

# Pets becoming established in the wild: free-living Vietnamese potbellied pigs in Spain

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## Abstract

*Pets becoming established in the wild: free-living Vietnamese potbellied pigs in Spain.*— Vietnamese potbellied (VPB) pigs (*Sus scrofa*) are a common pet in North America and Europe, but their recent decrease in popularity has increased their abandonment. Our main aim was to identify potential cases of free-living VPB pigs in Spain through an in-depth Google search. We identified 42 cases of free-living VPB pigs distributed throughout the country. The number of free-living VPB pigs reported increased by year but the species abundance still seems to be low. Signs of VPB pig reproduction and possible hybrids between VPB pigs and wild boar or feral pigs have been also reported. Free-living VPB pigs could erode the gene pool of the Spanish wild boar population and exacerbate the damage (e.g. crop damage or spread of diseases) already caused by wild boar. Urgent evaluation and adequate management of wild VPB pig sightings is needed to prevent their establishment in natural habitats.

Key words: Feral pig, Google search, Pet trade, Wild boar.

## Resumen

*Mascotas que se establecen en la naturaleza: cerdos vietnamitas que viven en libertad en España.*— Los cerdos vietnamitas (*Sus scrofa*) son una mascota habitual en Norteamérica y Europa; sin embargo, su popularidad ha disminuido recientemente y esto ha provocado que se abandonen cada vez más. El objetivo principal de este trabajo es identificar casos de cerdos vietnamitas que viven en libertad en España a través de una búsqueda exhaustiva en Google. Se han identificado 42 casos de cerdos vietnamitas que viven en libertad distribuidos por todo el país. El número de casos aumenta cada año, aunque la abundancia de la especie aún parece ser baja. También se han observado indicios de que los cerdos vietnamitas se reproducen en libertad y de posibles híbridos de éstos con jabalíes o cerdos asilvestrados. El hecho de que los cerdos vietnamitas vivan en libertad podría reducir el patrimonio genético de la población española de jabalí, así como agravar los daños que este ya causa en España (como los daños a cultivos o los accidentes de tráfico). Con vistas a evitar que se establezcan en hábitats naturales, es urgente evaluar y gestionar debidamente las observaciones de cerdos vietnamitas salvajes.

Palabras clave: Cerdo asilvestrado, Búsqueda en Google, Comercio de mascotas, Jabalí.

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## Introduction

The deliberate or accidental release of pets has frequently resulted in the successful establishment of new wild populations (e.g. Bertolino & Lurz, 2013). Over the last years, Vietnamese potbellied pigs (*Sus scrofa*; hereafter VPB pigs; fig. 1) have become a popular pet species in many regions of the world (Braun & Casteel, 1993), including Spain (Jarandilla, 2011). However, their popularity has recently declined, leading to their frequent abandonment (Tynes, 1997). Given that this is a very opportunistic species, it could be expected that released or abandoned VPB pigs eventually establish free-living populations. Nevertheless, to our knowledge this has not yet been demonstrated. In this paper our main objective was to report, for the first time, the existence of free-living VPB pigs in Spain. In addition, we aimed to gather complementary information regarding these potential introductions, concerning the year, locality and habitat type in which they were observed (table 1). We also investigated whether pregnant VPB female pigs, piglets and/or hybrids between VPB pigs and wild boar (or feral pigs) were reported, as such sightings could indicate that VPB pigs are successfully establishing wild populations (see an example in Magalhaes & Jacobi, 2013). Finally, we briefly discuss the potential risks associated with the successful establishment of free-living VPB pigs.

## Material and methods

We identified cases of free-living VPB pigs by means of a thorough Google search. We searched for terms that stemmed from the following words (in Spanish) in the following combinations: Vietnamese pig or Vietnamese boar, combined with wild boar or hybrid or wild or hunting or stalking or harvested or escaped or abandoned or abandonment (i.e.  $9 \times 2 = 18$  combinations). We identified all the cases in which VPB pigs (or their reported hybrids with wild boar or feral pigs; see below) were unequivocally reported as roaming freely. We stopped the search for a word combination when 100 consecutive results did not identify any additional valid record, i.e., when we retrieved only repeated cases, results that did not exactly relate to free-living VPB pigs (e.g. web pages offering VPB pigs for sale), and/or cases in which it was impossible to unequivocally identify free-living VPB pigs (e.g. unclear observations, inconsistent rumours, etc.). Most valid cases were reported through searches in Internet forums (mainly in hunting websites) and in online newspapers and television channels. In total, more than 1,800 records were checked (18 word combinations and at least 100 records per search). All the searches were conducted between mid-February and mid-March 2013.

When possible, we recorded the year, locality (and province), and number of individuals for each reported case (table 1). We differentiated between cases in urban and rural areas because the former would correspond to momentary VPB pig escapes

or abandonments, whereas the latter would be more closely associated with individuals potentially becoming established in the wild. All the records from cities/towns, urban parks, highways close to the city/town, and so on were included in the urban area category, and those from natural environments (scrublands, woodlands, crops interspersed with natural vegetation, etc.) in the rural area category (table 1). We also recorded the presence of pregnant VPB pig females, piglets and/or potential VPB pig hybrids with wild boar or feral pig (table 1), as such sightings could indicate the establishment of viable free-living populations. Reported hybrids were described as individuals showing mixed morphological characteristics between VPB pigs and wild boar or feral pigs (fig. 1B). Furthermore, we differentiated between killed, captured or observed individuals, and we recorded the source of information: reported by hunters, reports in the news (online newspapers or televisions), and reports provided by forest rangers, hikers, bikers, and similar (table 1).

## Results

We identified 42 cases of free-living VPB pigs (table 1, fig. 2). A very low percentage (< 1%) of the total records obtained through a Google search reported valid cases of free-living VPB pigs. Cases of free-living VPB pigs were relatively well distributed throughout Spain (fig. 2). Many occurred close to main cities, especially those identified near the coast (fig. 2). Free-living VPB pigs were firstly reported in Spain in 2007, and since then the number of cases has increased considerably. VPB pigs were recorded slightly more frequently in rural than in urban areas (57.15% vs 42.85%,  $n = 42$ ). The first hybrid between VPB pig and wild boar (or feral pig) was reported in 2010, and since then, the proportion of records of potential hybrids has increased substantially (table 1). Hybrids were reported in > 25% of the total cases (table 1). In addition, pregnant females or females taking care of piglets were also sporadically observed, captured or killed (table 1).

Table 1 also shows that: 1) on most occasions, only one individual was observed, captured or killed (70%,  $n = 34$ ), although some pairs and larger groups were also reported; 2) the number of records of observed, captured and killed individuals was similar; captured and killed animals were better sources for the identification of VPB pigs and hybrids (fig. 1); 3) most cases were reported either by hunters or in newspapers; and 4) nearly all the cases recorded in urban areas were reported in newspapers, and all the records provided by hunters came from rural landscapes.

## Discussion

In this study we provide the first evidences of free-living VPB pigs in Spain, and, to the best of our knowledge, elsewhere in Europe, although they are also common pets in other countries. According to



Fig. 1. A. A docile Vietnamese potbellied pig captured by a hunter in a wild environment within northern Spain (ID 3 in table 1 and fig. 2); B. Four potential hybrids between Vietnamese potbellied pigs and wild boar (on the left of the picture) killed during a hunting day in northern Spain (ID 1 in table 1 and fig. 2). The morphological aspect of reported hybrids differs notably to that of young wild boar (on the right of the picture).

*Fig. 1. A. Un cerdo vietnamita dócil capturado por un cazador en un entorno natural del norte de España (ID 3 en la tabla 1 y en la fig. 2); B. Cuatro posibles híbridos entre cerdos vietnamitas y jabalíes (a la izquierda de la imagen) cazados en el norte de España (ID 1 en la tabla 1 y en la fig. 2). El aspecto morfológico de los híbridos observados difiere notablemente del de los jabalíes jóvenes (a la derecha de la imagen).*

our findings, free-living VPB pigs have been reported throughout the country. Although the number of cases identified was not high, it has increased in recent years. Importantly, our results indicate that VPB pigs might have successfully established wild populations because signs of VPB pig reproduction (*i.e.* pregnant females and females taking care of piglets, and/or hybrids of VPB pigs and wild boar or feral pigs) have been frequently observed in the wild. Reasons for the successful establishment, spread and adaptation

of VPB pigs to wild habitats are probably related to their highly adaptive and opportunistic behaviour, the scarcity of natural predators, and the favourable climatic conditions in Spain.

Internet search engines are increasingly used in ecological studies (*e.g.* Maccallum & Bury, 2013), and in particular to monitor the escapes/releases of non-native pets into the wild (see Kikillus *et al.*, 2012). From this perspective, Google searching could be an appropriate tool to monitor the presence of free-liv-

Table 1. Cases of free-living Vietnamese potbellied pigs in Spain identified through an in-depth Google search (see Methods for details): ID. Locality numbers plotted in fig. 2; N. Number of pigs observed, captured or killed in each case; A. Area (R. Rural, U. Urban); H. Hybrid; P/N. Pregnant/nursing (\* females that were taking care of piglets); T. Type (K. Killed, C. Captured, O. Observed); S. Source (H. Hunters, N. Newspaper, O. Others: O<sup>1</sup> Forest rangers, O<sup>2</sup> Conservationists).

*Tabla 1. Casos de cerdos vietnamitas que viven en libertad en España identificados mediante una búsqueda exhaustiva en Google (en el apartado Methods se ofrece información más detallada): ID. Números de las localidades indicadas en la fig. 2; N. Número de cerdos observados, capturados o cazados en cada caso; A. Área (R. Rural, U. Urbana); H. Híbrido; P/N. Embarazada/lactante (\* hembras con crías); T. Tipo (K. Muerto, C. Capturado, O. Observado); S. Fuente (H. Cazadores, O. Otros: O<sup>1</sup> Guardabosques, O<sup>2</sup> Conservacionistas).*

ID	Locality	Province	N	A	H	P/N	Year	T	S
1	Castillo de Onielo	Palencia	4	R	Yes	Yes	2013	K	H
2	Olivares de Duero	Valladolid	1	R	–	–	2013	O	H
3	Mucientes	Valladolid	1	R	No	No	2013	C	H
4	Maella	Zaragoza	6	R	–	No	2012	C	N
5	Unknown	Alicante	–	R	Yes	–		O	H
6	Mallorca	Baleares	16	U	Yes	No	2012	C	N
7	Puig de Santa Magdalena de Inca	Baleares	1	R	Yes	No	2012	K	N
8	Cartagena	Murcia	1	U	No	–	2012	O	N
9	Elche	Alicante	1	U	No	No	2007	C	N
10	Santander	Cantabria	4	U	Yes	Yes*	2011	C	N
11	Argentona	Barcelona	1	R	No	No	2011	K	H/N
12	Pontons	Barcelona	1	R	No	No	2010	K	H
13	San Antonio	Baleares	1	U	No	No	2011	C	N
14	Olesa de Montserrat	Barcelona	2	R	Yes	No	2010	K	H
15	Valencia	Valencia	1	U	No	No	2008	C	N
16	András	Pontevedra	1	U	No	No	2008	C	N
17	Unknown	Huesca	–	R	–	–	2012	K	H
18	Unknown	Coruña	1	R	–	–	2012	O	H
19	Concejo de Siero	Asturias	1	R	No	No	2012	O	H
20	Murcia	Murcia	1	U	No	No	2012	K	O <sup>1</sup>
21	Cuenca río Verdugo	Pontevedra	–	R	Yes	–	2012	O	H
22	Unknown	Valencia	2	R	Yes	No	2012	K	H
23	Unknown	Almería	–	R	No	–	2012	O	H
24	Retuerta del Bullaque/ Los Yébenes	Ciudad Real/ Toledo	4	R	No	No	2012	K	H
25	Villaviciosa y Sariego	Asturias	–	R	No	No	2012	O	H
26	Valencia	Valencia	1	R	No	No	2012	O	O <sup>2</sup>
27	Elda	Alicante	4	U	No	Yes*	2012	O	N
28	Parque Almirajara	Málaga/ Granada	–	R	Yes	–	2011	O	O
29	La Seu de Urgell	Lleida	1	R	Yes	No	2013	O	O
30	Badajoz	Badajoz	1	U	No	No	2010	O	N

Table 1. (Cont.)

ID	Locality	Province	N	A	H	P/N	Year	T	S
31	Baños de la Encina	Jaén	–	R	Yes	No	2012	K	H
32	Zaragoza	Zaragoza	1	U	No	No	2012	C	N
33	Vélez–Málaga	Málaga	1	U	No	No	2008	C	N
34	Rojales	Alicante	2	U	No	No	2011	C	N
35	Santiago de Compostela	Coruña	1	U	No	No	2010	C	N
36	Valencia	Valencia	1	U	No	No	2012	C	N
37	Zaragoza	Zaragoza	1	U	No	No	2007	C	N
38	Campo Lameira	Pontevedra	1	R	No	No	2010	C	H
39	La Solana	Ciudad Real	1	U	No	No	2012	C	N
40	Parque Natural del Montgó	Alicante	1	R	No	No	2007	C	N
41	San Vicente del Raspeig	Alicante	4	U	No	No	2009	C	N
42	Southern Alicante	Alicante	–	Rural	No	No	2013	O	H

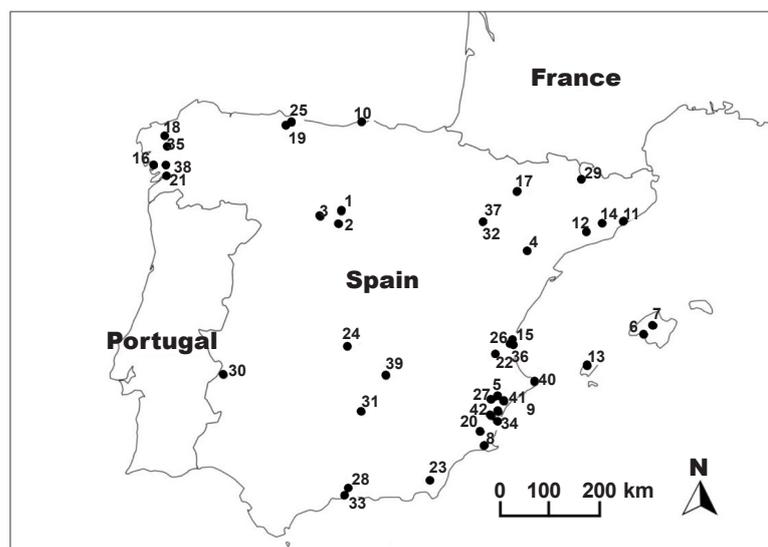


Fig. 2. Localities in which free-living Vietnamese potbellied pigs or reported hybrids between Vietnamese potbellied pigs and wild boar or feral pigs were observed, captured or killed. Dots generally represent approximate locations, as on most occasions we could not obtain the exact coordinates where free-living Vietnamese potbellied pigs were observed. Numbers correspond to the ID of each locality in table 1.

*Fig. 2. Localidades en las que se observaron, capturaron o cazaron cerdos vietnamitas en libertad o híbridos entre cerdos vietnamitas y jabalíes o cerdos asilvestrados. Por lo general, los puntos representan las localidades aproximadas, puesto que en la mayoría de las ocasiones no fue posible obtener las coordenadas exactas en las que se observaron los cerdos vietnamitas en libertad. Los números son los que figuran en la columna ID de cada localidad en la tabla 1.*

ing VPB pigs in Spain. However, the use of Internet searches in scientific studies presents several limitations that must be taken into account. For example, in our study it was almost impossible to check the reliability of most of the observations of free-living VPB pigs; nevertheless, pictures of killed or captured VPB pigs were frequently shown on the websites returned from our searches. Similarly, identification of hybrids between VPB pigs and wild boar (or feral pigs) was not unequivocal through Google searching, and therefore genetic studies are needed to accurately confirm their presence in the wild. In addition, Google searching excludes communities that use Internet less frequently (Maccallum & Bury, 2013), such as older people, or residents in small villages (Proulx et al., in press). Such communities may be closer to wildlife, as these people frequently work in the field (e.g. farmers and gamekeepers); it could therefore be expected that their knowledge about the presence of free-living VPB pigs would be higher than that of other people. Taking this into consideration, we could have underestimated the number and distribution of wild VPB pigs. In contrast, given that striking news is especially highlighted in websites, the presence of free-living VPB pigs could also have been overestimated in our study. In any case, Internet search engines offer some advantages over conventional field-monitoring programs. For example, they permit cost-effective and rapid assessments to detect the recent introduction of invasive animals (Proulx et al., in press), such as the case addressed in the present manuscript.

The introduction of VPB pigs into the wild is a result of their deliberate or accidental release, and seems to have been favoured by the huge development of the online pet-trade (Magalhaes & Jacobi, 2010). Thus, the number of Spanish websites advertising VPB pigs for sale estimated through a Google search increased from less than 10 in 2006 to more than 1,300 in 2012. As a result, the prize paid for VPB pigs in Spain has decreased drastically, dropping from several hundred euros to as little as 20 euros, a fact that facilitates their abandonment (Lord & Wittum, 1998). According to our results, VPB pigs observed were mostly solitary, suggesting that the number of individuals released per event was low. Nevertheless, as observed with other introduced pets (e.g. Alda et al., 2013), only a few founders may have been sufficient to establish free-living populations of VPB pigs across Spain. Furthermore, free-living VPB pigs were frequently documented in parks and gardens in urban areas, indicating these areas could play a key role in the establishment of free-living populations. This closely resembles the manner in which racoons were introduced (*Procyon lotor*) in central Spain (García et al., 2012).

As VPB pigs have become established in wild ecosystems in Spain only recently, we can only speculate about the risk they may pose. Given the notable genetic divergence between European and Asian *S. scrofa* (Fernández et al., 2010), free-living VPB pigs could cause erosion of the gene pool of Spanish wild boar populations. In addition, they could

create problems similar to those already caused by the wild boar in large areas of Spain (e.g. negative effects on crops and/or natural vegetation, Herrero et al., 2006; Gómez & Hódar, 2008).

The fact that we found only a few cases of apparently successful establishment of VPB pigs in the wild suggests they are not yet abundant in our setting. However, previous experiences suggest that calls for early management action are required, because by the time released exotic animals are publicly recognised as a problem, it is often too late for effective action, due to logistic, economic, or scale factors (Bertolino & Genovesi, 2003). We therefore recommend the situation should be suitably managed before it runs out of control. An in-depth monitoring plan is needed to determine the current distribution and abundance of free-living VPB pigs in Spain, and to accurately assess the risk they may cause. To prevent further releases of exotic pets in the wild, we urgently need stricter trade regulations in Spain (see for a wider explanation on this topic Bertolino & Lurz, 2013). At the same time, we need to increase public awareness about the risks of free-living pets and the benefits of their prevention and mitigation for native biodiversity.

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### References

- Alda, F., Ruiz–López, M. J., García, F. J., Grompper, M. E., Eggert, L. S. & García, J. T., 2013. Genetic evidence for multiple introduction events of racoons (*Procyon lotor*) in Spain. *Biological Invasions* 15: 687–698.
- Bertolino, S. & Genovesi, P., 2003. Spread and attempted eradication of the grey squirrel (*Sciurus carolinensis*) in Italy, and consequences for the red squirrel (*Sciurus vulgaris*) in Eurasia. *Biological Conservation*, 109: 351–358.
- Bertolino, S. & Lurz, P. W. W., 2013. *Callosciurus* squirrels: worldwide introductions, ecological impacts and recommendations to prevent the establishment of new invasive populations. *Mammal Review*, 43: 22–33.
- Braun, W. F. & Casteel, S. W., 1993. Potbellied pigs: miniature porcine pets. *Veterinary Clinics of North America: Small Animal Practice*, 23: 1149–1161.
- Fernández, A. I., Alves, E., Óvilo, C., Rodríguez, M. C. & Silió, L., 2010. Divergence time estimates of East Asian and European pigs based on multiple near complete mitochondrial DNA sequences.

- Animal Genetics*, 42: 86–88.
- García, J. T., García, F. J., Alda, F., González, J. L., Aramburu, M. J., Cortés, Y., Prieto, B., Pliego, B., Pérez, M., Herrera, J. & García-Román, L., 2012. Recent invasion and status of the racoon (*Procyon lotor*) in Spain. *Biological Invasions*, 14: 1305–1310.
- Gómez, J. M. & Hódar, J. A., 2008. Wild boars (*Sus scrofa*) affect the recruitment rate and spatial distribution of holm oak (*Quercus ilex*). *Forest Ecology and Management*, 256: 1384–1389.
- Herrero, J., García-Serrano, A., Couto, S., Ortuño, V. M. & García-González, R., 2006. Diet of wild boar *Sus scrofa* L. and crop damage in an intensive agroecosystem. *European Journal of Wildlife Research*, 52: 245–250.
- Jarandilla, L., 2011. *Cerdos vietnamitas*. Editorial Hispano Europea, Barcelona.
- Kikillus, K. H., Hare, K. M. & Hartley, S., 2012. Online trading tools as a method of estimating propagule pressure via the pet-release pathway. *Biological Invasions*, 14: 2657–2664.
- Lord, L. & Wittum, T., 1998. Survey of humane organizations and slaughter plants regarding experiences with Vietnamese potbellied pigs. *The Journal of the American Veterinary Medical Association*, 211: 562–565.
- Magalhaes, A. L. B. & Jacobi, C. M., 2010. E-commerce of freshwater aquarium fishes: potential disseminator of exotic species in Brazil. *Maringá*, 32: 243–248.
- 2013. Asian aquarium fishes in a Neotropical biodiversity hotspot: impeding establishment, spread and impacts. *Biological Invasions*, 15: 2157–2163.
- Mccallum, M. L. & Bury, G. W., 2013. Google search patterns suggest declining interest in the environment. *Biodiversity and Conservation*, 22: 1355–1367.
- Proulx, R., Massicotte, P. & Pépino, M., in press. Googling trends in conservation biology. *Conservation Biology*.
- Tynes, V. V., 1997. Potbellied pig husbandry and nutrition. *Veterinary Clinics of North America: Exotic Animal Practice*, 2: 193–208.
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