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Mapping Multiple Wild Pig Species' Population Dynamics in Southeast Asia During the African Swine Fever Outbreak (2018–2024)

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ABSTRACT

The 2018 arrival of African swine fever (ASF) in China was followed by reports of wild pig deaths across most countries in Southeast Asia. However, the magnitude and duration of population-level impacts of ASF on wild pig species remain unclear. To elucidate the spatiotemporal spread of ASF in the region for native pig species, we gathered qualitative information on wild pig population dynamics in Southeast Asia between 2018 and 2024 from 88 expert elicitation questionnaires representing sites in 11 countries. Peak reported population declines occurred in 2021 and 2022, with more than half of respondents reporting declining wild pig populations, far higher than in earlier years. The reported declines waned to 44.23% in 2024, whereas simultaneously, the number of populations reported to be "increasing" increased from 11.3%–13.2% in 2019–2022 to 28.9% in 2024. These reports suggest that the ASF outbreak may have peaked for wild boars and bearded pigs in mainland Southeast Asia, Borneo, and Sumatra, with some subsequent recovery. However, the disease is still expanding into the ranges of island endemic species, such as new reports for the

Sulawesi warty pig (*Sus celebensis*) in September of 2024. Island endemics remain particularly vulnerable to extinction from ASF and require urgent monitoring and conservation action.

1 | Introduction

African swine fever (ASF) is a contagious viral hemorrhagic disease affecting members of the family Suidae (pigs, hogs, boars, and babirusa) (Daniel et al. 2024). The disease causes high mortality in most Suidae species, with significant potential for transboundary spread. ASF originated and remains widespread in Africa but is currently also present in Europe, Asia-Pacific, and one island in the Caribbean (Yu et al. 2023). There has been significant research on ASF, its impacts, spread, and mitigation methods in Europe over the last two decades (Guinat et al. 2016; Sauter-Louis et al. 2021; European Food Safety Authority 2024).

ASF arrived in Asia in 2018, via the Chinese domestic pork industry, causing near-100% fatality in farmed pigs (Normile 2019, Luskin et al.2021). This was followed by confirmed ASF deaths in domestic and wild pigs in 2019 and 2020 in 10 Southeast Asian countries (Luskin et al. 2021; FAO 2024). The most widespread ASF reporting is done by the World Animal Health Information System (WAHIS) and the FAO's EMPRESS-AH reporting system (WAHIS 2023; FAO 2021). Both data-sharing resources have limitations; WAHIS collates presence-only reports of ASF cases, not the effects on pig populations, and reports include cases from mainlands and large islands, with less detail for more remote areas. The FAO dataset compiles information from WAHIS and national reporting systems, but all data sources focus more on domestic pigs than wild populations and are spotty for Southeast Asia. Thus, there is a gap in knowledge about the spread of ASF in Asian wild pigs, especially relative to domestic pigs.

There have been isolated reports of the disease decimating native wild populations of wild boar (*Sus scrofa*) and bearded pig (*Sus barbatus*) from 2020 to 2023 in Peninsular Malaysia and Borneo (Ewers et al. 2021; Luskin et al. 2023; Meijaard et al. 2024). Namely, the Pasoh Forest Reserve, a long-term wild boar monitoring site in Peninsular Malaysia, revealed that the arrival of ASF was associated with a 100-fold increase in mortality and an 87% decline in pig activity on camera traps from May to July 2022 (Luskin et al. 2023). There have been few other reports about the population dynamics for these species in other areas—or for the 10 other endemic wild pig species in the region. However, it is expected that there are significant challenges with managing this disease in tropical Asia due to smallholder farm practices with limited disease awareness and biosecurity, lack of available vaccinations, and the spread of disease via humans (e.g., regulated and unregulated transport of pigs and pig products; Luskin et al. 2021; Daniel et al. 2024). Low biosecurity measures, anthropogenic effects like waste management, and the movement ecology of Suidae were all identified as risk factors in studies of the spread of ASF in Europe (Salazar et al. 2022; Chenais et al. 2019; Sauter-Louis et al. 2021). The lack of information on ASF impacts on populations limits pig conservation efforts, disease control efforts, pig husbandry interventions for local livelihoods, and inferences about the cascading ecological impacts such as for apex carnivores, which depend on pigs as a key prey resource (Wolf and Ripple 2016; Luskin et al. 2021; Luskin et al. 2023).

Here, we map Asian wild pig population dynamics from 2018 to 2024 to make inferences about where and when ASF has likely caused significant mortality and where there is evidence of recovery. There is an urgent need for updates on the ASF outbreak because it has rapidly swept through most of Asia over the last 5 years (Luskin et al. 2021; WAHIS 2023; Meijaard et al. 2024). Time-sensitive, scientific queries are often mismatched with the slow and expensive process of fieldwork, data collection, and negotiating data territoriality and difficulties in coordination among investigators. To overcome these hurdles, we introduce a rapid expert elicitation approach to assess the spatiotemporal spread of ASF in Southeast Asia by developing a network of experts to provide local insights at the site level quickly. We tested if a temporal or spatial pattern of disease spread dynamics could be detected for this expert elicitation.

2 | Methods

2.1 | Study System

We defined our study area broadly as tropical regions east of Assam in India (>93°E longitude) and including the countries of Brunei, Cambodia, China (Yunnan province only), India (Assam state only), Indonesia, Laos, Malaysia, Myanmar, Papua New Guinea, the Philippines, Singapore, Thailand, and Vietnam.

There are 12 native endemic wild pigs in our study region, of which only the wild boar (*S. scrofa*) has portions of its range where it is not endemic. We sought information on the bearded pig (*S. barbatus barbatus, S. barbatus oi*), the Javan warty pig (*Sus verrucosus*), the Palawan bearded pig *(Sus ahoenobarbus*), Sulawesi babirusa (*Babyrousa celebensis*), the hairy babirusa (*Babyrousa babyrussa*), the Togian babirusa *(Babyrousa togeanensis*), the Sulawesi warty pig (*Sus celebensis*), Visayan warty pig (*Sus cebifrons*), Philippine warty pig (*Sus philippensis*), Mindoro warty pig (*Sus oliveri*), and the Pygmy hog (*Porcula salvania*).

2.2 | Surveying Experts

Our objective was to use expert elicitation to map region-wide spatiotemporal dynamics of ASF impacts in wild pig populations. Expert elicitation has proven an effective tool for conservation applications (Macdonald et al. 2018; Runting et al. 2019). We circulated an online survey (Figure S2) from June to September 2024 to wildlife ecologists working in the study region. We reached over 250 potential participant experts through a regional listserv (an optional email group for sharing and receiving messages en masse, in this case for a professional ecological audience) for Southeast Asian wildlife ecologists, coauthors of Mendes et al.

2024 (a Southeast Asia wide camera trapping survey), and the IUCN Red List Suidae Specialist Group. We asked initial contacts to forward the request to colleagues with the necessary experience and relevant observations.

We asked participants about their local knowledge and impressions of wild pigs at field sites where they have knowledge and experience during 2018–2024, covering the period before, during, and after the known ASF outbreak in the region. Specific questions included the location of field sites (respondents drew a polygon around their site), experts' experience at the site, their impressions of wild pig populations in each year from 2018 to 2024, and the underlying data or reason for their observations (e.g., camera trapping, interviews with field assistants at the locations). The survey was conducted using Survey123 (Esri 2024).

2.3 | Data Processing and Mapping

Survey responses regarding the perceived trajectory of wild pig populations during the period of ASF spread were coded for the three possible single-choice answers: declining populations, stable populations, or recovering populations (Figure S3). Respondents could also answer "I don't know" for any year that they could not provide a perceived trend in population. Data outside the spatial scope of the study (outside of the fourteen countries listed) were removed, as were entries that reported "I don't know" for all years. For some entries, we contacted the respondent to clarify responses, and some data were amended on the basis of these follow-up discussions.

Respondents' study site polygons (self-reported) were converted to centroid points to avoid spatial bias between responses because there was high variability in the specificity of drawn polygons. From this point vector layer, we generated an Inverse Distance Weighted (IDW) interpolation with QGIS version 3.36.3 (QGIS.org 2024) for each year from the survey. IDW was chosen because it is comparatively robust when there are limited data points, allowing it to be applied in scenarios where disease case data are sparse. The IDW resulted in a raster map estimating the approximate conditions of pig populations based on expert perception.

3 | Results

Our survey resulted in 88 responses from 62 respondents after data were excluded for not meeting study criteria (Figure S1a). Responses came from 11 different countries (Myanmar, China, India, Malaysia, Thailand, Laos, Cambodia, Vietnam, Indonesia, Brunei, and the Philippines) (Table 1; Figure 1 and Figure S1a) representing 78 sites. They included 9 of the 12 native pig species (Table 2). However, there were relatively few responses from key areas with endemic pigs, including Java, Sulawesi, most of the Philippines, and small island areas (Table 2). Camera trap data were reported to have been involved in the assessments for 78.6% of responses.

For the overall trend that combines all regions and all species, the peak in reported population declines occurred in 2022. In 2021 and 2022, 53% and 54.4% of respondents reported "declining or abnormally low" wild pig populations at their sites, respectively. This was up from 20.8% and 32.3% in 2019 and 2020 to 15.1% in 2018 (Figure 2a). The reported number of populations reported to be "increasing or abnormally high" increased from 11.3%–13.2% in 2019–2022 to 28.9% in 2024 (Figure 2b,d). These latter reports suggest that the ASF outbreak may have peaked in some areas of mainland SEA, Sumatra, and Borneo from 2021 to 2023 and that many populations there are now recovering.

Importantly, the disease still appears to be impacting and expanding into the ranges of the rarer island endemic pig species, such as the Sulawesi warty pig (*S. celebensis*) in September of 2024, whose first report of declining populations due to disease occurred in August 2024 (Figure 2e). There were no observations for the Javan warty pig (*S. verrucosus*), the Palawan bearded pig (*S. ahoenobarbus*), or the hairy babirusa (*B. babyrussa*).

4 | Discussion

At the onset of the ASF outbreak, it was considered that the mass mortality of multiple endemic wild pig species in Asia was a catastrophic conservation threat and likely driving a dramatic reorganization of forest ecology (Luskin et al. 2023). The trend over time of responses to our survey suggests that ASF outbreak may have peaked in populations of wild boar and Bornean bearded pig in mainland SEA, Sumatra, and Borneo from 2021 to 2023 and that they may now be recovering; future peaks may be imminent for more remote and less monitored populations. All but two species (*S. scrofa*, *S. barbatus*) were significantly data-lacking, and three species were not represented in any survey responses (*S. ahoenobarbus, S. verrucosus, B. babyrussa)*. These insights from more data-rich areas of Southeast Asia evidence the devastating impacts of ASF on pig populations, highlighting the importance of monitoring, prevention, and mitigation for less studied island endemics, which are relatively data deficient and inherently more vulnerable to disease outbreaks. Our results also indicate that ASF can peak and dissipate in these areas, and wild pig populations have the potential to rebound, even after major declines.

Although some areas such as Borneo and Peninsular Malaysia were hit by ASF intensively and early and appear to now be experiencing early recovery (Figure 2b,d), more isolated islands may only recently be moving into an intensive period of ASF infection driving down populations.

Respondents reported some areas in Vietnam to already be defaunated prior to and during the survey timeline. They attributed lowered *S. scrofa* abundance not only to ASF, but more widely due to pervasive hunting. The sites reported in the survey for Vietnam have suffered from sustained and intense hunting (Tilker et al. 2020; Mahmood et al. 2021), whereas further west in the region hunting has been ramping up more recently (e.g., in Cambodia). In other areas with less hunting, the patterns of decline and recovery over time align with the known spread of ASF (FAO 2024; WAHIS 2023).

TABLE 1 | Sample sizes per species and region.

Species	Borneo	Asian mainland and Thailand	Peninsular Malaysia[a] and Sumatra	Other islands
Sus barbatus	34	0	2	0
Sus scrofa	0	25	12	3
Other	0	3	0	11

Note: Count reflects the number of survey responses related to a species, in a particular region.
[a]Including Singapore.

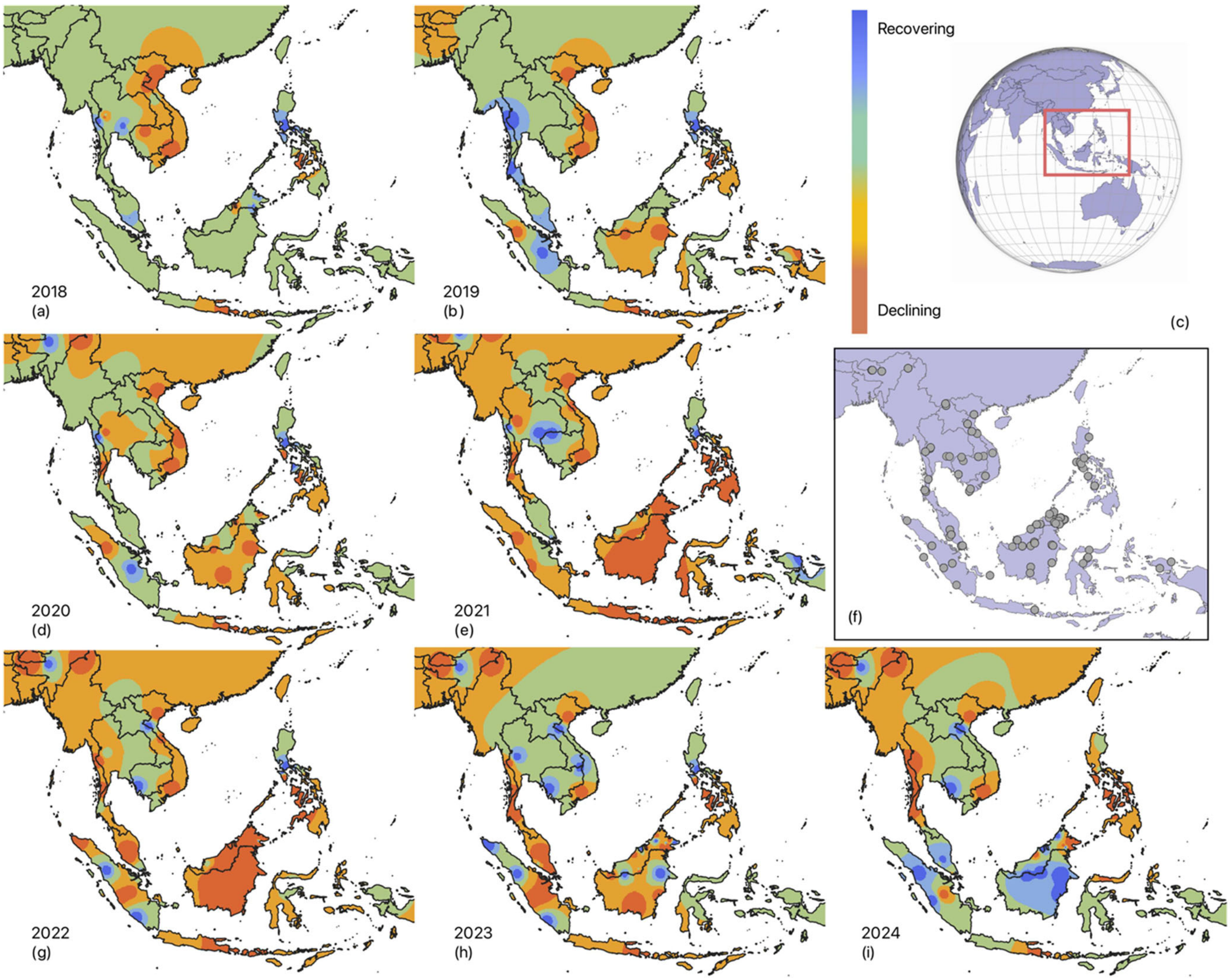

FIGURE 1 | Map of perceived pig population trends over the period of ASF spread in Southeast Asia (2018–2024; a, b, d, e, g, h, i, respectively). Red indicates areas where experts perceive declining pig populations, and blue indicates perceived increasing populations. Panel (f) shows locations where responses were given, panel c is a locator globe.

4.1 | Ecological Implications

The unchecked spread of ASF poses an existential threat to the long-term survival of Suidae species, which in turn risks destabilizing the ecosystems where they exist. Asian wild pigs play key roles in maintaining ecosystem functions, including seed predation and dispersal (Curran and Webb 2000), trophic and non-trophic herbivory (Luskin et al. 2017, 2019; Luskin, Johnson et al. 2021), soil turnover, and as prey for apex predators (Wolf and Ripple 2016). They are often considered ecosystem engineers. Throughout Southeast Asia, *S. scrofa* is one of the most important prey species for tiger (*Panthera tigris*) and, equally threatened in the region, leopard (*Panthera pardus*). The implications of rapid population collapse of wild pigs in key tiger landscapes may

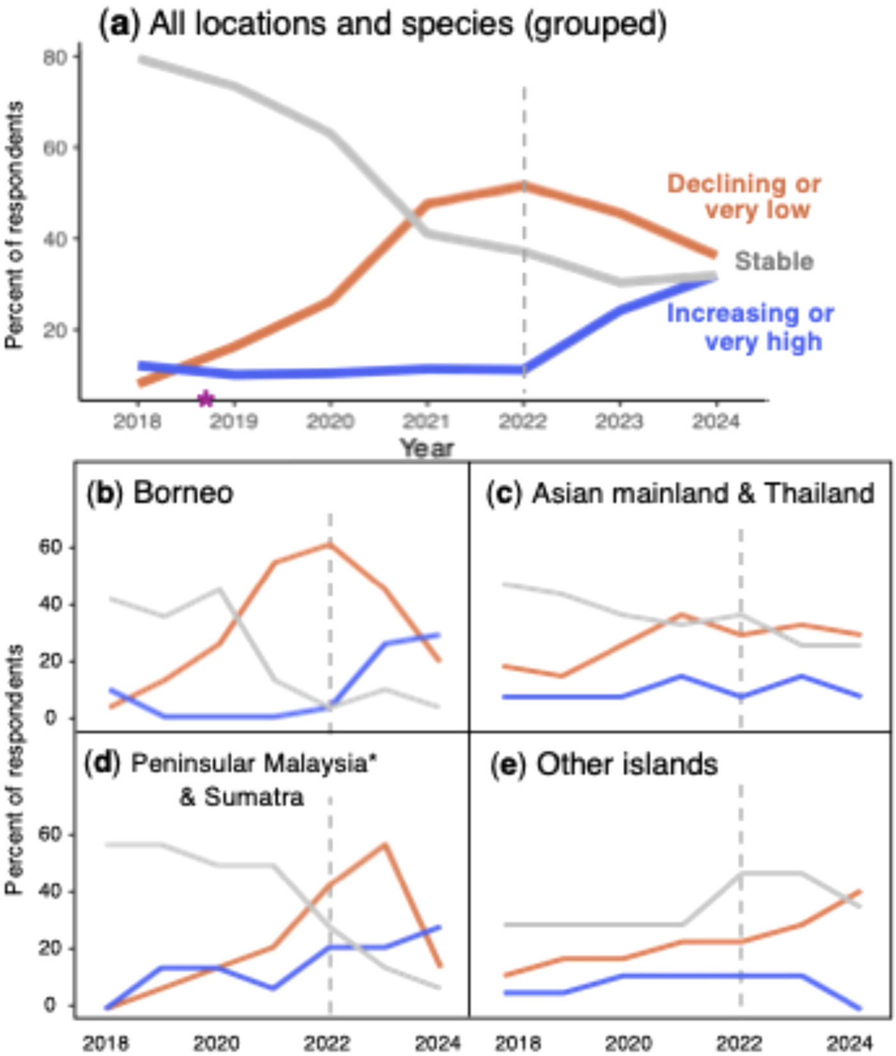

FIGURE 2 | Reported wild pig population trends through time for all locations and species (a) and specific subregions (b–e). The dashed line shows peak reports of pig declines across the whole region (panel a, orange line in 2022) and has been included on all panels for interpretation of the local disease outbreak dynamics relative to the regional trends. The pink asterisk represents the first ASF case in wild pigs in China in late 2018. The rising blue line may suggest some recent recovery of pig populations from ASF in particular areas.

TABLE 2 | Sample sizes per species.

Species	Responses
Sus scrofa	40
Sus barbatus	36
Porcula salvania	3
Sus philippensis	2
Babyrousa togeanensis	2
Babyrousa celebensis	1
Sus cebifrons	1
Sus celebensis	1
Sus oliveri	1

be substantial on these top carnivores and may impact ongoing recovery and tiger conservation efforts. Prey switching away from wild pigs could increase threats to more vulnerable prey species and increase conflicts with people, such as through intensified livestock predation.

There are also ecological factors unique to Southeast Asia that may influence the spread of ASF, yet these remain largely unexplored, namely, the long-distance nomadic movements of bearded pigs in Peninsular Malaysia, Sumatra, and Borneo in response to the sporadic general flowering and mast fruiting events (Curran and Leighton 2000, Hancock et al. 2005; Luskin and Ke 2017, Ke and Luskin 2019). There may be time for infected bearded pigs to move considerable distances because ASF has an incubation period of 4–15 days (Beltrán-Alcrudo et al. 2017). Even sick pigs that are not moving could be encountered by healthy individuals moving through an area.

4.2 | Socioeconomic and Other Implications

Endangered predators are not the only species with their food sources at risk with declining pig populations. Respondents in

Indonesian Borneo, Malaysian Borneo, and Sulawesi reported that the decline in wild pig populations has affected human food security in rural areas and is leading hunters to target other game species that are mostly slower reproducing, with significant cascading ecological implications, further affecting species interactions, ecosystem functioning, and biodiversity. A survey conducted in rural Kalimantan found that the declining availability of bearded pig meat led to a doubling of its price since 2020. Up to 76% of these respondents perceived bearded pigs to have declined in the forest in the last 3 years (Spencer et al. Under review).

4.3 | Recommendations

We acknowledge this rapid expert response mapping approach should be considered preliminary and is not necessarily as robust as direct observation (e.g., using the actual detection rates from cameras, which are not yet available). Incomplete sampling of experts in the region and bias in personal observations limit the conclusions we can draw from this rapid qualitative form of data collection. Nonetheless, most of our respondents reported camera traps informed their opinions, providing more confidence in the results presented here.

These results may be sufficient to guide the research community towards increased data collection and disease management in areas where peak impacts have not yet been reached (i.e., Sulawesi and nearby islands) and at-risk populations are under-monitored. For example, there are no official records of ASF infection in the endemic Mindoro warty pig population; WAHIS (2023) only includes ASF reports of domestic pigs, even though partner agencies and local indigenous people report sudden and unexplainable death of the wild Mindoro warty pig (*S. oliveri*) in at least one area on the island which may be ASF-related. Our results sufficiently demonstrate that some areas believed to be most impacted by ASF (such as Borneo) show signs of recovery in 2024.

Our survey indicates that many of the IUCN Red List Vulnerable and Endangered pig species are lacking in observations, including *P. salvania, Babyrousa toeanensis*, and *S. cebifrons*, compared to their Least Concern confamilial, *S. scrofa*. Localized reports represent important examples of ASF's impact on endemic and island-isolated populations, such as the mass die-off of *S. philippensis* in Mindanao, the Philippines in 2021, with over 140 fatalities in a month (Chavez et al. 2021); many die-offs such as this are likely to occur without observation. Although disease trends for common Suidae may provide valuable transfer knowledge to rarer species, improving observations and data availability of more vulnerable species remains essential.

ASF mitigation strategies have been limited and largely ineffective thus far. An ASF epidemiological model for Singapore suggests that although active carcass removal and decontamination efforts could not control the spread, speed, or severity of the ASF outbreak in wild boars, prompt removal of carcasses could shorten the epidemic's duration and reduce recurring infections caused by carcass-mediated transmission (Lim et al. 2024). Educating communities on the safe handling and disposal of infected carcasses is crucial to prevent such contamination. We defer to the prior work done on ASF mitigation strategies (Luskin et al. 2021; Ewers et al. 2021; Meijaard et al. 2024); rather than adding to their recommendations, our work serves to emphasize that these methods and enhanced monitoring should be implemented to prevent further ecological and societal damage due to the spread of this disease. Further, information about the effectiveness of various prevention measures is sorely needed, especially comparing high-risk areas that have or have not received mitigation efforts.

Simulation studies of ASF spread in Southeast Asia are also needed, such as that conducted by Salazar et al. (2022) in Europe. Yet, these models require more observations on pig demographics, their movements, and their ASF infection status than are currently available in the region. Several efforts are being made to gather and publicize consistent, current data about the spread of ASF, including datasets published by organizations such as WAHIS and the FAO (WAHIS 2023; FAO 2021). Projects focused on wild pig populations at the citizen science scale, such as the Babi Hutan Project, are also critically important approaches to pursue (Daniel et al. 2024). These sources should be leveraged along with pig ecology studies.

The expert survey also suggests some tentative optimism about the recovery of some affected Southeast Asian pig species. Even in areas with a major ASF outbreak, such as in Borneo where *S. barbatus* populations were widely reported to be in decline or have no detections in some early-peaking sites from 2021 to 2023, these species appear to persist and be recovering. Although much remains to be understood about ASF dynamics in Asia, the resilience of some native wild pigs bodes well for the resilience ecosystems they inhabit and shape.

5 | Limitations

We acknowledge the inherent biases in qualitative data or regional response gaps and limitations associated with only distributing the survey in English. We prioritized producing a rapid update at a regional scale rather than new fieldwork at particular sites, which is more time-consuming and less geographically representative. We note that there is a proposed project to leverage existing trapping among our respondents for a more quantitative assessment of population trends, but this is not anticipated to finish for more than 12 months.

Our methodology also demonstrates shortcomings in rapid reporting methods. Follow-up work could improve on our approach by closer collaboration with non-English-speaking organizations to facilitate survey collection in multiple languages and make it more feasible for non-academic respondents to participate. Future work should also attempt to quantify the effectiveness of preventative and mitigation methods, such as those conducted in Europe (Sauter-Louis et al. 2021; European Food Safety Authority et al. 2024). Finally, strict data-sharing regulations inhibited information flows for key species and areas, and thus, international agreements toward open data policies for disease tracking should be a priority.

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Ethics Statement

We obtained permission to conduct the survey from the University of Queensland (document ID: 2024/HE001984).

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

References

Beltrán-Alcrudo, D., M. Arias, C. Gallardo, S. Kramer, and M. L. Penrith. 2017. *African Swine Fever: Detection and Diagnosis—A Manual for Veterinarians. FAO Animal Production and Health Manual No. 19*. Food and Agriculture Organization of the United Nations (FAO).

Chavez, J. B., H. D. Morris, G. L. SuanMoring, L. E. D. Gamalo, and E. A. LasticaTernur. 2021. "Suspected African Swine Fever (ASF) Mass Die-Offs of Philippine Warty Pigs (*Sus philippensis*) in Tagum City, Mindanao, Philippines." *Suiform Soundings* 20, no. 1: 811.

Chenais, E., K. Depner, V. Guberti, K. Dietze, A. Viltrop, and K. Ståhl. 2019. "Epidemiological Considerations on African Swine Fever in Europe 2014–2018." *Porcine Health Management* 5: 6.

Curran, L. M., and M. Leighton. 2000. "Vertebrate Responses to Spatiotemporal Variation in Seed Production of Mast-Fruiting Dipterocarpaceae." *Ecological Monographs* 70, no. 1: 101–128. https://doi.org/10.2307/2657169.

Curran, L. M., and C. O. Webb. 2000. "Experimental Tests of the Spatiotemporal Scale of Seed Predation in Mast-Fruiting Dipterocarpaceae." *Ecology Monograph* 70: 129–148.

Daniel, O. Z., S. P. Heon, C. A. Donnelly, H. Bernard, C. D. L. Orme, and R. M. Ewers. 2024. "Rapid Spread of African Swine Fever Across Borneo." *BioRxiv* 2024–2006.

Esri. 2024. *Survey 123, 3.20*. Esri. https://www.esri.com/en-us/arcgis/products/arcgis-survey123/overview.

European Food Safety Authority (EFSA). 2024. *African Swine Fever*. EFSA. https://www.efsa.europa.eu/en/topics/topic/african-swine-fever.

European Food Safety Authority. A. E. Boklund, K. Ståhl, et al. 2024. "Risk and Protective Factors for ASF in Domestic Pigs and Wild Boar in the EU, and Mitigation Measures for Managing the Disease in Wild Boar." *EFSA Journal* 22: e9095.

Ewers, R. M., S. K. S. S. Nathan, and P. A. K. Lee. 2021. "African Swine Fever Ravaging Borneo's Wild Pigs." *Nature* 593: 37–37.

Food and Agirculture Organization of the United Nations (FAO). 2021. *EMPRES-I + Global Animal Disease Information System*. FAO. https://empres-i.apps.fao.org/general.

Food and Agriculture Organization of the United Nations (FAO). 2024. *African Swine Fever (ASF) Situation Update in Asia & Pacific—African Swine Fever (ASF)*. FAO. https://www.fao.org/animal-health/situation-updates/asf-in-asia-pacific/en.

Guinat, C., S. Gubbins, T. Vergne, J. L. Gonzales, L. Dixon, and D. U. Pfeiffer. 2016. "Experimental Pig-to-Pig Transmission Dynamics for African Swine Fever Virus, Georgia 2007/1 Strain." *Epidemiology and Infection* 144: 25–34.

Hancock, P. A., E. J. Milner-Gulland, and M. J. Keeling. 2005. "An Individual Based Model of Bearded Pig Abundance." *Ecological Modelling* 181: 123–137.

Ke, A., and M. S. Luskin. 2019. "Integrating Disparate Occurrence Reports to Map Data-Poor Species Ranges and Occupancy: A Case Study of the Vulnerable Bearded pigSus Barbatus." *Oryx* 53, 2: 377–387. https://doi.org/10.1017/s0030605317000382.

Lim, R. B. H., Z. P. Heng, K. Ho, et al. 2024. "Modeling Singapore's First African Swine Fever Outbreak in Wild Boar Populations." *Transboundary and Emerging Diseases* 2024: 5546893.

Luskin, M., A. Ke, E. Meijaard, M. Gumal, and K. Kawanishi. 2017. *Sus barbatus (Errata Version Published in 2018). The IUCN Red List of Threatened Species 2017*. IUCN. https://doi.org/10.2305/IUCN.UK.2017-3.RLTS.T41772A44141317.en.

Luskin, M. S., K. Ickes, T. L. Yao, and S. J. Davies. 2019. "Wildlife Differentially Affect Tree and Liana Regeneration in a Tropical Forest: An 18-Year Study of Experimental Terrestrial Defaunation Versus Artificially Abundant Herbivores." *Journal of Applied Ecology* 56: 1379–1388.

Luskin, M. S., D. J. Johnson, K. Ickes, T. L. Yao, and S. J. Davies. 2021. "Wildlife Disturbances as a Source of Conspecific Negative Density-Dependent Mortality in Tropical Trees." *Proceedings of the Royal Society B* 288: 20210001.

Luskin M. S., and A. Ke. 2017. "Bearded Pig *Sus barbatus* (Müller, 1838)." In *Ecology, Conservation and Management of Wild Pigs and Peccaries*, edited by M. Melletti, and E. Meijaard, 175–183. Cambridge University Press.

Luskin, M. S., E. Meijaard, S. Surya, Sheherazade, C. Walzer, and M. Linkie. 2021. "African Swine Fever Threatens Southeast Asia's 11 Endemic Wild Pig Species." *Conservation Letters* 14: e12784.

Luskin, M. S., J. H. Moore, C. P. Mendes, M. B. Nasardin, M. Onuma, and S. J. Davies. 2023. "The Mass Mortality of Asia's Native Pigs Induced by African Swine Fever." *Wildlife Letters* 1: 8–14.

Macdonald, E. A., S. A. Cushman, E. L. Landguth, A. J. Hearn, Y. Malhi, and D. W. Macdonald. 2018. "Simulating Impacts of Rapid Forest Loss on Population Size, Connectivity and Genetic Diversity of Sunda Clouded Leopards (*Neofelis diardi*) in Borneo." *PLoS ONE* 13, no. 9: e0196974.

Mahmood, T., T. T. Vu, A. Campos-Arceiz, et al. 2021. "Historical and Current Distribution Ranges and Loss of Mega-Herbivores and Carnivores of Asia." *Peerj* 9: e10738.

Meijaard, E., A. Erman, M. Ancrenaz, and B. Goossens. 2024. "Pig Virus Imperils Food Security in Borneo." *Science* 383: 267–267.

Mendes, C. P., W. R. Albert, Z. Amir, et al. 2024. "CamTrapAsia: A Dataset of Tropical Forest Vertebrate Communities From 239 Camera Trapping Studies." *Ecology* 105: e4299.

Normile, D. 2019. "Afrcian Swine Fever Marches Across Much of Asia." *Science* 364, no. 6441: 617–618.

QGIS.org. 2024. *QGIS Geographic Information System*. QGIS Association.

Runting, R. K., Ruslandi, B. W. Griscom, et al. 2019. "Larger Gains From Improved Management Over Sparing-Sharing for Tropical Forests." *Nature Sustainability* 2: 53–61.

Salazar, L. G., N. Rose, B. Hayes, et al. 2022. "Effects of Habitat Fragmentation and Hunting Activities on African Swine Fever Dynamics Among Wild Boar Populations." *Preventive Veterinary Medicine* 208: 105750.

Sauter-Louis, C., F. J. Conraths, C. Probst, et al. 2021. "African Swine Fever in Wild Boar in Europe—A Review." *Viruses* 13, no. 9: 1717.

Spencer, K. L., D. J. Ingram, N. B. Anirudh, et al. (Under review). *Wild Meat Consumption in Changing Rural Landscapes of Indonesian Borneo*. People and Nature.

Tilker, A., J. F. Abrams, A. Nguyen, et al. 2020. "Identifying Conservation Priorities in a Defaunated Tropical Biodiversity Hotspot." *Diversity and Distributions* 26: 426–440.

Wolf, C., and W. J. Ripple. 2016. "Prey Depletion as a Threat to the World's Large Carnivores." *Royal Society Open Science* 3: 160252.

World Organisation for Animal Health (WAHIS). 2023. *Animal Disease Events [African Swine Fever]*. WAHIS. https://wahis.woah.org/#/event-management.

Yu, Z., L. Xie, P. Shuai, et al. 2023. "New Perspective on African Swine Fever: A Bibliometrics Study and Visualization Analysis." *Frontiers in Veterinary Science* 10: 1085473. https://doi.org/10.3389/fvets.2023.1085473.

Supporting Information

Additional supporting information can be found online in the Supporting Information section.