning by scavengers	Cano-Terriza et al. 2018; Carrasco-Garcia et al. 2018, Szewczyk et al. 2021		O'Neill et al. 2020
Early outbreak investigation and intervention	Linden et al. 2019, Sauter Louis et al. 2021		
Avoiding disturbance in ASF infected sites			Petit et al. 2020
Deterrents to reduce wild boar carrion consumption	Denzin et al. 2020		
Effectiveness of single or combined interventions (carcass retrieval, culling, fencing). Impact of baiting and feeding on ASF risk.	Mur et al. 2012, Schulz et al. 2019, Dellicour et al. 2020, Flis et al. 2020, Jo & Gortázar 2020, 2021, Morelle et al. 2020, Yang et al. 2021		Guinat et al. 2017, Croft et al. 2020, Jori et al. 2020, O'Neill et al. 2020, Pepin et al. 2020, Han et al. 2021, Gervasi & Guberti 2021, 2022, Taylor et al. 2021
Focus control efforts on high-density populations; Risk scoring of infected area to focus control efforts	Podgórski et al. 2020		Loi et al. 2019
Optimizing WB carcass search and surveillance	Morelle et al. 2019, Cappai et al. 2020, Cukor et al. 2020, Havránek et al. 2020, Lim et al. 2021,		

	Szewczyk et al. 2021, Allepuz et al. 2022		
Hunter and farmer perceptions on ASF control, stakeholder involvement	Vergne et al. 2016, Marton et al. 2019, Emond et al. 2021, Stončiūtė et al. 2021, Urner et al. 2020, 2021a, 2021b		

Table 3.- Incomplete checklist for preparedness in the event of African swine fever (ASF) outbreak in wild boar.

Capacity or item	**Comments**
Preventive Task Force	Create a preventive and multidisciplinary task force with professionals targeted for each operation and who will be ready in case of an outbreak (communication, fencing, passive surveillance, analysis, …)
Baseline information on wild boar population size and distribution as available	This can feed into the rapid landscape and habitat assessment and risk mapping, combined with existing data on pig farm distribution
Contact list of relevant actors in the control effort	This will include contacts in the hunting scene and the environment and conservation services
Trained and equipped carcass-search and retrieval/sampling teams	Forestry agents must be informed and trained (ASF and biosecurity) and have field experience

Rapid landscape and habitat assessment and risk mapping	Fast identification of high-density wild boar populations, wild boar-pig farm overlap, natural and artificial barriers, natural habitat corridors, habitat quality
Wild boar monitoring	Set up camera-trap grids in infected and peripheral zones and gather all available information on local/regional wild boar distribution, abundance (hunting data, modeling), and management
Coordination facilities (may be mobile, like those used in forest fires)	
Sampling & sample transport material (kit format)	Train relevant stakeholders on sampling, sample transport, and biosecurity measures. Where possible, use simple methods and protocols to improve e.g. hunter and ranger compliance.
PPEs and disinfection materials, outbreak zone signaling	
Safe carcass transport materials and destruction facilities	May consist of mobile facilities or contracts with rendering plants
Fencing materials and building capacities for several hundred km	Pre-arrangements to avoid delays in public purchase Several kilometers of electric fencing must be stored for rapid deployment (before the building of permanent fences)

Wild boar traps and trained personnel	The material to build the traps must be stored and ready to be used by experienced staff
Night-shooting material and trained personnel	Professionals must be trained in night shooting and biosecurity rules
Intensive media campaign for the public	Most new outbreaks are caused by human error. It is therefore very important to intensively inform and educate the public about the occurrence of the disease and about the correct biosecurity rules
Help and support for hunters, seeking compensation and financial support	Many hunters want to help (hunt or look for deaths), but then have trouble getting financial support and compensation. Financial support comes from the state budget and obtaining it is often very complicated. The rules for obtaining support should be simple and hunters should be assisted by government officials with the correct completion of applications for support. Biosecurity training and compliance are needed.

Table 4.- Selected strengths and weaknesses regarding ASF preparedness and ASF control in wild boar.

Strengths	**Weaknesses**
Integrated monitoring. Integrated population and disease monitoring is improving. Wild boar population data and methods for density estimation in the absence of hunting	Wild boar monitoring may be neglected due to inter-agency differences in priority setting or lack of capacity. There is space for increasing vertical (regional to international)

are available. Early detection and prompt intervention can allow controlling point introductions. After ASF entry, monitoring contributes to understanding outbreak dynamics and to assess the effectiveness of interventions.	and horizontal (animal health – environment/hunting) coordination among agencies and between governmental agencies and academia, combining top-down and bottom-up approaches.
Stakeholder involvement. In-depth knowledge on hunter perceptions and how to engage them in ASF control. Relevant stakeholders are known.	Hunter willingness to contribute to ASF control may change over time due to practical and ethical concerns. Knowledge on perceptions and attitudes of other stakeholders and the public remain under-studied. Professionals and policy makers should contribute to increase the knowledge of citizens in how to use the tools available, such as citizen science. Communication and engagement strategies must be planned and implemented.
Veterinary services. Good ASF knowledge, laboratory capacities, and training are available in the official veterinary services.	Information and training for outbreak management is not always extended to other relevant agencies and stakeholders. Field intervention capacities often depend on other departments and non-government stakeholders.
Carcass destruction. Wild boar carcass destruction is clearly identified as an	Capacities for finding, retrieving and safely disposing of sick or dead wild boar in real field

important component of integrated ASF control.	settings may not be sufficient and are costly to maintain.
Fencing. Even incomplete fencing has shown to contribute to slow down wild boar mediated ASF spread. and to contribute to eradication in point introductions.	Expensive large-scale fencing has so far failed to impede ASF spread in front-like settings. Large-scale fencing may be in conflict with conservation legislation.
Depopulation. Wild boar and feral pig depopulation strategies have been successfully tested in real settings and can contribute to ASF control in point introductions and possibly in endemic situations as part of integrated strategies.	Hunters may oppose to depopulation for ethical and other reasons. Night shooting or trapping may be unavailable in certain situations. Trapping & other means of silent wild boar control, as well as hunting as a means of wild boar control, deserve experimental research and meta-analysis.

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