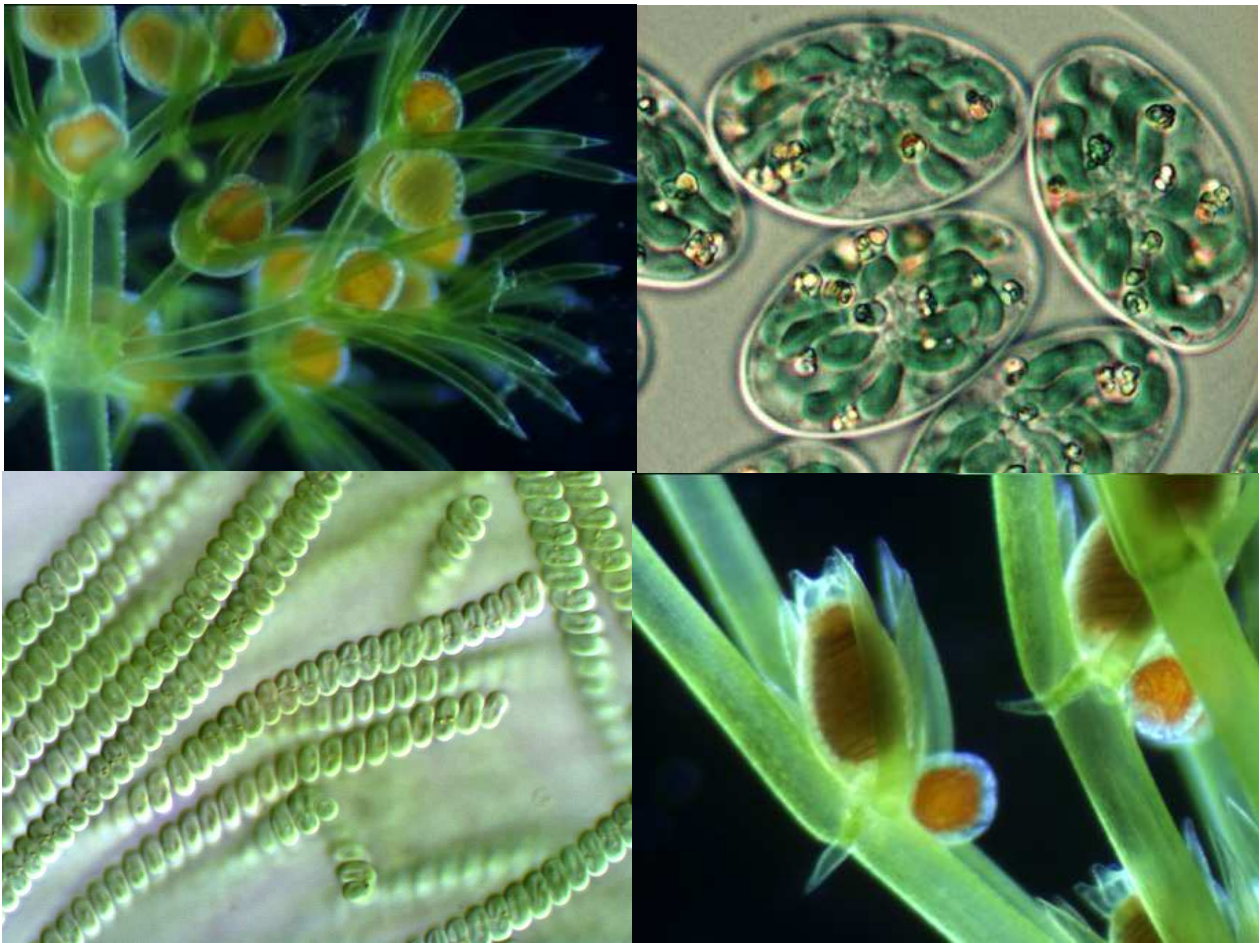


**The Fourth Asian Pacific Phycological Forum
Mini-Symposium
“Network of Asia Oceania Algal
Culture Collections”**



**November 1, 2005
RAMA Gardens Hotel, Bangkok Thailand**

**Organized by
Makoto M. Watanabe
Susan Blackburn**

**Cover Algal photographs supplied courtesy of
Microbial Culture Collection at National Institute
for Environmental Studies, Japan
Top left : *Nitella hyalina* NIES-1623
Top right: *Glaucocystis nostochinearum* NIES-966
Bottom left: *Spirulina subsalsa* NIES-27
Bottom right: *Chara braunii* CH-14**

PROGRAM

Network of Asia Oceania Algal Culture Collections (AOAC)

Tuesday November 1, 2005

Conveners: Makoto M. Watanabe (National Institute for Environmental Studies, Japan)
Susan Blackburn (CSIRO Marine and Atmospheric Research, Australia)

1. Introduction

9:45-9:57 Objectives and activities of AOAC

Makoto M. Watanabe (National Institute for Environmental Studies, Japan)

2. Country Reports

9:57-10:08 The CSIRO Collection of Living Microalgae (CCLM)

Ian Jameson (CSIRO Marine and Atmospheric Research, Australia)

10:08-10:19 Current development and prospectives of FACHB-Collection

Lirong Song (Institute of Hydrobiology, Chinese Academy of Science, China)

10:19-10:30 Algal Culture Collections in Japan

Fumie Kasai (National Institute for Environmental Studies, Japan)

10:30-10:41 Microalgal Culture Collection in the Biological Resource Center, Korea: Introducing molecular techniques for the cyanobacterial classification

Hee-Mock Oh (Biological Resource Center, Korea)

10:41-10:52 The University of Malaya Algae Culture Collection (UMACC):1987 - 2005

Siew-Moi Phang (Institute of Biological Sciences, University of Malaya, Malaysia)

10:52-11:03 Cawthron Culture Collection: a unique collection of New Zealand micro-algae

Lesley Rhodes (Cawthron Institute, New Zealand)

11:03-11:14 Algal culture collections in Thailand: the present status

Aparat Mahakhant (Microbiological Resources Centre (MIRCEN), Thailand)

11:14-11:25 Algal Culture Collection in Vietnam National University, Hanoi

Duong Duc Tien (Center of Biotechnology, VietNam National University, Vietnam)

3. Panel Discussion

11:25-12:00 Panel Discussion on AOAC Action 2005

Chair: Susan Blackburn (CSIRO Marine and Atmospheric Research, Australia)

AOAC ABSTRACTS

Objectives and activities of Network of Asia Oceania Algal Culture Collections (AOAC)

Makoto M. Watanabe

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A round table session of Algal Culture Collections from Asia-Oceania was held on the evening of 12 October 2004 as part of the 10th International Congress of Culture Collections, Tsukuba, Japan. The objectives of the round table session were to determine the support of member countries for constructing a network of algal culture collections in the Asia Oceania region. The session comprised a report on the status of algal culture collections from each member country and a discussion on the rationale for, member composition and management of a network. The strong support for a network was evoked by participants.

AOAC will consist of algal culture collections in the Asia Oceania region, both microalgae and macroalgae. Representation of AOAC will be on a country basis, with each country representative co-coordinating linkages and communication within each country. NIES, Japan is the lead agency with Dr. Makoto Watanabe, Coordinator of AOAC and Dr. Susan Blackburn, CSIRO, Australia Assistant Coordinator. The objectives of AOAC are:

- To identify and foster synergy and linkages between algal culture collections in Asia Oceania.
- To build and improve capacity of algal culture collections in Asia Oceania in research, education and the applications of microalgae.
- To preserve and improve knowledge of algal biodiversity in Asia Oceania. and
- To integrate and disseminate knowledge and data on algal culture collections in Asia Oceania.

The discussion will be made on the action plan of AOAC. In particular, it is a priority matter to establish a database of strains held in algal culture collections in Asia Oceania (format to be determined but in line with international standards of data management for culture collections/biological resource centers proposed by GBIF and OECD's GBRCN recommendation).

The CSIRO Collection of Living Microalgae

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The Australian CSIRO (Commonwealth Scientific and Industrial Research Organisation) Collection of Living Microalgae (CCLM) (<http://www.marine.csiro.au/microalgae/index.html>) was established in the 1960s and currently maintains over 800 strains from 140 genera representing the majority of marine and some freshwater microalgal classes. The Collection is incorporated within CSIRO microalgae research and provides a supply service of microalgal strains to industry, government and university organizations in 30 countries. The strains have primarily been sourced from Australian waters spanning tropical to polar biogeographic zones. Research within CSIRO and in partnership with collaborators spans a wide base within the three areas of environment, aquaculture and biotechnology. Environmental, research undertaken include physiological studies of different life history stages of microalgae, toxin production in harmful algal bloom (HAB) species, phylogenetic studies of different populations of HAB species, and bloom dynamics studies. Aquaculture and Biotechnology research include optimizing the nutritional benefit of microalgal diets in larval and broodstock aquaculture species, including important nutrients such as vitamins and polyunsaturated fatty acids and optimizing high biomass production systems through the use of photobioreactors. Gene discovery research utilizing CCLM strains is also being applied to microalgal biosynthetic pathways as part of multidisciplinary projects within CSIRO. CCLM is the major microalgal culture collection in Australia and is one of only twenty national research facilities under the federal Department of Environment, Science and Technology. Other small research collections are associated with Australian research institutions including Australian Water Quality Centre, Australian Antarctic Division Culture Collection, CSIRO Centre for Environmental Contaminants Research Culture Collection, Melbourne University Culture Collection, Murdoch University Algal Culture Collection, and University of Tasmania Harmful Algae Culture Collection.

Current development and prospectives of FACHB-Collection

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Over the past decade, growing awareness for the important of algae has prompted the development of algal culture collections in China. This is evidenced by the increasing demanding for algal strains from many areas of basic and applied disciplines. FACHB-Collection, known as the Freshwater Algae Culture Collection of the Institute of Hydrobiology, Chinese Academy of Science (CAS), has been playing a major role in providing service for algal strains for research and exploitation in China. In addition, a lot of studies have been conducted in association with the collection. Based on long-term study on freshwater eutrophication in many lakes and reservoirs in China, we have developed a database on bloom-forming algae covering information on ecological, physiological and toxicological parameters of each species or strain. Based on *cpcBA*-IGS nucleotide sequence , diversity of 30 strains of *Microcystis* from China, Australia, Japan and France were investigated. It was indicated that there were significantly differences between 18 Chinese strains and 2 Australian strains of *Microcystis* , the strains of Japan and French have little difference compared to 18 Chinese strains, The derived neighbor-joining (NJ) and maximum likelihood (ML) trees indicated that 20 Chinese strains of *Microcystis* can be divided into two clusters. Our collection has also kept a great deal of terrestrial algae due to its richness and function in diverse habitats such as in paddle field, arid or desert environments. A database on terrestrial algae in China was established, of which distribution and function of desert strains are of particular importance. With the growing awareness on bioresources protection, the role of the culture collections has been greatly recognized and a new proposal conceived for better management and development of Culture Collections in China.

Algal Culture Collections in Japan

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In Japan, three public culture collections have actively distributed microalgae strains for research, development and education, i.e. Microbial Culture Collection at the National Institute for Environmental Studies (NIES), Institute of Applied Microbiology Culture Collection, University of Tokyo (IAM) and Marine Biotechnology Institute Culture collection (MBIC). They hold 1855 (1500 available), 417 (279), 389 strains, respectively. NIES Collection started in 1983 as a collection holding microalgae related to environmental issues, such as *Microcystis* and *Chattonella*, and now it holds a variety of algae including phylogenetically related colorless flagellates and endangered macroalgae. Mitochondria, chloroplast and whole genomes were determined in *Mesostigma viride*, *Nephroselmis olivacea* and *Cyanidioschyzon merolae* which are maintained in NIES Collection. IAM Collection was founded in 1953, and is the oldest algal collection in Japan. It holds a number of *Chlorella* strains that have been utilized in physiological studies. MBIC maintains mostly marine species, especially of Prasinophyceae and the chlorophyll d producing cyanobacterium *Acaryochloris*. Several other culture collections focus on some particular groups of algae, e.g. red tide forming microalgae strains held in Akashiwo Research Institute of Kagawa Prefecture, and microalgae for aquaculture held in National Research Institute of Aquaculture (NRIA). NRIA has ca. 300 strains including 50 strains essential for aquaculture in Japan. On the other hand, as a national program, National Bio-Resource Project started in April 2002, to set up core institutes for preservation of various bioresources to promote life science research in Japan. NIES Collection was chosen as the core institute of algae, and is collaborating with University of Tsukuba, National Science Museum, University of Tokyo, Kobe University and Hokkaido University.

Microalgal Culture Collection in the Biological Resource Center, Korea: Introducing molecular techniques for the cyanobacterial classification

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In 2002, the Microalgal Culture Collection (MCC) was established at the Biological Resource Center (BRC) that was founded in 1985 as a national center affiliated with the Korea Research Institute of Bioscience and Biotechnology (KRIBB) in Korea. The MCC-BRC has been playing an important role for the collection, preservation and distribution of microalgae. These activities are carrying out in connection with the environmental and industrial research activities at the Environmental Biotechnology Laboratory. At present, about 650 microalgal strains in unialgal cultures (39 strains of Bacillariophyceae, 318 strains of Chlorophyceae, 191 strains of Cyanophyceae, 38 strains of the others and 63 unidentified strains) were isolated from Korean freshwaters and are being maintained. The MCC-BRC is developing a database of the conserved collections and will extend this activity to the nationwide microalgal collections kept by other collections. Molecular approaches seem to be particularly useful in the detection and identification of specific stains, especially those that are morphologically identical at the species level. The genetic locus used in our laboratory was *cpcBA*-IGS, which includes the highly variable intergenic spacer (IGS) region between *cpcB* and *cpcA* within the phycocyanin operon. Phycocyanin is an accessory pigment that gives cyanobacteria their characteristic blue-green color and is contained only in the cyanobacterial photosynthetic apparatus. The *cpcBA*-IGS appears to be more useful in discriminating between strains than the commonly employed 16S rRNA gene, which exhibits low intragenetic variability in many cyanobacteria. Therefore, it seems that this culture-independent method could be applied to identify cyanobacterial strain and to determine cyanobacterial community structure.

The University of Malaya Algae Culture Collection (UMACC):1987 - 2005

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The University of Malaya Algae Culture Collection (UMACC) established in 1987, started as a research-based collection which grew to serve teaching and consultancy activities. Selected cultures are also made available to researchers from other universities and research institutions. The UMACC comprises about 150 microalgal strains isolated from various habitats in Malaysia. Recently, 20 isolates of Antarctic microalgae were added into the collection. Various studies to explore the potential applications of the UMACC microalgae were conducted, and these include the following: (i) screening of the microalgae for high-value chemicals such as polyunsaturated fatty acids, carotenoids and phycobiliproteins, (ii) use of the microalgae to treat agro-industrial wastewaters such as rubber and palm oil mill effluents, and sago factory wastewater, as well as textile wastewaters, (iii) use of the microalgae as biomonitors for heavy metal pollution and nitrogen enrichment in freshwater ecosystems, (iv) use of the microalgae as mosquito larvicidal agents; (v) use of the microalgae as aquaculture feed and (vi) Antarctic algal studies especially on their response and adaptation to environmental stress.

Cawthron Culture Collection: a unique collection of New Zealand micro-algae

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Cawthron Institute holds a significant culture collection of micro-algae for New Zealand, which contains more than 150 isolates of marine micro-algae, most of which are toxic and unique. The collection is central to Cawthron's research, which includes the development of harmful algal bloom technologies, for example the cross reactivity testing of DNA probes, development and testing of LC-MS methods for marine biotoxins, the preparation of chemical standards and development of cryopreservation techniques. The collection also houses source materials for screening for pharmacologically useful compounds. It has been used extensively by other researchers since the collection was established in 1994, e.g. more than 300 cultures and culture extracts have been supplied to approx. 100 users in New Zealand and overseas in the past year. The collection is partially funded by the New Zealand Foundation for Research, Science and Technology.

Algal culture collections in Thailand: the present status

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Recently, the research and study on biodiversity and sustainable utilization of algae have been actively done in all regions of Thailand. In 1996, only two service Algal Culture Collections (ACCs), one at MIRCEN, TISTR and another at Bangsean Institute of Marine Science (BIMS), Burapha University (BU) and one small specialized ACC at Institute of Food Research and Product Development (IFRPD), Kasetsart University (KU) were reported by MIRCEN, TISTR. In 2004, still two only service ACCs were reported by MIRCEN, TISTR. In case of small specialized ACCs, beside the one at IFRPD, KU another two ACCs were also reported. The two additional ACCs were established at Applied Algae Research Laboratory (AARL), Faculty of Science and at Department of Soil Science, Faculty of Agriculture, Chiang Mai University (CMU). As the result, at present only 5 ACCs related to agriculture, industrial, environment, research and education activities were established in Thailand. All of these ACCs are associated with universities or research institute which indicates the important role they play to support education, research, government and public activities. Almost all of the collections are small in size, holding less than 500 strains and maintained under precarious conditions due to inadequate knowledge and economical support. Subsequently, some of the most important strains have already been lost, and many strains are exposed to serious conditions. Therefore, the establishment of inter-cooperation between ACCs in both national and international level for the exchange of knowledge and technology in ACCs management is strongly recommended.

Algal Culture Collection in Vietnam National University, Hanoi

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The Algal Culture Collection of Vietnam National University, Hanoi is the oldest type culture collection laboratory in Vietnam. It was established in 1970 with 50 strains.. A database on terrestrial algae in Vietnam was established to assist distribution and function of biofertilizer strains.

Since 1990 and especially from the Tenth International Congress for Culture Collections (2004) where a report on the current status of algal culture collection in Vietnam was presented, the Algal Culture Collection in Vietnam National University, Hanoi has undergone many changes.

At present, the number of algal culture strains in the collection is more than 620. These strains include *Cyanophyta*, marine microalgae, soil and fresh water algae belonging to phyla of *Chlorophyta* (*Charales*, *Chlorococcales*, *Desmidiiales*) and *Heterokontophyta*.

Research is focussed on various areas including: (1) use as indicators for environmental stress (2) wastewater bioremediation. (3) diversity of Vietnam algae (4) apply broadly in aquaculture and agriculture.

Hence, there is a need in the near future for better coordination, which could lead to the establishment of an intergrated, well funded, and well maintained algal culture collection, serving not only Vietnam National University, Hanoi but also national interests.

POSTER ABSTRACTS

RELATED TO AOAC

Glaucophyte algae isolated from Thailand

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The division Glaucophyta is a distinct group of algae that includes cyanelles instead of chloroplasts. So far, nine genera and ca. 13 species were described. However, some of them were found once or twice and considered to be doubtful. Only four species (genera) maintained in culture collections have been utilized for research including ultrastructure and genome analysis of the cyanelle. We isolated several strains belonging to *Glaucocystis*, *Gloeochaete* and *Cyanophora* from four localities in Thailand. Morphological observations showed two types of *Glaucocystis*, which were isolated from two different localities. One was similar to previously described *G. nostochinearum*, whereas the other was inconsistent with any species previously described. Molecular phylogeny inferred from 18S rDNA sequences showed that the former belonged to a same clade as European and Japanese strains (*G. nostochinearum*) maintained in SAG and NIES, respectively, and the latter formed a sister clade. *Gloeochaete* strains isolated from Thailand also showed genetic differentiation from a European strain, irrespective of similar morphology. In contrast, a *Cyanophora* strain isolated from Thailand was included in a same clade with other European and Japanese strains of *Cyanophora* spp. These results may indicate glaucophyte species endemic to this region.

Biodiversity and applications of Australian microalgae

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A broad diversity of microalgae are held in the CSIRO Collection of Living Microalgae, with strains mostly sourced from Australian waters from the tropics to Antarctica. Microalgae are known for their global distribution at the morphological species level. However Australian microalgae held in the CSIRO Collection of Living Microalgae (<http://www.marine.csiro.au/microalgae>) can have unique chemical, molecular and physiological characteristics. Within a single species there can be considerable diversity between and within populations; indeed there can be diversity between different strains. Such regional biodiversity and strain specificity has implications for microalgal applications including the search for novel bioactive compounds and use of microalgae in human health, agrifood, biotechnology and aquaculture. A particular focus for CSIRO is omega-3 long chain polyunsaturated fatty acids (ω 3 LC-PUFA). ω 3 LC-PUFA are very beneficial for human health and are usually sourced by consuming seafood or fish oil supplements; however microalgae and other micro-organisms are the primary producers of ω 3 LC-PUFA and fish obtain them via the marine food chain. CSIRO is investigating microalgae and thraustochytrids as single cell alternatives to fish oils. We are also researching both novel strains and high biomass production systems including photobioreactor technology. As part of the CSIRO Food Futures Flagship we are taking a gene discovery route to both understand the biosynthesis of ω 3 LC-PUFA and also to produce these important fatty acids in oilseed crop plants.

Applied marine microalgae in aquaculture in Vietnam

**Tran Hai Linh¹, Duong Duc Tien¹, Nguyen Minh Giang¹, Vu Thanh Lam¹
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Algal culture collection of Vietnam National University, Hanoi has more than 620 microalgae strains. Among them, over 25 strains are marine microalgae and most of these isolates originated in Vietnam. Marine microalgae species can vary significantly in their nutritional value. Nevertheless, a carefully selected mixture of microalgae can offer an excellent nutritional package for larval aquaculture animals. Microalgae have been found to have good nutritional properties, either as monospecies or within a mixed diet, include *Skeletonema costatum*, *Isochrysis* sp., *Tetraselmis suecica*, *Nannochloropsis* sp., *Chaetoceros calcitrans*, *Chaetoceros muelleri*, *Pavlova lutheri*, *Dunaliella* sp., *Chroomonas* sp. In which so *Skeletonema costatum*, *Isochrysis* sp., *Chaetoceros calcitrans*, *Pavlova lutheri* are the most common species used to feed larval, early juvenile and broodstock stages of bivalve molluscs, and fed to *Artemia* or rotifers, which are then fed on to later larval stages of crustacean and fish larvae. These results demonstrated that DHA-containing lipid bodies in cells can be produced and accumulated in marine *Isochrysis* sp. As an adjunct, the collection supplies some species such as *Skeletonema costatum*, *Isochrysis* sp., *Nannochloropsis* sp., *Chroomonas* sp. as food for larvae and aquaculture farms in HaTinh, HaiPhong and QuangNinh province in Vietnam.

**MINUTES OF THE FIRST
MEETING OF AOAC**

Minutes of the first meeting of AOAC

October 14, 2004

Continental Room, Okura Frontier Hotel, Tsukuba Japan

Attendants:

Australia

Dr Susan Blackburn
Mr Ian Jameson

China

Dr Song Lirong

Japan

Dr Makoto Watanabe
Dr Fumie Kasai

Malaysia

Dr Phang Siew-Moi Phang
Dr Wan-Loy Chu

United Kingdom

Dr Frithjof Kuepper (independent linkage)

This meeting was a follow-up to a round table session of Algal Culture Collections from Asia-Oceania held on the evening of 12 October 2004 18:00-21:00 as part of the 10th International Congress of Culture Collections, Tsukuba, Japan. The objectives of the round table session were to determine the support of member countries for constructing a network of algal culture collections in the Asia Oceania region. The session comprised a report on the status of algal culture collections from each member country and a discussion on the rationale for, member composition and management of a network. The strong support for a network evoked by participants led to the submission of a resolution to the World Federation of Culture Collections (WFCC), that an Algal Culture Collection network for Asia-Oceania would be established.

This follow-up meeting was instigated to develop draft objectives and an action plan for the network. AOAC will consist of algal culture collections in the Asia Oceania region, both microalgae and macroalgae. Representation of AOAC will be on a country basis, with each country representative co-coordinating linkages and communication within each country. NIES, Japan is the lead agency with Dr. Makoto Watanabe, Coordinator of AOAC and Dr. Susan Blackburn, CSIRO, Australia Assistant Coordinator.

Objectives:

- Identify and foster synergy and linkages between algal culture collections in Asia Oceania.
- to build and improve capacity of algal culture collections in Asia Oceania in research, education and the applications of microalgae.
- to preserve and improve knowledge of algal biodiversity in Asia Oceania.
- to integrate and disseminate knowledge and data on algal culture collections in Asia Oceania.

Activities:

- Establish a database of strains held in algal culture collections in Asia Oceania (format to be determined but in line with international standards of data management for culture collections/biological resource centres proposed by GBIF and OECD's GBRCN recommendation)
- Convene regular meetings of the members of the network.
- Conduct training courses/workshops to develop skills needed within algal culture collections and by other algal researchers.
- Facilitate national and regional research initiatives in Asia Oceania on:
 - biodiversity.
 - environmentally important algae, e.g. cyanobacteria, toxic dinoflagellates, harmful algal blooms,
 - economically important algae, e.g. *Spirulina*, aquaculture species.
- Establish links with other regional networks.

Action 2004/05:

- Establish a directory of algal culture collections and researchers in Asia Oceania. Country representatives to collate this information nationally and submit to NIES by 31 December 2004.
- Investigate UNESCO sponsorship for AOAC workshops and training
- Hold second meeting of AOAC in conjunction with the Asia Pacific Phycological Forum in Bangkok, November 2005.

Composition of AOAC for 2004-05:

Coordinator : Dr. M. Watanabe

Assistant Coordinator Dr. S. Blackburn

Secretary: Ms. Tomoko Kato

Country Representatives:

Australia	Dr. Susan Blackburn (Mr. Ian Jameson)
China	Dr. Lirong Song - freshwater Dr. Guo Jian – marine
Indonesia	Dr. Nining Betawati Prihantini
Japan	Dr. Fumie Kasai
Korea	Dr. Hee-Mock Oh Dr. In Kyu Lee
Malaysia	Dr. Siew-Moi Phang (Dr. Wan-Loy Chu)
New Zealand	(Dr. Lesely Rhodes)
Thailand	Dr. Aparat Mahakhant
Vietnam	Dr. Duong Duc Tien

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