Aims and Objectives

- A study on biology and application potential of polar organisms: cold-adaptation mechanism and bioinformatics
- To define cold-adaptation mechanism of polar organisms
- To develop polar organisms as an application bioresource
- To construct a hub-network of polar bioinformatic database

Research Goal

Preliminary-phase (2011-2013)
- Antarctic organisms: Cold-adaptation mechanism and its application

Achievements

- Research based on polar genomics
  - Construction of polar genomic information using NGS platform
  - Construction of polar proteinomic information
  - Profiling polar gene expression profiles of cold-adapted polar organisms
  - Profiling polar proteomic properties of cold-adapted polar organisms
  - Construction of cold-adapted protein profiles based on 3-Dimensional structure
  - Determination of cold-adapted protein
  - Development of multiplex biomarkers
- Application study using polar genes and proteins

Research Methods

- Bioinformatic study on polar biology
  - Research approaches using genetics, transcriptomics, and proteomics
  - Discovery of cold-adapted genes and proteins
  - Analysis of gene structure
  - Construction of standard proteomics maps
  - Analysis of regulatory genes and proteins

- Cold-adaptation mechanism of polar organisms
  - Analysis of cold-adapted molecular signaling mechanism
  - Analysis of differential gene expression driven by variety of different polar environmental factors
  - Analysis of protein activity and determination of 3-D protein structure

- Application study based on polar bioinformatics
  - Development of cold-tolerant organisms
  - Development of cold-active enzymes
  - Development of biomarkers involved in cold-adaptation mechanism

Research Background

- Since the Convention on Biological Diversity (CBD) and ABS (Access to genetic resources and Benefit-Sharing) entered into force, the US, Japan, EU, England, Russia, China, etc. are currently in talks to admit the nation’s sovereignty over bioresources.
- Since most of developed countries have recognized polar organisms as strong future resources and works on application studies, their researches have been focusing on systematic screening and collection of marine organisms and a large scale of Omics research.
- Consequently, fundamental studies on polar bioresources, as well as application approaches, are considered critical subject to Korean government, operating scientific stations in both the Arctic and Antarctica.
**Overall Outcomes**

*Complete genome of Antarctic fish, the first case for the Antarctic higher animal*
- Sequenced 650 Mb complete genome of the Antarctic cod
- Identified 13,000 unique genes comparing other fish
- Published to the Genome Biology (IF 10.5, JCR rate 2.4%)

*Draws big picture of bioadaptation mechanism and suggestion of evolutionary evidence for cold environmental organisms*

*Drives polar researches by providing polar biological information on genomics and proteomics*

*Leads international research collaborations by polar bioinformatic hub-network system using genome and proteome data*

*Suggests application potential of polar genomic and proteomic data for new bioresource developments in the field of health and medical improvements*

*Determined the three-dimensional protein structure of the antifreeze protein from a glacial bacterium*
- Developed application possibility to utilize as a cryoprotectant for animal cells and diatom
- Published to the Acta Crystallographica Section D (IF 14.1, JCR rate 2.4%)

*Developed a cold-tolerant crop by using genes from an Antarctic hairgrass*
- The first transgenic crop resistant against environmental stress developed using genes from Antarctic plant
- Domestic patent pending and published to the Plant Science (IF 4.1, JCR rate 9.5%)

*Conducted the genomic database of the Antarctic cod*
- Established intra- and international collaboration platform
  - http://antagen.kopri.re.kr

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**Future Plans**

*Draws big picture of bioadaptation mechanism and suggestion of evolutionary evidence for cold environmental organisms*

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