

## Final project report

*Project ID:* 2002/1.4  
*Title:* Use of bioindicators in the assessment of natural and anthropogenic changes in the Antarctic environment

*Principal investigator:* Prof. Silvano Focardi  
*Institution:* University of Siena  
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*Duration:* 2 years  
*Assigned funding:* € 191.000

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### Activities and results

The aims of the project were to determine the effects of changes caused by human presence and atmospheric transport of contaminants on the marine ecosystem, and to identify organisms sensitive to small variations in environmental parameters.

#### 2002/03 TNB Station

Research concerned monitoring of the Adelie penguin (*Pygoscelis adeliae*) and the Antarctic skua (*Catharacta maccormicki*). The main activities were conducted at Edmonson Point (74°20'S, 165°08'E) where there is a penguin rookery and about 100 pairs of nesting skuas. Various censuses of marine bird species present in the area of the Italian bases were conducted using the international monitoring protocol (CCAMLR EMP).

#### 2003/04 MZS Station

Biological samples were collected to study mechanisms of global transport and residue profiles in relation to latitude and resident or migratory habits of organisms in order to:

study antioxidant systems and develop new uses of biomarkers; obtain insights into the biodiversity of extremophilous microbes and cyanobacteria in Antarctic ecosystems; find any correlations between pollutants and production, storage and role of primary and secondary lipid metabolites.

#### P.J. Lenie Field Station (USA), King George Island

A researcher took part in the NSF programme for an ecotoxicological study on three species of penguins. Tissues and organisms were collected to determine residues of POPs in Antarctic food chains.

The research conducted in the two year period 2002-2004 made it possible to proceed with the ecophysiological and ecotoxicological studies on marine organisms and contribute to the long-term programmes promoted by the CCAMLR EMP, obtaining interesting results in different disciplinary fields. The results can be summarised as follows:

Evaluation of oxidative stress: analysis and definition of an integrated approach for ecotoxicological studies, identification of effects induced by the main classes of environmental contaminants on Antarctic fish, investigation of mechanisms of biotransformation and detoxification. A battery of biomarkers based on biological responses at molecular, biochemical and cellular level, was selected for use as early signals of environmental stress in monitoring changes occurring in Antarctica as a consequence of local and global alterations.

Phenotypic and genomic characterisation of extremophilous microorganisms, study of enzymic bioconversions and biomolecules: the marine organisms collected were classified taxonomically and their lipid metabolism and biochemistry were determined. Several biochemical pathways for secondary metabolites in Antarctic benthic organisms were successfully characterized.

Determination of levels of bioaccumulation and biomagnification of POPs in organisms of marine food webs and assessment of their toxicity. Certain POPs, for example PCN, PBDE and synthetic musks, were detected for the first time in tissues at concentrations lower than those found in tissues from other areas with human impact.

Correlation between reproductive success of Adélie penguins and environmental parameters at breeding colony and seaice conditions showed a close relation between this species and factors affecting reproductive performance. This study provided the parameters required by CCAMLR and demonstrated the importance of

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environmental data for explaining oscillations in reproductive parameters, especially in long-term programmes conducted in different Antarctic sites.

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### Products

#### A – papers in scientific magazines

1. Ancora S., Volpi V., Olmastroni S., Focardi S., Leonzio C. (2002). Assumption and elimination of trace elements in Adelie penguins from Antarctica: a preliminary study. *Mar. Environ. Res.*, **54**: 341-344
2. Cerrano C., Calcinai B., Cucchiari E., Di Camillo C., Nigro M., Regoli F., Sarà A., Schiaparelli S., Totti C., Bavestrello G. (2004). Are diatoms a food source for Antarctic sponges? *Chemistry & Ecology* **20**: 57-64
3. Coppellotti O, Vannucci D. (2003) Citrate synthase from Antarctic ciliates: adaptation to low temperatures and comparison with temperate ciliates. *Polar Biology* **26**: 452-457.
4. Corsi I., Bonacci S., Santovito G., Chiantore M., Castagnolo L., Focardi S. (2004) Cholinesterase activities in the Antarctic scallop *Adamussium colbecki*: tissue expression and effect of ZnCl<sub>2</sub> exposure. *Mar. Environ. Res.*, **58**, 401-406
5. Corsi I., Bonacci S., Santovito G., Chiantore M., Castagnolo L., Focardi S. (2004) Preliminary investigation on cholinesterases activity in *Adamussium colbecki* from Terranova Bay: field and laboratory study. *Chem. Ecol.*, **20**, 79-87
6. Corsolini S., Ademollo N., Focardi S. (2003) Persistent organic pollutants in selected organisms of an Antarctic benthic community. *Organohalogen Compounds*, **61**: 329-332.
7. Corsolini S., Ademollo N., Mariottini M., Focardi S. (2004). Poly-brominated diphenyl-ethers (PBDEs) and other Persistent Organic Pollutants in blood of penguins from the Ross Sea (Antarctica). *Organohalogen Compd.*, **66**: 1695-1701
8. Corsolini S., Ademollo N., Romeo T., Olmastroni S., Focardi S. (2003) Persistent organic pollutants in some species of a Ross Sea pelagic trophic web. *Antarctic Science*, **15**(1): 95-104.
9. Corsolini S., Ademollo S., Mariottini M., Fossi S., Guerranti C., Perra G., Duhamel G., Focardi S. (2002) Polychlorinated biphenyls, polychlorinated-dibenzodioxins and -dibenzofurans in mackerel icefish and marbled rockcod from the Kerguelen Islands (Antarctica). *Organohalogen Compounds*, **57**: 161-164
10. Corsolini S., Covaci A., Ademollo N., Focardi S., Schepens P. (2003) Levels and enantiomeric signatures of organochlorine pesticides (OCPs) and polybrominated diphenyl ethers (PBDEs) in marine organisms from Antarctica. *Organohalogen Compounds*, **61**: 61-64
11. Corsolini S., Kannan K., Imagawa T., Focardi S., Giesy J.P. Polychloronaphthalenes and other dioxin-like compounds in Arctic and Antarctic marine food webs. *Environ. Sci. Technol.*, **36**: 3490-3496 (2002).
12. Corsolini S., Romeo T., Ademollo N., Greco S., Focardi S., (2002). POPs in key species of marine Antarctic ecosystem. *Microchemical J.*, **73**: 187-193
13. Cutignano A., Cimino G., Giordano A., d'Ippolito G., Fontana A. (2004). Polyketide origin of 3-alkylpyridines in the marine mollusc *Haminoea orbignyana*, *Tetrahedron Lett.*, **45**: 2627-2629
14. Cutignano A., Notti V., d'Ippolito G., Cimino G., Fontana A. (2004). Lipase-mediated production of defensive toxins in the marine mollusc *Oxynoe olivacea*. *Organic & Biomolecular Chemistry*, **2**: 3167-3171.
15. d'Ippolito G., Cutignano A., Tucci S., Romano G., Miralto A., Cimino G., Fontana A. (2004). The Role of Complex Lipids in the Synthesis of Bioactive Aldehydes of the Marine Diatom *Skeletonema costatum*, *Biochim. Biophys. Acta: Molecular and Cell Biology of Lipids*, **1686**:100-107
16. Faraone-Mennella M.R., A. Petrella, M. Romano, S. Castellano, A. Gambacorta, B. Nicolaus, L. Lama, B. Farina (2002) The ADP-ribosylation system in thermophilic microorganisms from Archaea and Bacteria kingdoms. *J.Biol. Regulators Hom. Agents* **16**(4): 329
17. Fontana A., Cutignano A., Giordano A., Domnech A., Cimino G. Biosynthesis of Aglajnes, Polypropionate Allomones of the Opisthobranch Mollusc *Bulla striata*. *Tetrahedron Lett.*, **45**: 6847-6850 (2004).
18. Gavagnin M., E. Mollo, F. Castelluccio, A. Crispino and G. Cimino (2003) Sesquiterpene metabolites of the Antarctic gorgonian *Dasystemella acanthina*. *J. Nat. Prod.* **66**: 1517-1519
19. Gavagnin M., M. Carbone, E. Mollo and G. Cimino (2003). Further chemical studies on terpenoid acylglycerols from the Antarctic nudibranch *Austrodoris kerguelenensis*. *Tetrahedron*, **59**, 5579-5583
20. Gavagnin M., M. Carbone, E. Mollo and G. Cimino (2003).. Austrodoral and austrodoric acid: nor-sesquiterpenes with a new carbon skeleton from the Antarctic nudibranch *Austrodoris kerguelenensis*. *Tetrahedron Letters*, **44**: 1495-1498
21. Giordano A., A. Trincone Freeing anomeric hydroxyl groups of peracetylated oligosaccharides by *Aspergillus niger* lipase. *Tetrahedron Letters* **43**: 4939-4942 (2003).
22. Kannan K., Corsolini S., Falandysz J., Fillmann G., Senthil Kumar K., Loganathan B.G., Mohd M. A., Olivero J., Van Wouwe N., Yang J. H., Aldous K.M., (2004). Perfluorooctanesulfonate and Related Fluorochemicals in Human Blood from Several Countries *Environ. Sci. Technol.*, **38**(17) : 4489 – 4495.
23. Kulcitki V., N. Ungur N., Gavagnin M., Carbone M. and Cimino G. (2004). Synthesis and absolute stereochemistry of marine nor-sesquiterpene austrodoric acid. *Tetrahedron Asymmetry* **15**:423-428.

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24. Kumar K. S., Kannan K., Corsolini S., Evans T., Giesy J. P., Nakanishi J., Masunaga S (2002) Polychlorinated dibenzo-p-dioxins, dibenzofurans and polychlorinated biphenyls in polar bear, penguin and south polar skua. *Environ. Pollut.*, **119**(2): 151-161
25. Lama, L., V. Calandrelli, A. Gambacorta, B. Nicolaus. (2004) Purification and characterization of thermostable xylanase and  $\alpha$ -xylosidase by the thermophilic bacterium *Bacillus thermantarcticus*. *Res Microbiol.* 155, 283-289
26. Nicolaus B., V. Schiano Moriello, L. Lama, A. Poli, A. Gambacorta (2004) Polysaccharides from extremophilic microorganisms. *Origin of Life Evol. Biosphere* **34** (1):159-169
27. Olmastroni S. Olmastroni, F. Pezzo, I. Bisogno, S. Focardi, (2004). Interannual variation in the summer diet of Adélie penguin (*Pygoscelis adeliae*) at Edmonson Point. CCAMLR Working Group on Ecosystem Monitoring and Management, WG-EMM 04/38.
28. Olmastroni S., Pezzo F., Volpi V., Focardi S. Effects of weather and sea ice on Adélie penguin reproductive performance. *CCAMLR Science* 11:99-109 (2004)
29. Poli A., Schiano-Moriello, V., Esposito, E., Lama, L., Gambacorta, A., Nicolaus, B. (2004). Exopolysaccharide productiobin by a new *Halomonas* starin CRSS isolated from saline lake cape Russell in Antarctica growing on complex and defined media. *Biotech Lett.* **26**: 1635-1638
30. Poli, A., E. Esposito, V. Schiano-Moriello, L. Lama, A. Gambacorta, B. Nicolaus. (2003) A newly species belonging to the genus *Halomonas*, isolated from salt lake in Antarctic, able to produce exopolysaccharide. *The Italian Journal of Biochemistry*, **52**: 6.07.
31. Regoli F, Nigro M, Chierici E, Cerrano C, Schiapparelli S, Totti C, Bavestrello G (2004) Variations of antioxidant efficiency and presence of endosymbiotic diatoms in the Antarctic porifera *Haliclona dancoi*, *Marine Environmental Research*, vol. 58: 637-640.
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33. Regoli, F., Nigro M., Chiantore, M., Winston, G.W. (2002) Seasonal variations of susceptibility to oxidative stress in *Adamussium colbecki*, a key bioindicator species for the Antarctic marine environment, *Science of the Total Environment*, **289**(1-3):205-211
34. Santovito G., Fassina D., Irato P., Piccinni E., Albergoni V. (2003). Effects of cadmium and copper exposure in antarctic teleosts: *Trematomus bernacchii* and *Trematomus newnesi*. *Pflugers Arc. – Eur. J. Physiol.*, **445**: R44.
35. Santovito G., Irato P., Piccinni E., Albergoni V. (2004). Physiological responses against copper-induced oxidative stress in Antarctic teleosts: *Trematomus bernacchii* and *Trematomus newnesi*. *Pflugers Arc. Eur. J. Physiol.*, **448**: R24.
36. Trincone A., A. Giordano, G. Perugino, M. Rossi, M. Moracci (2003) Glycosynthas-catalyzed syntheses at pH below neutrality. *Biorganic and Medicinal Chemistry Letters* **13**:4039-4042
37. Trincone, A., E. Pagnotta, A. Giordano, G. Perugino, M. Rossi and M. Moracci (2003) Enzymatic synthesis of 2-deoxyglycosides using the  $\beta$ -glycosidase of the archaeon *Sulfolobus solfataricus*. *Biocatalysis and Biotransformation* **21**:17-24

### B – book chapters

1. Corsolini S., Olmastroni S., Ademollo N., Minucci G., Focardi S., 2003. Persistent organic pollutants in stomach contents of Adélie penguins from Edmonson Point (Victoria Land, Antarctica). In: *Antarctic Biology in a global context*, Ed. A.H.L. Huiskes, W.W.C. Gieskes, J. Rozema, R.M.L. Schorno, S.M. van der Vies, W.J. Wolff. Backhuys Publishers, Leiden, The Netherlands. pp. 296-300
2. Gambacorta, A., M. De Rosa, L. Lama and B. Nicolaus Sulfolobales lipids: new solutions in the lipid's world. In: *Biochemistry and Molecular Biology in the Thermophilic Archaeon Sulfolobus solfataricus*, pp. 1-22 (B. Farina, M.R. Faraone-Mennella, eds.), (2004), Research Signpost, Trivandrum, Kerala, India

### C - proceedings of international conferences

1. Benedetti M., Gorbi S., Bocchetti R., Fattorini D., Nigro M., Regoli F. (2004). Biochemical characterization of the antioxidant system and 7-ethoxyresorufin O-deethylase (EROD) in early life stages of Antarctic silverfish (*Pleuragramma antarcticum*). European Society of Comparative Physiology and Biochemistry 23th Annual Conference "Coping with environmental factors at sea: a molecular approach". Cesenatico 23-27 September
2. Benedetti M., Gorbi S., Fattorini D., Notti A., Nigro M., Regoli F. (2004). Environmental prooxidant conditions modulate the antioxidant efficiency in early life stages of Antarctic silverfish (*Pleuragramma antarcticum*). 11th Annual Meeting of Society of Free Radicals in Biology and Medicine (SFRBM), November 17-21, St Thomas, US-Virgin Islands
3. Bonacci S., Corsi I., Santovito G., Chiantore M., Castagnolo L., Focardi S. (2003) Colinesterases activity in Antarctic scallop *Adamussium colbecki*: background levels and sensitivity to pollutants. Proceedings of 13th Annual Meeting SETAC Europe, Hamburg, Germany, 7 April - 1 May 2003.
4. Bonacci S., Romani R., Corsi I., Hagger J.A., Browne M.A., Dissanayake A., Incozza A., Santovito G., Galloway T.S., Rosi G., Focardi S. (2004) Colinesterases activity in Antarctic scallop *Adamussium colbecki*: background levels and sensitivity to pollutants. Proceedings of 14th Annual Meeting SETAC Europe, Prague, Czech Republic, 18-24 April 2004.

## Programma Nazionale di Ricerche in Antartide (PNRA)

5. Corsolini S., Ademollo N., Nigro M., Focardi S., (2003). Fate of Persistent Organic Pollutants: Accumulation in Tissues of the Antarctic Soft-shelled Clam *Laternula elliptica*. The 8th International Congress of Toxic Combustion By-products: Origin, Fate and Health Impacts. Umea University, Umea, Sweden. June 17-19, 2003. pp. 54.
6. Corsolini S., S. Olmastroni, N. Ademollo, G. Minucci and S. Focardi, 2003. Persistent organic pollutants in stomach contents of Adélie penguins from Edmonson Point (Victoria Land, Antarctica). *CCAMLR Scientific Abstracts 2003*.
7. Corsolini S., S. Olmastroni, N. Ademollo, G. Minucci, S. Focardi, 2003. Persistent organic pollutants in stomach contents of Adélie penguins from Edmonson Point (Victoria land, Antarctica). WG-EMM 03/58.
8. Gorbi S., Benedetti M., Fattorini D., Pretti C., Vaccaro E., Gervasi P.G., Nigro M., Regoli F. (2004). Modulation of CYP1A response to coexposure with metals and organic chemicals in the Antarctic fish *Trematomus bernacchii* and Mediterranean eel *Anguilla anguilla*. 14th Annual Meeting of Society of Environmental Toxicology and Chemistry SETAC, Prague 18-22 April
9. Olmastroni S. F. Pezzo, I. Bisogno, S. Focardi, (2004). Interannual variation in the summer diet of Adélie penguin (*Pygoscelis adeliae*) at Edmonson Point. *CCAMLR Scientific Abstracts 2004*.
10. Olmastroni S., F. Pezzo, V. Volpi, S. Focardi, 2003. Observations of Adélie penguins in two seasons with contrasting weather and sea-ice conditions- a brief report. *CCAMLR Scientific Abstracts 2003*.
11. Olmastroni S., Kerry K., Volpi V., Pezzo F., Corsolini S., Focardi S., (2003). At sea foraging behaviour of Adélie penguins from Edmonson Point, Antarctica. Fifth Conference on Fish Telemetry Held in Europe, Ustica Is., Palermo, Italy, June 9-13, 2003. pp. 89.
12. Olmastroni S., S. Corsolini, F. Pezzo, S. Focardi and K. Kerry, (2003). Observations of Adélie penguins in two seasons with contrasting weather and sea ice conditions- a brief report. WG-EMM 03/59.
13. Romeo T., Corsolini S., Ademollo N., Greco S., Andaloro F., Focardi S., (2004). Livelli di composti organici persistenti in due aree antartiche: Mare di Ross e Isole Elephant e Shetlands. XVI Congresso AIOL, Terrasini, Italy, 18-22 ottobre 2004. pp. 197.
14. Santovito G., Coppellotti O., Piccinni E., Cassini A. (2003). Antioxidant responses to altered pO<sub>2</sub> and cadmium exposure on Euplores rarisseta, Antarctic and sub-Antarctic populations. Proceedings of 4th European Congress of Protistology and 10th European Conference on Ciliate
15. Volpi V., S. Olmastroni, F. Pezzo, S. Focardi, (2004). Ecologia riproduttiva del pinguino di Adelia (*Pygoscelis adeliae*) a Edmonson Point, Mare di Ross, Antartide. Variabilità interannuali durante sette stagioni riproduttive. In: *Conservazione e Gestione degli Ecosistemi XIV Congresso Nazionale SitE*, Siena 4-6 Ottobre 2004, p. 75

### D – proceedings of national meetings and conferences

1. Ballerini T., S. Olmastroni, G. Tavecchia, F. Pezzo, S. Focardi, (2004). Parametri demografici della popolazione di pinguini di Adelia a Edmonson Point, Mare di Ross, Antartide. In: *Conservazione e Gestione degli Ecosistemi XIV Congresso Nazionale SitE*, Siena 4-6 Ottobre 2004, p. 92
2. Corsi I., Bonacci S., Santovito G., Chiantore M., Castagnolo L., Focardi S. (2002) Preliminary investigation on cholinesterases activity and gonadal histology in *Adamussium colbecki* from terranova bay: field and laboratory study. *Atti del 3° Convegno Nazionale sulle Scienze del Mare "Ambienti estremi e aree di transizione"*, Bari, 27-30 novembre 2002.
3. Olmastroni S., K. Kerry, S. Focardi, 2004. Adélie penguin (*Pygoscelis adeliae*) three dimensional foraging in relation to sea ice. In: *Conservazione e Gestione degli Ecosistemi XIV Congresso Nazionale SitE*, Siena 4-6 Ottobre 2004, p. 75
4. Olmastroni S., F. Pezzo, V. Volpi, S. Focardi, 2002. Nuotare o camminare? Ecologia e strategie alimentari del pinguino di Adelia in due colonie del Mare di Ross, Antartide. *Abstracts del III Convegno Nazionale delle Scienze del Mare 27-29 Novembre*, Bari, Italia. p. 54.
5. Romeo T., Corsolini S., Ademollo N., Greco S., Andaloro F., Focardi S., (2004). Livelli di composti organici persistenti in due aree antartiche: Mare di Ross e Isole Elephant e Shetlands. XVI Congresso AIOL, Terrasini, Italy, 18-22 ottobre 2004. pp. 197.
6. Romeo T., Corsolini S., Ademollo N., Greco S., Andaloro F., Focardi S., (2004). Livelli di composti organici persistenti in due aree antartiche: Mare di Ross e Isole Elephant e Shetlands. XVI Congresso AIOL, Terrasini, Italy, 18-22 ottobre 2004. pp. 197.
7. Santovito G., Fassina D., Disertori X., Irato P., Piccinni E., Albergoni V. (2002). Risposte fisiologiche a stress ossidativi indotto da rame in teleostei antartici. *Atti del 63° Congresso Nazionale Unione Zoologica Italiana*, Rende, 22-26 settembre 2002, p. 129.
8. Santovito G., Fassina D., Irato P., Piccinni E., Albergoni V. (2002). Effects of cadmium and copper exposure in antarctic teleosts: *Trematomus bernacchii* and *Trematomus newnesi*. *Atti del 53° Congresso Nazionale della Società Italiana di Fisiologia*, Ferrara, 16-19 settembre 2002, p. 215.
9. Santovito G., Irato P., Piccinni E., Albergoni V. (2003). Physiological responses against copper-induced oxidative stress in Antarctic teleosts: *Trematomus bernacchii* and *Trematomus newnesi*. *Atti del 54° Congresso Nazionale della Società Italiana di Fisiologia*, Chieti, 29 settembre – 2 ottobre 2003, pp. 122-123.
10. Santovito G., Irato P., Piccinni E., Albergoni V. (2004). Risposte fisiologiche indotte da zinco in teleostei antartici. *Atti del 65° Congresso Nazionale Unione Zoologica Italiana*, Taormina-Giardini Naxos, 21-25 settembre 2004, p. 139.

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11. Santovito G., Piccinni E., Albergoni V., Cassini A. (2003). Evoluzione molecolare della superossido dismutasi a rame/zinco nei teleostei antartici *Trematomus bernacchii* e *Chionodraco hamatus*. Atti del 64° Congresso Nazionale Unione Zoologica Italiana, Varese, 21-25 settembre 2003, p. 106.
12. Santovito G., Piccinni E., Albergoni V., Cassini A. (2004). Molecular evolution of copper,zinc superoxide dismutase in Antarctic teleosts: *Trematomus bernacchii* and *Chionodraco hamatus*. Atti del 55° Congresso Nazionale della Società Italiana di Fisiologia, Pisa, 4-7 ottobre 2004, pp. 122-123.
13. Volpi, V. S. Olmastroni, F. Pezzo, S. Focardi, (2004). Ecologia riproduttiva del pinguino di Adelia (*Pygoscelis adeliae*) a Edmonson Point, Mare di Ross, Antartide. Variabilità interannuali durante sette stagioni riproduttive. In: Conservazione e Gestione degli Ecosistemi XIV Congresso Nazionale SItE, Siena 4-6 Ottobre 2004, p. 75

### E – thematic maps

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### F – patents, prototypes and data bases

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### G – exhibits, organization of conferences, editing and similar

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### H - formation (PhD thesis, research fellowships, etc.)

- Ademollo N. (2003). Trasporto ed accumulo di contaminanti organici in organismi marini artici ed antartici. Ph.D. Thesis in Polar Science Università degli Studi di Siena.
- Bakiu R. (2004). Clonaggio e sequenziamento del cDNA della superossido dismutasi a rame e zinco di teleostei antartici. B. Sc. Molecular Biology. Science Faculty. Università degli Studi di Padova.
- Benanti M. (2004). Clonaggio e sequenziamento del cDNA della superossido dismutasi a rame e zinco di teleostei antartici. B. Sc. Molecular Biology. Science Faculty. Università degli Studi di Padova.
- Casara S. (2004). Clonaggio e sequenziamento del cDNA della superossido dismutasi a rame e zinco di teleostei antartici. B.Sc. in Biotechnology. Science Faculty. Università degli Studi di Padova.
- Libralesso D. (2004). Risposte fisiologiche correlate all'esposizione a zinco in teleostei antartici. Biological Science degree. Science Faculty. Università degli Studi di Padova..
- Mantoan M. (2004). Induzione di enzimi antiossidanti in risposta a variazioni di temperatura in teleostei antartici. Biological Science degree. Science Faculty. Università degli Studi di Padova.
- Olmastroni S. (2002) Factors affecting the foraging strategies of Adélie penguin (*Pygoscelis adeliae*) at Edmonson Point, Ross Sea, Antarctica. Ph.D. in Polar Science Università degli Studi di Siena.
- Bisogno I. (2003) Analisi di contenuti stomacali di Pinguino di Adelia (*Pygoscelis adeliae*) nidificante in due colonie del Mare di Ross, Antartide. Degree thesis in Biological Science. Faculty of Science. Università degli Studi di Siena

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## Research units

### *n.1 – Scientific coordinator Simonetta Corsolini*

Simonetta Corsolini	Researcher	Dip. Scienze Ambientali Università' di Siena
Nicoletta Ademollo	Researcher	Dip. Scienze Ambientali Università' di Siena
Francesco Pezzo	Researcher	Dip. Scienze Ambientali Università di Siena
Susan G.Trivelpiece	Researcher	US AMLR Program
Wayne Z. Trivelpiece	Researcher	US AMLR Program
Valerio Volpi	Researcher	Dip. Scienze Ambientali Università' di Siena
Luana Bonelli	Technician	Dip. Scienze Ambientali Università' di Siena
Teresa Romeo	Researcher	Dip. Scienze Ambientali Università' di Siena

### *n. 2 Scientific coordinator Vincenzo Albergoni*

Arnaldo Cassini	Professor	Dip Biologia, Univ di Padova
Ester Piccinni	Professor	Dip Biologia, Univ di Padova
Olimpia Coppellotti	Professor	Dip Biologia, Univ di Padova
Noemi Favero	Researcher	Dip Biologia, Univ di Padova
Paola Irato	Researcher	Dip Biologia, Univ di Padova
Gianfranco Santovito	Technician	Dip Biologia, Univ di Padova
Franco Cattalini	Technician	Dip Biologia, Univ di Padova

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### *n. 3 Scientific coordinator* Marco Nigro

Giada Frenzilli	Researcher	Dip. Morfologia Umana e Biol. Univ. di Ancona
Francesco Regoli	Professor	Univ. di Ancona
Stefania Gorbi	Researcher	Univ. di Ancona

### *n. 4 Scientific coordinator* Aldo Viarengo

Giovanni Pons	Researcher	Dip. di Sci Tecnol. Avanzate, Univ. Piemonte Orientale
Bruno Burlando	Researcher	Dip. di Sci Tecnol. Avanzate, Univ. Piemonte Orientale
Valeria Magnelli	Researcher	Dip. di Sci Tecnol. Avanzate, Univ. Piemonte Orientale
Francesco Dondero	Researcher	Dip. di Sci Tecnol. Avanzate, Univ. Piemonte Orientale
Valentina Evangelisti	Researcher	Dip. di Sci Tecnol. Avanzate, Univ. Piemonte Orientale

### *n. 5 Scientific coordinator* Agata Gambacorta:

Nicolaus Barbara	Researcher	ICMIB – CNR Napoli
Licia Lama	Researcher	ICMIB – CNR Napoli
Antonio Trincone	Researcher	ICMIB – CNR Napoli
Enrico Esposito	CTER	ICMIB – CNR Napoli
Valeria Calandrelli	CTER	ICMIB – CNR Napoli
Ida Romano	CTER	ICMIB – CNR Napoli
Eduardo Pagnotta	CTER	ICMIB – CNR Napoli
Adriana Panico	Student	ICMIB – CNR Napoli
Mauriello Schiano	Student	ICMIB – CNR Napoli

### *n. 6 Scientific coordinator* Guido Cimino

Angelo Fontana	Researcher	ICMIB – CNR Napoli
Maria Letizia Ciavatta	Researcher	ICMIB – CNR Napoli
Ernesto Mollo	Technician	ICMIB – CNR Napoli
Gennaro Scognamiglio	Technician	ICMIB – CNR Napoli

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**Date: 6/11/08**