

## **Appendix 4**

### **1.Recommendations in support of policy**

During the AMBIO project, we perform an important effort to provide baseline data on bacteria, cyanobacteria and microalgae. The observation that a lot of green algal sequences are new to science, despite their morphological indistinctness, and that molecular studies show a previously undiscovered diversity of bacteria and cyanobacteria, illustrate the paucity of available data on Antarctic microorganisms. The low overlap in species composition between different samples/areas as observed during e.g. cultivation of bacteria and green algae similarly indicates that we barely scratched the surface of Antarctica's microbial diversity and that scientific efforts to characterize these communities should be continued.

While it is rather early to offer detailed policy advice, our data already indicate the microbial diversity of various Antarctic sites sampled is comprised of important numbers of uncharted micro-organisms in all the categories sampled. In view of the potential applications of cold-adapted micro-organisms and enzymes and the potential new active molecules of medical or industrial use, it seems important to try to collect, characterize and preserve these organisms. Because of the sensitivity of the Antarctic ecosystem to global warming, this task may be considered more urgent.

The current data on microorganisms reveals the existence of some unique taxa in lacustrine environments, suggesting that they could be used to designate specially protected areas (ASPAS). During further analysis we will try to identify which unique environmental and regional conditions explain the occurrence of unique organisms in order to provide a firm scientific basis for promoting the establishment of an ASPA in a specific region (Cowan & Tow, 2004).

### **2.Perspectives for the second term**

Trough collaboration with international partners, the number of samples available for analysis using high throughput techniques during the second term is still increasing (Belgian Basis (BELDIVA 2009), Macquarie Islands (Dana Bergstrom, Australia), Byers (Bart Van de Vijver) and South Georgia (Dominic Hodgson)). Such a large set of samples will allow us to obtain more robust results.

The characterization based on SSU of the strains currently available is completed and will lead to a scientific paper on the diversity of green algae (De Wever *et al.* in prep.). Further analysis will mainly focus on the use of other markers such as ITS2. The current phylogenetic tree will be extended with sequences of strains that are currently being purified and from newly acquired strains (incl. Amsterdam Island strains). The analysis of the Amsterdam Island strains is currently in progress and the morphological observation of the genus *Desmodesmus*, which is absent on the Antarctic continent, offers interesting perspectives for studying its distribution and ecophysiology.

The characterization of strains (bacteria and cyanobacteria) will continue as new isolates will be made until the end of year 3 and because new taxa will require extensive characterization to permit formal description. Taxa with particular patterns of geographic distribution will be identified in order to do a more detailed screening in the second phase. For these groups, specific oligonucleotides will be designed. Finally, the probes will be applied to samples from similar Arctic environments, this will help us elucidate if bipolar distribution occurs among terrestrial microbial organisms.

The DGGE analysis for studying the uncultivated diversity of bacteria, cyanobacteria and microalgae is mostly completed. With the upcoming results, the integrated analysis of all DGGE data will enable us to assess (i) the importance of geographical and local environmental variables, and (ii) life history characteristics (e.g. sexual vs. asexual life cycle, the formation of resting stages) in shaping the microbial communities in Antarctic lakes.

Further analysis of the uncultivated diversity will continue using Real Time Quantitative PCR and clone libraries on a subset of samples based on the DGGE results. A small number of samples with a contrasting bacterial community composition (based on the DGGE data), including some that were studied using cultivation will be used for the construction of clone libraries (TM2, SK5).

### **3. Outreach and dissemination**

As intended, a website has been developed and maintained up-to-date by the three partners. It is hosted by the coordinator's institution at <http://www.ambio.ulg.ac.be>.

We consulted our international partners during the MERGE business meeting in Saint Petersburg (07/07/2008) in order to deposit our data into existing databases (AAD and EBA biodiversity databases).

On the 6th of December 2007, the AMBIO first polar public meeting took place. After an internal meeting which gathered the different partners, the project manager and members from the follow-up committee, public conferences with invited foreign speakers were given (<http://www.ambio.ulg.ac.be/programmeMeeting/programmeAMBIO.pdf>).

In May 2007, the Polar and Alpine Microbiology conference took place in Banff Canada. The 3 AMBIO's partners participated to the conference. In parallel, the MERGE-Canada meeting was held and the AMBIO project was presented by the coordinator. The Banff conference allowed a deep interaction with the follow-up committee members present at the conference (see §7 in this form).

In addition, at the MERGE business meeting in Saint Petersburg (07/07/08), we could also discuss with several members of the follow-up committee (Prof. W. Vincent, Prof. A. Quesada, Prof. T. Naganuma).

On the 15<sup>th</sup> of December 2008, the second AMBIO annual meeting (Ann. 3) took place at the University of Liège. It was held along with the ANTAR-IMPACT project. The program manager and partners shared their results with the follow-up committee in the morning session. In the afternoon, general seminars were given. At the end of the day, the three partners met for an internal discussion of their results, and plans for phase 2.

The Powerpoint presentation “Antarctica: a microbial continent” (C, P2, P3) has been produced in a French version and presented at various meetings (see below). It is now available online on the AMBIO website and will be soon translated in English.

All partners have participated in discussion meetings with IPF and members of BE-POLES concerning the future Belgian basis to form a platform to propose scientific activities.

#### **4. Publications of the teams**

##### **Peer review**

Zakhia, F., Jungblut A.-D., Taton, A., Vincent, W.F. and Wilmotte A. 2007. Chapter 8. Cyanobacteria in cold Ecosystems. In 'Psychrophiles: from Biodiversity to Biotechnology'. Eds: Margesin, R., Schinner, F., Marx, J.-C., Gerday, C. Springer-Verlag, p 121-135.

##### **Papers in preparation:**

Fernández-Carazo, R., Hodgson, D., Wilmotte, A. Impoverished cyanobacterial diversity in biotopes of the Transantarctic Mountains (82°S)

Verleyen E, Hodgson DA, De Wever A, Hoshino T, Imura S, Kaup E, McMinn A, Roberts D, Kudoh S, Kanda H, Sabbe K, and Vyverman W. Physical and chemical limnology in east Antarctic ice-free oases and nunataks.

De Wever A, Leliaert, F, Vanormelingen P, Van der Gucht K, Verleyen E, Hodgson, DA, Sabbe K, Vyverman W. The molecular diversity of green algae in Antarctic microbial mats.

#### **5. Posters and oral presentations at symposia, conferences and workshops**

Di Prisco G, Danis B, De Broyer C, Dettai A, Ellis-Evans C, Huiskes A, Verde C, Wilmotte A. FP7 : Research on climate change in polar environments must include effects on biota of both polar regions. Conference Proceedings 'Polar Environment and Climate: The challenges', International Symposium organised by the EC DG for Research, Volume 11: 140-142.2007. Publications.europa.eu, Luxembourg.

Marinelli F, Tutino ML, Wilmotte A. Access and conservation of polar bacterial diversity, and the impacts of climate changes. Conference Proceedings 'Polar Environment and Climate: The challenges', International Symposium organised by the EC DG for Research, Volume 11: 158-160. 2007. Publications.europa.eu, Luxembourg.

- Fernandez-Carazo, R., Zakhia, F., Taton, A., Wilmotte, A. Antarctic cyanobacterial communities: baseline data on their diversity and distribution. Belgian Biodiversity Platform conference: Biodiversity and Climate Change, 21-22 May 2007, Brussels (Belgium). (Poster)
- Verleyen E., Hodgson D.A., Sabbe K., Wilmotte A., De Wever A., Vyverman W. High latitude lacustrine microbial biodiversity in response to future climate change. Belgian Biodiversity workshop, 21-22/05/2007, Brussel. (Poster)
- Verleyen E, Hodgson DA, Sabbe K, Wilmotte A, De Wever A and Vyverman W. Biodiversity assessments of lacustrine microbial communities in Antarctic lakes. Astrobiology workshop, Royal Academy of Sciences, 12/06/2007, Brussels, Belgium (Oral presentation)
- Fernandez-Carazo, R., Hodgson, D., Wilmotte, A. Forlidas Pond and Lundström lake: cyanobacterial diversity in the Antartctic at 82°S. Monod Conference 'Environmental genomics: from individual genomes to genomes of complex communities', 9-13 June 2007, Roscoff (France). (Poster)
- Fernandez-Carazo R, Zakhia F, Taton A, Verleyen E, Vyverman W, Hodgson DA and Wilmotte A. Diversity and distribution of cyanobacteria in Antarctica. Proceedings of the 17th Symposium of the International Association for Cyanophyte Research, 25-29/06/2007, p 92. Mérida City, Mexico (Oral presentation 75)
- Sabbe K., Verleyen E., Taton A., Wilmotte A., Cousin S., Van der Gucht K., De Wever A., Hodgson D.A. and Vyverman W. Influence of environmental and geographic factors on the diversity and distribution of cyanobacteria and protists in microbial mats of Antarctic lakes. 4th European Phycological Congress, Oviedo, Spain, 23-27/07/2007. (Poster)
- Vyverman W., Sabbe K., Vanormelingen P. and Verleyen E. Dispersal limitation constrains global patterns in lacustrine diatom diversity and taxonomic turnover. 4th European Phycological Congress, Oviedo, Spain, 23-27/07/2007. (Oral presentation)
- Verleyen E., Vyverman W. et al. Global patterns in lacustrine diatom diversity and taxonomic turnover are constrained by dispersal. 30th SIL congress, Montréal, Canada, 12-18/08/2007. (Oral Talk)
- De Wever A., Verleyen E., Sabbe K., Taton A., Wilmotte A., Cousin S., Van der Gucht K., Hodgson D.A. and Vyverman W. Patterns in diversity and distribution of Antarctic microbial mat communities determined by environmental and geographical factors. 10th Symposium in Aquatic microbial ecology, Faro (Portugal), 2-7/09/2007 (Oral presentation).

- Hodgson, D., Convey, P., McInnes, S., Sands, C., Fernández-Carazo, R. and Wilmotte, A. The last lakes on Earth: Aquatic life in the Dufek Massif, Antarctica. British Ecological Society Annual Meeting. 0-12 September 2007. Glasgow (UK). (Oral communication).
- Verleyen E., Sabbe K., Sterken M., Vanormelingen P. & Vyverman W. Historical processes constrain patterns in global protist diversity. ESF 1st Biodiversity Conference, Marne-la-Vallée, Paris (France), 3-5/10/2007. (Poster)
- Fernández-Carazo, R., Ertz, D., Wilmotte, A. Cyanobacterial diversity at Utsteinen: The impact of the "zero emission research station in Antarctica. 11th Bioforum, 11 October 2007, Liège (Belgium). (Poster).
- Peeters, K., Willems A. 2007. Analysis of the bacterial diversity of samples from the Belgian Antarctic Base through cultivation. Meeting of the Belgian Society for Microbiology. Evolution in the microbial world. Brussels, 23 November 2007. (Poster)
- Zakhia F, Lemaire C, Taton A and Wilmotte A 2007. Cyanobacterial diversity in a laminated microbial mat from the Antarctic Peninsula. 13th Annual Symposium of the Belgian Society for Microbiology, "Evolution in the Microbial World". November 23, 2007, p. 99. Brussels, Belgium (poster) (5th poster price).
- De Wever A, Verleyen E, Van der Gucht K, Zakhia F, Fernandez Carazo R, Sabbe K, Wilmotte A, Vyverman W. Biogeographical patterns in Antarctic microbial communities. 3rd international conference on polar and alpine microbiology, Banff, Canada, 11-15/05/2008. (Poster).
- Peeters K., E. Verleyen, D. Ertz, D. Hodgson and A. Willems. 2008. Bacterial diversity of Antarctic samples through cultivation. Third International Conference on Polar and Alpine Microbiology, Banff, Alberta, Canada, May 11 - 15, 2008. (Poster)
- Zakhia F., R. Fernandez, K. Peeters, A. Willems, C. Souffreau, A. De Wever, E. Verleyen, K. Van der Gucht, K. Sabbe, W. Vyverman and A. Wilmotte. 2008. AMBIO: a BELSPO project on the diversity and biogeography of Antarctic microbial communities. Third International Conference on Polar and Alpine Microbiology, Banff, Alberta, Canada, May 11 - 15, 2008. (Poster)
- Zakhia F, Lemaire C, Taton A and Wilmotte A 2008. Cyanobacterial diversity in a laminated microbial mat from the Antarctic Peninsula. Third International Conference on Polar and Alpine Microbiology, Banff, Alberta, Canada, May 11 - 15, 2008. (Poster)
- Verleyen E., Wilmotte A., Hodgson D.A., De Wever A., Zakhia F., Fernandez-Carazo R., Waleron K., Sterken M., Sabbe K., D'Hondt S., Dasseville R., Van der Gucht K., & Vyverman W. Spatiotemporal patterns in Antarctic microbial community structure in

response to climate related environmental changes. SCAR/IASAC IPY Open Science Conference, Saint Petersburg, Russia, 4-11/07/2008. (Oral presentation)

Wilmotte A, Fernandez-Carazo R., Zakhia F., Verleyen E., Namsaraev Z., Simon P., Waleron K, Taton A, Hodgson DA, Gibson J. Molecular diversity and distribution of Antarctic cyanobacteria, based on rRNA sequences. SCAR/IASAC IPY Open Science Conference, Saint Petersburg, Russia, 4-11/07/2008. (Poster).

Peeters K., E. Verleyen, D. Ertz, D. Hodgson and A. Willems. 2008. Exploring the heterotrophic bacterial diversity of Antarctic samples through cultivation. Meeting of the Belgian Society for Microbiology. Stress responses in the microbial world. Brussels, 12 December 2008. (Poster).

## **6. Articles in newspapers, media activities**

Becquevort, S., A. Borges, D. Cardinal, P. Claeys, M. De Batist, C. De Broyer, F. Dehairs, B. Delille, G. Feller, T. Fichet, H. Goosse, P. Huybrechts, C. Lancelot, R. Lorrain, F. Pattyn, K. Sabbe, V. Schoemann, J.-L. Tison, A. Vanreusel, F. Volckaert, A. Willems, and A. Wilmotte. 2007. *Opinie & Analyse: Omdat Antarctica belangrijk is. De Standaard*, 1-2 September 2007.

Becquevort, S., A. Borges, D. Cardinal, P. Claeys, M. De Batist, C. De Broyer, F. Dehairs, B. Delille, G. Feller, T. Fichet, H. Goosse, P. Huybrechts, C. Lancelot, R. Lorrain, F. Pattyn, K. Sabbe, V. Schoemann, J.-L. Tison, A. Vanreusel, F. Volckaert, A. Willems, and A. Wilmotte. 2007. *Forum – Carte blanche: Station belge dans l'Antarctique: "émission zero" pour un gain maximal? Le Soir*, 4 September 2007.

## **7. Valorisation for a Wide Audience**

- i.* 'Le Printemps des sciences' 19.03.07 - 23.03.07 (Liège, Belgium) : « Comment les cyanobactéries exploitent au mieux la lumière ». A workshop for secondary school students and presentation of the International Polar Year and some related projects: MERGE and AMBIO.
- ii.* 'Semence de curieux' 25.03.07 - 01.04.07 (Liège, Belgium). 2 Radio Broadcasts of RTB: Interview on the cyanobacteria in Polar regions with Dr Annick Wilmotte
- iii.* Wilmotte, A. 2007. L'API, année polaire internationale. Focus sur les poles. *Bulletin de l'ASBL Sciences et Culture*, Liège, Belgium n° 406, p 52-58. mars-avril 2007
- iv.* Conference, "L'Antarctique est un continent microbien" 23.08.07, (Gembloux, Belgium). In the Congress of the 'Science Professor Society', Faculté Agronomiques de Gembloux, by Dr Wilmotte

- v. Conference, 'L'Antarctique, un continent microbien' 09.09.07 (Tour et Taxis, Brussels, Belgium) by Dr Annick Wilmotte at the occasion of the inauguration of the Belgian polar base
- vi. Conference, "Reconstructie van vroegere klimaatsveranderingen met behulp van de Antarctische kustmeren als natuurlijke archieven", 09.09.07, in dutch. Wide audience conference presented by Dr Elie Verleyen, at the occasion of the inauguration of the belgian polar base. The use of "natural archives" from Antarctica in order to reconstruct the climate changes is presented. Tour et Taxis, Brussels (Belgium)
- vii. Conference, "Genetic diversity and distribution of cyanobacteria in Antarctica" 20.09.07 (University of Amsterdam, The Netherlands). by Dr Wilmotte at the Faculteit der Natuurwetenschappen, Wiskunde en Informatica, Instituut voor Biodiversiteit en Ecosysteem Dynamica (IBED),
- viii. European 'Researcher Night' 28.09.07, Liège (Belgium). Wide audience activities in the frame of the european "Researcher Night", at the Institut de zoologie, Quai Van Beneden, Dr Zakhia showed polar cyanobacteria at the visitors.
- ix. Le 'Printemps des sciences' 23.03.08 - 27.03.08 (Liège, Belgium) : « Comment les cyanobactéries exploitent au mieux la lumière ». A workshop for secondary school students and presentation of the International Polar Year and some related projects: MERGE and AMBIO.

## **8. Training and Education**

C hosted an Erasmus fellow (Prof. J Elster) for 10 days and a graduate student (S. Chfalmi) for a technical training of 12 weeks. Both were trained in molecular diversity of Antarctic cyanobacteria. A bilateral cooperation project between C and Prof. J. Elster (Academy of Sciences) is supported (2008-10) by the CGRI/Czech Republic for training and cooperation concerning the polar cyanobacteria taxonomy.

P3 hosted one Erasmus student (Poland, Paulina Leduchowska) for a laboratory training of 4 months in 2008 and two master students (Sofie Geeraerts, Monica Krasinski, 4th year Biochemistry & Biotechnology) for 6 weeks of laboratory training.

P2 hosted a bachelor student for a 1-month study on the morphology and phylogeny of Antarctic green algal strains.