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## WORLD HERITAGE NOMINATION – IUCN TECHNICAL EVALUATION

### ILULISSAT ICEFJORD (DENMARK) ID N°: 1149

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#### 1. DOCUMENTATION

- i) **IUCN/WCMC Data Sheet** : 1 reference (Bibliography in nomination includes 267 references)
- ii) **Additional Literature Consulted:** Born, E.W. and Bocher, J. 2001. **The Ecology of Greenland**. Ministry of Environment. Nuuk. 429p.; Hansen, Kjeld.2002. **A Farewell to Greenland's Wildlife**. Copenhagen. 154p.; Nowlan, L. 2001. **Arctic Legal Regime for Environmental Protection**. IUCN Environmental Policy and Law Paper 44; Nordic Council of Ministers. 1996. **The Nordic Arctic Environment-Unspoilt, Exploited, Polluted?**; AMAP. 1997. **Arctic Pollution Issues**. Oslo; CAFF. 2002. **Protected Areas of the Arctic-Conserving a Full Range of Values**. Ottawa; CAFF. 1994. **Protected Areas in the Circumpolar Arctic**. Directorate for Nature Management, Norway; Nordic Council of Ministers. 1999. **Nordic Action Plan to Protect the Natural Environment and Cultural Heritage of the Arctic**. Oslo. 95p.; IUCN. 2003. **Global Strategy for Geological World Heritage sites**. Draft.
- iii) **Consultations:** 8 external reviewers contacted. Government officials from Ilulissat, Nuuk and Copenhagen. Staff of Geological Survey of Denmark and Greenland.
- iv) **Field Visit:** Jim Thorsell, August, 2003.

#### 2. SUMMARY OF NATURAL VALUES

Ilulissat Icefjord is located within the Arctic Circle on the west coast of Greenland in the bay of Disko Bugt (bight) in the Municipality of Ilulissat. The size of the site is 4,024 km<sup>2</sup>, comprising 3,199 km<sup>2</sup> of glacier ice, 397 km<sup>2</sup> of land, 386 km<sup>2</sup> of fjord and 42 km<sup>2</sup> of lakes. The Ilulissat Icefjord is a tidewater ice-stream which drains into the bay of Disko Bugt, which is partially blocked by the large island of Disko. The Icefjord (locally called Kangia) is the sea mouth of Sermeq Kujalleq, one of the few glaciers through which the ice of the Greenland ice cap reaches the sea. It is the most prolific and second fastest ice-calving tidewater glacier (glaciers that calve into the sea) in Greenland producing a constant procession of icebergs and still actively eroding the fjord bed. Surrounding geology includes heavily glaciated Precambrian gneiss and amphibolite rocks extending some 50 km inland to the ice cap with flanking lateral moraines and ice-dammed lakes. Also common are glacial striations, roches moutonnées, and perched erratics typical of glaciated landscapes.

The Greenland ice cap is the only remnant in the Northern Hemisphere of the continental ice sheets from the Quaternary Ice Age. The ice cap formed during the Middle and Late Pleistocene over a once temperate landscape, the south central part of which drained through large rivers to Disko Bugt, still marked as channels under the ice and submarine troughs. The ice cap's oldest ice is estimated to be 250,000 years old, maintained by an annual accumulation of snow matched by loss through calving and melting at the margins. The ice cap holds a detailed record of past climatic change and atmospheric conditions (in trapped air bubbles) for this entire length of time, and shows that during the last ice age the climate fluctuated between extreme cold and warmer periods. This ended around 11,550 years ago, since when the climate has been more stable. Around Ilulissat Icefjord, the evidence of glaciation is mainly from the last 100,000 years. This culminated in the "Little Ice Age" 500–100 years ago when the ice expanded in pulses to a maximum during the 19<sup>th</sup> century. A glacial recession has occurred during the 20<sup>th</sup> century. In 1851 the ice front across the fjord was 25 km east of the sea. By 1950 it had retreated some 26 km further east.

Sermeq Kujalleq is a river of crevassed ice with a catchment area of about 6.5% of the Greenland ice cap (~110,000 sq. km). The ice stream is a narrow well-defined channel approximately 3-6 km wide. It stretches from the nose of the glacier to the 1,200m contour (about 80–85 km inland) which is just below the point where ice accumulation is balanced by ablation. Near the ice sheet, it has a hummocky smooth surface with relatively few crevasses. The extensive summer melt is drained by large meltwater rivers often running in deep canyons and disappearing through moulins (glacial holes) into a sub-glacial drainage system sometimes termed ice karst. 50 km from the glacier front the ice becomes increasingly rugged; lakes and water-filled crevasses disappear. Marginal crevasses extend 5 km or more to each side of the ice stream. About 45 km inland from the front, the surface funnels towards the main outlet. At the grounding line the glacier is consistently moving at the unusually fast rate of 19m a day or about 7 km a year.

The calving front of the glacier has an average height of 80m while the mean ice thickness in the fjord is approximately 700m. The outermost 10km of the glacier is mostly a floating mass of ice. The floating part of the glacier moves up and down with the tide, with a maximum range of 3m, decreasing towards the grounding zone. This tidal variation results in a diurnal fluctuation of the grounding line, and ice-quake activity, varying in intensity with the tidal cycle, can be felt up-glacier about 8 km from the glacier front. The fjord is frozen solid in winter and covered with floating brash and massive ice in summer. The annual calving through Ilulissat Icefjord of over 40 cu. km of ice is 10% of the production of the Greenland ice cap and more than any other glacier outside Antarctica. Occasionally, large tabular icebergs of up to 0.4 cu. km break off. Calving is continuous and one estimate of the calving rate is around 35 cu. km a year. Generally bergs take 12 to 15 months to push through the ice-brash cover of the fjord and if sufficiently deep, accumulate over a sill in the bedrock at the fjord mouth until pushed or floated off. They are extremely variable in size and shape from small pieces to mountains of ice more than 100m above sea level, often with pointed peaks. The whitish ice is often cut by bands of transparent bluish ice formed by the freezing of melt water in the marginal crevasses. Once at sea, the icebergs travel both south and north of Disko Island before entering Davis Strait between Greenland and Canada where they are first carried north by the West Greenland Current, then towards Canada, and finally southwards with the Baffin and Labrador Currents, many not melting before they reach latitude 40°N.

As Ilulissat Icefjord is located 250km north of the Arctic Circle, the climate is characterised by sunless winters and nightless summers only two to three months long. The main plant communities of the area are heath, fell-field, snow-patch, herb-slope, willow-scrub, fen, river-bank, seashore and aquatic. The upwelling caused by calving icebergs brings up nutrient-rich water which supports prolific invertebrate life and attracts great numbers of fish, seals and whales that feed on the generated nutrients. Twenty species of fish have been recorded in the area, the dominant species being the flatfish Greenland halibut. Sea birds are common in the area, with numerous breeding colonies of fulmars and gulls attracted by the high primary productivity of the glacier front and by fish discarded by the local fishery. Land birds include several species of geese, snow buntings, rock ptarmigan and Peregrine falcon. Land mammals are few with arctic hare and arctic fox common. Several important archaeological sites are found in the area.

### **3. COMPARISON WITH OTHER AREAS**

Only one natural World Heritage site is found north of the Arctic Circle – Laponian Area in Sweden. Although this site contains many small remnant valley glaciers, it is primarily a vegetated mountain and plains landscape. There are no sites in the Greenland Tundra Biogeographical Realm. 17 sites on the World Heritage List contain glaciers, all of which are valley glaciers, while Ilulissat emanates from and contains part of an ice sheet. Indeed, the Greenland ice sheet is the only remnant in the Northern Hemisphere of the continental ice sheets of the Quaternary Ice Age. Several existing World Heritage sites encompass fjords, notably the St Elias mountain complex (which contains tidewater glaciers) in USA/Canada, Gros Morne National Park in Canada, and Te Wahipounamu - SW New Zealand. However, Ilulissat is an icefjord totally covered by calving ice from the Greenland ice sheet. The most comparable protected area in the arctic is the Northeast Greenland National Park, which is

much larger in size and features include fjords and ice streams but none is as active or has such high volume and velocity as that displayed at Ilulissat. Major glaciers also occur in Svalbard and Iceland but none is similar to the ice stream and icecap in Ilulissat. In Norway two fjord landscapes are being considered for nomination but glaciers are not present in either area.

The 1.7 million km<sup>2</sup> Greenland ice sheet is substantially smaller in size than the Antarctic ice sheet at 13.5 million km<sup>2</sup>. The climatic regimes are also different with substantial surface melting in Greenland due to its warmer low arctic temperatures. Glacial ice in the Antarctic is much older - 700,000 years - compared to 250,000 in Greenland. The velocity and mode of discharge of ice in Antarctica is much different, being relatively slow with discharges mostly made onto surrounding ice shelves rather than continuously into fjords as seen in Ilulissat. Eight ice streams do exist in Antarctica, six of which have greater discharges (up to twice that of Ilulissat), mostly in the form of sudden calving events and with much slower annual velocities. Apart from the legal constraint of applying the World Heritage Convention in the Antarctic, no large protected areas exist on that continent.

One other site in the arctic region which has been nominated for World Heritage status is Wrangel Island Reserve in the East Siberian Sea of the Russian Federation. Wrangel Island was, however, not glaciated during the last ice age and is largely covered by tundra vegetation. Its values are primarily biological, based on its diverse wildlife population. There is thus no similarity between Wrangel Island and Ilulissat.

In summary, the Ilulissat Icefjord is the pre-eminent glacier in the northern hemisphere in terms of the annual volume of ice it produces (equivalent to 10% of the Greenland ice sheet production) and the high velocity at which the ice discharges into the sea (7 km per year). Its other distinctive characteristic is the intensive erosion caused by the ice stream which is greater than any other and provides the world's most outstanding example of large-scale valley and fjord forming processes. The dramatic setting of the Icefjord with its continuous active movement is a natural phenomenon not found to this extent elsewhere.

## **4. INTEGRITY**

### **4.1 Legislation**

The nominated area is protected and conserved by an established framework of government legislation and protective designations and by local planning policies. The principal of these legislative measures is the 1980 Nature Conservation Act for Greenland. This act is the foundation framework for the protection of species, ecosystems and protected areas, although a new Act is now being prepared. Ilulissat itself is protected under the Greenland Home Rule Executive Order of March, 2003, and by the management plan adopted by the Municipal Council in 2002. A strong point in this Executive Order is its prohibition of any mining in the protected area. IUCN finds the legal basis satisfactory but feels the management plan will need to be revised in the near future if pressures from tourism and resource harvesting continue to grow.

### **4.2 Boundaries**

The boundary of the site has been drawn to encompass all the interdependent elements of the geological process of the icefjord – the relevant portion of the inland icecap, the ice stream, the glacial front and the fjord. The boundary also follows the watershed of the fjord and thus incorporates the adjacent moraines, kame terraces and deltas. Excluded are the settlements of the nearby villages of Ilimanaq and Ilulissat where a *de facto* buffer zone is defined within the municipality plan.

### **4.3 Management**

Along with climatic limitations and the fact that no roads exist in the site, the area's physical features retain a high degree of natural integrity. There is extensive hunting and fishing,

however, which occurs in a portion of the site and many biological resources have been diminished (particularly nesting seabirds) through over-harvesting. As the site is not being nominated for its living resources, these concerns may seem peripheral to this evaluation but nevertheless are part of the natural attraction of the area and should be closely monitored.

The site itself is managed cooperatively by a Board consisting of representatives from the Ministry of Environment and Nature and the Municipality of Ilulissat. Relevant authorities from Denmark are involved on an advisory basis and attend the annual Board meeting. The Municipality is responsible for day to day site management and will soon hire a full time site manager. Additional staff within the Municipality are involved on a part-time basis as are Game Rangers from the Greenland government who control fishing and hunting along the coast.

IUCN's concerns over management relate to tourism and the need to update the management plan (currently valid until 2007) in light of its possible inscription on the World Heritage List. As tourist numbers are expected to grow from their current level of 10,600 visitors per year, more attention will be required to ensure that impacts are minimized. This includes the use of helicopters to access the region which will need some flight path restrictions as well as careful monitoring of the operation of the planned tourism cabins within the site. A visitor centre is also planned and, wisely, its location will be within the town of Ilulissat rather than on the edge of the site itself. Recognising Ilulissat's status as a protected area is recent and it would be useful, therefore, to request a monitoring report on implementation of the management plan in 3 years time (assuming the site is inscribed).

## **5. ADDITIONAL INFORMATION**

### **5.1 Scientific Research**

Scientific research over 150 years has made Ilulissat Icefjord and surrounds one of the best observed ice-streams in the world. A significant and unique set of glaciological records and many scientific publications have been written about the site. The site displays most of the surface characteristics of the Greenland ice margin clearly, compactly and accessibly. From the relatively ice-free mid 18<sup>th</sup> century onwards, the Icefjord interested many scholars who noted its fluctuations over the years. Study, especially over the last 10-20 years using aerial photography, core drilling, deep radar sounding and satellite monitoring, has been intensive. Such research has enlarged understanding of ice-stream dynamics, glacial erosion and deposition, Quaternary geology and prehistoric climates through the examination of ice cores. With the concern over monitoring global climate change, Ilulissat will have much to offer in future as well. Research into the fauna found within the site's locality has, however, been far less. Finally, understanding the area's 4500 years of human history, evident in the archaeological sites, has illustrated the interplay between glacial movements and human migration.

### **5.2 Nomination Document**

The nomination document as presented by the Danish and Greenland Home Rule governments is very thorough and provides an excellent introduction to modern glaciology and the current understanding of the recovery of the Quaternary glaciation. The authorities should be commended for preparing one of the better examples of a natural World Heritage nomination.

## **6. APPLICATION OF CRITERIA / STATEMENT OF SIGNIFICANCE**

The Ilulissat Icefjord has been nominated under natural criteria (i) and (iii).

### **Criterion (i): Earth's History and Geological Features**

The Ilulissat Icefjord is an outstanding example of a stage in the Earth's history: the last ice age of the Quaternary Period. The ice-stream is one of the fastest (19m per day) and most active in the world. Its annual calving of over 35 cu. km of ice accounts for 10% of the production of all Greenland calf ice, more than any other glacier outside Antarctica. The glacier has been the object of scientific attention for 250 years and, along with its relative ease of accessibility, has significantly added to the understanding of ice-cap glaciology, climate change and related geomorphic processes. IUCN considers that the nominated site meets this criterion.

### **Criterion (iii) Superlative natural phenomena, scenic beauty**

The combination of a huge ice sheet and a fast moving glacial ice-stream calving into a fjord covered by icebergs is a phenomenon only seen in Greenland and Antarctica. Ilulissat offers both scientists and visitors easy access for close view of the calving glacier front as it cascades down from the ice sheet and into the ice-choked fjord. The wild and highly scenic combination of rock, ice and sea, along with the dramatic sounds produced by the moving ice, combine to present a memorable natural spectacle. IUCN considers that the nominated site meets this criterion.

The nomination fulfills the relevant Conditions of Integrity and the site is under no serious threat.

## **7. RECOMMENDATION**

IUCN recommends that the World Heritage Committee **inscribe** the Ilulissat Icefjord on the World Heritage List under natural criteria (i) and (iii).

IUCN also suggests that the Committee recommend the authorities to revise the management plan to better take into account the growing pressures from tourism and to focus more attention on the biological resources of the site. Specific issues that should be taken into account include:

- ensuring that hunting, fishing and tourism activities are undertaken using principles of sustainability and environmental capacity, and
- formulating and implementing a zoning plan to define tourism limits.

A monitoring report on progress achieved should be requested for 2007.