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## **Stakeholder's practices and representations of contacts between domestic and wild pigs: a new approach for diseases risk assessment?**

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### **Abstract :**

*The emergence and re-emergence of diseases, in which 60 to 70% are zoonotic, raise a number of economic, environmental, and public health issues, especially important as breeding systems are in close contact with wildlife. In the Corsican pastoral system, free roaming livestock and wild animals share the same resources, creating a high potential risk of contact and inter-specific transmission of pathogenic agents. Researchers are facing the challenge of thinking more efficient ways to design sanitary risk assessments and disease management systems, by adapting classic epidemiological/ecological approaches to systemic conceptions, that take into account more socially oriented components (such as stakeholder's strategies and knowledge, production system choices, etc.). We aim to present an original approach to understand the practices and representations of farmers and hunters, as potential factors for the emergence of diseases. Such an approach would be complementary to ecological and epidemiological approaches for evaluating the risk of contacts between animals and the risk of pathogen transmission. Indeed, it provides a systemic understanding of the issues on emerging diseases, and tries to renew scientific and technical paradigms for the management of these diseases.*

**Keywords:** wild boar; pigs; wildlife; pathogen transmission; practices; representations; risk assessment

### **1. Context and objectives: understanding contacts between wildlife and livestock to renew diseases risk assessment and management paradigms**

The emergence and re-emergence of diseases, in which 60 to 70% are zoonotic (AFSSA, 2006; FAO, 2009), raise a number of economic, environmental, and public health issues. In extensive breeding systems characterized by a close contact between livestock and wildlife, these issues are particularly important. In pastoral systems, livestock and wild animals share the same resources, generating a high potential risk of inter-specific transmission of pathogenic agents.

The risk of disease emergence is even higher when species are taxonomically close, as it is the case of wild boar and domestic pigs (Wu et al, 2012). But studies on the nature of contacts between wildlife and domestic animals is still limited (Jones et al, 2008.; Brahmatt et al, 2012; Jori et al., 2012; Miguel et al, 2013.). Understanding these contacts and the associated practices is a key element to design relevant risk assessment approaches. Whereas assessment methods are generally exclusively based on epidemiological and/or ecological approaches, the complexity of the system (i.e the close link between ecosystem, breeding

system, hunting system,...), would require wider and more socially oriented scope to understand the disease emergence mechanisms. Reconsidering the management of these diseases at the interface “human-animal-ecosystem” (report "One Health", MAE 2011), researchers are thus facing the challenge of thinking new ways to build sanitary risk appraisal designs and disease management devices..

In Corsica, pig breeding is mainly based on traditional forest-pastoral system (outdoor free-range breeding), which mobilizes resources and involves transhumance summer practices. The production system is oriented towards the development of dry sausage, processed on-farm (Casabianca and Sainte Marie, 1998). The producer is often a "food chain producer" combining activities of breeding, multiplying, feeding and slaughtering (a large part of breeding pigs are still slaughtered on-farm), and transforming and selling, often directly to consumers.

Meanwhile, agricultural decline in recent decades has led to a notable increase of wild boar populations, which are often intensively hunted. Hunting is a strong and culturally rooted activity in rural areas (8 to 10% of the Corsican population practices hunting). It is nowadays estimated that about 40,000 wild boars are shot annually in Corsica, by a crew 200 to 250 hunters. Wild boar potentially carries several infectious or parasitic diseases of major economic importance such as Aujeszky's disease. From the public health perspective, they can be the source of many zoonotic diseases such as brucellosis, trichinosis, toxoplasmosis tuberculosis and Hepatitis E (Richomme, 2009; Richomme et al, 2010; Meng et al., 2009). Some of these diseases are present in Corsica and others such as African swine fever are raising awareness as the geographic proximity of Sardinia, where it is endemic, represents a potential risk of emergence.

Finally, this production system in which the animals are very often roaming free, involves strong interactions with the surrounding ecosystems. Therefore it is an ideal model for understanding the dynamics of pathogens between the wild and domestic components and assessing risk factors influencing their transmission and dissemination. We propose in this paper an original analysis of actors' practices and representations of those contacts, aiming to assess the risk assessment procedures and disease management approaches, and to provide new perspectives for further interdisciplinary research.

## **2. Methods: investigating breeders and hunters**

Considering the complexity of such a system and issues, understanding the mechanisms of disease emergence requires the integration of data from ecology and veterinary sciences as well as economics and social sciences. This study was carried out by surveys on hunting and farming activities, aiming to highlight the importance of actors' practices and representations, as potential factors for the emergence of diseases. It also aimed to understand the features of farming systems (i.e. knowledge and environmental factors leading to farmers 'choices).

The surveys were conducted as semi-structured interviews on a sample of 60 farmers and hunters (20 farmers, 20 hunters and 20 farmers-hunters), spatially distributed in various areas

of free-range pig production in the Haute-Corse and South-Corsica, according to their importance of livestock. The interviews focused on the farming system components, diseases present in the herd, the observed or suspected contacts between wild boars and pigs, the farmers' and hunters' knowledge on animal behavior and clues of the presence of wild boar (tracks), the importance of the crossed animals in swine offspring, or in hunting bags, etc.

Finally, an additional approach focused on the mapping of these representations, according to each farmers' and hunters' perception, in order to highlight and visualize the risk of emergence across the region, and analyze that risk under different geographical features (vegetation, resources, access to lands, climate,...)

The data are quantitative and qualitative. From the actor's speech, pieces of information are identified as descriptive criteria, and processed in analytical tools built specifically for the analysis of discursive material (Miles and Huberman, 2003).

### **3. Results and discussion : practices and risk assessment**

#### *Presence of crossbred boars (hunting and livestock): breeding system issues*

The first and most important results concern the presence of crossbred boars in farms and hunting lists. Farmers refer to sows giving regularly birth to crossbred animals, every year. In some farms, especially in Haute-Corse (around 30% of farms), sows are left roaming free in pastureland when they are on heat, thus being exposed to a high risk of getting covered by a wild boar, given their high density in these areas. On the contrary, some farmers, especially those involved in a quality channel (PDO Corsican charcuterie) or in the local breed management design (regional association for the management of Corsican "Nustrale" pig breed), closely monitor their reproductive system: mating is time-bounded and organised in special areas (closed parks).

On the other hand, hunters report an increasing number of crossbred boars in their hunting results, particularly in hunting areas located near the pasture lands (80% in certain areas). Some elder hunters even speak of the disappearance of the genuine wild "Corsican" boar because of changes in the phenotype (ear shape, posture,..) and the observed behavior of the animal (the crossed wild boars are less difficult to flush out, and often fight back against hunting dogs).

The Corsican traditional farming system is not homogeneous as the practices may differ significantly from one farm to another. But the presence of crossbred animals is a wide shared observation in all surveyed areas. This phenomenon seems to be increasing steadily according to interviewees. It highlights frequent contacts between domestic and wild animals and questions the design of farming systems based on practices enhancing these contacts.

#### *Managing the contacts: Is it really a problem for farmers and hunters?*

As animals share the same resource, other types of contact can also occur in addition to mating. We distinguished direct contact (covering and "snout to snout") and indirect

contact (ingestion of plants previously in contact with another animal) which are potentially important. Farmers and hunters recognize that animals are “almost constantly” in contact, but they highlight the fact that they are not in the same place at the same time (daylight for pigs, nightfall for wild boars).

Despite the potential importance of these contacts, only a few breeders adopt radical strategies to reduce them. The most effective strategy seems to be to closely monitor the reproduction period and keep the females indoors during the oestrus period, in order to limit cross species breeding. However, this practice requires an additional amount effort and investment from the farmer that only a few interviewed individuals were keen to implement. Some farmers have reported the use of boars accompanying sows in the pasture lands, with the objective to deter the intrusion of wild boars in the herd. Signs of fighting on the “protective” boar (scars, wounds) are frequently observed, highlighting regular contacts between males, when implementing this strategy. Finally, another system shared by most of farmers consists in killing those wild boars they meet in the pasture area. Moving systematically with a hunting rifle, farmers seeking their herds on their journey shoot all wild boars they eventually observe close to their animals.

But given the frequency of contacts observed, and the small number of farmers who have implemented specific strategies to limit such contacts, it is worth wondering if those interactions between pigs and wild boars represent a real problem for farmers? Few of them (around 10%) admit willing to change their breeding system in regard of this phenomenon, as this would generate an additional workload. Finally, these results highlight the fact that analyzing stakeholder behavior is indeed an essential approach to understand issues concerning the risk of disease emergence.

#### *Practices at risk: lack of monitoring and waste management*

Can we therefore qualify these practices as risky? If answering to this question would require further analysis, we can still highlight the fact that the lack of monitoring of animals during the heat is likely to represent a risk factor for enhancing contacts. But other practices that could facilitate the transmission of diseases between species were also identified, particularly concerning the management of waste (animal carcasses). At farm level, we observed making use of a service of carcass disposal is an unusual practice. It seems common to carry a dead animal in an unfrequented place in the forest and to leave it there (while occasionally the animal is buried). The risk of ingesting the remains of pig carcasses by wild animals (wild boars, foxes, stray dogs,...) is thus potentially important. Furthermore, few farmers (2%) admit to feed their herd with remains of slaughtered pigs.

Concerning hunters’ practices, we observed that a common behavior is to leave the offal (guts) behind after dressing off the wild boar carcass, or to feed hunting dogs with the carcass offal. As the dog is a potential host for many parasites and viruses, it thus participates in maintaining the biological cycle of pathogens. Among the farmers-hunter category, pigs are sometimes directly fed with wild boar remains, causing thereby a risk of direct contamination.

Ingestion of remains of dead livestock by wildlife (boars, foxes, ...), or remains of animals hunted by domestic animals (dogs, pigs) seems to be a widespread phenomenon resulting from practices that appears to be common in pig production and hunting areas. It raises the need to incite actors to change their practices, in order to reduce the risk of disease emergence.

#### **4. Conclusion and Perspectives: combining scientific approaches to appraise risk**

These few results underline the importance and need of understanding the practices and perceptions of the different actors, that shape the spatial distribution of animals and the risk of disease emergence. If scientific literature widely considers wildlife as a reservoir of diseases, these results highlight the bidirectional pathway of pathogen circulation between the domestic and the wild components.

Combined with epidemiological and ecological approaches, of which the objective is to obtain a reliable assessment of the dispersion of a disease, this type of approach provides a systemic posture. The complexity of a pathoecosystems is indeed partially shaped by actors' practice. Therefore, transdisciplinary and combined approaches between epidemiologists social scientists and ecologists, would allow scientists and managers to better understand this complexity, and provide decision makers with relevant data to shape management designs that address more efficiently the challenge of the emergence and re-emergence of diseases at the wildlife-livestock –human interface.

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