Revised Proposal for an OSPAR MPA in waters beyond national jurisdiction:
Rainbow hydrothermal vent field

Revised Nomination Proforma

Presented by WWF
Proforma for compiling the characteristics of a potential MPA

A General information

1. Proposed name of MPA

Rainbow hydrothermal vent field

2. Aim of MPA

• Protect, conserve and restore species, habitats and ecological processes which are adversely affected as result of human activities;
• Prevent degradation of and damage to species, habitats and ecological processes following the precautionary principle.

3. Status of the location

The Rainbow vent field is located beyond the limits of national jurisdiction of the coastal States in the OSPAR Maritime Area, 45 nm outside the EEZ of the Azores.

According to Article 134 (2) UNCLOS, activities in the Area (sea-bed, ocean floor and subsoil thereof) shall be governed by the provisions of Part XI. According to Article 137 (2) UNCLOS “All rights in the resources of the Area are vested in mankind as a whole, on whose behalf the Authority shall act. These resources are not subject to alienation. The Minerals recovered from the Area, however, may only be alienated in accordance with this Part and the rules, regulations and procedures of the Authority.”

According to Article 86 et seq. UNCLOS the superjacent waters are considered as High Seas, which are open to all States, including the freedom of scientific research.

According to Article 238 UNCLOS all States have the right to conduct marine scientific research.

4. Marine region

OSPAR Region V, Mid Atlantic Ridge, SW of Azores
Fig. 3a (above): Location of hot hydrothermal vents on the Mid Atlantic Ridge (MAR). Source: Desbruyères et al. 2001

Fig. 3b (right): Bathymetry of the Triple Junction zone of the MAR near the Azores. The blue square indicates the envisaged MOMAR study area for long-term observations.

Fig. 2: Map of the OSPAR Maritime Area with Economic Exclusive Zones of coastal states indicated in light blue. Dark blue = 1000-2000 m depth stratum as potential off-shelf fishing area. Arrow indicates location of Rainbow hydrothermal vent field just outside the Azores EEZ. Source: S. Christiansen/WWF NEAME
5. Biogeographic region
Atlantic Realm; Atlantic Subregion; North Atlantic Province

6. Location
The Rainbow hydrothermal vent field is located at 36° 13’ N, southwest of the Azores on the Azorean segment of the Mid-Atlantic Ridge (MAR) at 2270-2320 m depth in international waters.

The coordinates of the proposed site given below are approx.:  
Marine Protected Area (Yellow): 36° 13’ N, 33° 52’ W to 36° 15’ N; to 33°56’ W
Present extent of vent fields (Red): 36°13’39” N, 33°54’20” W to 36°13’49” N, 33°54’ W

7. Size
The marine protected area (Yellow) has an extent of 15 x 24 nm.

8. Characteristics of the area
The Rainbow hydrothermal vent field has been discovered on the Mid-Atlantic Ridge (MAR) in 1997, during the FLORES cruise (Fouquet et al. 1997). The field comprises more than 30 groups of active small sulphide chimneys. There are numerous inactive structures among a large number of rather short-lived active venting sites.

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1 The boundaries of the proposed MPA shall reflect the need for a precautionary buffer zone around the presently known vent fields. The boundary proposal was meant to be inspected and eventually corrected by scientific experts.
Unlike in its neighbouring fields and many others presently known on the mid-ocean ridges, the vents are situated on an ultramafic substrate which has been exposed by large-scale faulting. The field is considered rather dynamic in space and time and showed changes in individual smokers at an interval of just one year. The western zone of the field has the roughest relief, while the sites of the eastern zone are located on a sedimental plateau. Most smokers are located at the western and eastern end of the field, the highest developed ones are PP28/35 and 29/37 (see detailed map) in the centre of the field. The youngest and most active sites are found in the western and eastern sites and were reported to be nearly azoic.

The Rainbow hydrothermal plume is the strongest such feature yet found on the MAR. A heat flux of 1-5 GW has been reported to be associated with the particle flux. A unique feature of the Rainbow fluids is that they have the lowest end-member pH, highest chloride concentration, and highest temperature 360-365°C of any MAR hydrothermal vent fluids yet sampled (end-member water refers to the ‘pure’ vent water that has not been diluted by surrounding water). Bursts of venting fluid cause temperatures to vary between 3-6°C in the mussel beds and 11-13°C in the shrimps environment. The low pH (2.8) and high metal concentration (Fe, Co, Ni, Cu) of high-temperature fluids probably result from the combination of seawater-ultramafic rock interaction and phase separation generating Cl-rich brines. The acid vent fluids have a particularly low organic but high inorganic content of methane, sulphur, calcium, iron and copper.

About 32 different species have been recorded in the Rainbow area so far, including several ones new to the MAR like the zoarcid fish species *Pachycara* sp n. Due to the environmental conditions, the species community differs considerably between Rainbow and the two other shallower fields, Lucky Strike and Menez Gwen, which lie in the Azorean Exclusive Economic Zone (EEZ). Rainbow is part of a continuum between *Rimicaris* (shrimp)-dominated and *Bathymodiolus* (mussel)-dominated assemblages, which cannot be explained by bathymetric zonation or geographic distance, but more likely by the metallic content of the end-member fluids. Similarities to the southern vent fields, namely TAG, Broken Spur and Snake Pit, are evident from the occurrence of the bresiliid shrimp *Rimicaris exoculata* prevailing over mussels at the chimneys. Mussels of the species *Bathymodiolus azoricus* and *B. seepensis* dominate the community on surrounding blocks within the active area. Several other species like the shrimp *Miocaris fortunata* and the polychaete *Amathys luti* are found in addition. In the young eastern sites, the polychaete *Spiowchaetopterus* sp. was reported to form dense aggregations. Along the active walls, crabs of the species *Segonzcia mesatlantica* were observed.

Observations of faunal composition, age structure and abundance indicated significant changes between 1998 and 2002 which suggest catastrophic events (change in hydrothermal activity) in this area (Vereshchaka et al. 2002)

Current human activities are mainly restricted to science. A private enterprise, however, has conducted a touristic excursion linked to scientific studies at Rainbow in 2002 but has currently not scheduled a further one.
Bibliography


Douville, E. et al. (2002): The Rainbow Vent fluids (36 degrees 14'N, MAR); the influence of ultramafic rocks and phase separation on trace metal content in Mid-Atlantic Ridge hydrothermal fluids. Chemical Geology 184(1-2), 37-48.


Santos, R. S., A. Colaço & S. Christiansen (eds.) (2003): Management of deep-sea hydrothermal vent fields MPA in the Azores Triple Junction. Arquipélagos – Life and Marine Science, Suppl. 4. (see Appendix 2)


http://www.deepoceanexpeditions.com (March 10, 2005)
B Selection criteria

a. Ecological criteria/considerations

1. Threatened and declining species and habitats
The area falls under the category ‘Oceanic ridges with hydrothermal vents/fields’.

2. Important species and habitats
Hydrothermal vents are self-supporting systems, seasonally exporting larvae to the surrounding deep sea. The lower toxicity of the venting fluids at shallower vent fields allows the mobile deep sea fauna from the surrounding abyssal plain to penetrate and use the accumulated biomass. This may lead to a general enhancement of food web activity near vents, in particular at hydrothermal vents located at slow-spreading ridges.

3. Ecological significance
1. High proportion of habitat in the OSPAR area
The Rainbow vent field is considered to be part of the group of northern vent fields on the MAR, together with Saldanha, Famous, Lucky Strike and Menez Gwen further north. Each of the vent fields is unique, but the group differs from the southern, deeper, group of vents in geological origin and depth-related variations in the nature of the venting systems, which are reflected by the benthopelagic and planktonic communities – new research points to ongoing speciation along the MAR and a gradual change of vent communities. Two mussel species of the genus *Bathymodiolus* show the differentiation between northern and southern species with a potentially intermediate form in the middle part of the vent fields. However, at Rainbow the mussels show also characteristics of the more southern vent fields. Also, the great abundance of shrimps at all active venting sites, especially *R. exoculata* and *M. fortunata*, indicate that Rainbow seems to present an intermediate between the two biogeographic groups of vents.

2. A high biological productivity system is represented.

4. High natural biological diversity
Hydrothermal vents communities generally do not host a high diversity of species. Vents are characterised by a high degree of specialisation among the associated fauna, and relatively high productivity and species abundances compared with the surrounding deep sea.

However, slow-spreading ridges such as the Mid Atlantic ridge relatively represent the highest species diversity found at vent communities. The taxonomic studies undertaken so far at Rainbow and adjacent vents can not be considered exhaustive, so a comparison of levels of biodiversity can not be made. A list of species identified so far can be found in Desbruyères et al. (2001).

5. Representativity
There are no representative vent fields in the OSPAR area. There are three main regions of venting activity which have come to light as a result of scientific research in the specific area: 1) in the Triple Junction area on the Mid Atlantic Ridge, SW of the Azores, 2) on the Reykjanes Ridge SW of Iceland and 3) on the Nansen-Gakkel Ridge in the Arctic Ocean. Little is known about the Icelandic and the Arctic Ocean vents, it is likely that many other vents are present and waiting to be discovered (the average vent occurrence rate is somewhere between one and every 30 to 130 km of ridge length). The Rainbow hydrothermal vent field with adjacent geological features is one of only 5 known vent fields in the Triple Junction area, among these are 3 hot vents (Menez Gwen, Lucky Strike, Rainbow) and two cold or warm vents (Saldanha, Famous). All of them differ significantly in depth, geological setting and associated fauna. In the MAR, a combination of source rock, depth, alteration of fluid composition and stability seem to be the determinants for the species composition. The fraction of species endemic to hydrothermal vents increases with depth.
6. Sensitivity

The small spatial extent and site-specific communities make vent fields potentially very sensitive to scientific exploration and commercial exploitation. Immediate concern is arising from the direct effects of sampling (substrate and specimens), the related risk of unintended species transfer between vents within a field, as well as impacts caused by movement of vehicles and litter.

Due to the small scale, the individual venting sites have potentially a very low resistance to human impact. The Mid Atlantic Ridge is considered to be a slow-spreading ridge and hydrothermal vents are estimated to be up to 1000’s of years in age, although possibly not active continually. However, some of the individual vents are only short-lived naturally, and new venting sites can form easily. Therefore, the MAR vent fields are relatively stationary in position, but dynamic regarding the individual smokers and long-term activity.

There are only insufficient data on the sensitivity of species, e.g. to the exposure to light or the experimental introduction of species.

7. Naturalness

Probably high, however there are anecdotal records of damages caused by underwater vehicles, extensive sampling, and litter.

b. Practical criteria/considerations

1. Potential for restoration

The Rainbow site does not seem to be in need for restoration. Generally, the potential for colonisation and recolonisation of suitable vent habitat seems to be very high as it reflects the natural process occurring at these intrinsically unstable sites. However, this may not lead to the same communities as before – comparable to communities’ succession on disturbed shallow water sites.

2. Degree of acceptance

Science: The scientific community due to its general understanding on environmental protection and conservation expressed the need for a management of hydrothermal vent research (Mullineaux et al. 1998, Dando & Juniper 2001, Santos et al. 2003). The scientific community is presently also actively developing a Code of Conduct for Responsible Science on vent fields (Juniper & Glowka 2003). It is not known, to which extent the geological ridge research community will comply with e.g. voluntary measures as proposed by the biological researchers. However, this will be debated in several international fora (e.g. CBD and UNICPOLOS). An InterRidge workshop identified a group of scientists responsible for site management and charged them with interacting with the parties involved in the identification of this possible MPA.

Tourism: Touristic activities are presently imbedded in research undertakings and are claimed to be “conducted with negligible or no effect on our oceans”.

Bioprospection: unknown

Mining: Any company that wants to exploit commercially the metal deposits of vents in “the Area” has to be licensed by the International Seabed Authority.

Fisheries: A no-take zone should be acceptable, as the Rainbow vent field is situated at 2200 m depth, thus deeper than fishing depth of commercial fisheries.

Transport: Management measures for the hydrothermal vent field will not interfere with ships passage.

Cable laying: As the proposed MPA will be of very small size, avoidance of it should not cause any conflicts and could possibly be carried out on a voluntary basis.
3. **Potential for success of management measures**

See above, if measures can be agreed and are accepted then the management objectives will be reached.

4. **Potential damage to the area by human activities**

Science: Presently, scientists are the only regular visitors (ca. 1 cruise per year so far) to the area. As such their potential threat to the area needs to be weighted against the value for conservation of the knowledge gained from the research. Immediate concern is arising from the direct effects of considerable sampling on substrate and specimens, the related risk of unintended species transfer between vents within a field, as well as impacts caused by movement of vehicles and litter (see Dando & Juniper 2001). The authors list the following direct impacts of research activities which should be subject to a Code of Conduct for human activities in and close to hydrothermal vent fields:

- Removing chimneys and rocks for geological investigations or chemical sampling
- Environmental manipulation, such as drilling, which can change fluid flow pathways and shut off the supply of fluids to colonies of vent organisms
- Clearing fauna, e.g. for experimental studies on recolonisation or collecting fauna for biodiversity or population studies
- Transplanting fauna between vents
- Placement of instrument packages that may disturb fauna and change water flows
- Observation, e.g. deleterious effects of light on photosensitive organisms
- The use of manned submersibles and remotely operated vehicles can damage fauna by landing on them or causing damage by the use of thrusters.
- Second order biological effects include changes in population numbers and composition as well as introduction and displacement of exotic species with research gear.

Tourism: Presently, tourism by submersible dives to the vent is probably a minor problem. The risks associated with these dives partly overlap with the points mentioned above. If however this type of adventure travel should increase in frequency, then impacts from operating the submersibles can be expected and "souvenirs" may be collected which will add to the removal of vent substrate or fauna due to scientific sampling.

Bioprospection: The specialised hyperthermophilic bacteria and Archaea colonising hydrothermal vents form the basis of biotechnological research and industry. Probably, samples needed for identifying new commercially interesting bacteria would be taken in the framework of a research cruise, and would not need extensive sampling. For other organisms, however, more extensive sampling could be required. However, the true extent of marine bioprospecting is unknown.

Mining: Mining, if it occurs, poses the most significant threat to hydrothermal vent ecosystems as it involves the removal of the habitat, alterations in fluid flow, production of a particle plume and disturbance/removal of the associated fauna. Inactive vents are not as readily to find compared to active vents which can be detected by their methane plumes. Vents on slow-spreading ridges generally accumulated more exploitable polymetallic sulphides than vents on fast-spreading ridges. Therefore, the active vents on the MAR, close-to-port, could become a prime target for deep sea mining in the future.

Fisheries: Any fishing at or near the very small hydrothermal vents would seriously impact the ecosystem, but most likely also retrieve metal-contaminated fish.

5. **Scientific value**

There is a high scientific value for a number of disciplines. Since its discovery in 1997, the area has been visited by several deep-sea research cruises. Long-term monitoring programmes as envisaged for this and other vent fields will be essential in fostering our knowledge on these ecosystems and their significance for the evolution of life on earth.
C. Proposed management and protection status

1. Proposed management

Today, the only human activities are science and, to a limited extent, also tourism. Since its discovery in 1997, several scientific expeditions visited the Rainbow area. The Rainbow vent field is part of a larger study area to the southwest of the Azores (MOMAR, see http://www.momar.org) which is designated for long-term monitoring of biological and geological evolution of hydrothermal vents. Uncoordinated activities are likely to counteract these long-term studies and so the international scientific “umbrella” organisation ‘InterRidge’ has begun measures to provide coordination infrastructure. As the two adjacent vent fields Lucky Strike and Menez Gwen will be managed as marine protected areas by the Regional Government of the Azores, human activities, including potential commercial interests in bioprospecting and mineral mining might shift to Rainbow in response.

The small spatial extent and site-specific communities make vent fields potentially highly vulnerable to the increasing levels of scientific and commercial exploitation. Different types of investigations such as long-term monitoring activities, manipulative experiments and geological sampling need international coordination so as not to interfere with each other and with other activities like tourism and potentially mining. As little is known about the ecosystem structure and will not be without extensive further research, the impact of such human interferences is unpredictable.

The designation of the Rainbow hydrothermal vent field as a marine protected area under OSPAR and the resulting coordination and management of activities would facilitate a spatial and temporal separation of incompatible activities and prevent unsustainable damage to the rare and sensitive ecosystem the vent field supports.

1.1. Management goals:

a. Maintain natural status and allow for natural development of the area with respect to geological conditions and the associated ecosystem.

b. Improve the scientific understanding of hydrothermal vent ecosystems

c. Improve the public understanding of hydrothermal vent ecosystems

1.2. Management objectives

d. Prevent unsustainable damage to the ecosystem

e. Ensure longterm sustainable scientific research by facilitating the spatial and temporal separation of incompatible human activities

f. Ensure that the increasing scientific knowledge contributes to public education.

g. Monitor the state of the ecosystem

As agreed during MASH 2005 (MASH 05/8/1), the following sections are left empty for the time being. A WWF proposal for possible management measures is presented in a separate document.

1.3. Management measures:

1.4. Management enforcement and authority:

2. Any existing or proposed legal status

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