WORLD HERITAGE NOMINATION - IUCN TECHNICAL EVALUATION

MIGUASHA PROVINCIAL PARK (CANADA)

1. DOCUMENTATION

i) **WCMC Data sheet:** (17 references)

ii) **Additional literature consulted:** Richard and Lelievre, Herve, 1998. **Comparative Study of the fossiliferous sites of the Devonian.** Ministry of Environment and Fauna, Government of Quebec, Cloutier; Wells, R.T. 1996. **Earth's geological history - a contextual framework for assessment of World Heritage fossil site nominations.** Working Paper No. 1 of Global Theme Study of World Heritage Natural Sites, IUCN. **Reglement sur les Parcs (Park Regulations)**. Government of Quebec. Selection of newspaper articles, media reports, tourist documents and popular science writings, including: Grescoe, T., 1997. Where Fishes Walked. **Canadian Geographic**.

iii) **Consultations:** 1 external reviewer. Director-General, Parks Quebec. Director, Miguasha Provincial Park. Officials from Parks Canada, Department of Parks & Wildlife and Quebec Department of Environment. Park palaeontologist and other park staff.

iv) **Field Visit:** May 1999. Paul Dingwall and Associate Professor David Elliott.

2. SUMMARY OF NATURAL VALUES

Miguasha Provincial Park is located on the north shore of the Ristigouche River, which also forms the southern coast of the Gaspe Peninsula in south-eastern Quebec, Canada (see Map 1). The Park, covering some 87ha, was established in 1985 to protect the coastal exposure of the Escuminac Formation. This Formation (see Map 2), which is Upper Devonian in age and contains a unique vertebrate fossil fauna, is 8km long and 1km wide. It attains a maximum height of 100m and is represented by four distinct outcrops. The most important of these extends for 3km, rises to 30m and essentially constitutes the park. Dating from 370 million years ago, the Escuminac Formation is composed of alternating layers of sandstone, silt and schists, and is overlain by the Carboniferous-age Bonaventure Formation whose reddish colour is the origin of the term "Miguasha" in the language of the native Micmac people.

The fossil assemblage at Miguasha is particularly important for representing fishes of the Devonian Period. Of the eight groups associated with this period, which is commonly referred to as the "Age of Fishes", six are found at Miguasha - this degree of representation being rare among sites of the same age throughout the world. Furthermore, the site is remarkable for the exceptional condition of fossil remains, including 3-dimensional specimens and allowing for observation and study of soft body parts such as gill imprints, digestive traces, blood vessels and cartilaginous elements of skeleton. Of great importance is the presence of the crossopterygian group of fishes, which share many characteristics with the tetrapods: (four-legged land animals). It was the discovery of one of these, the Eusthenopteron (the so-called "Prince of Miguasha") which focused the attention of the international scientific community on the Escuminac Formation, giving rise to the modern conception of evolution from fish to land dwelling vertebrates.

The site is also distinguished by fossil invertebrates, plants, and spores including the first terrestrial scorpion, 10 species of plants belonging to the first vascular flora of the primitive Devonian forests, and some 80 spore species. These allow a picture of the Devonian ecosystem to be constructed.

3. COMPARISON WITH OTHER AREAS

Miguasha is included on the Global Indicative List of geological sites as compiled by the World Heritage Geological Working Group. Sites with important fossil values on the World Heritage List include the Canadian Rocky Mountain Parks (which contain as one of their many features the famous Burgess Shales), the Dinosaur Provincial Park (with 60 species of Cretaceous dinosaurs) and the Grand Canyon National Park (where exposed horizontal strata display fossil remains over 2 billion years of geological time). The Australian Fossil Mammal Sites (Riversleigh/Naracoorte) are considered to be among the world's ten greatest fossil sites (Wells, 1996). They illustrate the evolution of Australia's mammal fauna. Many other World Heritage sites contain notable fossils as one element of their total value but there is no site on the list for its fossil values alone.

The State Party commissioned a study, published in 1998, to establish the relative scientific and conservation significance of the world's Devonian fossil sites. The scientifically based methodology for this comparative assessment takes careful account of the 10-question checklist developed by IUCN for evaluating the significance of fossil sites (see Annex 1), and the nine recommendations in the 1996 report of Wells for establishing the World Heritage standing of a fossil site. The authors derived seven criteria for addressing the relative significance of sites: vertebrate biodiversity; faunal representativeness; evolutionary representativeness; environmental representativeness; palaeobiological representativeness; quality of fossil preservation, and abundance of specimens. An initial evaluation was made of 61 of the world's Devonian vertebrate fossil sites, selected by a process of extensive bibliographic search and consultation with other scientists. The list was then reduced to 15 key sites, including Miguasha, by eliminating those not meeting at least one of five qualifying criteria, viz.: more than 10 vertebrates species; more than three major groups of fishes; more than one environmental component; macroremains of vertebrates; and more than 100 vertebrate specimens.

These 15 sites were then evaluated using a scoring system, awarding either an arbitrary score or an absolute score based on actual numbers. From this evaluation, Miguasha is ranked as being:

- 6th in overall vertebrate biodiversity, its lower ranking due mainly to the absence of sharks, and some other minor groups;
- 1st in representativeness of evolutionary events particularly because of the presence of many first and last representatives of animal groups, and organisms of unusual anatomical interest;
- 3rd in palaeobiological representativeness, measured from features such as ingested prey, or growth series;
- 1st in quality of fossil preservation, especially on account of the existence of 3-dimensional and soft anatomy specimens; and
- 1st in abundance of specimens, due in particular to the accessibility of the site and extensive collections by museums and research institutions over the past century.

A final, overall rating places Miguasha first in seven of the 10 significance categories assessed, and either second or third in the remaining three categories. The study, therefore, concludes that among more than 60 of the world's most important Devonian fossil sites, the Escuminac Formation of Miguasha is outstanding as the most representative of the Devonian Period. Furthermore, Miguasha is revealed as globally paramount in representing evolutionary events, the exceptional quality of specimen preservation and the abundance of vertebrate fossils.

The comparative assessment report is considered a fair reflection of Miguasha's primary ranking among the world's Devonian fossil sites. The report is authoritative and its authors have impeccable credentials in palaeontology for undertaking the study with internationally recognised expertise in Devonian fossil vertebrates including sarcopterygian fishes - the group from which land animals developed; and placoderms - a group of jawed vertebrates confined to the Devonian.

There are some qualifications that should be borne in mind, however. The comparative assessment report highlighted some of the inherent methodological difficulties in undertaking comparisons among fossil sites. For example, deciding what features to evaluate and how to score them.

Devonian fish sites, being marine in origin are relatively widespread and consist of many of the same species. Miguasha, thus, is not the only such site of renown for fossil fishes. Two of these, Gogo Station and Canowindra, both in Australia, were included among the 15 key sites evaluated in the comparative study. In the final analysis, the Gogo size is ranked fifth and Canowindra fourteenth. Gogo, though globally significant, is more restricted than Miguasha in its representation of Devonian environments, and is less exceptional in terms of vertebrate anatomical preservation. Canowindra is comparatively low-ranked in all respects among the 15 key sites. The other significant site, Rhynie Chert in Scotland, is significant only for preservation of terrestrial plants and lacks the vertebrate faunas necessary for it to represent the Devonian as the "Age of Fishes".

4. INTEGRITY

The long-term security of protection and management of the site are not in question, and all relevant conditions of integrity are satisfactorily met. This site fully meets World Heritage Integrity criteria where other sites fail to do so. The comparative study mentioned above shows that of the 15 key Devonian age fossil sites assessed in the world, only Miguasha enjoys formal protection.

The nominated site is a Provincial Park within an extensive protected area system in the Province of Quebec. It has statutory protection in perpetuity under Quebec law, with legislative provision both for park management and for protection against mining activities. The land tenure is public property under the jurisdiction of the Quebec Government. The administrative system for parks in Quebec is currently being restructured under a new Ministry of Fauna and Parks. Responsibility for park operations has been transferred to the State-owned Societe des etablissements de plein air du Quebec (SEPAQ), while legal, policy and planning functions will be conducted by a new Societe de la faune et de parcs (SFP).

There is a legally binding management plan for the Park which establishes the paramount protection objectives of management while providing for compatible recreational, education and research uses through use of a zoning system. The plan prohibits all forms of exploitation, modification or exploitation which might detrimentally affect the park environment and natural values.

The park boundaries are appropriately located to encompass a substantial proportion of the Escuminac Formation, including its most continuous surface expression. There are plans to extend the park boundaries in future.

Annual visitation is approximately 40,000 with use restricted to low-impact observation and appreciation of the park environment. The collection of fossils is strictly prohibited except for approved scientific and educational purposes. There is remarkably very little experience of illegal collection, but many instances of visitors adding valuable fossils to the collections. The entire area of the park and a surrounding privately owned 775ha Peripheral Zone are protected from mineral exploration and excavation activities. There are no permanent residents in the Park and the Park headquarters are located in the Peripheral Zone, which also has about 120 residents. The park is

adequately staffed and financed to ensure security of protection and meet the educational and recreational needs of visitors.

5. ADDITIONAL COMMENTS

The 1993 nomination of Miguasha Provincial Park for inscription on the World Heritage List was withdrawn by the State Party pending development of a contextual framework for assessing World Heritage fossil sites, and further examination of the comparative significance of Miguasha in relation to the natural values of other Devonian fossil sites. IUCN has since developed this contextual framework, including a checklist of criteria for measuring the World Heritage significance of sites (see Annex 1). These have been carefully taken into account in the new nomination as well as in the comparative study (Section 3 above).

The Committee have previously rejected three earlier fossil nominations (*Jixian* (Permian exposures in China), the *Petrified Forest on Lesbos* (Greece), and the *Fossil Findings of Ipolytarnoc* (Hungary)) as they did not meet natural criteria. Despite this the rigorous comparative assessment applied to this nomination should be seen as a significant step forward in objectively assessing the outstanding universal value of fossil sites.

6. APPLICATION OF WORLD HERITAGE NATURAL CRITERIA

Miguasha is nominated in accordance with World Heritage natural criterion (i), as an outstanding representative of a major stage in the earth's history, including the record of life.

Its claim is based upon the site's international scientific reputation as the most outstanding place in the world for preserving fossils that characterise the Devonian Period as the "Age of Fishes" (360-410 million years ago).

Miguasha is of paramount importance in having the greatest number and best preserved fossil specimens found anywhere in the world of the lobe-finned fishes that gave rise to the first four-legged, air-breathing terrestrial vertebrates - the amphibians. In fact, Miguasha's extensive fossil assemblage includes the oldest known specimen of the world's amphibian ancestors.

Of all the world's Devonian fossil sites that contain significant representation of the fishes, Miguasha stands out as the most significant in terms of its representation of evolutionary events, the exceptional quality of fossil preservation and the abundance of vertebrate fossils. It also ranks highly among all other sites in terms of overall representation of biodiversity.

There are about 60 important Devonian fossil sites in the world, of which 15 are regarded as key sites in revealing the vertebrate animal life of that geological time period. Rigorous comparative analysis of these sites, using a wide range of significance criteria, has revealed that the Escuminac Formation of Miguasha Provincial Park is clearly the most outstanding, particularly in respect of its representation of evolutionary events, the quality of fossil preservation and the abundance of fossils. The reviewers are satisfied that this analysis is scientifically sound and that the conclusions are valid.

Miguasha cannot claim, however, to represent all elements of Devonian life and environments - but no one site anywhere in the world can do this. The best one can expect is optimum representation of key biotic and palaeoenvironmental elements. In its representation of vertebrate life, Miguasha is the most outstanding fossil site in the world for illustrating the Devonian as the "Age of Fishes". In this respect, Miguasha has an unequivocal claim to being of universal value in terms of natural criterion (i).

In addition Miguasha satisfies the World Heritage integrity criteria where other sites fail to do so. The comparative study shows that of the 15 key Devonian age fossil sites assessed in the world, selected from a total of 61, only Miguasha is formally protected.

7. RECOMMENDATION

It is recommended that the Miguasha Provincial Park be **inscribed** on the World Heritage List under criterion (i). The Committee may wish to note the rigorous comparative assessment applied to this nomination, in order to establish its outstanding universal value, as a model methodology for future fossil nominations.

ANNEX 1

IUCN FOSSIL SITE EVALUATION CHECKLIST

In evaluating prospective fossil sites for inscription on the World Heritage List, IUCN has prepared the following ten questions which provide some indicative measures of significance. These questions are not meant to be binding, but for evaluation purposes it would be expected that fossil sites of truly outstanding universal value would rate highly in most, if not all, of the following:

1. Does the site provide fossils which cover an extended period of geological time? ie. how wide is the geological window?

2. Does the site provide specimens of a limited number of species or whole biotic assemblages? ie. how rich is the site in species diversity?

3. How unique is the site in yielding fossil specimens for that particular period of geological time? ie. would this be **the** type locality for study or are there other similar areas that are alternatives?

4. Are there comparable sites elsewhere that contribute to the understanding of the total "story" of that point in time/space? ie. is a single site nomination sufficient or should a serial nomination be considered?

5. Is the site the only or main location where major scientific advances were (or are being) made that have made a substantial contribution to the understanding of life on earth?

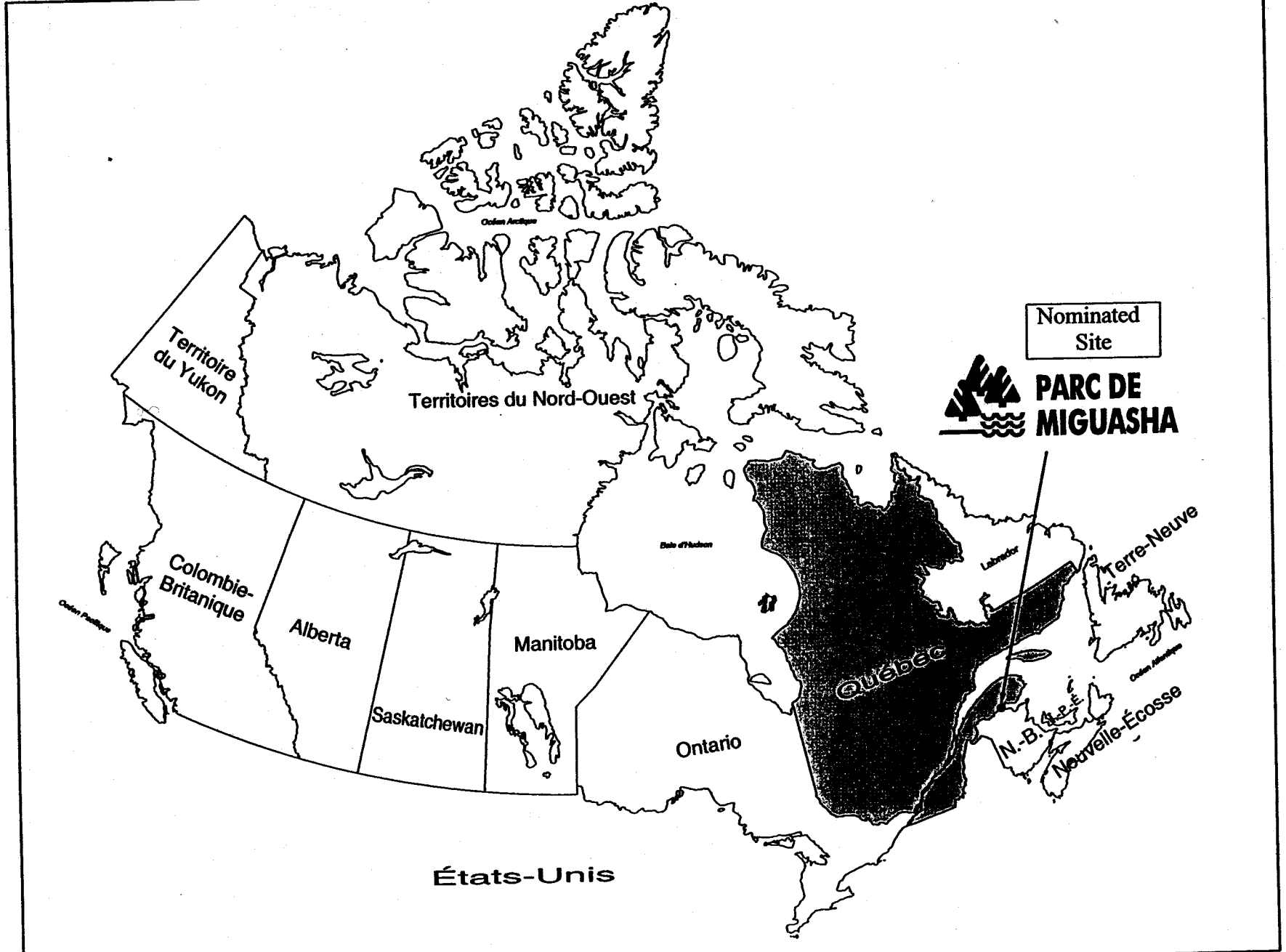
6. What are the prospects for on-going discoveries at the site?

7. How international is the level of interest in the site?

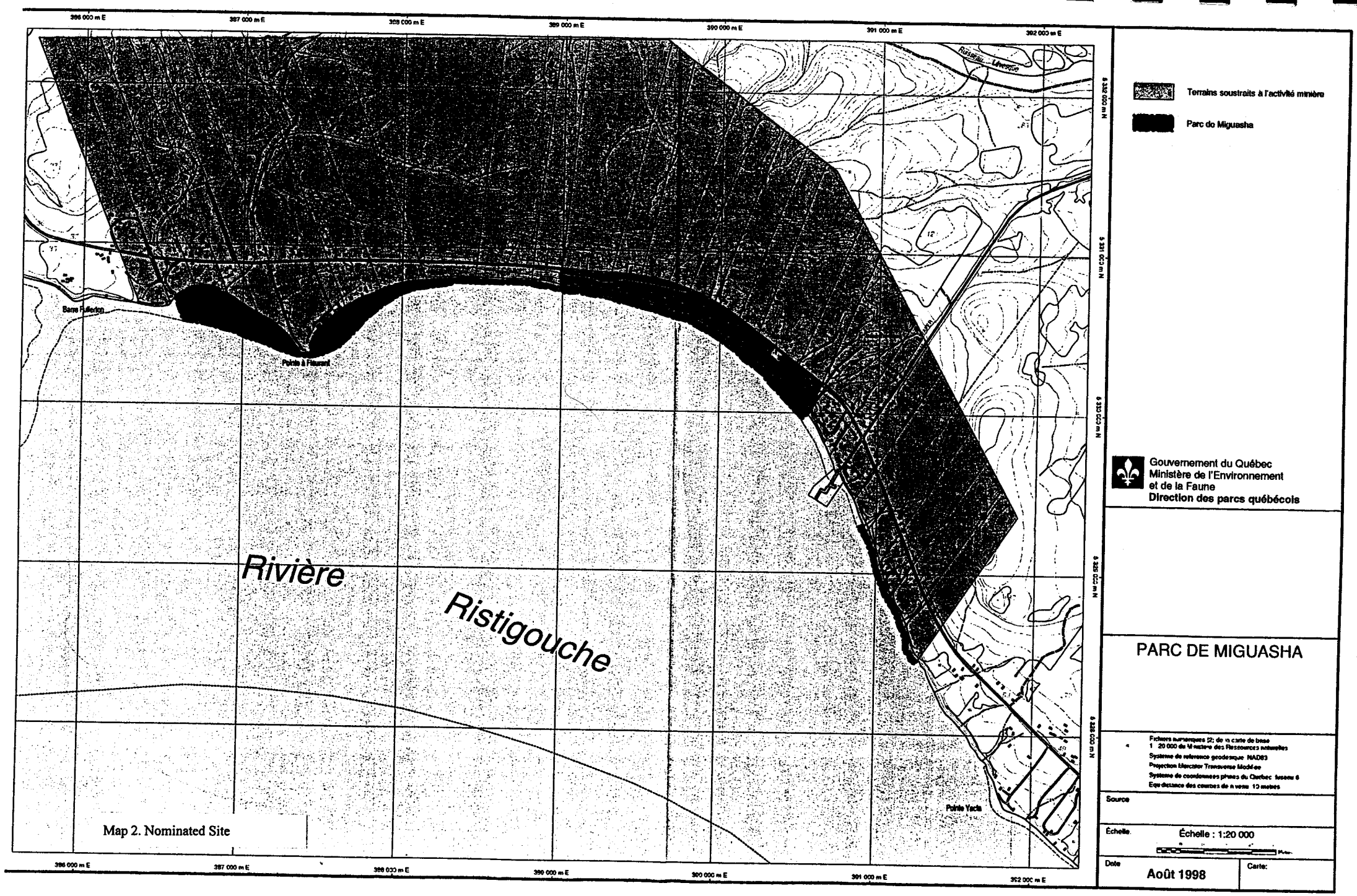
8. Are there other features of natural values (eg. scenery, landform, vegetation) associated with the site? ie. does there exist in the adjacent area modern geological or biological processes that relate to the fossil resource?

9. What is the state of preservation of specimens yielded from the site?

10. Do the fossils yielded provide an understanding of the conservation status of contemporary taxa and/or communities? ie. how relevant is the site in documenting the consequences to modern biota of gradual change through time?



Map 1. Location of Nominated Site



Map 2. Nominated Site