

12a. Genetic resources for food and agriculture: animal genetic resources

Type: State / Benefit Indicator

Indicator Description

Genetic diversity is an important component of biological diversity. Rare and native breeds of farm animals are part of our cultural heritage, are often associated with traditional land management required to conserve important habitats, and may have genetic traits of value to future agriculture.

The genetic diversity in UK breeds can be assessed by the effective population size (N_e), which accounts for the total number of animals in a population and the relative numbers of sires and dams (male and female parents). A low effective population size signifies a greater likelihood of in-breeding and risk of loss of genetic diversity.

This indicator shows the change in the average effective population sizes for breeds of goats, pigs, horses, sheep and cattle classified by the UK Farm Animal Genetic Resources Committee as Native Breeds at Risk (NBAR).

Effective population size of Native Breeds at Risk in the UK

The average effective population size of the native breeds at risk included in this UK indicator:

for **pigs** decreased from 176 in 2000 to 159 in 2014 and to 135 in 2019;

for **horses** decreased from 178 in 2000 to 96 in 2014 and to 97 in 2019;

for **sheep** increased from 245 in 2000 to 407 in 2014 and to 424 in 2019;

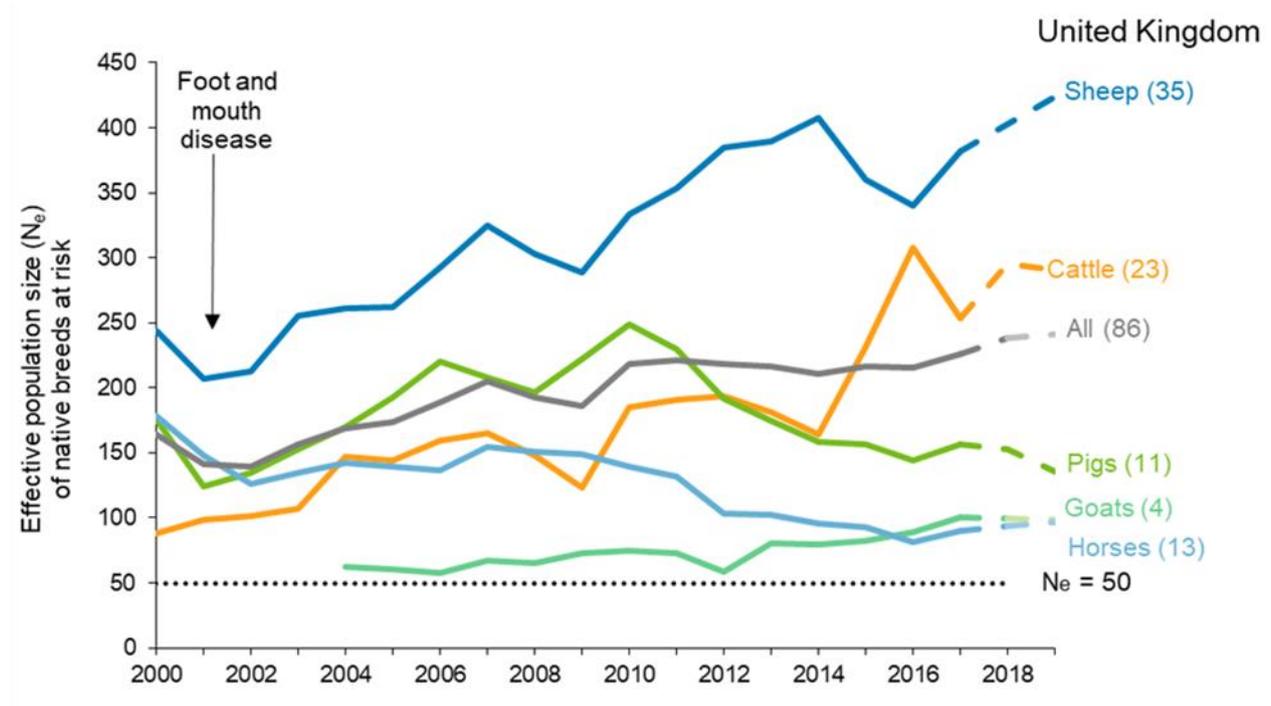
for **cattle** increased from 88 in 2000 to 164 in 2014 and to 291 in 2019; and

for **goats** the dataset starts in 2004 when it was 62, increasing to 79 in 2014 and increasing to 99 in 2019; prior to 2004, effective population size could only be calculated for one breed.

The *average* effective population sizes calculated between 2000 and 2019 for the native breeds at risk of goats, pigs, horses, sheep and cattle were each above 50, the figure set by the United Nations Food and Agriculture Organisation (FAO) as a threshold for concern. However, in 2019, of the Native Breeds at Risk, 2 breeds of goat (Saanen and Toggenburg), 4 breeds of horse (Cleveland Bay Horse, Eriskay Pony, Hackney, and Suffolk Punch), and one breed of cattle (Vaynol), had a N_e less than or equal to 50. No breeds of sheep or pig had effective population sizes below the threshold in 2019.

There has been no reported UK extinction of any breeds of pigs, horses, sheep, cattle or goats since 1973.

Figure 12a.1: Average effective population size (N_e) of Native Breeds at Risk in the UK, 2000 to 2019



Notes:

1. The number of breeds included in the indicator varies year by year as a result of data availability for both sires and dams (data for both are needed to calculate effective population size). The maximum number of breeds included in each measure is shown in brackets after the species name in the legend. The annual data collection for the 2019 data accounts for 74% of the total breeds and these are for 4 goat breeds, 11 pig breeds, 12 horse breeds, 31 sheep breeds, and 18 cattle breeds. Further details of how many breeds are included in each year can be found in the technical background document and the datasheet.
2. Data for two thirds of the breeds data was collected through the 3-yearly survey in October 2018. Therefore, data for 2018 and 2019 are provisional, hence the last part of the lines are showed as 'dashed'. It is expected that the 2018 and 2019 data can be confirmed in late 2021 when the next triennial exercise has taken place.
3. Based on data in the UK Farm Animal Genetic Resources Breed Inventory published on 7 May 2020.
4. Due to a clerical error, Shetland pony was previously classed incorrectly as a NBAR and has been removed in the 2019 inventory update. This error first appeared in the 2014 inventory which was published in 2015. Also, over the course of time, historic data for some breeds has been revised. Therefore, this indicator is not directly comparable with previous publications. The Breed Inventory Results published on 7 May 2020 can be accessed through the following link: <https://www.gov.uk/government/statistics/uk-farm-animal-genetic-resources-fangr-breed-inventory-results>. The Excel dataset provides information on revisions.
5. The dotted black line shows effective population size (N_e) equal to 50; the level set by the United Nations Food and Agriculture Organisation as a threshold for concern. The dark grey line is an average of all 86 Native Breeds at Risk for which N_e could be calculated; this is included to provide context but is not assessed.

Source: British Pig Association, Defra, Grassroots Systems Ltd., Rare Breeds Survival Trust, and participating breed societies.

Indicator assessment

Assessment of change in effective population size of Native Breeds at Risk in the UK

Goat breeds: Long term (2004 to 2019): Improving; Short term (2014 to 2019) Improving; Latest year (2019) Decreased

Pig breeds: Long term (2000 to 2019): Deteriorating; Short term (2014 to 2019) Deteriorating; Latest year (2019) Decreased

Horse breeds: Long term (2000 to 2019): Deteriorating; Short term (2014 to 2019) Little or no overall change; Latest year (2019) Increased

Sheep breeds: Long term (2000 to 2019): Improving; Short term (2014 to 2019) Improving; Latest year (2019) Increased

Cattle breeds: Long term (2000 to 2019): Improving; Short term (2014 to 2019) Improving; Latest year (2019) Decreased

Note: Long and short-term assessments are based on a 5% rule of thumb. The base years for these assessments use a 3-year average. See [Assessing Indicators](#).

Further detail

The indicator shows the change in the average effective population sizes (N_e) for breeds of goats, pigs, horses, sheep and cattle classified by the UK Farm Animal Genetic Resources Committee as Native Breeds at Risk (NBAR). The UK Farm Animal Genetic Resources (FAnGR) Committee [breed inventory](#) was first published in 2014 with information for pigs, goats and horses, and was expanded in 2015 to include sheep and cattle.

In the inventory published in 2020, all 5 native breeds of goats, all 11 native breeds of pigs, 13 of 19 native horse breeds, 47 of 60 native sheep breeds, and 27 of 34 native cattle breeds were classified as NBAR (for definitions of native breeds, and native breeds at risk, see Appendix 1 of the [UK Country Report on Farm Animal Genetic Resources 2012](#)).

For goats and pigs, data to calculate effective population size is available for all years for all breeds included in the indicator (from 2004 to 2019 for 4 goat breeds, and from 2000 to 2019 for 11 pig breeds). However, for horses, sheep and cattle, the number of breeds contributing to the indicator increases over time as more data becomes available (for details see the technical document).

Data in the inventory is sourced from individual breed society records. As all pedigree animals need to be registered with their respective society to receive their pedigree certificate, the breed society records are comprehensive. To maximise efficiency in data collection, central database suppliers who maintain the breed society databases supply the data to the Defra Farm Animal Genetic Resources team. Breed societies have given their permission for these companies to supply the data every year for this exercise. In addition, data for additional breeds is collected from individual breed societies on a 3-yearly basis, the latest was in October 2018. The most recent triennial exercise collected data for two thirds of the breeds for 2015, 2016 and 2017, so for some breeds there are missing values for these 3 years and for 2018 and 2019. It is anticipated that the next triennial exercise will be in late 2021, and will collect new data for the years 2018, 2019 and 2020.

Effective population size is a calculation which takes account of the total number of animals in a population and the relative number of sires and dams (male and female parents). A low effective population size signifies a greater likelihood of in-breeding and risk of loss of genetic diversity. A larger effective population size implies a lower risk of inbreeding and higher genetic diversity.

The assessment of change for the indicator was made by applying a 5% [rule of thumb](#). The arithmetic mean of the first 3 years of the data series for each species was compared with the last point to determine the assessment for the long-term trend, and an arithmetic mean of the year 5 years back in the time series and the year either side calculated to compare with the last point to assess the short-term trend. A 5% rule of thumb was chosen to recognise the human element in the choice of which sires breed with which dams (which is not random for non-feral breeds), and because this level has already been chosen by the Rare Breeds Survival Trust to identify changes from the previous year's Watchlist publication. It should be noted that single year variations in the measures are not hugely meaningful, due to the human element in which sires breed with which dams.

The FAO recommends a minimum effective population size (N_e) of at least 50 individuals to reduce the rate of inbreeding to less than 1% and ensure the long-term survival of a breed. Figure 12a.1

shows that, *on average*, all 5 species have N_e greater than 50. However, examination of the data for the individual breeds (Figure 12a.2) reveals that there are a small number of breeds with N_e less than or equal to 50 in many years. The breeds which are represented in Figure 12a.2 may change from year to year; see the downloadable datasheet for details. In 2019, 2 breeds of goat (Saanen and Toggenburg), 4 breeds of horse (Cleveland Bay Horse, Eriskay Pony, Hackney, and Suffolk Punch), and one breed of cattle (Vaynol), had a N_e less than or equal to 50. No breeds of sheep or pig had effective population sizes below the threshold in 2019.

Pigs

No NBAR pig breeds have had an $N_e < 50$ since 2004. There was a dip in pig numbers in 2001 as a result of foot and mouth disease, and a peak in 2007 as a result of breeding for export. Four pig breeds have increased in N_e since 2000 (the biggest increase was for Oxford Sandy and Black), 2 breeds have remained stable and 5 breeds have decreased – the largest decrease was for Landrace from 651 in 2000 to 87 in 2019.

Horses

Eight of the 13 horse breeds in the indicator have had declines in N_e , showing a long-term decrease, however more recently in the short-term the N_e has changed little. Due to a clerical error, Shetland pony was previously classed incorrectly as a NBAR and has been removed in the 2019 inventory update. This error first appeared in the 2014 inventory which was published in 2015 and therefore this indicator is not directly comparable with previous publications. The Eriskay pony has had an effective population size of less than 50 each year since 2000 with the N_e for 2016 and 2018 being 4. Since 2001 when it joined the indicator, the Suffolk Punch has had an N_e of less than 50 every year but one (2009, when the value was 53). The N_e for New Forest Pony has declined from 716 in 2000 to 289 in 2019. Since 2002 when it joined the indicator, the Cleveland bay horse has had an N_e of 50 or less than for 9 of the 18 years it has been included, with the lowest effective population size being 31 in 2016. The N_e for the Dales pony increased from 110 in 2000 to 122 in 2019, an increase of 15%. The N_e for British Percheron/Percheron, for which there are only 6 years' worth of data (2012 to 2017), has an effective population size range of between 18 and 22.

Sheep

As with pigs, there was a dip in numbers in 2001 as a result of foot and mouth disease. The time series for these breeds varies in length; of the 26 breeds with at least 10 years of data, 20 breeds have had an increase in N_e (for example, Boreray, Shropshire, Kerry Hill, and Leicester Longwool) and 5 a decrease (Black Welsh Mountain, Cotswold, Manx Loaghtan, Wensleydale and Whitefaced Woodland), with one breed remaining stable (Border Leicester a 2% increase). There has been a strong increase in the N_e for Boreray, from a low of 15 in 2001 to 186 in 2019. There are 6 years of data (2012 to 2017) for Cambridge, but N_e is low (ranging between 34 and 42) for all 6 years.

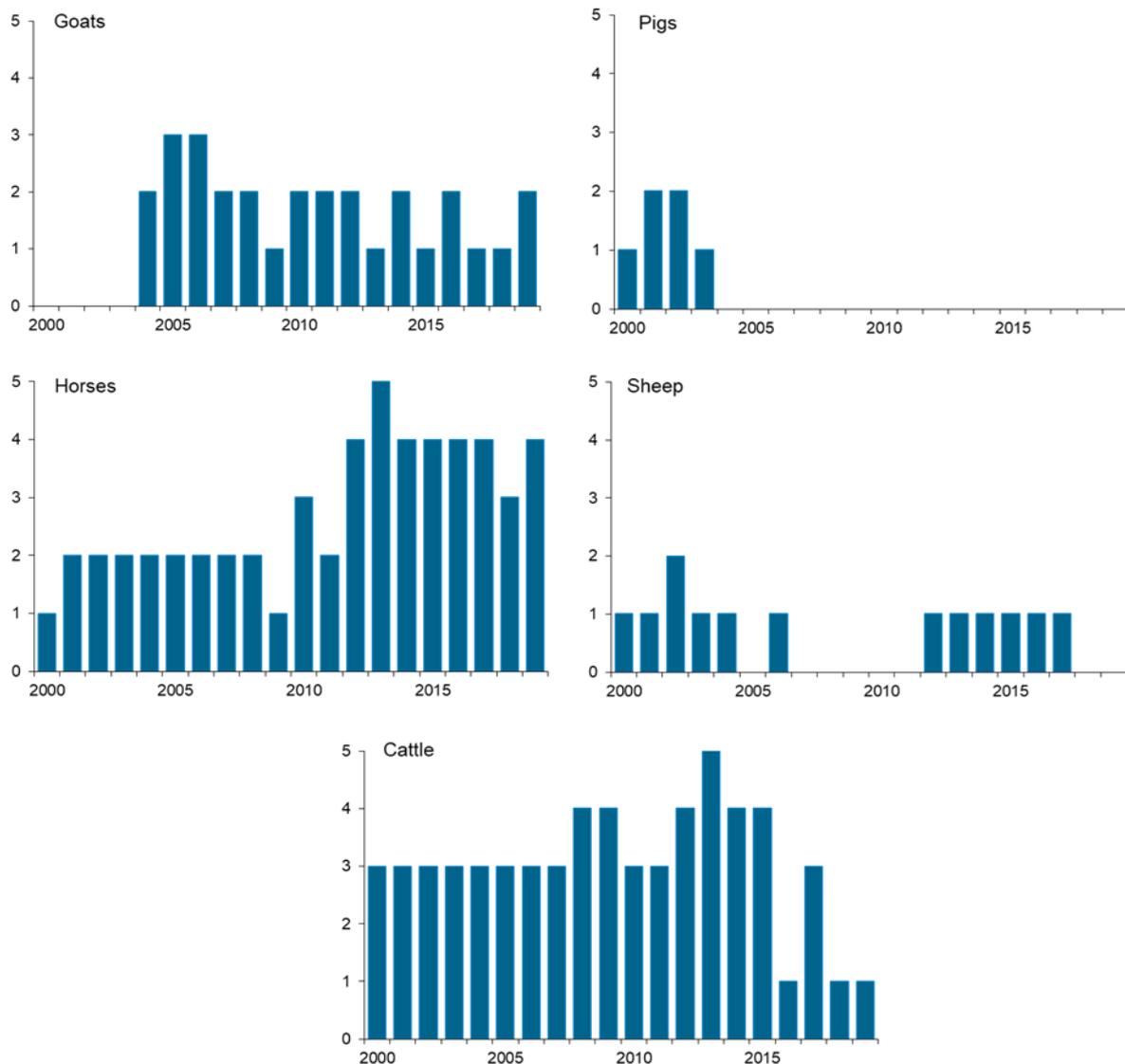
Cattle

As with sheep, the time series for the breeds contributing to the indicator varies in length. Of the 16 breeds with at least 10 years of data, 14 have increased (for example, Belted Galloway, Lincoln Red including Lincoln Red (Original), and Luing) and 2 breeds have decreased (Galloway and Gloucester). The effective population size of Vaynol has been in single figures for 9 of the 12 years it has been included in the indicator in since 2008 apart from 2016 where it was 10, 2017 where it was 13, and 2019 where it is 15. The effective population size of Chillingham for which there are only 3 years data (2012 to 2014) is 3 for each of those years.

Goats

The average N_e of the 4 goat breeds in the indicator is above 50 and has increased in the short term. Three of the 4 breeds increased. Bagot increased in N_e from 48 in 2000 to 116 in 2019. Golden Guernsey increased in N_e from 196 in 2004 to 360 in 2019. Saanen has increased slightly in N_e from 43 in 2004 to 50 in 2019; the highest point in the data range (2004 to 2019) was in 2017 when the N_e was 70. Toggenburg has remained stable.

Figure 12a.2: Number of NBAR breeds in the UK with $N_e \leq 50$ within the overall trends, 2000 to 2019



Note: Based on data in the UK Farm Animal Genetic Resources Breed Inventory published on 7 May 2020.

Source: British Pig Association, Defra, Grassroots Systems Ltd., Rare Breeds Survival Trust, and participating breed societies.

Relevance

Genetic diversity is an important component of biodiversity. The UK genetic diversity indicator focuses on the diversity of Native Breeds at Risk of a number of farm animal species (cattle, sheep, goats, horses and pigs). Genetic diversity in livestock breeds is important for a number of reasons. Aside from their cultural importance, local adaptation and links to breed specific products, native or rare livestock breeds provide a resource from which to develop new breeds or improve existing breeds.

UK farm animal genetic resource is a key asset in economic, environmental, social and cultural terms. Native breeds of farm animals are often associated with traditional land management required to conserve important habitats. The indicator is relevant to the commitments on conservation of native breeds in the UK National Action Plan on Farm Animal Genetic Resources (FAnGR).

The indicator is also relevant to outcome 3 in [Biodiversity 2020: A strategy for England's wildlife and ecosystem services](#) and a number of international targets (see Annex A and B of the aforementioned publication).

Background

The UK is home to some of the richest and most diverse farm animal genetic resources in the world, with approximately 700 breeds including cattle, sheep, goats, pigs, horses and ponies and poultry; the UK contains more than 9% of the total of global livestock breeds. There are some 200 native breeds according to the definition adopted by the UK Farm Animal Genetic Resources (FAnGR) Committee, the majority of which are considered to be "at risk". A list of known breeds in the UK is given in Appendix 2 of the [2012 UK Country Report on Farm Animal Genetic Resources](#) and in the Annex of the [2010 Poultry in the UK report](#). Defra and its FAnGR Committee monitor the status of UK breeds to determine if they are native, exotic, at risk or not; and ensure that eligible species/breeds:

- Are offered potential protection in an outbreak of an exotic disease (as far as possible within the constraints of controlling the disease).
- Have potential access to a grazing supplement under agri-environment schemes.

Many of the UK's habitats that are now valued for their biodiversity were created by, or for, farm animals. These habitats include various types of upland and lowland grasslands and heathlands, hay meadows and pasture-woodlands. Other habitats, such as sand dunes, salt marshes and even woodlands may also benefit from light grazing. If these habitats are not grazed they may lose their special conservation value as they become invaded and eventually dominated by scrub and trees through the process of ecological succession.

Although it is not possible to measure the genetic variation in all traits of interest, the average rate of loss in genetic variation can be estimated, since this rate can be described by calculating the 'effective population size'.

The UK Farm Animal Genetic Resources (FAnGR) Breed Inventory is an electronic monitoring system. It was first published by Defra in July 2014 and updated annually since then. The monitoring system contains data on the status and trends in the domestic pig, goat, horse, sheep and cattle farm animal genetic resources with continuous data from 2000 to 2018 for around 100 breeds which are present in the UK. More recently, the electronic monitoring system for FAnGR is now starting to collect more information and more regularly, which should lead to an improvement with the data provided in non-triennial years.

Defra and the Farm Animal Genetic Resources Committee will continue to monitor populations of UK livestock breeds regularly; the list of Breeds considered to be at Risk is kept under annual review using the monitoring data collected, with Breeds at risk potentially eligible for protection in an outbreak of an exotic disease (within the constraints of controlling the disease).

Supplementary information from the Rare Breeds Survival Trust Watchlist

The Rare Breeds Survival Trust (RBST) works to conserve and protect the United Kingdom's rare native breeds of farm animals from extinction as a resource for future generations and for the benefit of agriculture. Between 1900 and 1973, the United Kingdom lost 26 of its native breeds. This was caused by changing farming methods and a much more intensive approach to food production. Since the formation of the Trust in 1973 no other native livestock breed has become extinct in the UK.

The RBST publishes an [annual watchlist](#), which highlights changes in breed population trends. The watchlist is divided into 6 categories: Critical; Endangered; Vulnerable; At Risk; Minority; and Other Native Breeds. Breeds are placed into categories based on species and the total number of registered breeding females in the United Kingdom. Population genetic factors (such as inbreeding and genetic erosion) and current trends in breed density and distribution (geographical concentration in a small area) can mean a breed will be vulnerable to disease outbreaks. These factors are also included in making assessments of status.

Within categories 1 to 5, the 2020-21 watchlist includes 27 breeds of sheep, 14 cattle, 11 pigs, 3 goats and 12 horse breeds.

Web links for further information

Defra: UK National Action Plan on Farm Animal Genetic Resources

(2006): https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69397/pb12190-fangr-actionplan.pdf (PDF, 1.3Mb)

Defra: Poultry in the UK:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69294/pb13451-uk-poultry-faw-101209.pdf (PDF, 3.5Mb)

Defra: UK Country Report on Farm Animal Genetic Resources 2012:

<https://www.gov.uk/government/publications/uk-country-report-on-farm-animal-genetic-resources-2012>

Defra: UK Breeds at risk list: <https://www.gov.uk/government/collections/fangr-resources-for-farmers-and-livestock-breeders>

Defra: Link to previous indicator, first published in 2009: Research Report: UK Biodiversity Indicators – development of an indicator of genetic diversity in selected farm breeds (WC0717) <http://randd.defra.gov.uk/> (search term = WC0717); Indicator fiche in The National Archives:

<http://webarchive.nationalarchives.gov.uk/20110311102613/http://www.defra.gov.uk/fangr/newsarchive.htm>

Defra: Technical Background Document: <https://www.gov.uk/government/statistics/england-biodiversity-indicators>

Defra: UK Farm Animal Genetic Resources (FAnGR). Breed inventory results 2000 to 2018:

<https://www.gov.uk/government/statistics/uk-farm-animal-genetic-resources-fangr-breed-inventory-results>

European Farm Animal Biodiversity Information System (EFABIS): UK page

<http://efabis.vet.agri.ee/> Note: Statistical data in the UK EFABIS database is automatically carried over to the clone database systems at the European level and global levels.

Food and Agriculture Organisation of the United Nations: Domestic Animal Diversity Information System (DAD-IS) <http://www.fao.org/dad-is/en/>

Food and Agriculture Organisation of the United Nations, Management of small populations at risk: <http://www.fao.org/3/a-w9361e.pdf>

Rare Breeds Survival Trust: Rare Breeds Survival Trust Watchlist: <https://www.rbst.org.uk/rbst-watchlist>

Last updated: October 2020

Latest data: 2019