

World Heritage Sites

Protected Areas and World Heritage



SURTSEY ICELAND

Surtsey is an outstanding example of a newly created and persistent volcanic island intensively studied for its geology, geomorphology and ecology ever since its eruption.

COUNTRY

Iceland

NAME

Surtsey

NATURAL WORLD HERITAGE SITE

2008: Inscribed on the World Heritage List under Natural Criterion ix.

STATEMENT OF OUTSTANDING UNIVERSAL VALUE

The UNESCO World Heritage Committee issued the following Statement of Outstanding Universal Value at the time of inscription:

Values

Surtsey is a new island formed by volcanic eruptions in 1963-67. It has been legally protected from its birth and provides the world with a pristine natural laboratory. Free from human interference, Surtsey has produced long-term information on the colonisation process of new land by plant and animal life.

Criterion (ix): Ongoing biological and ecological processes: Surtsey was born as a new volcanic island in 1963-67 and since that time has played a major role in studies of succession and colonisation. It has been the site of one of the few long term studies worldwide on primary succession, providing a unique scientific record of the process of colonisation of land by plants, animals and marine organisms. Not only is it geographically isolated, but it has been legally protected from its birth, providing the world with a pristine natural laboratory, free from human interference. Above all, because of its continuing protection, Surtsey will continue to provide invaluable data on biological colonisation long into the future.

Integrity

The property includes the whole island and an adequate surrounding marine area, and thus all the areas that are essential for the long term conservation of the ecological processes on Surtsey. There is also a relatively small but functional marine buffer zone that is not part of the inscribed property. It is noted that part of the evolution of Surtsey is the process of coastal erosion which has already halved the area of the island and over time is predicted to remove another two thirds leaving only the most resistant core.

Protection and Management Requirements

Surtsey is a highly controlled, isolated environment and so threats are very limited. The purpose of strictly prohibiting visits to Surtsey is to ensure that colonisation by plants and animals, biotic succession and the shaping of geological formations will be as natural as possible and that human disruption will be minimised. It is prohibited to go ashore or dive by the island, to disturb the natural features, introduce organisms, minerals and soils or leave waste on the island. Nearby construction is also strictly controlled. The most significant management issue will be to retain the level of control and protection from human influence that has characterised the protective history of Surtsey. It is noted that, as an island ecosystem, there is the potential for human disturbance and pollution from a very wide area. Contingency planning, for example for oil spills, is required for the property and its wider surroundings. Given the lack of access a creative and positive approach to presenting the property will be required to ensure that visitors are able to appreciate, but not disturb, its values.

IUCN MANAGEMENT CATEGORY

Ia Strict Nature Reserve

BIOGEOGRAPHICAL PROVINCE

Icelandian (2.5.5)

GEOGRAPHICAL LOCATION

Surtsey is a small island lying 33 km from the mainland, the most remote of a chain of islands off the south-west coast of Iceland. The site is bounded by the following coordinates, reading clockwise from the north: 63°20'22''N x 20°35'31''W; 63°18'15''N x 20°31'16''W; 63°16'08''N x 20°36'04''W; 63°16'08''N x 20°40'00''W; 63°17'52''N x 20°40'00''W.

DATES AND HISTORY OF ESTABLISHMENT

1963: Surtsey volcano emerged from the sea in November, remaining active until mid 1967;

1965: Surtsey Island and surrounding seas declared a Strict Nature Reserve;

1974: Surtsey Research Centre appointed supervisors of the Reserve;

1999: Reserve covered by the Nature Conservation Act No.44;

2006: Reserve expanded to include the underwater slopes of the volcano and the submarine islets.

LAND TENURE

State, in the Municipality of Vestmannaeyjar. Supervised by the Surtsey Research Centre under the national Environment and Food Agency.

AREA

3,370 ha. Comprises 140 ha of land, 1,320 ha of submerged volcano, and 1,910 ha of ocean. These are surrounded by Surtsey Nature Reserve, a largely marine buffer zone of a further 3,190 ha, not included in the nominated area.

ALTITUDE

±130m below sea level to 155m (Austurbunki)

PHYSICAL FEATURES

Iceland is on and a part of one of the world's most active tectonic boundaries, the Mid-Atlantic ridge between the North American and Eurasian plates, the discovery of which in the 1950s led to general acceptance of Wegener's 1915 theory of continental drift. It is young land, dating from Pliocene times some 16.5 million years ago. Its vulcanism results from both rising magma which causes the plates to diverge and from lying on the hot spot over a magmatic plume. The main island is 90% basalt volcanic rock with 29 active volcanic systems, much hydrothermal activity and an eruption on average every three years. The Vestmannaeyjar system is a chain of 14 young volcanic islands and 30 skerries, just off the southwest coast, of which Surtsey is the most distant. This system last erupted, catastrophically, in Eldfell on nearby Heimaey in 1973 and has had 24 small episodic eruptions during the last 11,500 years, with more occurring undersea.

Surtsey emerged from the sea in mid-November 1963 in the explosion when upwelling magma at 1155°-1180°C met seawater at 10°C. Between 1964-65 three islets of tephra (volcanic ash) formed and were washed away. In mid 1964 submarine hydromagmatic explosions became effusive lava flows as the new rock blocked off the magma. The eruption ended in mid 1967, the longest ever known on Iceland and in 1979 its hydrothermal system slowed as the tephra hardened to tuff and became more resistant to heat. Surtsey is the type locality for basaltic tephra hardened to tuff at relatively low post-eruption temperatures. by hydromagmatic explosions in shallow water. The island's area was 2,650 ha in 1963, but after erosion of the loose tephra and lava by many harsh winter seas it is now 1,410 ha. Three accompanying islets (Surtla, Surtlingur and Jólnir), now seamounts, appeared and disappeared but their submarine erosion has stabilised. Surface erosion continues but the volcanic necks and tuff cones will endure.

The volcano formed on a short submarine ridge, rising 285m above the former sea bed to 155m above sea level. Its size is approximately 1.33km by 1.8km, formed of the crescentic tuff cones of Austurbunki and Vesturbunki, surrounding the two craters Surtur and Surtungur, with a wide apron of lava to their south, gullied northern talus slopes of tephra, aeolian sand and debris, and a long spit of lava boulders and coastal sediments to the north. The volcanic rock is alkali basalt. The tuff is a dense yellow-brown altered basaltic glass cemented by minerals (palagonite), vesiculated by little pockets of trapped steam

and containing xenoliths of sea bed rocks probably carried by icebergs from Greenland and caught up in the explosion. The surface is littered with rounded ejected lapilli. By 2005 85% of the tephra had been converted to palagonite tuff. The lava shield is 230m thick, reaching under water to a foundation of laval rubble. It covers the south half of the island, ending in cliffs 80m high in places. The surface is mostly smooth pahoehoe with some jagged aa lava; there are small hollow lava tubes and several caves containing speleothems and encrusted with mineral evaporites. Hydrothermal activity on the island continues: there are steaming fissures and a spring at 80°C is warmed by deep underground intrusions of magma. The soil has low nutrient content and low water retention. Blown loose tephra and sand make it difficult for life to take hold on exposed surfaces. For 43 years Surtsey has remained the most closely observed of submarine eruptions, a natural geological, geomorphological and ecological laboratory which since its first appearance as sterile land has been protected from human influence with its surface and ecology left to nature.

CLIMATE

The climate is humid sub-Arctic with relatively warm winters, cool summers and strong winds but it can be foggy and is often overcast. Measured on neighbouring Heimaey which averages 1°C cooler than Surtsey, the average winter temperature is 1.5-2°C with some 80 days below freezing; the summer average is around 10°C. Temperatures below -15°C or higher than 20°C are uncommon. The average annual rainfall is 1,600mm, falling mostly between October and March, a third of it as a mixture of rain and snow. Winds are strong, prevailing from the east off the mainland, and of hurricane strength 15 days a year. Waves are driven from the southwest and can be very high: 16.68m was recorded at a measuring buoy, and the lava cliffs are heavily eroded.

VEGETATION

Except for sea-borne pioneers, the development of vegetation in the sub-Arctic climate has been slow and it remains thin except around a colony of gulls. The basic soil is porous, with low water retention and no humus; tephra areas are salty and abraded by blown sand. Annual studies started in 1964. The first life found were moulds, bacteria and fungi followed in 1965 by the first vascular plants such as sea rocket *Cakile arctica* and other sea-borne coastal pioneers with large, salt-tolerant and easily floating seeds, probably from the nearby land. Light seeds such as *Salix* spp. and spore-bearing plants arrived by wind. Mosses followed in 1968, lichens in 1970. There followed a pause in colonisation until around 1990 a colony of gulls settled on the lava near the south end of the island. They brought in guano, seeds on their feet, in nesting materials and in faeces; also lichens, fungi and marine larvae, which have created healthy grassland around the colony by their enrichment of the soil.

By 2005 there were 51 vascular species, nine previously seen having failed to colonise. These included 32 forbs, 14 grasses, 5 sedges and rushes, 4 shrubs and two ferns; also 75 bryophytes, 71 lichens and 24 fungi. There are four vegetation communities: sand shore, gravel flat, lava and grassland. Three plants dominate the sand: sea sandwort *Honckenya peploides*, lyme grass *Leymus arenarius* and oyster plant *Mertensia maritima*; three are also commonest on the gravel: northern rock-cress *Arabidopsis petraea*, sea campion *Silene uniflora* and thrift *Armeria maritima*. The main lava species are procumbent pearlwort *Sagina procumbens*, reflexed saltmarsh-grass *Puccinellia coarctata*, and common scurvygrass *Cochlearia officinalis*. 10% of this community is covered by bryophytes. The forb-rich grassland is dominated by smooth meadow-grass *Poa trivialis*, annual meadow-grass, arctic fescue *Festuca rubra* and lyme grass, with the forbs mouse-ear *Cerastium alpinum*, sea mayweed *Tripleurospermum maritimum*, common chickweed *Stellaria media*, scurvygrass and sea sandwort. Bryophyte diversity is relatively high. This community is beginning to resemble bird enriched grasslands elsewhere in the archipelago. The most widespread species on Surtsey are sea sandwort, procumbent pearlwort, common mouse ear, annual meadow-grass *Poa annua* and lyme grass.

FAUNA

The first gulls landed two weeks after land first appeared and birds have been annually monitored ever since. The first birds began prospecting for nest sites in 1966. 89 species of birds have been recorded: 45 seabirds, 44 terrestrial species of which 12 bred on the island in 2005 and two more have nested. 57 breed elsewhere in Iceland, the rest are winter visitors, migrants or vagrants, mainly from Europe. The black guillemot *Cephus grylle* and northern fulmar *Fulmarus glacialis* (350-400 pairs in 2003) were the first to breed on the cliffs, in 1970. The lesser blackbacked gull *Larus fuscus* (150-200 pairs in 2003), herring gull, *L. argentatus*, great blackbacked gull *L. marinus* and glaucous gull *L. hyperboreus* form the colony; kittiwakes *Rissa tridactyla* (130 pairs) are fairly common on the cliffs. The first and still commonest land bird to breed was the snow bunting *Plectrophenax nivalis* in 1996. The first grazers

were 2 pairs of greylag geese *Anser anser* in 2002. The most frequent migrant wader is the oystercatcher *Haematopus ostralegus*.

335 species of invertebrates are recorded, 26% of Iceland's total, of which 174 had arrived in the first ten years. Of these, flies (136 species) mites & ticks (62), hymenopterans (28), springtails (24), beetles (21) and Lepidoptera (21) were the most plentiful but there were only 13 species of spiders. A midge was found in 1964, a moth in 1965 and a spider in 1966. The gull colony has contributed many species. Of marine mammals, seals visited early and by 1983 grey seals *Halichoerus grypus* were breeding on the northern spit; harbour seals *Phoca vitulina* may also be breeding. Killer whales *Orcinus orca*, minke whales *Balaenoptera acutorostrata*, harbour porpoise *Phocoena phocoena* and Atlantic white-sided and white-beaked dolphins *Lagenorhynchus acutus* and *L. albirostris* spp have been seen offshore. Marine species have accrued as planktonic algae or as benthic larvae. In the benthos about 80 species of macroalgae grow, especially in the first 15 metres, and 180 benthic animals, mostly below that, have been found in the rocky littoral and sublittoral zones; the unstable substrate may limit the spread of some species. Along the shores algae have a 60% coverage but other species are limited by the heavy breakers and by scouring mostly to annuals and a few small animals. The sublittoral is bouldery and rocky in the south and east, sandy in the north. Shallow water has opportunistic algae and mussels; at deeper levels there is a forest of kelp *Laminaria hyperborea* with a richer understorey of algae and fauna of sponges, hydroids, bivalves and sea star. Sessile animals dominate the hard-bottom community.

CONSERVATION VALUE

Surtsey is an outstanding example of a newly created persistent volcanic island intensively studied for its geological, geomorphological and ecological processes. It was protected from its first appearance and is the type locality of such emergent vulcanism. It lies within a WWF Global 200 Eco- region.

CULTURAL HERITAGE

Iceland has a long history of volcanic eruptions which has entered their literature. The island was named the ey (island) of Surt, the fire giant of the Eddas.

LOCAL HUMAN POPULATION

Vestmannaeyjar on Heimaey is Iceland's main fishing village. It has 4,200 people, fewer than in 1973 when a third of its houses were destroyed by the eruption of Eldfell. Surtsey itself is uninhabited.

VISITORS AND VISITOR FACILITIES

The public is not allowed on Surtsey but there are overflights by helicopter, boat tours around the island, and cruise ships often pass nearby. A visitors' centre with a permanent warden will be established in Vestmannaeyjar village, which has museums and an exhibit of the houses burned in the 1973 eruption. It is reached by air or ferry and has hotels, hostels and campsites.

SCIENTIFIC RESEARCH AND FACILITIES

Surtsey is an unusual long-lasting example of a marine volcanic island as a laboratory, the geology, geomorphology and ecology of which has been studied, and protected, from the first month after its appearance in the most closely observed of any submarine eruption. For forty years it has been photographed and visited briefly in summer by a few scientists who have studied and monitored every aspect of its appearance and disappearance and its colonisation by plants, birds and marine organisms. Apart from the physical growth of the island, research has covered lightning, magmatic temperatures, volcanic gasses, the possibility of abiogenesis, lava viscosity, the development of palagonite tuff, wave erosion and the hydrothermal system, which has been monitored and mapped continuously. It has also been the site of one of the few world studies with long-term data on primary succession. The Surtsey Research Society maintains one hut with 8-10 beds and a helipad, assists ongoing research by the Iceland Institute of Natural History and the Marine Research Institute and has published 11 issues of *Surtsey Research* since 1965. More than 900 papers and books have been published on the island. The nomination bibliography lists 105 references, and 220 are given in a supplementary *Bibliography of Surtsey 1963-2006*. Regular seminars are held on aspects of the island. Vestmannaeyjar also has a local research centre. The site is a remarkable illustration of northern island biogeography exactly contemporaneous with the publishing of the theory of island biogeography by McArthur and Wilson.

MANAGEMENT

The present state of preservation is excellent. From the first, the island was protected by strict visitor regulations against accidental introduction of plants and animals or disturbance of the land, and wastes were taken out. The boundaries were later drawn to protect the surrounding seabed and sea mounts. Fishing is permitted in the buffer zone, but neither mining nor construction, and in 2006 bottom-towed net fishing nets were banned in the core zone. The 1999 Act provides for punishment of any infringements. A Surtsey Nature Reserve Management Plan for 2007-2017 has been drafted. The Surtsey Research Society monitor visits the island and maintains the field hut. It is assisted by the Institutes of Natural History and Marine Research. A Municipal Plan for the Vestmannaeyjar archipelago 2002-2014 was ratified in 2005 for its protection as a Managed Nature Reserve, mainly for its large seabird colonies and uncommon species. Continual monitoring is done, at annual, biannual and regular longer intervals, of the climate, waves, new vegetation, insects, birds, vegetation plots, erosion, palagonite tuff, hydrothermal activity, the ecosystem and marine biota.

MANAGEMENT CONSTRAINTS

The effects of natural phenomena are accepted as part of the essence of Surtsey and the minimum of construction has been allowed: one abandoned lighthouse foundation on Austerbunni may be removed. A main shipping route from Europe runs between Vestmannaeyjar and the coast and quantities of flotsam wash up on the coast, as an oil spill could also do in the future.

COMPARISON WITH SIMILAR SITES

The main bases for comparison with similar existing World Heritage sites, considered in the categories under which they have been nominated, are:

(viii) The island as an outstanding example, pristine, intact and undisturbed by man, of geological and geomorphological volcanic processes which have lasted over 40 years of rapid change and have been monitored from their first appearance. It is important as evidence of the submarine eruption of a new island, for the post-eruption conversion of tephra to palagonite tuff, for its hydrothermal system, for coastal erosion of lava, and for the submarine abrasion of volcanic islets.

(ix) An excellent example of a more than 40 year-long intensive study and record of the continuing ecological and biological development of coastal and marine ecosystems, the dispersion and succession of plants, of colonisation by animals and the interactions between the two on a fresh volcanic substrate. It resembles the Aeolian Islands as a textbook example of vulcanism.

Several parallels with Surtsey exist among World Heritage sites, though none with a similar record of meticulous monitoring from their first appearance although the Aeolian Islands have long been well observed. Many volcanic islands do not last as long as Surtsey after erupting. The one major exception is *Anak Krakatau*, in Ujong Kulon, which appeared in 1927-30 from the flooded crater of the first great 1883 Krakatau eruption. This is also an active phreato-magmatic tephra cone and has been documented, if sporadically, but is also visited by tourists and even camping fishermen. It is in a state of continuous minor eruption.

Other volcanically active island World Heritage sites include:

- The *Isole Aeolie* in the Mediterranean off Sicily, another 'geological textbook'. Stromboli and Vulcano have been continually active and monitored for centuries;
- The *Galapagos Islands*: Fernandino is a small relatively recent volcanic island. Isabella Island has five vents, all very active, Cerro Azul being the highest;
- *Halemauau* the currently extremely active fire pit on Kilauea, Hawaii;
- *Heard & McDonald Islands* in the South Indian Ocean, which are pristine but almost completely glaciated. The Big Ben peak of Mt. Mawson is quite active;
- *Morne Trois Pitons* on Dominica is an old volcano with five peaks. It has many hydrothermal features: solfataras, hot springs and a boiling lake;
- *The Pitons* on the Caribbean island of St Lucia has an active solfatara.

There are also the dormant, inactive or relict volcanic island sites of Teide and St Kilda also in the north Atlantic, Jeju off South Korea, with a large inactive tephra cone, Cocos Island and Malpelo Island in the east Pacific, Komodo in Indonesia, Gough & Inaccessible Islands in the south Atlantic and the Lord Howe Islands, New Zealand Sub-Antarctic Islands and MacQuarie Island groups in the south Pacific, which have considerable biological diversity.

STAFF

The Surtsey Research Centre administers the island but most of the workers are volunteers from or working with the Iceland Institute of Natural History and the Marine Research Institute. Training in protected area conservation and management is given by the Environment and Food Agency.

BUDGET

The state gives the Surtsey Research Society €7,000 (US\$9,550) a year, and the research institutes finance research and monitoring. The coastguard provides transport.

LOCAL ADDRESSES

Environment and Food Agency of Iceland, Suðurlandsbraut 24, IS-108 Reykjavík, Iceland.

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Website: www.surtsey.is

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