

Water buffalo

Bubalus bubalis



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Government**

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Identity and taxonomy

Species: *Bubalus bubalis*

Common names: Asian water buffalo, Asian buffalo, Asiatic buffalo, water buffalo

Family: Bovidae

Related species (from Huffman 2005):

<i>Bison</i>	<i>Bison bison</i> (American bison), <i>B. bonasus</i> (European bison, wisent)
<i>Bos</i>	<i>Bos frontalis</i> (gaur), <i>B. grunniens</i> (yak), <i>B. javanicus</i> (banteng), <i>B. sauveli</i> (kouprey), <i>B. taurus</i> (domestic cattle)
<i>Boselaphus</i>	<i>Boselaphus tragocamelus</i> (nilgai)
<i>Bubalus</i>	<i>Bubalus depressicornis</i> (lowland anoa), <i>B. mindorensis</i> (tamaraw), <i>B. quarlesi</i> (mountain anoa)
<i>Pseudoryx</i>	<i>Pseudoryx nghetinhensis</i> (saola, Vu Quang ox)
<i>Syncerus</i>	<i>Syncerus caffer</i> (African buffalo, cape buffalo)
<i>Taurotragus</i>	<i>Taurotragus derbianus</i> (giant eland, Derby eland), <i>T. oryx</i> (common eland)
<i>Tetracerus</i>	<i>Tetracerus quadricornis</i> (four-horned antelope, chousingha)
<i>Tragelaphus</i>	<i>Tragelaphus angasii</i> (nyala), <i>T. buxtoni</i> (mountain nyala), <i>T. eurycerus</i> (bongo), <i>T. imberbis</i> (lesser kudu), <i>T. scriptus</i> (bushbuck), <i>T. spekii</i> (sitatunga), <i>T. strepsiceros</i> (greater kudu)

Description

The water buffalo has been associated with people since prehistoric times. It is one of the oldest species of domesticated livestock and continues to be used as a source of milk and meat, and as a draft animal.

The wild Asian buffalo, from which the domestic water buffalo originates, is a large and powerful animal. Individuals stand 1.5–1.9 metres at the shoulder. Body length ranges from 2.4–3.6 metres. Males (bulls) can weigh up to 1200 kilograms and females (cows) 800 kilograms (Roth 2004). Domestic water buffalo are often smaller in size, having been bred for tractability. Typical weights for domestic varieties range from 250 kilograms for some small animals in China, to 300 kilograms for animals in Burma and 500–600 kilograms for animals in Laos (Ligda 1998).

Water buffalo have sparse hair that is ashy gray or black. Their relatively long tail is bushy at the tip. Their legs are often dirty white up to the knees. Adult buffalo are almost hairless and their skin color varies with weather conditions. It is often difficult to ascertain skin color as the animals are usually covered with mud. Domestic varieties range in colour from black to ashy gray to reddish. A black and white variety exists in Indonesia (Ligda 1998). Calves have a reddish coat that darkens with age.

Both sexes have horns, although the female's are usually smaller than the male's. Horns of both sexes are heavy-set at the base, ribbed, and triangular in cross-section (Roth 2004). Two broad types of domestic water buffalo are recognised: the river-type from western Asia (with curled horns) and the swamp-type from eastern Asia (with swept-back horns) (Department of Environment and Heritage 2004). Australia has a mix of both types, with the swamp-type dominating. Feral water buffalo in Australia are usually light to dark grey, but the natural population also contains numbers of pink, albinoid and piebald types (grey and white patches) (Lemke 1994).

Biology

Genetics:	The river-type water buffalo has 50 chromosomes. The swamp-type has 48 chromosomes. The two types can interbreed and all offspring are fertile.
Gestation period:	300–340 days
Young per birth:	One (usual) or two (very rarely)
Weaning:	6–9 months
Sexual maturity:	Females 18 months to two years; males three years. Cows can reproduce for 15–18 years; bulls decline in fertility after 6–7 years but may remain active for longer (Ingawale & Dhoble 2004; Soysal et al. 2005).
Life span:	Up to 25 years in the wild; 29 years in captivity (Roth 2004).

Although water buffalo are considered to be slow breeders, research in Australia indicates that weaning can be carried out as late as 12 months of age without any effect on the mother's conception times (Ligda 2004). This suggests that water buffalo may have high reproduction rates when nutrition levels are high and predation is low. The mating period in Australia peaks around March (Roth 2004).

Social organisation

During most of the Australian dry season (May–October), males and females form separate herds. Females form clans, consisting of mothers and daughters, of roughly 30 individuals. Females and calves, led by one of the older cows, occupy the forested plains, where food and shade are most plentiful. Each clan has a home range varying from 170–1000 hectares, which may overlap with the range of other clans. Clans may come together at night to form a herd of up to 500 animals at a communal resting area.

At the age of three, males leave the female herds, often forming bachelor herds. Bachelor herds may number up to 10 individuals. These herds typically have slightly larger ranges than the ranges of female clans, and male ranges will overlap those of the female clans. Males inhabit more open plains with little shade, or slopes with drier vegetation. Older bulls are often solitary, but have been observed in female herds year-round. Older bulls and young males ejected from the herds may wander thousands of kilometres in search of new territories (Roth 2004).

Diet

Water buffalo eat a range of grasses and other plants but also chew the bark off trees to obtain minerals (DEH 2004). In the wet season (November–April), water buffalo graze aquatic grasses and grass-like wetland plants. They eat a broader range of food in the dry season, feeding on grasses, herbs and the leaves of plants like pandanus. Males consume up to 30 kilograms of dry matter each day (DEH 2004). Buffalo are known to eat a wider range of forage than cattle and are physiologically better adapted to poor quality feed compared to cattle (Lemke 1994).

Preferred habitat

Wild Asian buffalo are found in tropical and subtropical forests and in wet grasslands. Because they are heavily dependent on water and spend a considerable time wallowing in rivers or mud holes, they are more frequently encountered in riverine forests and grasslands, marshes and swamps (Roth 2004).

In Australia, most feral water buffalo are found in the ‘Top End’ of the Northern Territory. They inhabit wetlands and floodplains where they have access to food and water. In low-rainfall years, many buffalo die and the survivors are restricted to more permanent wetlands in the northern part of their range. After a series of wet years, the population builds, with densities of up to 34 animals per square kilometer (DEH 2004).

In the wet season, water buffalo tend to graze flood plains at dawn and dusk. Around mid-morning they move to water to drink and wallow, before returning to graze from mid-afternoon until dark (Roth 2004). They retreat to upland savannah woodlands for nurseries and overnight camps, and for grazing recently germinated annual grasses (Petty et al. 2007).

In drier times, feral buffalos prefer to graze at night, spending most of the day in wallows (Roth 2004). During the late dry season, buffalo will graze perennial grasses on savannah woodlands (Petty et al. 2007).

Water buffalo are more sensitive to heat than most bovids because they have fewer sweat glands. Wallowing in mud helps keep the water buffalo cool. Wallowing also serves to cake the animal with mud, thereby protecting it from biting insects (Roth 2004).

Domestic water buffalo are found in similar tropical and subtropical environments to their wild ancestors. However, their range can extend if they are provided with adequate shelter. With suitable protection, farmed water buffalo have been able to tolerate most conditions in southern Australia (Lemke 1994). They are also found at elevations up to 2800 metres in Nepal (Roth 2004).

Predators and diseases

Dingoes and crocodiles are capable of taking young water buffalo (DEH 2004). Buffalo suffer many of the same diseases as cattle (Geering et al. 1995). Potential exotic diseases include bovine brucellosis and foot-and-mouth disease.

History of introduction

Between 1825 and 1843, about 80 water buffalo were transported from South-East Asia to Melville Island and Cobourg Peninsula (in what is now the Northern Territory) to provide the remote settlements with meat. When these settlements were abandoned in the mid-1800s, the buffalo were left to roam and soon colonised the permanent and semi-permanent swamps and freshwater springs of the Top End. By the late 19th century, large numbers of water buffalo could be found on the northern flood plains and Melville Island. From about 1886, a small buffalo harvesting industry developed and the animals were shot for their hides (Lever 1985).

During the first half of the 20th century, harvesting buffalo for their hides continued. There were also some exports of live animals and attempts at re-domestication. By 1955–56, nearly 400 000 buffalo had been shot for hides and a further 140 000 had been slaughtered for pet food and human consumption (Lever 1985). However, the prices for buffalo products were subject to fluctuation; business interest tended to wax and wane in line with prices, while feral buffalo numbers continued to increase. A safari hunting industry, which developed in the Top End during the 1960s, had little impact on buffalo numbers.

By the 1970s, feral buffalo numbers were so high that they were destroying wetlands and harbouring diseases that could affect native species and livestock; the most significant of these diseases being brucellosis (*Brucella abortus*) and bovine tuberculosis (*Mycobacterium bovis*). A water buffalo eradication program was initiated for environmental reasons and as part of the Brucellosis and Tuberculosis Eradication Campaign (BTEC), which commenced in the 1970s.

Distribution and abundance in Australia

Feral water buffalo occur within suitable wetland habitats across tropical northern Australia (Figure 2).



Figure 2. Distribution of feral water buffalo in Australia (DEW 2004).

During the 1980s, it was estimated some 350 000 water buffalo lived in the Top End of the Northern Territory. However, the BTEC almost eradicated them from the wild. In Kakadu National Park, the number was reduced from about 20 000 animals in 1988 to less than 250 animals in 1996. The current population of water buffalo in the Northern Territory is now estimated at 80 000 animals (Clive McMahon, pers. comm. 2008).

Feral water buffalo have never been a major problem in Queensland. A survey of water buffalo in 1981–82 suggested low population levels, with only a few sightings in north Queensland and the Gulf, and a single report from south-west Queensland (Mitchell *et al.* 1982). At the time of the survey, up to 200 bulls were thought to exist in the State (Mitchell *et al.* 1982). In 2005, a survey again confirmed that feral buffalo were restricted to small areas of the state (Figure 3).

Currently there are no exact figures for feral water buffalo in Queensland. Buffalo are occasionally sighted in the far north region of Burke Shire. Up to 12 animals a year are reported, with higher numbers in dry years when they may travel from the Northern Territory in search of food. There is likely to be many more buffalo in this region, as buffalo are only sighted when they are moving through or feeding out in the open. 'There is a considerable area of inaccessible country to the west of Burketown, to the north of Doomadgee and along the coast, with numerous large lakes and lagoons that could harbour buffalo' (Russell Cunningham, Burke Shire Ranger, pers. comm. 2008).

Apart from water buffalo kept in zoos, Queensland has a small number of water buffalo dairy farms on the Atherton Tableland and at Maleny on the Sunshine Coast. In Queensland there are approximately 1800 registered farmed buffalo (Robert Collins, DPI&F, pers. comm. 2008). Domestic water buffalo are farmed for meat and hides in small numbers in all states.

There is also a growing market for buffalo milk (Victorian Department of Primary Industries 2000). There are approximately 15 000–20 000 head of domestic water buffalo in Australia (Australian Buffalo Industry Council 2008).

Overseas distribution

The wild Asian buffalo originally ranged from eastern Nepal and India, to Indochina and what is now Malaysia. By the mid-20th century, the original wild herds had been substantially reduced and eliminated from much of their range. In 1990, it was believed that remnant wild populations were restricted to a few small herds in India, Nepal and Thailand. The total wild population was estimated to be fewer than 4000 animals. Due to interbreeding with domestic cattle, it is also possible that no purebred wild Asian buffalo remain. Interbreeding with domestic buffalo is the major threat to wild Asian buffalo. Diseases and parasites (transmitted by domestic livestock) and competition for food and water between wild buffalo and domestic stock are also significant threats (Massicot 2004; Roth 2004).

The water buffalo appears to have been one of the earliest domesticated animals in Asia. Evidence of their existence in prehistoric time dates from around 4000 BC (Diamond 1997). They were introduced to the Near East and north Africa as domestic animals around 600 AD, before being brought to Europe in the Middle Ages. Herds still exist in Italy and Bulgaria (Ligda 1998). More recently, water buffalo have been introduced as farmed animals into the United States, South America, Central America, Australia and Oceania.

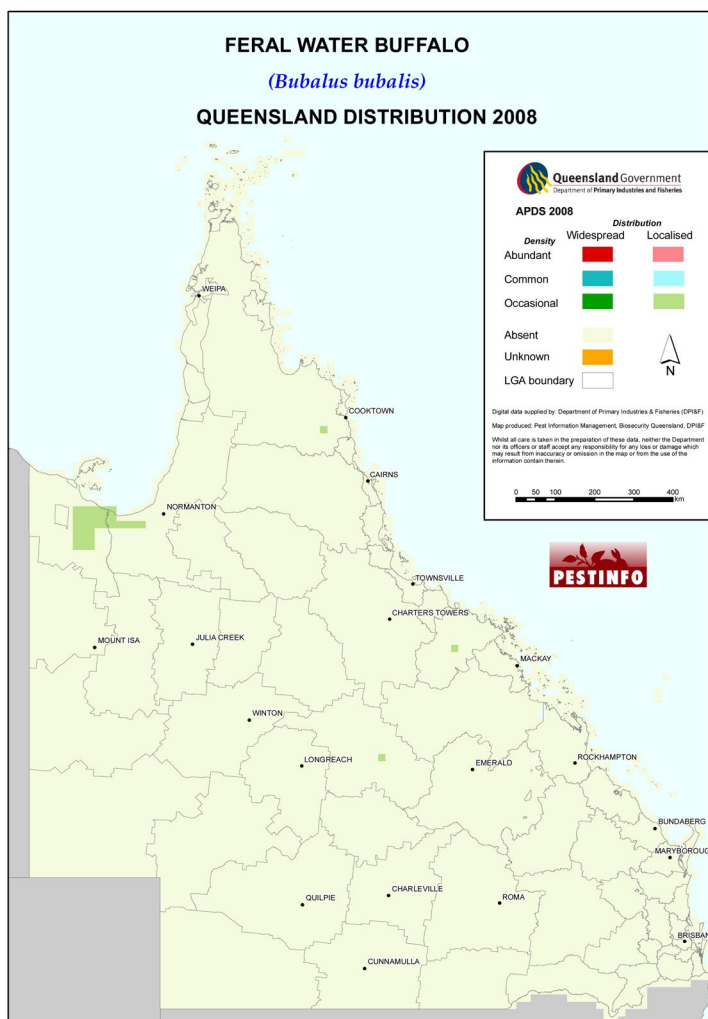


Figure 3. Distribution of water buffalo in Queensland

Management

Current and potential impacts in Australia

Water buffalo can cause significant environmental damage. Their habit of wallowing stirs up mud, making the water body unsuitable for many aquatic plants and animals. They consume substantial amounts of grass and other plants, and compete for food with native wildlife. As they move from one wetland area to another they create 'swim channels'. Where these channels intersect with tidal creeks, saltwater is able to move into freshwater wetlands, often killing plants and animals intolerant to saltwater (DEW 2006).

Habitat degradation by water buffalo can also impact on native fauna. It is believed that this habitat degradation decreases nesting activity in magpie geese (*Anseranas semipalmata*) and also possibly crocodiles (Northern Territory Government 2007). The reduction and degradation of waterholes may also impact on endangered species such as the Gouldian finch (*Erythrura gouldiae*) (O'Malley 2006).

Water buffalo have been the primary cause of two major 'ecological cascades' in Kakadu National Park. The first cascade occurred between 1960 and 1985, when buffalo populations increased exponentially and reached the area's maximum carrying capacity. Due to high levels of grazing, vegetation damage and soil compaction, water buffalo severely affected vegetation structure and composition in the main habitat types of flood plains, monsoon rainforests, savannah woodlands and open forest. Across all habitat types, there was a significant decrease in biomass (both green and litter) and a decrease in vegetative cover. In the flood plains, there was an increase in saltwater channels, a loss of freshwater vegetation and siltation of some ponds. Monsoon rainforests and savannah woodlands experienced a decrease in fire fuel loads and an increase in weeds (Petty et al. 2007).

The second cascade, from 1985 to 1994, corresponded with BTEC and a rapid decline in buffalo numbers. This sudden reversal in grazing pressure caused significant changes in vegetation ground cover and biomass (Petty et al. 2007). There is anecdotal evidence that *Mimosa pigra*, a weed of national significance, became much more abundant soon after water buffalo were removed by the BTEC campaign. In some areas, however, flood plains largely reverted to their natural state; there were fewer buffalo wallows, the water cleared, there was less salt intrusion, and plants such as red water lilies, grasses and sedge plants (valuable food for native animals) reappeared. However, rehabilitation work in these areas is often costly, requiring weed control, as well as the ongoing removal of buffalo (Findlayson et al. 1997; DEW 2006). Savannah woodlands experienced a rapid increase in biomass and change in plant species, which subsequently increased fires; and the lasting impact in monsoon rainforests was an increase in weed abundance (Petty et al. 2007).

The direct effect of buffalo on ground-level vegetation and soils in Kakadu National Park indirectly altered competitive relationships between trees, grasses and forbs, and also produced significant changes to fuel loads and fire regimes which, in turn, further altered species composition and overall structure of the savannah. The simple removal of buffalo was not enough of an impetus for Kakadu National Park's savannah system to revert to its previous state.

The current secondary increase in buffalo numbers in Kakadu National Park may in fact cause a third 'ecological cascade', the consequences of which are not yet known (Petty et al. 2007).

Queensland has not yet suffered environmental damage to the same extent as the Northern Territory, due to its low numbers of water buffalo. Approximately 2.24% of Queensland's mainland consists of wetlands considered suitable habitat for water buffalo (DIWA 1993). An additional concern is that buffalo may carry diseases that affect domestic stock. Buffalo were targeted under the BTEC program for this reason and the threat of new exotic diseases remains.

Current and potential benefits of water buffalo in Australia

The Australian Buffalo Industry Council Inc. (ABIC) was formed in 2000 to promote and consolidate the industry throughout Australia. The ABIC has membership in all states and actively promotes water buffalo meat and milk (ABIC 2005). There is now a national register for farmed buffalo (Sharp 2008).

Australian farmers looking to diversify often consider buffalo farming. Water buffalo may be farmed for milk and meat, with hides a by-product of meat production. Buffalo farmers in Australia are now selectively breeding buffalo to enhance meat and milk production, using methods such as artificial insemination and import of riverine buffalo from Italy and Bulgaria (ABIC 2008).

Because the Australian population of wild water buffalo is not as extensive as it once was, the feral buffalo meat supply has contracted. However, there appears to be a niche market for the animal's low-fat, low-cholesterol meat. This market has potential to expand. Buffalo may have some physiological advantages over cattle; they usually do not carry cattle tick except under exceptionally stressful conditions (Lemke 1994). There is also demand for buffalo in South-East Asia, with 3905 live buffalo exported from Australia in 2007 (Australian Buffalo News 2008).

Buffalo milk is an emerging product in Australia. Dairy buffalo are efficient milk producers. In India, water buffalo comprise about 35% of milk animals (other than goats) but produce almost 70% of the milk (Ligda 1998). In Australia, buffalo milk is used mainly for production of speciality cheeses. Buffalo milk is the traditional source of mozzarella cheese (Ligda 1998).

In less developed countries, water buffalo are valuable draft animals. However, they have few applications in Australia for this purpose.

In some areas of the United States and Australia, where there are substantial populations of feral water buffalo, a secondary industry has developed based on hunting. In Australia, buffalo hunting is an established business activity in the Northern Territory, catering mainly to international clients. A recent Rural Industries Research and Development Corporation (RIRDC) report on safari hunting (Dryden & Craig-Smith 2004) suggested that there was potential to develop a more extensive safari hunting industry in Australia, based on water buffalo and other feral animals. Water buffalo have recently been introduced to a safari hunting reserve in South Australia (Magnum Hunts & Taxidermy 2005). Other safari hunting operators may seek to diversify in the same way, placing water buffalo 'behind wire' for clients to shoot.

Part of the attraction of water buffalo hunting may be the association by name with the African or cape buffalo (*Syncaerus caffer*). The cape buffalo is ranked among the 'big five' iconic African animals and is considered by some to be the most dangerous animal on that continent.

However, the water buffalo is quite a different animal—a domestic animal turned feral. While the horns may be spectacular, the water buffalo hunting experience has been described as ‘not unlike that of shooting an unusually large and extra wary dairy cow with a high velocity rifle in exotic surroundings’ (Frith, cited in Lever 1985).

Impact overseas

The wild Asian buffalo is listed as endangered by the International Union for Conservation of Nature (IUCN) (Massicot 2004). In India and Nepal, proposed hydro-electric and irrigation projects threaten some of the last known homes of the species. In contrast, the worldwide population of water buffalo is around 150 million and, in many regions, numbers are increasing. The popularity of the animal in less developed countries reflects the water buffalo’s value as a multi-purpose beast, able to work as a draft animal as well providing milk, meat and leather. It is estimated that there were about 82 water buffalo per 1000 people in Asian agricultural populations in 1992 (Ligda 1998).

Feral water buffalo have been recorded as a pest in Sri Lanka where they cause damage to various agricultural crops, mainly in the dry zone (Bambaradeniya *et al.* 2005). Feral water buffalo populations also exist in Brazil, where they are a threat to important wetlands in the Amazon Basin (Thornback 1983; Kane 1989).

Legislative status in Australia

The Australian Vertebrate Pests Committee (VPC) has listed water buffalo as a category ‘3bM’ species (moderate threat). The VPC recommends that state and territory pest management agencies restrict the possession of water buffalo using a system of permits.

Under the Queensland *Biosecurity Act 2014*, water buffalo are not invasive animals. However, water buffalo are listed as ‘prohibited fauna’ under the Queensland *Nature Conservation Act 1992* and can only be kept under permit.

Feral water buffalo are a declared pest in Western Australia under the *Agriculture and Related Resources Protection Act 1976*. North of the 20th parallel (where the most suitable water buffalo habitat exists) they are declared in categories A1, A2 and A3. This means that their entry is prohibited; they are subject to eradication; and keeping these animals is prohibited. Elsewhere in the state, they are declared in categories A5 and A6. This means that the animals (if they are found) are to be controlled and their possession is regulated by a permit system.

In the Northern Territory, there is no specific feral animal legislation. Buffalo are not prohibited entry under the Territory Wildlife Regulations 2004. However, powers to control animals such as buffalo may be exercised under the *Territory Parks and Wildlife Conservation Act 2005* (to remove buffalo from Kakadu National Park), the *Stock Diseases Act 2004* (used for the BTEC program) and the *Soil Conservation and Land Utilization Act 2001*.

Small numbers of water buffalo are legally farmed in all states. Outside tropical areas of the Northern Territory, Western Australia and Queensland, escaped or released buffalo are unlikely to develop significant pest populations. However, the possession and sale of water buffalo in close proximity to tropical wetlands poses a risk.

Potential distribution

One of the primary factors that limits the potential range of a pest species is climate. Climate-modelling software (CLIMATE Version 1) was used to predict the area of Australia where climate is suitable for water buffalo (Figure 4). Based purely on an assessment of climatic parameters, substantial areas of north Queensland appear suitable. However, it is important to note that other habitat requirements, such as the presence of wetlands, will determine the species' range and abundance.

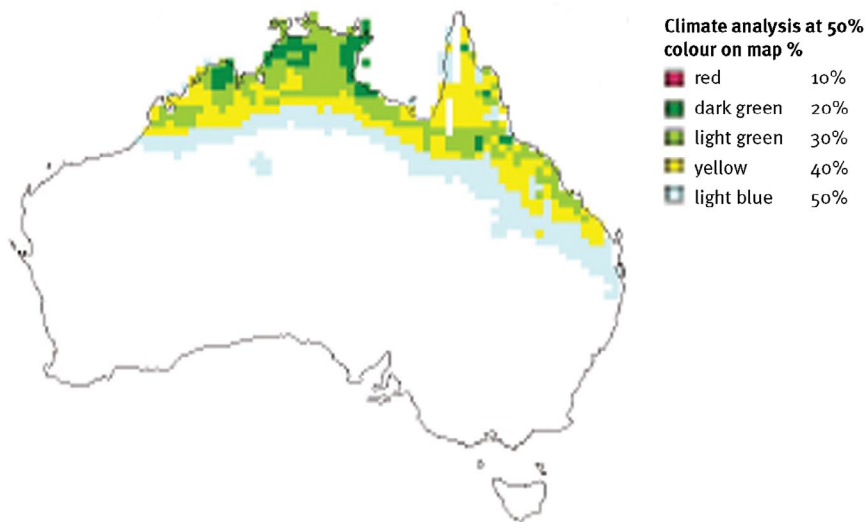


Figure 4. Potential distribution of *Bubalus bubalis* based on climatic suitability (climatic suitability is highest in red and green areas and marginal in yellow and blue; white areas are considered climatically unsuitable).

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