

Unusual Mortality of the Philippine Warty Pig (*Sus philippensis* Nehring, 1886) in Mt. Kitanglad Range Natural Park: A Call for Enhanced Biorisk Management for Protected Areas

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ABSTRACT

Philippine warty pig *Sus philippensis* Nehring, 1886, is a Vulnerable species endemic to the Philippines. Its population is reportedly declining due to anthropogenic pressures, including deforestation, habitat loss, hunting, and reemerging infectious diseases. This research note provides information on the unusual mortality of seven warty pig individuals in different sites within Mt. Kitanglad Range Natural Park (MKRNP) in Bukidnon, Philippines, potentially caused by the African swine fever virus (ASFV). This paper highlights the urgent need to enhance biorisk management among protected landscapes across the country.

Keywords: Biorisk, Philippine warty pig, African swine fever, Mt. Kitanglad, Philippines

INTRODUCTION

Philippine warty pig *Sus philippensis* Nehring, 1886, locally known as “*Baboy Ihalas*,” is one of the four wild pig species endemic to the Philippine archipelago. It is a Vulnerable species based on the assessment of the International Union for the Conservation of Nature (IUCN) and the Philippine Red List Committee (PRLC) (Heaney & Meijaard, 2017; DENR-BMB, 2020). Two subspecies are presently known: *S. (p.) philippensis* Nehring, 1886 in Luzon, and *S. (p.) mindanensis* Forsyth Major, 1897 in Mindanao.

Wild populations of the *S. philippensis* have been continuously challenged by forest loss, habitat fragmentation, and hunting. In the Philippines, local and indigenous communities continue to hunt the warty pig for its bushmeat (Tanalgo, 2017; Villegas et al., 2022). Luskin et al. (2020) also reported that along with other endemic wild pigs in Southeast Asia, *S. philippensis* is threatened by African Swine Fever (ASF). The study by Chavez et al. (2021) provided scientific evidence of mass mortality of the *S. philippensis* population suspected to be caused by the said reemerging infectious disease. There is deficient scientific data on parasites and diseases affecting *S. philippensis* (Melletti & Meijaard, 2017). Disease management is often undefined, especially for the species in the wild.

Moreover, gaps in implementing a biorisk management plan for protected areas threaten susceptible species. Biorisk management should detail biosafety and biosecurity protocols (Destura et al., 2021). While used interchangeably, biosafety refers to containment protocols that prevent accidental exposure to disease-causing organisms. On the other hand, biosecurity is concerned with the

systems to prevent the transmission of pathogens to flora and fauna (Beeckman & Rüdelsheim, 2020). Disease management is critical to biodiversity conservation, especially concerning threatened wildlife such as *S. philippensis*.

The Mt. Kitanglad Range Natural Park (MKRNP) covers 47,270 ha of land in the Province of Bukidnon, Northern Mindanao, Philippines. It is home to rare and endemic species, which makes it a conservation priority under Republic Act 8978, further expounded through its inscription as an ASEAN Heritage Park in 2009 (DENR, 2015). Heaney et al. (2006) confirmed the presence of *S. philippensis* within the protected landscape. As a biological sanctuary, fauna and flora monitoring in the MKRNP is governed by a Protected Area Management Board (PAMB) through the Protected Area Management Office (PAMO).

This paper reports the unusual mortality incidence of seven *S. philippensis* individuals within the vicinity of Mt. Kitanglad Range Natural Park, Bukidnon, Philippines. It is suspected that the cause of death is African Swine Fever (ASF), which has been previously reported in nearby provinces. The goal is to provide a baseline for the institutionalization of biorisk management to safeguard and prevent the extirpation of local warty pig populations in the country.

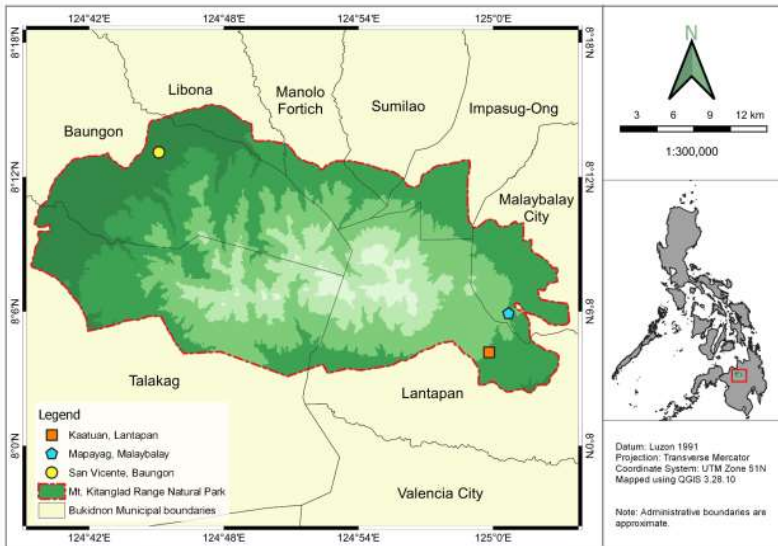
OBJECTIVES OF THE STUDY

This study aimed to a) provide a report on the unusual mortality of Philippine warty pig *Sus philippensis* Nehring, 1886, individuals in the Mt. Kitanglad Range Natural Park (MKRNP); and b) discuss the need for institutionalized biorisk management toward disease prevention and control in Philippine-protected landscapes.

MATERIALS AND METHODS

Figure 1

Coordinates map of the Mt. Kitanglad Range Natural Park (MKRNP), Bukidnon Province, Philippines



The data used in this paper are based on the official reports of the Protected Area Management Office (PAMO) of the Mt. Kitanglad Range Natural Park (MKRNP), a protected landscape in Bukidnon, Mindanao Island, Philippines. The park is home to diverse wild flora and fauna, including the Vulnerable Philippine warty pig (*Sus philippensis*), which is endemic to the Philippines. Observations were made in three areas within MKRNP: Kaatuan, Mapayag, and San Vicente.

The Kitanglad Guard Volunteers (KGV) play a crucial role in monitoring the conservation of the protected landscape. Through regular foot patrolling in coordination with the PAMO, they document the status of flora and fauna and report any potential environmental threats. Their reports are then shared with the relevant agencies for necessary action. In this paper, the KGV documented the unusual mortality of warty pigs within the MKRNP. The KGV, comprised of dedicated and trained volunteers, are recognized as “environmental heroes” for their selfless commitment to safeguarding the park’s natural resources and biodiversity.

A comprehensive review of the literature in the current research allows for a thorough grasp of the historical context and gaps in implementing biorisk management in the Philippines. This review presents comparative studies with other regions affected by ASF to provide a broader context and identify successful practices that could be adopted in the Philippine context. It also allows the integration of a holistic view of potential threats, including environmental and anthropogenic factors that could contribute to wild pig mortality.

Such data is often utilized for sound management, protection, and conservation decisions in partnership with non-government organizations (NGOs) and academic institutions, among other relevant agencies. The PAMO regularly collaborates with these organizations to develop policies and programs to manage and conserve the park's natural resources and wildlife. The data collected by the KGV is an important tool in making informed decisions about the park's management and conservation.

Meanwhile, the Provincial Veterinary Office of Bukidnon analyzed samples of the dead warty pig individuals to determine the cause of the mortality. However, the African Swine Fever Virus (ASFV) could not be confirmed due to the conditions of the samples. ASF is a highly contagious viral disease that affects domestic and wild pigs, and its presence in the park could have serious ecological consequences. Therefore, the PAMO and its partners continue to monitor the park's wildlife and take necessary measures to prevent the spread of the disease.

Ethics

The information presented and published in this paper has been obtained with the consent of the Protected Area Management Office (PAMO) of the Mt. Kitanglad Range Natural Park (MKRNP). PAMO is a government agency responsible for managing and protecting the natural resources and biodiversity of the MKRNP, a protected area in the province of Bukidnon, Philippines. The consent provided by PAMO ensures that the information in this paper has been collected in compliance with the regulations and policies governing the use of data from the MKRNP.

RESULTS AND DISCUSSIONS

Figure 2

*Photos of dead individuals of Philippine warty pig *Sus philippensis* Nehring, 1886, in the Mt. Kitanglad Range Natural Park, Bukidnon, Philippines*



The Kitanglad Guard Volunteers (KGV) documented the unusual mortality of seven *S. philippensis* individuals within the Mt. Kitanglad Range Natural Park (MKNRP), a protected landscape through RA 8978, otherwise known as the “Mt. Kitanglad Range Protected Area Act of 2000.” The first incident was reported on September 2022 in Barangay Kaatuan, Lantapan, Bukidnon (8.069603, 124.997127), where three dead warty pigs were recovered (Figure 2B). Another two dead individuals were found in Barangay San Vicente, Baungon (Figure 2C). In November 2022, another two warty pigs were found dead in Barangay Mapayag, Malaybalay City (8.098408, 125.011483) (Figure 2A).

Although the Provincial Veterinary Office reported no confirmation of African Swine Fever (ASF) in the province of Bukidnon, an unusual mortality of *S. philippensis* is a legitimate concern. It is a significant indicator of insufficient biorisk management, especially within a protected landscape. Villegas et al. (2022) reported ASF as one of the conservation threats against the dwindling *S. philippensis* populations. Luskin et al. (2023) recommended implementing of succinct measures to prevent the spread of ASF. The same was elaborated by Chavez et al. (2021), where *S. philippensis* mortality was also documented in

Tagum City, Davao del Norte, suspected to be infected with ASF.

ASF is a contagious viral disease affecting domestic and wild pig populations. Although it has no known adverse effect on humans, ASF poses a 100% mortality risk to pigs, thus impacting the swine industry. Wedzerai (2022) reported that the viral disease caused livelihood disruption and led to the closure of pig farms without sufficient biorisk management in the Philippines. Spatio-temporal analysis showed ASF outbreaks in the country were concentrated from August to October in the Northern island of Luzon (Hsu et al., 2023). Outbreaks in Vietnam in 2019 resulted in the death of approximately 6 million pigs, affecting the pig value chain across the country (Nguyen-Thi et al., 2021). The same was observed in China, where rapid outbreaks have affected the global food supply chain and induced a food crisis (Woonwong et al., 2020).

Transmission of ASF to the wild pig populations is probable, although there is limited scientific evidence at present (Cabanas et al., 2022). Luskin et al. (2020) initially described that the virus affects 11 endemic pigs in Southeast Asia, including the Philippine warty pig (*S. philippensis*), Sunda bearded pig (*S. barbatus barbatus*), Javan warty pig (*S. verrucosus*), Sulawesi babirusa (*Babyrousa celebensis*), Hairy babirusa (*B. babyrussa*), Togian babirusa (*B. togeanensis*), Sulawesi warty pig (*S. celebensis*), Visayan warty pig (*S. cebifrons*), Palawan bearded pig (*S. ahoenobarbus*), Mindoro warty pig (*S. oliveri*), and Pygmy hog (*Porcula salvania*). Of these species, only two are not threatened, while the rest are either Vulnerable or Critically Endangered. This adds to the anthropogenic and environmental threats against *S. philippensis*, further contributing to the decline in its population (Villegas et al., 2023). ASF presents a risk of extinction for rare endemic pigs and a potential domino effect on rare carnivores (FAO, EU, & WOA, 2022).

In response, the Protected Area Management Office (PAMO) staff were trained as Protected Area Biosafety Officers by the Bukidnon Provincial Veterinary Office to monitor similar cases within the MKRNP, including in the proximal Mt. Kalatungan Range Natural Park (MKaRNP). This is a critical step to capacitate biosafety and biosecurity personnel with a crucial role in preventing other unusual mortality or disease outbreaks, not only for *S. philippensis* but also for other wildlife species. The lack of professional biorisk officers is emphasized in this situation, as discussed by Destura et al. (2021).

The Philippines has been a pioneer in the Southeast Asian region in terms of biosafety guidelines, having promulgated its National Biosafety Guidelines as early as 1991. However, despite this early initiative, significant gaps in implementing the guidelines still need to be addressed. A study by Destura et

al. (2021) revealed inefficiencies in implementing and monitoring established biosafety and biosecurity protocols. The study further emphasized critical gaps in biorisk management, including a limited understanding of biosafety and biosecurity, no integration of disaster risk reduction and management (DRRM) principles, limited institutional capacity, lack of robust regulatory systems, and inefficient coordination mechanisms at the local level. This highlights the need for more dedicated efforts, especially aimed at a comprehensive review of the gaps, challenges, and future directions in biorisk management in the country.

The isolation of protected areas from other suitable pig habitats provides a natural barrier to transmitting ASF due to the restricted movements of wild pigs. However, human entry introduces biorisk into these landscapes without biosafety and biosecurity protocols. In the wild, Guberti and Masuilis (2019) proposed that ASF detection should start with the first documentation of dead pigs. An active search for carcasses should follow to identify the geographic extent of the disease, thus allowing the designation of infected areas. Proper disposal of the carcasses must also be observed to prevent the further spread of ASF. Confirmatory tests must be done to detect the presence of the ASF virus in the recovered carcasses, ultimately determining the next critical steps for disease management.

There is still much work to protect biodiversity and ecosystems. Despite the high risk of species decimation, biorisk management in protected landscapes remains a developmental need, which is an urgent concern. It is imperative to prioritize the protection of these landscapes to avoid the loss of critical species and their habitats. In South Korea, the African Swine Fever (ASF) outbreak has been a significant challenge in managing wild pig populations. Despite efforts such as fencing and depopulation, a study by Lim et al. (2023) revealed that ASF management remains extra challenging. In Vietnam, it was documented that higher levels of biosecurity with modern technology reduced the risk of ASF transmission (Nguyen-Thi et al., 2021). The findings of Wang et al. (2023) specified technical capacity, farm size, income, production systems, and government inspections as indicators of pig farm biosafety in China. It is important to continue exploring systems and practices in other countries that can be employed in the Philippines.

Reemerging infectious diseases urge the institution of biorisk management for protected areas to safeguard wildlife populations. While this study discusses ASF, other diseases are also prevalent, such as the avian influenza virus that poses severe threats to wild bird populations, especially the Critically Endangered Philippine Eagle (*Pithecophaga jefferyi*) (Blagodatski et al., 2021; Mayuga, 2023). In response, the Philippine Eagle Center (PEC) established an isolated National

Bird Breeding Sanctuary (NBBS) in Barangay Eden, Toril, Davao City, to deter disease transmission to the National Bird. The same concern is applicable among bat populations, leading to the establishment of biosafety protocols to prevent the human-to-bat transmission of COVID-19 (Cox-Witton et al., 2021). Destura et al. (2021) proposed biological risk response, rehabilitation, mitigation, and preparedness protocols. This includes establishing protocols and regulations, capacity building, education, knowledge management, risk communication, research and innovation, monitoring and evaluation, and financial sustainability.

CONCLUSIONS

The Philippine warty pig (*Sus philippensis* Nehring, 1886) is facing a severe threat from an infectious disease known as African Swine Fever (ASF), which has the potential to decimate wild populations. This paper documents the unusual deaths of seven warty pig individuals within the Mt. Kitanglad Range Natural Park (MKRNP) located on Mindanao Island, Philippines. It is suspected that ASF may have caused these deaths, although it cannot be confirmed at present. This is a cause for concern as the loss of a few warty pig individuals can significantly impact the population's conservation status and long-term survival. Diseases are prevalent threats, even to species inhabiting protected landscapes, especially if no biorisk management plan exists. Further monitoring needs to be undertaken to detect possible ASF infection and additional mortalities nearby. The MKRNP needs to implement stricter biorisk protocols and regular disease surveillance. This case highlights an urgent need to improve biorisk management in protected landscapes to prevent and control the spread of diseases across the country.

RECOMMENDATIONS

In the case of MKRNP, urgent needs must be addressed, such as comprehensive and regular disease surveillance, especially concerning ASF. A trained biorisk management team must be deployed to accomplish this task. Visitors must be strictly screened to reduce the risk of contamination and disease transmission. This strategy may include but is not limited to, prohibiting the consumption of pork products and derivatives within the natural park. A thorough cleaning and disinfection should also be implemented before and after a visit to the natural park. The participation of the local and Indigenous Peoples provides an advantage as they are familiar with the forest landscape. Local information dissemination and awareness campaigns must be strategized to gain public participation in the

combat to protect local warty pig populations against ASF.

The threat of reemerging infectious diseases on biodiversity conservation cannot be overemphasized, particularly in protected areas primarily mandated to safeguard, preserve, and manage wildlife. As such, it has become imperative to establish biorisk management to protect these landscapes. A multi-stakeholder collaboration that involves the Department of Environment and Natural Resources (DENR), Department of Agriculture (DA), and other relevant government agencies, academic institutions, non-government organizations (NGOs), and private institutions to develop and promulgate guidelines that would effectively address this issue. The guidelines must be comprehensive, address all potential risks, and be strictly adhered to pursue wildlife conservation and management.

The top priority is the development of specific action plans and protocols for biorisk management. These include provisions on regular screening procedures, visitor management, and emergency response strategies for ASF and other disease outbreaks. Public participation must also be emphasized, involving local and Indigenous communities in monitoring and conservation efforts. While this is already undertaken in the studied protected areas, disease prevention, and management capacity-building efforts should be added to upskill forest guards and volunteers. Technological infusion, particularly remote sensing and Geographic Information Systems (GIS) mapping, enhances monitoring efforts and provides real-time data on wildlife health and mortality incidents.

For future studies, there is a need to employ ASF detection and confirmation to strengthen the findings. They should aim to thoroughly examine the mortality cases and ensure more rigorous collection and preservation of samples for disease confirmation. Longitudinal studies may also be employed to monitor the health of the warty pig populations over time. This would provide more robust data and help establish more evident links between ASF and mortality rates. Lastly, disease surveillance in other protected areas must be scientifically reported to enable the government and other concerned agencies to develop national intervention plans and policies.

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