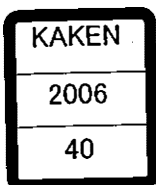


カンボジアのトンレサップ湖における生物多様性維持機構の評価

著者	塚脇 真二
著者別表示	Tsukawaki Shinji
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研究代表者 塚 脇 真 二
(金沢大学自然計測応用研究センター 助教授)

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はじめに

東南アジア最大の湖であるとともに熱帯低地に位置する湖沼としては世界最大のトンレサップ湖は、雨季と乾季とで面積が5倍にも変化し、それにもなつて水深も大きく変わる湖として有名である。高水位期になると低水位期の湖畔に繁茂していた植生は水没して一部が浸水林となり、世界でもまれな景観として同国有数の観光地ともなっている。また、この湖は世界でも類を見ないほどに多種多様で、豊富な現存量を有する生物相を擁することで知られ、たとえば単位面積あたりの漁獲高は淡水域としては世界最高の部類に入るとされる。さらにこの湖は栄華をきわめたクメール王朝期を含め現在に至るまで、カンボジアに住む人々の社会・文化・生活のあらゆる面にわたって密接な存在であり続けてきた。トンレサップ湖そのものの自然環境や湖が生み出す水産資源がカンボジアの人々を支え続けてきたともいえよう。これに加え、アジア有数の大河メコンとトンレサップ川によって連絡する同湖は、メコン河の天然の遊水池として同河下流域の洪水の防止に大きく貢献していることが知られている。またメコン河はチベット高地に端を発し南シナ海へ注ぐ広大な水系であることから、寒帯から熱帯に至るさまざまな気候帯に生息する生物群集の連続性が知られており、生物地理学上、同湖はこれらの生物の保育地として重要な位置にあるともいえる。

このようにトンレサップ湖は学術的にきわめて興味深い湖沼であり、カンボジアのみならずメコン河流域に位置する諸国にとっても社会生活の基盤としてかけがえのない存在である。しかし、カンボジアやその周辺諸国における長年の戦乱や政情不安などのためこれまで同湖の調査が十分になされてきたとはいえず、かつての調査結果にも散逸してしまったものが多い。たとえば、雨季と乾季で湖の景観を大きく変化させる水や堆積物の収支について、定量的な観測・解析はいまだ行われていない。また魚類や鳥類の種類・現存量の豊富さから、この湖にはそれを支えるだけの自然環境や生物群集が存在することは容易に想像されるものの、生物群集の詳細やそれらが構築する生態系に関する基礎情報はほとんどない。産業的に重要な魚類の生態すらその大部分が未解明である。そして一方では、湖自体やメコン河水系の大規模開発が計画あるいは実施されている最近の社会情勢や、熱帯低地に位置するこの湖が地球温暖化による海面上昇の影響を直接的に被りやすいことを考えると、湖の自然環境にかかわる基盤情報を収集・解析・提示することはまさに急務といえる。なかでもこの湖が誇る生物多様性とそれを保障している環境要素の詳細を明らかにし、生態系としての維持機構を評価することは、学術的にも社会的にも重要である。

本研究の研究代表者ならびに研究分担者を中心とする「トンレサップ湖総合学術調査提言委員会」の現地調査が平成12年度に実施され、わずか2週間あまりの調査期間にもかかわらず、生物、水文、地質・地形、そして水産の各調査分野において、この湖の学術上の希少性ならびに社会的な重要性が確認された。それと同時にこの湖の生物多様性の維持機構を評価する急務性が明確なものとなり、そのためにはこの湖特有の環境条件をまず明らかにし、その結果をふまえて水界生態系の中

でもっとも多様性が高いとされる無脊椎動物群の種構成の把握が、同湖の全生物相ならびに生態系解明の第一段階として必要だということが認識された。一方、平成12年度から平成14年度にかけて本研究代表者らによって実施された科学研究費補助金海外学術調査「カンボジアのトンレサップ湖における過去2万年間の環境変遷史」の成果から、現在のトンレサップ湖にみられる自然環境が今から約5,500年前の同湖とメコン河との連絡に始まること、またそれ以後は現在に至るまで安定した水域として存在したことが明らかとされている。同湖で現在みられるような自然環境の出現や多種多様な生物群集の存在は、過去から現在にいたるまでの同湖の環境変遷史上で位置づけられるべきものであり、同湖が誇る生物多様性が湖とメコン河との連絡なしには解釈できないことは明らかであるが、その一方で同湖の過去の自然環境ならびにその変遷史を解明するためには、いまだに不明な点が数多く残されている同湖の現在の自然環境を正しく評価する必要性も生じてきた。

そこで本補助金研究では、トンレサップ湖北半部および南半部において、湖の最高水位期および最低水位期それぞれに、流況などの水文学的観測、無脊椎動物群の第一の繁殖基盤と考えられる浸水林域を中心とする植生調査、ならびに底質・湖底地形調査などによって湖全域の環境条件ならびにその季節的な差異をまず明らかにし、そのうえで水界無脊椎動物群の種構成を調べ、同湖全域におけるこれらの空間的な分布ならびに季節変化を把握につとめた。これに加えて魚類の分類学的研究もあわせ実施した。そして、湖の環境条件と水界無脊椎動物群との地理的ならびに季節的な関連性を相互に参照し総括することで、トンレサップ湖の生物多様性の維持機構についての基礎的評価を行った。調査結果の一部はまだ解析中であるものの、現在までに上述の研究目的はほぼ達成することができたといえる。それぞれの分野における調査経過や調査結果については研究経過・研究成果の項をごらんいただきたい。なお、本研究の遂行にあたっては、本補助金に加えてUNESCO Fund-in Trust MAP-IHP Joint Programme「Ecological and Hydrological Research and Training for Young Scientist in Tonle Sap Biosphere Reserve, Cambodia: Research and Training for Young Scientists」、および金沢大学21世紀COEプログラム「環日本海域の環境計測と長期・短期変動予測」ならびに北海道大学21世紀COEプログラム「新自然史科学創成：自然界における多様性の起源と進化」を合わせ用いた。

研究組織

研究代表者：塚脇真二（金沢大学自然計測応用研究センター・助教授）

研究分担者：片倉晴雄（北海道大学大学院理学研究科・教授）

研究分担者：大高明史（弘前大学教育学部・教授）

研究分担者：平吹喜彦（東北学院大学教養学部・教授）

研究分担者：神谷隆宏（金沢大学大学院自然科学研究科・教授）

研究分担者:遠藤修一(滋賀大学教育学部・教授)

研究分担者:奥村康昭(大阪電気通信大学工学部・助教授)

研究協力者:成田哲也(元京都大学生態学研究センター)

研究協力者:本村浩之(鹿児島大学総合研究博物館・助教授)

研究協力者:石川俊之(北海道大学大学院地球環境科学研究院・学術研究員)

研究協力者:向井貴彦(岐阜大学地域科学部・講師)

研究協力者:荒木祐二(横浜国立大学大学院環境情報学府・大学院生)

研究協力者:大八木英夫(日本大学大学院総合基礎科学研究科・大学院生)

研究協力者:古内正美(金沢大学大学院自然科学研究科・助教授)

研究協力者:竹林洋史(徳島大学工学部・助教授)

研究協力者:陰地章仁(株式会社中部日本鉱業研究所)

海外研究協力者: Sieng Sotham (Director, Department of Geology, General Department of Mineral Resources, Ministry of Industry, Mines and Energy, Kingdom of Cambodia)

海外研究協力者: Touch Sambath (Deputy Director, Department of Geology, General Department of Mineral Resources, Ministry of Industry, Mines and Energy, Kingdom of Cambodia)

海外研究協力者: Ben Bunnarin (Chief Scientist, Department of Geology, General Department of Mineral Resources, Ministry of Industry, Mines and Energy, Kingdom of Cambodia)

海外研究協力者: Im Sim (Researcher, Department of Geology, General Department of Mineral Resources, Ministry of Industry, Mines and Energy, Kingdom of Cambodia)

海外研究協力者: Ang Cheoulean (Professor, Faculty of Archaeology, Royal University of Fine Arts, Kingdom of Cambodia)

海外研究協力者: Im Sokrithy (Deputy Director, Department of Demography and Development, Authority for the Protection of the Site and the Management of Angkor Region, Kingdom of Cambodia)

海外研究協力者: Ea Darith (Chief Researcher, Department of Monument and Archaeology, Authority for the Protection of the Site and the Management of Angkor Region, Kingdom of Cambodia)

海外研究協力者: Hang Peou (Director, Department of Water and Forest Authority for the Protection of the Site and the Management of Angkor Region, Kingdom of Cambodia)

海外研究協力者: Chhay Rachna (Researcher, Department of Monument and Archaeology, Authority for the Protection of the Site and the Management of Angkor Region, Kingdom of Cambodia)

海外研究協力者: Ven Sophrn (Researcher, Department of Monument and Archaeology II, Authority for the Protection of the Site and the Management of Angkor Region, Kingdom of Cambodia)

海外研究協力者: So Im Monichoth (Deputy Director, Department of Hydrology and

Riverworks, Ministry of Meteorology and Water Resources, Kingdom of Cambodia)
 海外研究協力者: Drong Powkhy (Japanese Interpreter, Siem Reap City, Kingdom of Cambodia)

海外研究協力者: Ly Vanna (Lecturer, Faculty of Archaeology, Royal University of Fine Arts, Kingdom of Cambodia)

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(3) 出版物

なし

研究成果による工業所有権の出願・取得状況

なし

研究経過・研究成果(英文)

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The First Field Mission of the Team "Evaluation of Mechanisms Sustaining Biodiversity in Lake Tonle Sap, Cambodia (Tonle Sap EMSB)" in November 2003

The first survey of the cooperating field research programme "Tonle Sap EMSB" lead by S. Tsukawaki of Kanazawa University, Japan was carried out from the 3rd to 12th of November 2003 in the northern part of Lake Tonle Sap off Siem Reap. The individual activities of each group are followings.

1. Zoological Biodiversity Group (A. Ohtaka, H. Katakura, T. Kamiya, T. Narita, K. Matsubayashi and Ven Sophorn)

To elucidate faunal composition of benthic and planktonic communities, the group collected various kinds of invertebrates mainly in flood plain area, by using an Ekman-Birge bottom sampler, plankton nets (Photo 1) and dipnets. In addition, fish specimens were obtained for analysis of their food habits.

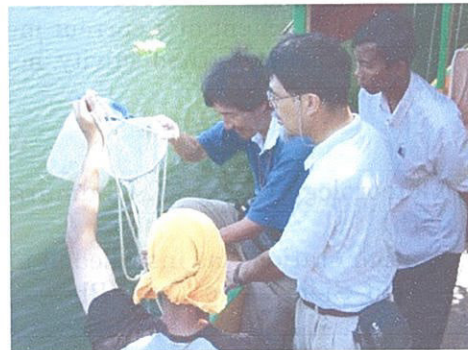


Photo 1: Plankton net sampling in the northern part of Lake Tonle Sap off Siem Reap.



Photo 2: Vegetational research in the northern part of Lake Tonle Sap off Siem Reap.

2. Plant Ecology Group (Y. Hirabuki, A. Takehara and Dornng Powkhy)

On the basis of floristic and vegetational researches mainly in flood plain area (Photo 2), the group collected about 130 vascular plant species, and described communities of floating- and submerged-plants at 60 quadrates arranged over the area near Phnom Krom, its width being about 6 km. Seasonal changes of plants, vegetation and habitats will be pursued under the flooding-draining continuum.

3. Limnology Group (S. Endoh, T. Fukuda and Y. Nitta)

In order to clarify the time variation of water movement and water quality, the group carried out continuous measurement every 10 minutes by using a current meter and a temperature-conductivity meter (Photo 3). As a result, the daily change of water temperature with an amplitude of about 0.5 C were found, whereas no characteristic variation in conductivity. Water current changes with a period of about one day might be caused by surface seiche oscillation.



Photo 3: Settlement of a current meter and a temperature-conductivity meter on the boat.

4. Meteorology Group (Y. Okumura and Ea Darith)

A weather station was installed at a citizen's house in Siem Reap City (Photo 4). The station was equipped with five kinds of sensors to detect wind speed and direction, indoor and outdoor temperature and humidity, atmospheric pressure, and precipitation. The data can be observed in real time and are recorded every 30 minutes

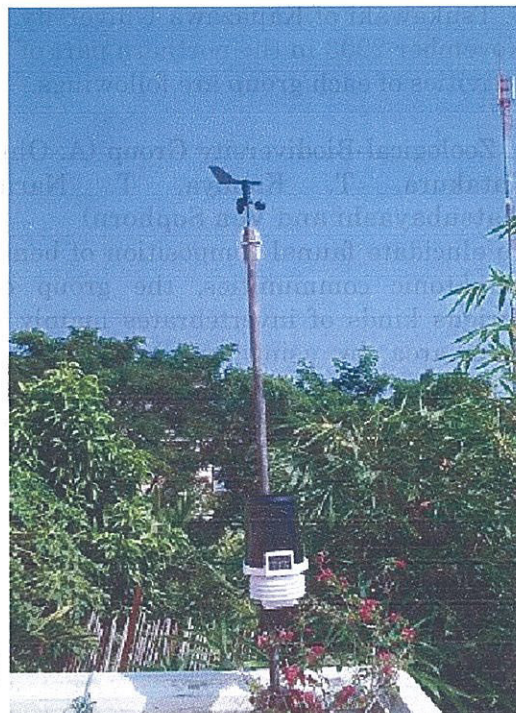


Photo 4: Installed weather station in Siem Reap.

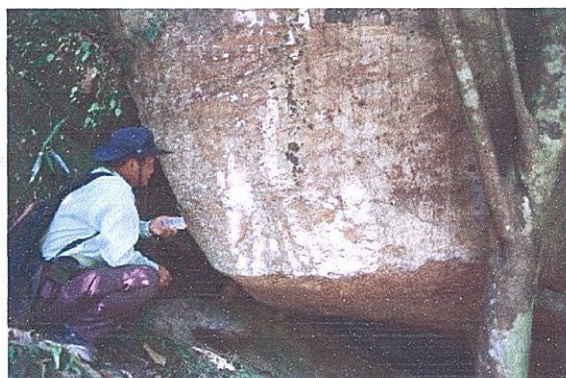


Photo 5: A sandstone outcrop in Phnom Kulen north of Siem Reap.

5. Geology Group (S. Tsukawaki, Sieng Sotham, Ly Vanna and A. Ooji)

Because the group has carried out geological researches in the lake since 1992 and has collected more than 300 samples from the lake floor, distribution and composition of lake sediments were already clarified. Thus, the group concentrated upon understanding research methods and purposes of other groups in order to support them at coming survey in May 2004 by using geological techniques.

Prepared by Dr. Shinji Tsukawaki
Date 15/12/2003

The Second Field Mission of the Team "Evaluation of Mechanisms Sustaining Biodiversity in Lake Tonle Sap, Cambodia (Tonle Sap EMSB)" in May 2004

The second survey of the cooperating field research programme "Tonle Sap EMSB", lead by S. Tsukawaki of Kanazawa University, Japan was carried out from the 7th to 21st of May 2004 in the northern part of Lake Tonle Sap off Siem Reap. The individual activities of each group are followings.

1. Zoological Biodiversity Group (A. Ohtaka, T. Narita, S. Watanabe and Ven Sophorn)

To elucidate the structure of animal community at the lowest water level of the lake, the zoological biodiversity group investigated in the offshore lake and marsh around the lake in Siem Reap district, from 12th to 19th of May 2004 (Photo 1). A total of 137 samples including benthic and planktonic invertebrates and fish were collected. The specimens will be identified in cooperation with specialists of respective taxonomic groups.



Photo 1: Animal sampling in the dried up area on the north of Phnom Krom south of Siem Reap.



Photo 2: Plant sampling in a water area in Siem Reap Province.

2. Plant Ecology Group (Y. Hirabuki, A. Takehara, Dorng Powkhy and Chhay Rachna)

The Plant Ecology group carried out floristic and vegetational researches on the floodplain spreading over southern part of Siem Reap City at the lowest water level of the lake from the 8th to 18th of May 2004 (Photo 2). About one hundred and ten vascular plant species were collected, and plant communities such as *Barringtonia* woodland, a few types of shrubby scrubs and more than ten types of herbaceous vegetation were described at 60 quadrates. Comparisons

between flooding and dry up seasons are undertaken to grasp drastic changes of floodplain vegetation.

3. Limnology Group (S. Endoh, Y. Fujita and S. Nakai)

Time variation and spatial distribution of water quality in the lake were investigated (Photo 3). Water movement was also measured using a cross board drogue. These results show very high turbidity of water, rather less conductivity, and high temperature especially in a calm day. A mirage was observed on the 8th of May.

Water current was observed toward the east with a speed of about 7 cm/s. Continuous measurement of water temperature and conductivity was started at the floating cafe.



Photo 3: Measurement of time variation and spatial distribution of water quality in the northern part of Lake Tonle Sap.

4. Meteorology Group (Y. Okumura and Ea Darith)

A weather station was installed at a citizen's house in Siem Reap City. The station was equipped with five kinds of sensors to detect wind speed and direction, indoor and outdoor temperature and humidity, atmospheric pressure, and precipitation. The data can be observed in real time and are recorded every 30 minutes. This time, a solar radiation sensor was added and dry batteries were changed.



Photo 4: Water depth measurement in the northern part of Lake Tonle Sap.

5. Geology Group (S. Tsukawaki and Y. Ishikawa)

Because the group has carried out geological researches in the lake since 1992 and has collected more than 300 samples from the lake floor, distribution and composition of sediments in its northern part were already clarified. Thus, the group concentrated upon understanding research methods and purposes of other groups in order to support them by using geological techniques (Photo 4).

Prepared by Dr. Shinji Tsukawaki
Date 12/06/2004

The Joint Field Research Mission of Teams "Evaluation of Mechanisms Sustaining Biodiversity in Lake Tonle Sap, Cambodia (Tonle Sap EMSB)" and "MAB-IHP Joint Programme Ecological and Hydrological Research and Training for Young Scientist in Tonle Sap Biosphere Reserve, Cambodia (Tonle Sap EMSB-u32)" from November to December 2004

The third field survey of the team "Tonle Sap EMSB" and the first field survey of the team "Tonle Sap EMSB-u32" both lead by S. Tsukawaki of Kanazawa University, Japan was carried out from the 27th of November to 21st of December 2004 in the northern and southern part of Lake Tonle Sap. The individual activities of each group are followings.

1. Zoological Biodiversity Group (A. Ohtaka, H. Katakura, H. Motomura, T. Ishikawa, T. Mukai, T. Narita, Y. Kuwahara, Y. Mukai and T. Vuthy)

To elucidate the water environment and structure of animal community at high water level of the lake, the zoological biodiversity group investigated in the lake and marsh around the lake in Siem Reap City and Chhnok Tru district of Kompong Chhnang Province, from the 28th of November to the 19th of December 2004 (Photos 1 to 10). A total of 588 samples, including benthic and planktonic invertebrates and fishes, were collected. The specimens will be analyzed in cooperation with specialists of respective taxonomic groups.

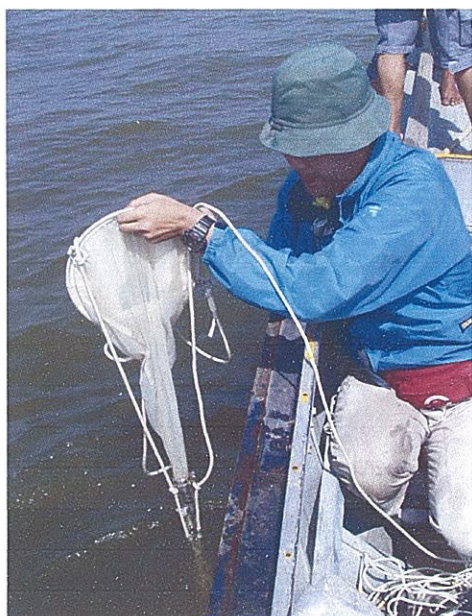


Photo 1: Collecting a plankton sample by means of a plankton net offshore Lake Tonle Sap



Photo 2: Inspecting fish specimens caught by a local fisherman at the littoral zone of Lake Tonle Sap.

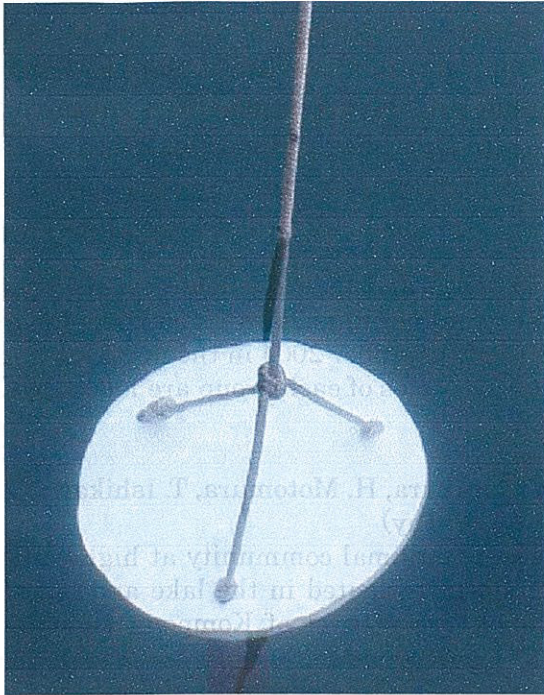


Photo 3: Secchi disk, for measuring transparency of the lake water. The Secchi disk transparency is determined by the depth the disk disappear.

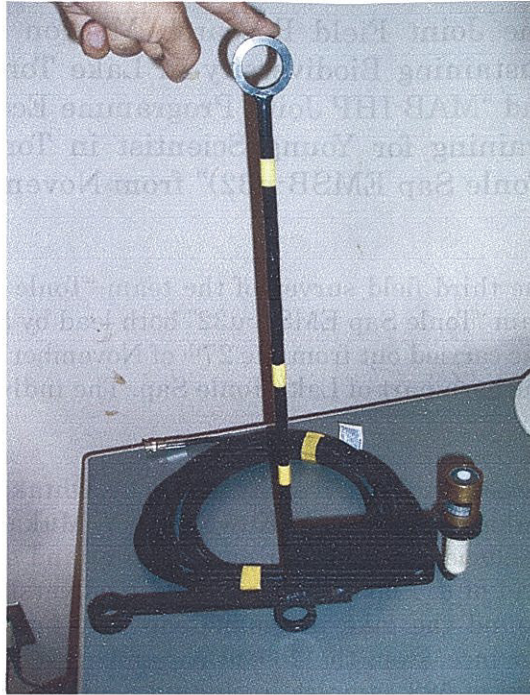


Photo 4: Quanta meter, for measuring photo reactive radiation (PAR) under the water-transparency is determined by the depth the disk disappear

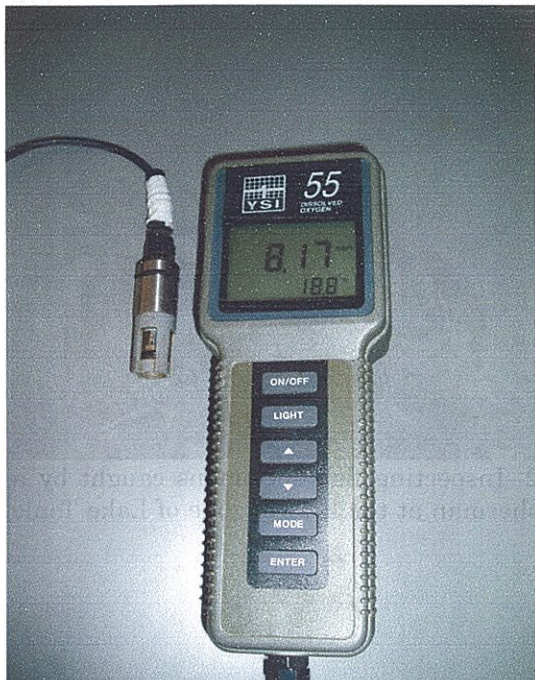


Photo 5: Dissolved oxygen meter, for measuring dissolved oxygen concentration and water temperature under the water.

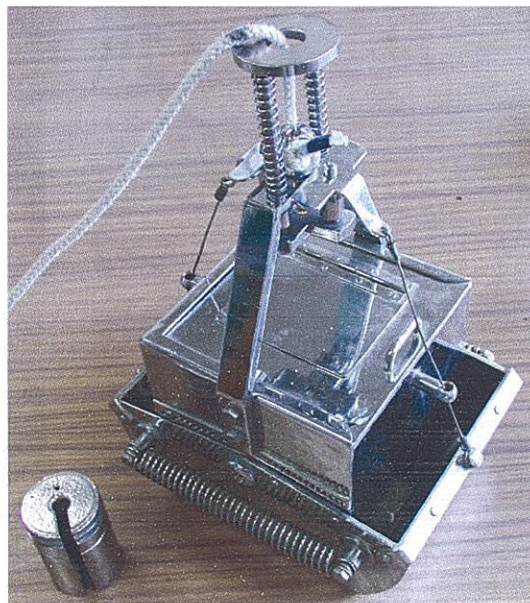


Photo 6: Ekman-Birge bottom sampler, for collecting bottom sediment and zoobenthos.

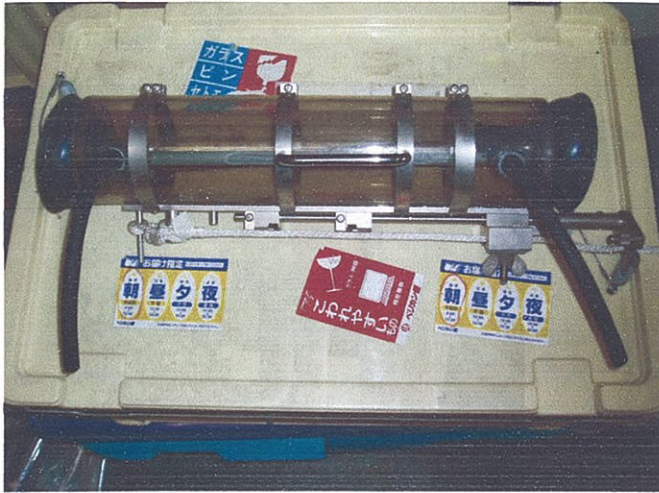


Photo 7: Van-dorn water sampler, for collecting water sample from aimed layer. Using the sample, amount of phytoplankton (cell number and chlorophyll pigments) and water quality can be studied at the aimed layer.



Photo 8: Plankton net, for collecting zooplankton staying water column quantitatively. The fine mesh (70 μ m) filtrate water when the net is hauled with the linked rope.



Photo 9: Double netting plankton net. A special plankton net with double fine-mesh netting cloth. Inner net with 100 μ m aperture collects larger plankton, mostly zooplankton. Outer net with 50 μ m aperture collects smaller plankton, mostly phytoplankton.

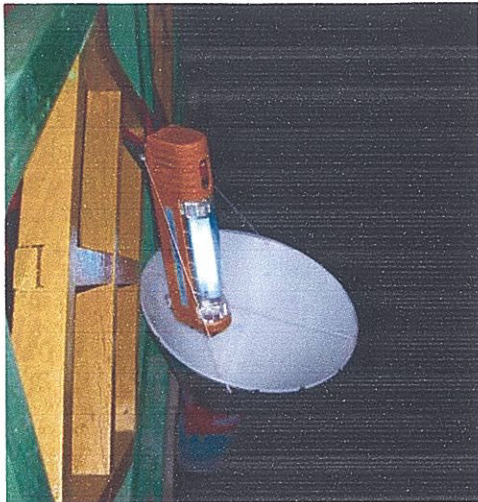


Photo 10: Light-trap equipment with a special fluorescent lamp illuminating ultraviolet rays, for collecting insect specimens. Insects flying for the light drop into the capture bottle through funnel under the lamp.



Photo 11: Floristic survey along a shoreline.

2. Plant Ecology Group (Y. Hirabuki, Y. Araki, D. Powkhy and C. Rachna):

From the 28th of November to the 15th of December 2004, a flooding season of Lake Tonle Sap, the plant ecology group carried out floristic and vegetational researches in the inundated area spreading over southern part of Siem Reap City and Chhnok Tru district of Kompong Chhnang Province (Photos 11 and 12). The group collected about 70 vascular plant species, and described herbaceous water-plant communities characterized by *Nymphoides indica*, *Nymphoides hastatum*, *Hydrilla verticillata*, *Polygonum barbatum*, *Eichhornia crassipes*, and the others. at 83 quadrates. Comparisons between flooding and dry up seasons are undertaken to grasp drastic changes of floodplain vegetation.

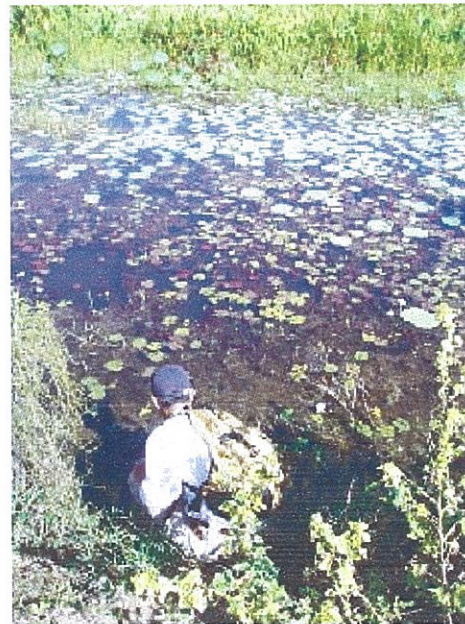


Photo 12: Description of herbaceous water-plant community at a deeply inundated habitat. Water depth was also measured by LCD digital depth sounder.

3. Limnology Group (Y. Okumura, S. Endoh, H. Oyagi, T. Fujii, K. Fujita, S. Nakai and S. I. Monichoth):

The limnology group carried out the following researches. 1: Transverse survey of both northern and southern parts of Lake Tonle Sap using a multi-parameter water quality profiler (Alec Electronics Co. Ltd (type AAQ1180); Photo 13), which measures vertical profiles of dissolved oxygen (DO), pH, chlorophyll concentrations, temperature, turbidity, and conductivity. Specifications of the instrument are shown in Table 1. The instrument is dropped into water with a cable slowly below 0.5 m/s, and then the data are obtained in real-time and recorded in the HDD on a computer. 2: Putting of water gauge and water thermometer at towers of both northern and southern parts of Lake Tonle Sap. 3: Flux measurement of Siem Reap River at the Arhg Krapear Brige. 4: Surface water sampling at both northern and southern parts of the lake, and several points of the related fluvial systems such as the Tonle Sap, Mekong, and Bassac Rivers.

Table 1. Specifications of the multi-parameter water quality profile.

Parameters	Sensor Type	Measurement range	Resolution	Accuracy	Time constant
Depth	Semiconductor Pressure Transducer	0~100 m	0.002 m	0.3% FS	0.2 sec
Temperature	Thermistor	-5~40 °C	±0.001°C	±0.02°C	0.28 sec
Conductivity	Inductive Cell	0~500 µS/cm	0.1 µS/cm	±20 µS/cm	0.2 sec
Turbidity	Backscattering Light (Formazine)	0~1000 FTU	0.03 FTU	±2% FS or 0.3 FTU	0.2 sec
Chlorophyll	Fluorescent Scattering Light (Uranine)	0~400 ppb	0.01 ppb	±1% FS or 0.1ppb	0.2 sec
DO	Galvanic Electrode	0~20 mg/L (0~200%)	0.01 mg/L (0.01%)	±0.2 mg/L (±1%)	3.5 sec
pH	Glass Electrode	0~14 pH	0.01 pH	±0.2	10 sec



Photo 13: The multi-parameter water quality profiler.



Photo 14: The river flux measurement by a current meter.

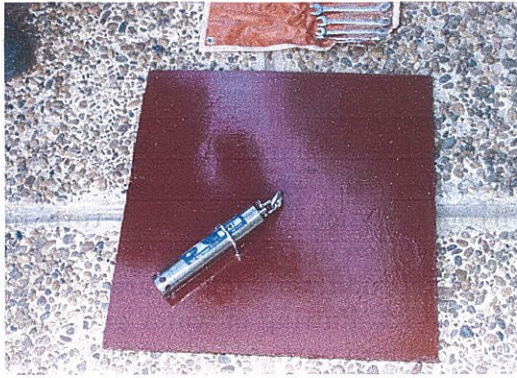


Photo 15: A water gauge by pressure.



Photo 16: Water sample.



Photo 17: A water thermometer, buoyancy and weight

4. Geology Group (S. Tsukawaki, S. Sotham, A. Ooji, S. Im and B. Bunnarin):

Because the group has carried out geological researches in the lake since 1992 and has collected more than 300 samples from the lake floor, distribution and composition of sediments in its northern part were already clarified. Thus, the group concentrated upon understanding research methods and purposes of other groups in order to support them by using geological techniques in the northern part of Lake Tonle Sap off Siem Reap City. On the other hand, the group carried out surface sediment sampling using a small grab sampler and cored sediment sampling using a



Photo 18: A surface sediment sample from the southern part of Lake Tonle Sap

Phleger type gravity core sampler in the southern part of the lake off Chhnok Tru district of Kompong Chhnang Province to grasp the composition of the surface sediments and time-spatial distribution of depositional facies of the sediments (Photos 18 to 20).



Photo 19: A grab sampler type DIK-140.



Photo 20: A Phleger type gravity core sampler.

Prepared by Dr. Shinji Tsukawaki
Date 05/01/2005

Optional Field Mission of Teams “MAB-IHP Joint Programme Ecological and Hydrological Research and Training for Young Scientist in Tonle Sap Biosphere Reserve, Cambodia (Tonle Sap EMSB-u32)” in January 2005

An optional field survey of the team “Tonle Sap EMSB-u32” lead by S. Tsukawaki of Kanazawa University, Japan was carried out from the 15th to 23rd of January 2005 in the northern and southern part of Lake Tonle Sap and related fluvial system such as the Mekong and Tonle Sap rivers. During the survey, both Plant Ecology and Limnology Groups carried out their researches. Participants and individual activities of each group are followings.

1. Participants of the Field Research

Shinji Tsukawaki (Kanazawa University, Leader)

Yuji Araki (Yokohama National University, Plant Ecology)

Hideo Oyagi (Nihon University, Limnology)

2. Activities of Plant Ecology and Limnology Groups

(1) Plant Ecology Group (Y. Araki)

From the 15th to 23rd of January, a falling season of the lake, the research of the Plant Ecology group stopped short only visual observation of forests in both emerged and submerged areas on the south of Siem Reap City and on the north of Chhnok Tru district of Kompong Chhnang Province. As a result of observation, many saplings of *Barringtonia acutangula* were found under the canopy, and were distributed widely from the interior region to the lakeside areas of the forests. Further, it was recognized that the number of aquatic vascular plants decreased in the submerged area.



Photo 1: Distribution of aquatic vascular plant on the emerged area in Siem Reap.



Photo 2: A view of the emerged and submerged areas from the tower off Chhnok Trou in Kompong Chhnang.

(2) Limnology Group (H. Oyagi)

The limnology group carried out the following researches from the 15th to 23rd of January, a falling season of the lake. 1: Transverse survey of both northern and southern parts of Lake Tonle Sap, and the Mekong River off Phnom Penh, and the Tonle Sap River off Kompong Chhnang using a multi-parameter water quality profiler (Alec

Electronics Co. Ltd type AAQ1180), which measures vertical profiles of dissolved oxygen (DO), hydrogen ion exponent (pH), chlorophyll concentrations, temperature, turbidity, and electric conductivity (EC). The instrument is dropped into water with a cable slowly below 0.5 m/s, and then the data are obtained in real-time and recorded in the HDD on a computer. 2: Confirmation of existence of the water gauge and water thermometer at towers of both northern and southern parts of the lake. 3: Surface water sampling at both northern and southern parts of the lake, and the related fluvial systems such as the Tonle Sap and Mekong rivers.

All data and water samples obtained during the survey have been under the investigation in the laboratory. Further, it was recognized that a surface water thermometer of the north tower off Siem Reap was unfortunately stolen.



Photo 3: Wreckage of the stolen water thermometer near the north tower off Siem Reap.



Photo 4: Transverse survey using a multi-parameter water quality profiler on the lake.



Photo 5: Surface water sampling at the Siem Reap River in Siem Reap City.

Prepared by Dr. Shinji Tsukawaki
Date 23/01/2005

Preliminary Report on the 2nd Mission of Tonle Sap EMSB-u32 Team "MAB-IHP Joint Programme Ecological and Hydrological Research and Training for Young Scientist in Tonle Sap Biosphere Reserve, Cambodia: Research and Training for Young Scientists" in February to March 2005

The 2nd mission of Tonle Sap EMSB-u32 Team "MAB-IHP Joint Programme: Ecological and Hydrological Research and Training for Young Scientist in Tonle Sap Biosphere Reserve, Cambodia: Research and Training for Young Scientists" Team (hereinafter "u32 team") were held in and around Lake Tonle Sap, Cambodia from the 23rd of February to the 13th of March 2005. Tsukawaki stayed in Cambodia till the 17th of March 2005 to participate the co-operative researches. All Japanese u32 members attended the mission, but only So Im Monichoth of the Hydrology Group could attend from Cambodian side because other three members had been away to join the other missions during the mission. A support party for the u32 team composed of both Cambodian and Japanese researchers and students participated in the mission. Further, two co-operative parties took part in the mission. The list of participants of the u32 team, the support party and the co-operative parties, daily record of the mission, and activities of each group are followings:

1. List of Participants

(1) Members of EMSB-u32 Team

Shinji Tsukawaki (Associate Professor, Institute of Nature and Environmental Technology, Kanazawa University, Head of EMSB-u32 Team: Sedimentology)
Toshiyuki Ishikawa (COE Researcher, Graduate School of Environmental Earth Science, Hokkaido University: Freshwater Zoology)
Takahiko Mukai (Lecturer, Faculty of Regional Studies, Gifu University: Ichthyology)
Yuji Araki (Graduate Student, Graduate School of Environment and Information Sciences, Yokohama National University: Plant Ecology)
Hideo Oyagi (Graduate Student, Graduate School of Integrated Basic Sciences, Nihon University: Freshwater Hydrology)
Monichoth So Im (Senior Scientist, Department of Hydrology and River Works, Ministry of Water Resources and Meteorology, Kingdom of Cambodia: Freshwater Hydrology)

(2) Members of Support Party for u32 Team

Sambath Touch (Deputy Director, Department of Geology, General Department of Mineral Resources, Ministry of Industry, Mines and Energy, Kingdom of Cambodia: Regional Geology)
Sokuntheara Choup (Senior Geologist, Environmental Office, Department of Geology, General Department of Mineral Resources, Ministry of Industry, Mines and Energy, Kingdom of Cambodia: Environmental Science)
Powkhy Drong (Japanese Interpreter, Siem Reap Office, Peace in Tour Co. Ltd., Kingdom of Cambodia: Plant Ecology)
Akihito Ooji (Academic Assistant, Institute of Nature and Environmental Technology, Kanazawa University: Regional Geology)
Kenichi Sakai (Undergraduate Student, Department of Civil Engineering, Faculty of Engineering, Kanazawa University: Environmental Science)

(3) Members of Co-operating Parties

Masami Furuuchi (Associate Professor, Graduate School of Natural Science, Kanazawa University: Atmospheric Science)

Hiroshi Takebayashi (Associate Professor, Department of Civil Engineering, Faculty of Engineering, Tokushima University, Japan: Civil Engineering)

Takeo Sakano (COE Researcher, Graduate School of Natural Science, Kanazawa University: Atmospheric Science)

Xuan Loc Luu (Graduate Student, Graduate School of Science and Engineering, Ritsumeikan University, Japan: Civil Engineering)

2 Daily Record of Survey (2005)

13th Feb. (Sun): Araki left Japan to Bangkok, Thailand. Stay in Bangkok.

14th (Mon.) to 22nd (Tue.) Feb.: Identification of Cambodian plant specimens at the library of Royal Forestry Department of Thailand by Araki. Stay in Bangkok.

23rd Feb. (Wed.): Tsukawaki, Ishikawa, Araki and Oyagi arrived in Phnom Penh, Cambodia from Japan through Bangkok, Thailand. Stay in Phnom Penh.

24th Feb. (Thu.): Preparation of chemical reagents and adjustment of research equipment, and pre-survey meetings in the offices of Department of Geology, General Department of Mineral Resources, Ministry of Industry, Mines and Energy, Department of Hydrology and River Works, Ministry of Water Resources and Meteorology, and Biology Division, National Institute of Education in Phnom Penh all day long. A co-operative party led by Dr. Takebayashi of Tokushima University arrived in Phnom Penh in the afternoon. Stay in Phnom Penh.



Photo 1. Preparation of chemical reagents at National Institute of Education (24/02/05).

25th Feb. (Fri.): Monichoth, Sambath and Sokuntheara joined the mission in the morning. Transfer from Phnom Penh to Kompong Chhnang situated on the middle reaches of the Tonle Sap River in the morning.



Photo 2. Adjustment of water gauge in Chhnok Tru Village (26/02/05).

Hydrological and sedimentological surveys in the main stream of the middle reaches of the river off Kompong Chhnang City in the afternoon by all the members. Stay in Kompong Chhnang.

26th Feb. (Sat.): Transfer from Kompong Chhnang to Chhnok Tru situated in the southern marginal part of Lake Tonle Sap. Hydrological and freshwater zoological surveys on a N-S transverse line in the southern part of the lake by Oyagi, Monichoth and Ishikawa, plant ecological survey in a forest of the southwestern

marginal coast of the lake by Araki and Sokuntheara, and sediment samplings in the upper reaches of the Tonle Sap River by Dr. Takebayashi, Mr. Loc and Tsukawaki with Sambath all day long. Return to and stay in Kompong Chhnang. Mukai arrived at Phnom Penh from Japan through Bangkok and stayed in Phnom Penh.

27th Feb. (Sun.): Sokuntheara left the mission and returned to Phnom Penh in the morning. Transfer from Kompong Chhnang to Chhnok Tru. Hydrological and freshwater zoological surveys on a NW-SE transverse line in the southern part of the lake by Oyagi, Monichoth and Ishikawa, plant ecological survey in a forest of the northeastern marginal coast of the lake by Araki and Sambath, and sediment samplings in the middle reaches of the Tonle Sap River by Tsukawaki, Dr. Takebayashi and Mr. Loc all day long. Return to and stay in Kompong Chhnang. Mukai arrived at Kompong Chhnang and joined the mission.

28th Feb. (Mon.): Hydrological and zoological indoor analyses of samples by Oyagi and Ishikawa in the morning. Transfer from Kompong Chhnang to Chhnok Tru, then ichthyological and plant ecological surveys in the southern part of the lake by Tsukawaki, Araki, Mukai, and Monichoth in the morning. Sediment samplings in the lower reaches of the Tonle Sap River by Dr. Takebayashi, Mr. Loc and Sambath all day long. Return to and stay in Phnom Penh.



Photo 3. Plant ecological survey in Chhnok Tru (28/02/05).

1st March (Tue.): Hydrological, plant ecological and zoological indoor analyses of samples and sort out of specimens by Oyagi, Araki, Mukai and Ishikawa all day long. Sediment samplings in the lowermost reaches of the Tonle Sap River by Tsukawaki, Dr/ Takebayashi, Mr. Loc and Sambath all day long. Stay in Phnom Penh.

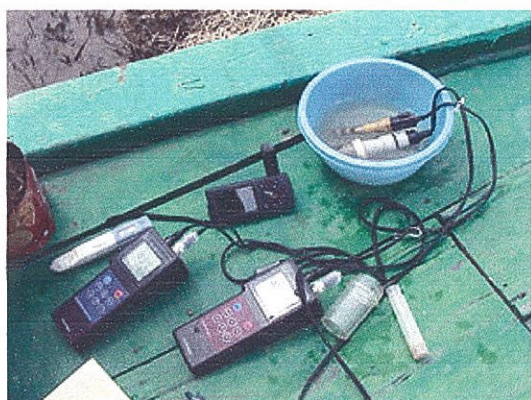


Photo 4. Measurement of surface water of the Mekong River in Phnom Penh (02/03/05).

2nd March (Wed.): Indoor sort out of plant specimens by Araki all day long. Hydrological and zoological surveys in the Mekong, Tonle Sap, and Bassac Rivers off Phnom Penh by Oyagi, Ishikawa, Mukai and Sambath, and sediment sampling in these rivers by Tsukawaki, Dr. Takebayashi and Loc the whole day. Stay in Phnom Penh.

3rd March (Thu.): Transfer from Phnom Penh to Kompong Thom situated to the northeast of Lake Tonle Sap by all the members of Japanese u32 with Sambath in the morning. Dr. Takebayashi and Mr. Loc left Phnom Penh going back to Japan.

Hydrological survey by Oyagi in the Seng River which is the largest tributary of the lake, flowing the city of Kompong Thom in the afternoon. Plant ecological and zoological preliminary surveys in the river and marshlands around the river by Araki,

Mukai and Ishikawa. Stay in Kompong Thom.

4th March (Fri.): Hydrological survey in the Seng River by Oyagi, and plant ecological and zoological preliminary surveys in the river and the marshlands around the river in the morning. Sambath left the mission and returned to Phnom Penh. Transfer from Kompong Thom to Siem Reap in the afternoon by all the members of Japanese u32. Hydrological, plant ecological and zoological preliminary surveys in the tributaries such as the Roluos River on the way to Siem Reap. Ooji and Sakai, members of the support



Photo 5. Surface water measurement of the Seng River in Kompong Thom (04/03/05).



Photo 6. Fish sampling in the lake off Siem Reap (05/03/05).

in Siem Reap.

6th March (Sun.): Hydrological and freshwater zoological surveys on a N-S transverse line of the northern part of the lake by Oyagi, Ishikawa, Tsukawaki and Sakai, and plant ecological and ichthyological surveys in a forest and a marshland of the northern coast near floating villages of the lake by Araki, Mukai, Ooji and Powkhy all day long. Stay in Siem Reap.

7th March (Mon.): Hydrological, plant ecological and zoological indoor analyses of samples and sort out of specimens by Oyagi, Araki, Mukai and Ishikawa in the morning. Installation of a water gauge and a water thermometer to the observation tower off Siem Reap City by Oyagi, Ishikawa and Sakai, a preliminary inspection of a forest and a marshland in the northwestern coast of the lake by Araki, Mukai with Powkhy. Stay in Siem Reap.

party, arrived from Japan to Siem Reap though Bangkok and joined the mission. Stay in Siem Reap.

5th March (Sat.): Powkhy joined the mission in the morning. A preliminary inspection of the northern part of the lake by all the members in the morning. Recovery of a water gauge and a water thermometer installed on an observation tower by Oyagi. Indoor adjustments of research equipment and preparation of chemical reagents, and pre-survey meeting at the office of Authority for the Protection and Management of Angkor and the Region of Siem Reap (APSARA) in the afternoon by all the members. Stay



Photo 7. Bottom sediment sampling in the lake off Siem Reap (06/03/05).

Installation of a water gauge and a water thermometer to the observation tower off Siem Reap City by Oyagi, Ishikawa and Sakai, a preliminary inspection of a forest and a marshland in the northwestern coast of the lake by Araki, Mukai with Powkhy. Stay in Siem Reap.

8th March (Tue.): Hydrological and freshwater zoological surveys on a NW-SE transverse line and primary productivity measurement of the northern part of the lake by Oyagi, Ishikawa and Tsukawaki, and plant ecological and ichthyological surveys in the forests, marshlands and rivers in the mountainous area such as Kubal Spien to the northeast of Siem Reap by Araki, Mukai, Sakai, Ooji and Powkhy all day long. Stay in Siem Reap.

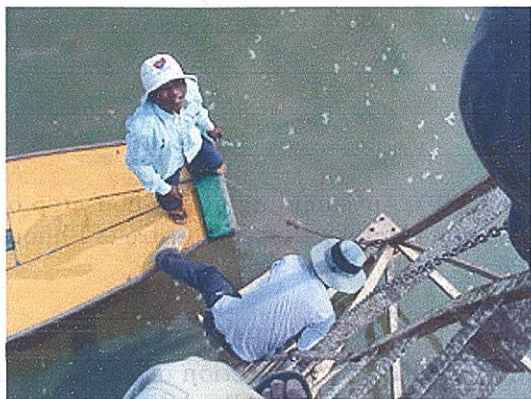


Photo 8. Reinstallation of the water pressure meter on the observation tower off Siem Reap (09/03/05).

9th March (Wed.): Freshwater zoological and ichthyological indoor analyses and sort out of samples by Ishikawa and Mukai, and adjustment of the water pressure meter by Oyagi and Sakai, plant ecological investigation in a forest on a northern emerged area of the lake by Araki, Ooji and Powkhy in the morning. Mukai left Siem Reap to Japan in the evening. Sokuntheara arrived from Phnom Penh and rejoined the mission. Stay in Siem Reap.

10th March (Thu.): Transfer from Siem Reap to Battambang through Srey Sophorn (Sisophorn in Thai) by all the

members. Hydrological, freshwater zoological and plant ecological preliminary surveys in the tributaries of the lake, such as the Srey Sophorn, Mongkul Borei, Ban Pring and Sangkes Rivers on the way to Battambang by all the members all day long. Stay in Battambang.

11th March (Fri.): Transfer from Battambang to Phnom Penh through Pursat and Kompong Chhnang. Hydrological, freshwater zoological and plant ecological preliminary surveys in the tributaries of the lake, such as the Mong Rissei, Svay Dongkeu and Pursat Rivers on the way to Phnom Penh by all the members all day long. Stay in Phnom Penh.

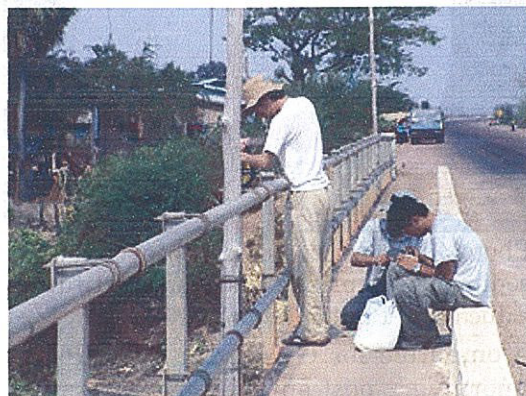


Photo 9. Water sampling at the Svay Dongkeu River in Pursat Province (11/03/05).

12th March (Sat.): Hydrological, plant ecological and zoological indoor analyses of samples and sort out of specimens by Oyagi, Araki and Ishikawa with assistance in the morning. Post-survey meetings in the offices of Department of Geology, General Department of Mineral Resources, Ministry of Industry, Mines and Energy, Department of Hydrology and River Works, Ministry of Water Rescues and Meteorology, and National Institute of Education in Phnom Penh. Ishikawa left Phnom Penh to Japan in the evening. Stay in Phnom Penh.

13th March (Sun): Indoor sort out of specimens and samples by all the members all day long. All the members except of Tsukawaki left Phnom Penh to Japan in the evening. A co-operative group, Drs. Furuuchi and Sakano of Kanazawa University arrived in Phnom Penh in the evening, and installation of an air-sampler on the housetop of

Diamond Hotel located in the city centre for an atmospheric research. Stay in Phnom Penh.

14th March (Mon.): Treatments of sediment samples from Lake Tonle Sap in a laboratory of National Institute of Education in Phnom Penh in the morning. Preliminary inspection of the confluence point of the Mekong, Bassac, and Tonle Sap Rivers with Drs. Furuuchi and Sakano in the afternoon. Recovery of the air-sampler on the housetop of Diamond Hotel in the evening. Stay in Phnom Penh.



Photo 10. Air sampling at the housetop of Diamond Hotel in the city centre of Phnom Penh (13/03/05).

15th March (Tue.): Drs. Furuuchi and Sakano left Phnom Penh to Bangkok, Thailand. Transfer from Phnom Penh to Neak Loeun situated in the lower reaches of the Mekong River. Inspection of a geological drilling by Dr. Yoshiki Saito of Geological Survey of Japan on an Alluvial plain all day long. Return to and stay in Phnom Penh.



Photo 11. Microscopic observation of sediment samples at National Institute of Education, Phnom Penh (16/03/05).

Committee for Geoscience Programmes in East and Southeast Asia (CCOP) in the morning, post-survey meetings in the offices of Department of Geology, Chulalongkorn University, and Department of Environmental Science, Mahidol University in the afternoon. Stay in Bangkok.

19th March (Sat.): Transfer from Bangkok to Japan.

16th March (Wed.): Microscopic investigations of sediment samples from Lake Tonle Sap and adjacent rivers such as the Tonle Sap and Mekong Rivers in a laboratory of National Institute of Education in Phnom Penh in the morning. Indoor sort out of samples and research equipment in the afternoon. Stay in Phnom Penh.

17th March (Thu.): Transfer from Phnom Penh to Bangkok, Thailand in the morning. Indoor work in the afternoon. Stay in Bangkok.

18th March (Fri.): A post-survey meeting in the office of Coordinating

3. Activities of Each Group

(1) Hydrology Group (H. Oyagi, S. I. Monichoth and K. Sakai)

The group carried out first transverse surveys of both northern and southern parts of Lake Tonle Sap on N-S and NW-SE directions using a multi-parameter water quality profiler, Alec Electronics Co. Ltd., type AQ1180, which measures vertical profile of dissolved oxygen (DO), hydrogen ion exponent (pH), chlorophyll concentrations, temperature, turbidity and conductivity of waters. Transverse surveys were also made in the junction area of the Mekong, Tonle Sap and Bassac Rivers off Phnom Penh, and the middle reaches of the Seng River in Kompong Thom City. The group also collected surface water samples along the transverse lines of both north and south lake, the major fluvial systems such as the Tonle Sap and Mekong Rivers, and main tributaries of the lake such as the Seng, Srey Sophorn and Mongkul Borei Rivers for their isotope measurements. Further, recovery and adjustment of water gauge and water thermometer installed on the observation towers in both north and south lake were carried out.



Photo 12. Transverse survey using a multi-parameter water quality profiler on Lake Tonle Sap (08/03/05).

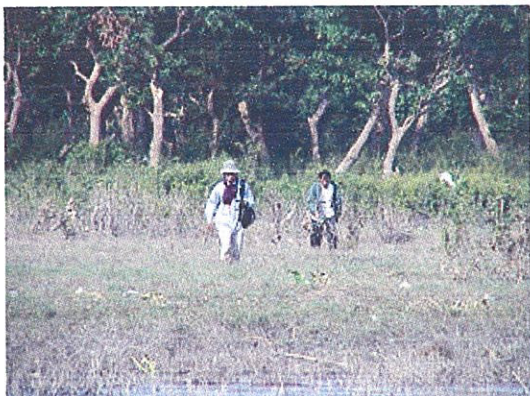


Photo 13. Plant ecological survey in a forest on the northern coast of the lake (07/03/15).

(2) Plant Ecology Group (Y. Araki, D. Powkhy and A. Ooji)

At water falling season of Lake Tonle Sap, the group carried out floristic and vegetational researches in the emerged forests both to the south of Siem Reap City and to the north of the village of Chhnok Tru, Kompong Chhnang Province along a certain number of traverse sections in the forests. Further, preliminary observations and samplings were made in main tributaries of the lake and adjacent marshlands in Kompong Thom, Srey Sophorn (Sisophorn), Pursat and Battambang Provinces. About sixty plant species were collected during the

survey. Specimens of the collected plant species were made and have been kept in a storage of Diamond Hotel in Phnom Penh till May 2005.

(3) Zoological Biodiversity Group (T. Ishikawa, T. Mukai and C. Sokuntheara)

To elucidate the water environment and structure of animal community at falling water season of Lake Tonle Sap, the group investigated in the water areas of the lake and adjacent marshlands in both south off Siem Reap City in the north and north off the village of Chhnok Tru of Kompong Chhnang Province in the south of the lake. A Secchi disk, an Ekman-Birge bottom sampler, and a plankton net were utilised to measure transparency of the lake water, to collect bottom sediments and zoobenthos, and to collect zooplankton staying water column, respectively. Benthic and planktonic

invertebrates and fishes were collected from several sites in the above-stated areas. The specimens collected during the survey have been under investigation in co-operation with specialists of respective taxonomic groups. In addition, the primary productivity of the lake were experimentally measured in both north and south of the lake.



Photo 14. Measurement of primary productivity in the northern part of the lake off Siem Reap (08/03/05).

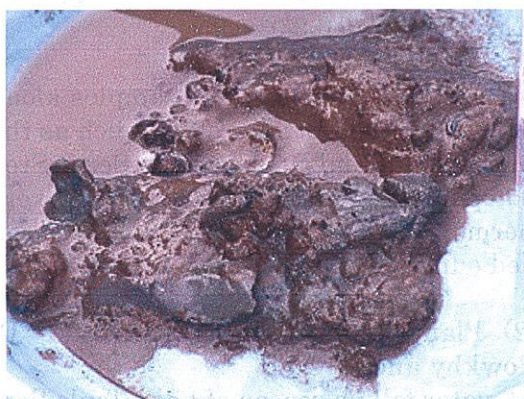


Photo 15. Sediment from the Tonle Sap River off Kompong Chhnang (26/03/05)

bottom sediments from the Tonle Sap River were composed mainly of bluish grey mud covered by thin soupy reddish brown mud. On the other hand, the sediments from the Mekong River consist mainly of fine to coarse-grained sand. These sediments have been kept in a storage of Department of Geology, General Department of Mineral Resources, Ministry of Industry, Mines and Energy in Phnom Penh for further sedimentological analyses in May 2005. Further, aerosol sampling in the city centre of Phnom Penh was carried out in co-operation with Drs. Furuuchi and Sakano of Kanazawa University on trial.

(4) Sedimentology Group (S. Tsukawaki and T. Sambath)

The group carried out mainly bottom sediment samplings in the Tonle Sap, Mekong and Bassac Rivers in co-operation with Dr. H. Takebayashi of Tokushima University, Japan and Mr. Luu Xuang Loc of Ritsumeikan University, Japan to clarify the distribution and composition of these sediments as an important source to Lake Tonle Sap. About one hundred and twenty sediment samples from the river floors and river banks of the above-stated rivers were successfully recovered. The

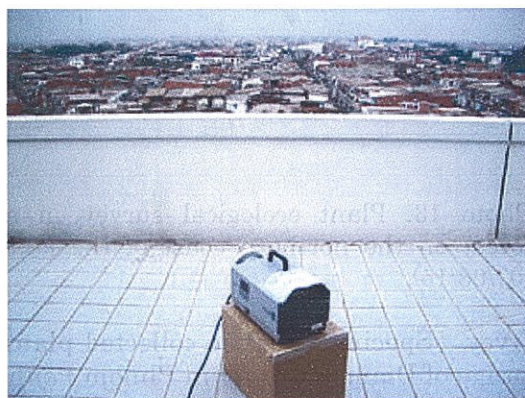


Photo 16. Air sampling at the housetop of Diamond Hotel in the city centre of Phnom Penh (14/03/05).

Prepared by: Dr. Shinji Tsukawaki
Date: 30/03/2005

The Joint Field Mission of Teams "Tonle Sap EMSB: Evaluation of Mechanisms Sustaining the Biodiversity in Lake Tonle Sap, Cambodia" and "Tonle Sap EMSB-u32: MAB-IHP Joint Programme Ecological and Hydrological Research and Training for Young Scientist in Tonle Sap Biosphere Reserve, Cambodia: Research and Training for Young Scientists" from May to June 2005

The joint field mission of Teams "Tonle Sap EMSB: Evaluation of Mechanisms Sustaining the Biodiversity in Lake Tonle Sap, Cambodia (hereafter "EMSB Team")" and "Tonle Sap EMSB-u32: MAB-IHP Joint Programme: Ecological and Hydrological Research and Training for Young Scientist in Tonle Sap Biosphere Reserve, Cambodia: Research and Training for Young Scientists (hereinafter "u32 Team")" led by Shinji Tsukawaki of Kanazawa University were held in and around Lake Tonle Sap, Cambodia from the 16th of May to the 5th of June 2005. Within all the schedule of the mission, both teams carried out the field research in the area of Siem Reap from the 24th to the 31st of May. Collaborating and support parties composed of Cambodian and Japanese researchers and students participated with the mission. The list of participants of both teams and the collaborating and support parties, and activities of each group are followings:

1. List of Participants

(1) Head of the Mission

Shinji Tsukawaki (Associate Professor, Institute of Nature and Environmental Technology, Kanazawa University, Japan: Sedimentology)

(2) Member of EMSB Team

Hiroyuki Motomura (Researcher, Australian Museum, Australia: Ichthyology)

Tetsuya Narita (Former Researcher of Kyoto University, Japan: Zoological Biodiversity)

Yasuaki Okumura (Associate Professor, Osaka Electro-communication University, Japan: Hydrology)

Akifumi Ohtaka (Professor, Faculty of Education, Hirosaki University, Japan: Zoological Biodiversity)

Sotham Sieng (Director, Department of Geology, General Department of Mineral Resources, Ministry of Industry, Mines and Energy, Kingdom of Cambodia: Regional Geology)

(3) Members of EMSB-u32 Team

Yuji Araki (Graduate Student, Graduate School of Environment and Information Sciences, Yokohama National University, Japan: Plant Ecology)

Racchna Chhay (Authority for the Protection and Management of Angkor and the Region of Siem Reap, Kingdom of Cambodia: Archaeology)

Sim IM (Researcher, Department of Geology, General Department of Mineral Resources, Ministry of Industry, Mines and Energy, Kingdom of Cambodia: Regional Geology)

Toshiyuki Ishikawa (COE Researcher, Graduate School of Environmental Earth Science, Hokkaido University, Japan: Freshwater Zoology)

Takahiko Mukai (Lecturer, Faculty of Regional Studies, Gifu University: Ichthyology)

Hideo Oyagi (Graduate Student, Graduate School of Integrated Basic Sciences, Nihon University, Japan: Freshwater Hydrology)

Monichoth So Im (Senior Scientist, Department of Hydrology and River Works, Ministry of Water Resources and Meteorology, Kingdom of Cambodia: Freshwater Hydrology)

(4) Members of Collaborating and Support Parties

Masami Furuuchi (Associate Professor, Graduate School of Natural Science and Technology, Kanazawa University, Japan: Atmospheric Science)

Touch Sambath (Director, Department of Geology, General Department of Mineral Resources, Ministry of Industry, Mines and Energy, Kingdom of Cambodia: Regional Geology)

Bunnarin Ben (Senior Geologist, Department of Geology, General Department of Mineral Resources, Ministry of Industry, Mines and Energy, Kingdom of Cambodia: Environmental Science)

Tomoyasu Fujii (Associate Professor, Faculty of Education, Nara University of Education, Japan: Hydrology)

Powkhy Drong (Japanese Interpreter, Siem Reap Office, Peace in Tour Co. Ltd., Kingdom of Cambodia: Plant Ecology)

Takeo Sakano (Academic Assistant, Department of Civil Engineering, Faculty of Engineering, Kanazawa University, Japan: Atmospheric Science)

Takahiro Murase (Research Student, Graduate School of Natural Science and Technology, Kanazawa University, Japan: Atmospheric Science)

Kosuke Fujita (Graduate Student, Faculty of Education, Shiga University, Japan: Hydrology)

Takayuki Watanabe (Technical Expert, Ocean Research Institute, University of Tokyo, Japan: Zoology)

Ryusei Watamabe (Undergraduate Student, Faculty of Education, Hirosaki University, Japan: Zoology)

Mika Komori (Undergraduate Student, Department of Civil Engineering, Faculty of Engineering, Kanazawa University, Japan: Atmospheric Science)

2. Activities of Each Group

(1) Zoological Biodiversity Group (A. Ohtaka, T. Narita, H. Motomura, T. Ishikawa, T. Mukai, T. Watanabe, B. Bunnarin and R. Watanabe)

To elucidate the water environment and structure of animal community at the lowest water season of Lake Tonle Sap, the group investigated in the water areas of the lake and adjacent marshlands in both south off the city of Siem Reap in the north and north off the village of Chhnok Tru of Kompong Chhnang Province in the south of the lake. A Secchi disk, an Ekman-Birge bottom sampler, and a plankton net were utilized to measure bottom sediments and zoobenthos, and to transparency of the lake water, to collect zooplankton staying water column, respectively (Photo 1). Benthic and



Photo 1. A plankton net sampling to collect zooplankton staying water column in the Mekong River.



Photo 2. Fish sampling using a scoop net in a pond near Lake Tonle Sap, south of Siem Reap

planktonic invertebrates and fishes were collected from several sites in the above-stated areas (Photo 2). The specimens collected during the survey have been under investigation in co-operation with specialists of respective taxonomic groups. In addition, the primary productivity of the lake were experimentally measured in both north and south of the lake.

(2) Plant Ecology Group (Y. Araki, D. Powkhy and C. Racchna)

At the lowest water season of Lake Tonle Sap, the group carried out floristic and vegetational researches in the emerged forests both to the south of the city of Siem Reap and to the north of the village of Chhnok Tru, Kompong Chhnang Province along a certain number of traverse sections in the forests (Photo 3). Further, the group also interviewed with local people about local and/or regional use of plant resources (Photo 4), and collected some plant specimens.



Photo 3. Floristic and vegetational research along a traverse section in the northern part of Lake Tonle Sap, south of Siem Reap.



Photo 4. Interview with local people about local use of plant resources in Siem Reap.

(3) Hydrology Group (Y. Okumura, H. Oyagi, S. I. Monichoth, T. Fujii and K. Fujita)

The group carried out first transverse surveys of both northern and southern parts of Lake Tonle Sap on N-S and NW-SE directions using a multi-parameter water quality profiler, Alec Electronics Co. Ltd., type AQ1180, which measures vertical profile of dissolved oxygen (DO), hydrogen ion exponent (pH), chlorophyll concentrations, temperature, turbidity and



Photo 5. Recovery of a water gauge and a water thermometer from the observatory tower in Lake Tonle Sap, south off Siem Reap.

conductivity of waters. Transverse surveys were also made in the junction area of the Mekong, Tonle Sap and Bassac Rivers off Phnom Penh, and the middle reaches of the Seng River in the city of Kompong Thom. The group also collected surface water samples along the transverse lines of both north and south lake, the major fluvial systems such as the Tonle Sap and Mekong Rivers, some tributaries of the lake, and rain water samples for measurements of their qualities and stable isotopic ratios of hydrogen and oxygen. Further, recovery and adjustment of water gauge and water thermometer installed on the observation towers in both north and south lake were carried out (Photo 5 and Photo 6). They in the south tower has been moved to the middle reaches of the Siem Reap River.

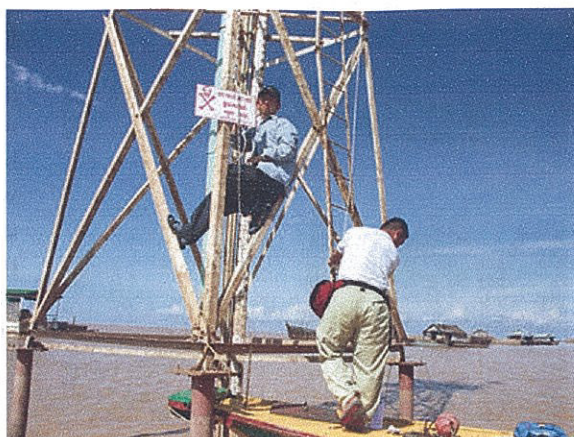


Photo 6. Adjustments of a water gauge and a water thermometer from the observatory tower in Lake Tonle Sap, south off Siem Reap

(4) Sedimentology Group (S. Tsukawaki, S. Sotham and I. Sim)

The group carried out mainly bottom sediment samplings in the Tonle Sap and Mekong Rivers in co-operation with Dr. H. Takebayashi of Tokushima University, Japan to clarify the distribution and composition of these sediments as an important source to Lake Tonle Sap. Ten cored sediment samples from the river floors of the above-stated rivers were successfully recovered (Photo 7 and Photo 8). These sediments have been kept in a storage of Department of Geology, General Department of Mineral Resources, Ministry of Industry, Mines and Energy in Phnom Penh for further analyses.



Photo 7. Onboard settlement of a Phleger type core sampler on the Tonle Sap River, off Kompong Chhnang



Photo 8. Core sampling using a Phleger type sampler on the Tonle Sap River off Kompong Chhnang.

(5) Atmospheric Science Group (M. Furuuchi, T. Sambath, T. Sakano, T. Murase and M. Komori)

In order to evaluate the situation of ambient air pollution, samplings of total suspended particulates (TSP), NO₂ and volatile organic compounds (VOC) were conducted in three different sites in Siem Reap respectively using portable high-volume air samplers and passive samplers: Angkor Vat, the city centre of Siem Reap and the top of Phnom Krom (Photo 9 and Photo 10). Similar samplings were also done in Phnom Penh and Shihanokeville. Obtained TSP samples will be analyzed on various chemical compositions such as Poly-aromatic hydrocarbons (PAHs), heavy metals, ions and carbons to discuss on the influence of emission sources. and carbons to discuss on the influence of emission sources.



Photo 9. Air sampling using a portable high-volume air sampler near the western approach of Angkor Vat, Siem Reap



Photo 10. Air sampling using a portable high-volume air sampler in a temple of Phnom Krom, south of Siem Reap

Prepared by: Dr. Shinji Tsukawaki
Date: 22 June, 2005

Report on the 4th Mission of Tonle Sap EMSB-u32 Team "MAB-IHP Joint Programme Ecological and Hydrological Research and Training for Young Scientist in Tonle Sap Biosphere Reserve, Cambodia: Research and Training for Young Scientists" in Cambodia from July to August 2005

1. Introduction

The 4th research mission of Tonle Sap EMSB-u32 Team "MAB-IHP Joint Programme: Ecological and Hydrological Research and Training for Young Scientist in Tonle Sap Biosphere Reserve, Cambodia: Research and Training for Young Scientists" Team (hereinafter "u32 team") were held in and around Lake Tonle Sap, Cambodia from July to August 2005. All Japanese u32 members attended the mission, but only Im Sim of the Sedimentology Group could attend from Cambodian side. Two members of Tonle Sap EMSB Team "Evaluation of Mechanisms Sustaining the Biodiversity in Lake Tonle Sap, Cambodia" supported financially by JSPS. A support party for the u32 team composed of both Cambodian and Japanese researchers and students participated also in the mission. Within all the schedule of the mission, the team carried out the synthetic field research in the area of Siem Reap and Kompong Chhnang in the northern and southern part of Lake Tonle Sap, respectively. The list of participants of the team and the support party, and activities of each group are followings:

2. List of Participants

(1) Head of the Mission

Shinji Tsukawaki (Associate Professor, Institute of Nature and Environmental Technology, Kanazawa University, Japan: Sedimentology)

(2) Members of EMSB-u32 Team

Yuji Araki (Graduate Student, Graduate School of Environment and Information Sciences, Yokohama National University, Japan: Plant Ecology)

Sim Im (Researcher, Department of Geology, General Department of Mineral Resources, Ministry of Industry, Mines and Energy, Kingdom of Cambodia: Regional Geology)

Toshiyuki Ishikawa (COE Researcher, Graduate School of Environmental Earth Science, Hokkaido University, Japan: Freshwater Zoology)

Takahiko Mukai (Lecturer, Faculty of Regional Studies, Gifu University: Ichthyology)

Hideo Oyagi (Graduate Student, Graduate School of Integrated Basic Sciences, Nihon University, Japan: Freshwater Hydrology)

(3) Members of EMSB Team

Hiroyuki Motomura (Researcher, Australian Museum, Australia: Ichthyology)

Yoshihiko Hirabuki (Professor, Department of Regional Planning, Faculty of Liberal Arts, Tohoku Gakuin University, Japan: Plant Ecology)

(4) Members of Support Party

Bunnarin Ben (Senior Geologist, Department of Geology, General Department of Mineral Resources, Ministry of Industry, Mines and Energy, Kingdom of Cambodia: Environmental Science)

Powkhy Drong (Japanese Interpreter, Siem Reap Office, Peace in Tour Co. Ltd., Kingdom of Cambodia: Plant Ecology)

Kenichi Sakai (Undergraduate Student, Department of Civil Engineering, Faculty of Engineering, Kanazawa University, Japan: Urban Geology)

Mizuki Tomita (COE Postdoctoral Fellow, Graduate School of Environment and Information Sciences, Yokohama National University, Japan: Plant Ecology)

Yukimi Takeshita (Undergraduate Student, Department of Civil Engineering, Faculty of Engineering, Kanazawa University, Japan: Sedimentary Geology)

3. Daily Record of Survey (in 2005)

Because all Japanese EMSB-u32 members have acquired to carry out their researches in Cambodia, each member conducted the research individually with the support and/or EMSB members. The daily records of each member are following:

17th July (Sun)

Araki: Transfer from Yokohama to Siem Reap via Narita and Bangkok. Stay in Siem Reap.

18th July (Mon.)

Araki: Plant ecological survey in the flooded forest area in the northern part of Lake Tonle Sap off Siem Reap with Powkhy. Stay in Siem Reap.



Photo 1. Plant ecological survey in the shrub area on the northern part of Lake Tonle Sap off Siem Reap

19th July (Tue.)

Araki: Plant ecological survey in the flooded forest area in the northern part of the lake off Siem Reap with Powkhy. Stay in Siem Reap.

20th July (Wed.)

Araki: Plant ecological survey in the flooded forest and shrub areas in the northern part of the lake off Siem Reap with Powkhy (Photo 1). Stay in Siem Reap.



Photo 2. Bundled firewood in a local village on the northern coast of the lake near Siem Reap.

21st July (Thu.)

Araki: Plant ecological survey in the flooded forest and shrub areas in the northern part of the lake off Siem Reap with Powkhy. Stay in Siem Reap.

22nd July (Fri.)

Araki: Plant ecological survey in the flooded forest area in the northern part of the lake off Siem Reap with Powkhy. Stay in Siem Reap.

23rd July (Sat.)

Ishikawa: Transfer from Sapporo to Narita via Haneda. Stay in Narita.

Araki: Plant ecological survey in the flooded forest area in the northern part

of the lake off Siem Reap with Powkhy (Photo 2). Stay in Siem Reap.

24th July (Sun.)

Ishikawa: Transfer from Narita to Phnom Penh via Bangkok. Stay in Phnom Penh.

Araki: Plant ecological survey in the flooded forest area in the northern part of the lake off Siem Reap with Powkhy. Stay in Siem Reap.

Oyagi: Transfer from Kawasaki to Phnom Penh via Narita and Bangkok. Stay in Phnom Penh.



Photo 3: Settlement of rain gauge in the school ground of the National Institute of Education, Phnom Penh

Phnom Penh.

Note: Motomura of the EMSB team arrived at Phnom Penh to join the Zoology Group.

25th July (Mon.)

Ishikawa: Preparation of chemical reagents and adjustment of research equipment with Motomura in a laboratory of the National Institute of Education in Phnom Penh. Stay in Phnom Penh.

Araki: Plant ecological survey in the flooded forest area in the northern part of the lake off Siem Reap. Stay in Siem Reap.

Oyagi: Preparation of chemical reagents

and adjustment and settlement of research equipment in a laboratory of the National Institute of Education (Photo 3) and Department of Geology, Ministry of Industry both in Phnom Penh. Stay in Phnom Penh.

Note: Tomita of the support party transfer from Yokohama to Siem Reap via Narita and Bangkok to join the Plant Ecology Group.

26th July (Tue.)

Ishikawa: Transfer from Phnom Penh to Kompong Chhnang with Oyagi, Sim, Bunnarin and Motomura. Water and plankton samplings in the Tonle Sap River off Kompong Chhnang with them. Stay in Kompong Chhnang.

Araki: Plant ecological survey in the flooded forest area in the northern part of the lake off Siem Reap with Tomita and Powkhy. Stay in Siem Reap.

Oyagi: Transfer from Phnom Penh to Kompong Chhnang with Ishikawa, Sim, Bunnarin and Motomura. Water samplings and water property measurements in the Tonle Sap River off Kompong Chhnang with them (Photo 4). Stay in Kompong Chhnang.



Photo 4: Water sampling in the southern part of Lake Tonle Sap off Chhnok Tru in Kompong Chhnang Province.

27th July (Wed.)

Ishikawa: Transfer from Kompong Chhnang to Chhnok Tru in the southern marginal part of Lake Tonle Sap with Oyagi, Sim, Bunnarin and Motomura. Water, fish and plankton samplings in the southern part of the lake (Photo 5). Return to and stay in Kompong Chhnang.

Araki: Plant ecological survey in the flooded forest area in the northern part of the lake off Siem Reap with Tomita and Powkhy. Stay in Siem Reap.

Oyagi: Transfer from Kompong Chhnang to Chhnok Tru in the southern marginal part of Lake Tonle Sap with Ishikawa, Sim, Bunnarin and Motomura. Water sampling and property measurements in the southern part of the lake with them. Return to and stay in Kompong Chhnang.



Photo 5: Fish in a local market of Kompong Chhnang.



Photo 6. Local fishing in the village of Chhnok Tru in the southern marginal part of Lake Tonle Sap.

part of Lake Tonle Sap with Ishikawa, Sim, Bunnarin and Motomura. Water sampling and property measurements in the southern part of the lake with them. Return to and stay in Kompong Chhnang.

29th July (Fri.)

Ishikawa: Transfer from Kompong Chhnang to Chhnok Tru in the southern marginal part of Lake Tonle Sap with Oyagi, Sim, Bunnarin and Motomura. Water and plankton samplings in the southern part of the lake with them (Photo 7). Return to and stay in Kompong Chhnang.

Araki: Plant ecological survey in the flooded forest area in the northern part of the lake

28th July (Thu.)

Ishikawa: Transfer from Kompong Chhnang to Chhnok Tru in the southern marginal part of Lake Tonle Sap with Oyagi, Sim, Bunnarin and Motomura. Water, fish and plankton samplings in the southern part of the lake (Photo 6). Return to and stay in Kompong Chhnang.

Araki: Plant ecological survey in the flooded forest area in the northern part of the lake off Siem Reap with Tomita and Powkhy. Stay in Siem Reap.

Oyagi: Transfer from Kompong Chhnang to Chhnok Tru in the southern marginal



Photo 7: Lake water sampling to measure primary product of the lake in the southern part of Lake Tonle Sap, off Chhnok Tru.

off Siem Reap with Tomita and Powkhy. Stay in Siem Reap.
Oyagi: Transfer from Kompong Chhnang to Chhnok Tru in the southern marginal part of Lake Tonle Sap with Ishikawa, Sim, Bunnarin and Motomura. Water sampling and property measurements in the southern part of the lake with them. Return to and stay in Kompong Chhnang.

30th July (Sat.)

Ishikawa: Transfer from Kompong Chhnang to Chhnok Tru in the southern marginal part of Lake Tonle Sap with Oyagi, Sim, Bunnarin and Motomura. Water and plankton samplings in the southern part of the lake with them. Return to and stay in Kompong Chhnang.

Araki: Plant ecological survey in the flooded forest area in the northern part of the lake off Siem Reap with Tomita and Powkhy (Photo 8). Stay in Siem Reap.



Photo 8: Plant ecological survey in the flooded forest area in the northern part of Lake Tonle Sap, off Siem Reap.

Oyagi: Transfer from Kompong Chhnang to Chhnok Tru in the southern marginal part of Lake Tonle Sap with Ishikawa, Sim, Bunnarin and Motomura. Water sampling and property measurements in the southern part of the lake with them. Return to and stay in Kompong Chhnang.

31st July (Sun.)

Ishikawa: Transfer from Kompong Chhnang to Phnom Penh with Oyagi, Motomura, Sim and Bunnarin. Indoor sort out of specimen in a room of the hotel. Stay in Phnom Penh.

Mukai: Transfer from Gifu to Siem Reap via Nagoya and Bangkok. Stay

in Phnom Penh.

Araki: Plant ecological survey in the flooded forest area in the northern part of the lake off Siem Reap with Tomita and Powkhy. Stay in Siem Reap.

Oyagi: Transfer from Kompong Chhnang to Phnom Penh with Ishikawa, Motomura, Sim and Bunnarin. Indoor analysis of water samples in a room of the hotel. Stay in Phnom Penh.

Tsukawaki: Transfer from Kanazawa to Phnom Penh via Kansai and Bangkok with Sakai and Takeshita of the support party. Stay in Phnom Penh.

Note: Support members Sakai and Takeshita transfer from Kanazawa to Phnom Penh via Kansai and Bangkok with Tsukawaki. Stay in Phnom Penh.

1st August (Mon.)

Ishikawa: Indoor sort out of specimen in a room of the hotel. Stay in Phnom Penh.

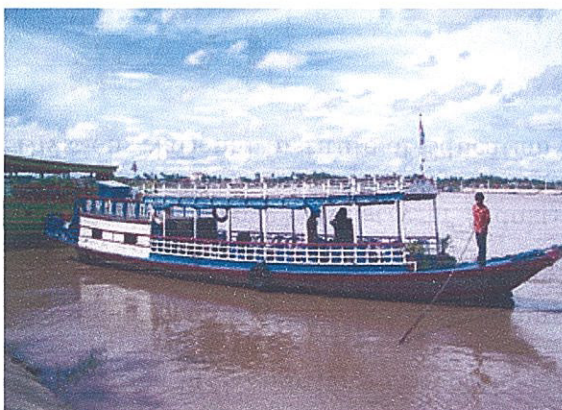


Photo 9: Water sampling in the Tonle Sap and Mekong Rivers off Phnom Penh.

Mukai: Adjustment of research equipment in a room of the hotel and fish sampling in markets in Phnom Penh with Motomura. Stay in Phnom Penh.

Araki: Plant ecological survey in the flooded forest area in the northern part of the lake off Siem Reap with Tomita and Powkhy. Stay in Siem Reap.

Oyagi: Transfer from Kompong Chhnang to Phnom Penh with Ishikawa, Motomura, Sim and Bunnarin. Water sampling in the Tonle Sap and Mekong Rivers off Phnom Penh with Takeshita and Sakai (Photo 9). Stay in Phnom Penh.

Tsukawaki: Meeting in the offices of Department of Geology, Ministry of Industry, Mines and Energy, Department of Hydrology and Riverworks, Ministry of Water Resources and Meteorology, and Biology Division, National Institute of Education in Phnom Penh. Stay in Phnom Penh.

2nd August (Tue.)

Ishikawa: Transfer from Phnom Penh to Siem Reap by a coach. Preparation of research equipment in a room of the hotel. Stay in Siem Reap.

Mukai: Transfer from Phnom Penh to Siem Reap by a coach. Preparation of research equipment in a room of the hotel. Stay in Siem Reap.

Araki: Plant ecological survey in the flooded forest area in the northern part of the lake off Siem Reap with Tomita and Powkhy (Photo 10). Stay in Siem Reap.

Oyagi: Transfer from Phnom Penh to Siem Reap by a coach. Preparation of research equipment in a room of the hotel. Stay in Siem Reap.

Tsukawaki: Transfer from Phnom Penh to Siem Reap by a coach. Short meetings in the offices of APSARA and Sophia University. Stay in Siem Reap.

Note: Transfer support members, Sakai and Takeshita and the EMSB member, Motomura, from Phnom Penh to Siem Reap by coach. Stay in Siem Reap.

3rd August (Wed.)

Ishikawa: Transfer from Siem Reap to Chongkneas in the northern marginal part of Lake Tonle Sap with Oyagi and Sakai. Water and plankton samplings in the northern part of the lake with them (Photo 11). Return to and stay in Siem Reap.

Mukai: Transfer from Siem Reap to Chongkneas in the northern marginal part of Lake Tonle Sap with Motomura and Takeshita.



Photo 10: Plant ecological survey in the shrub area on the north of Lake Tonle Sap near Siem Reap.



Photo 11: Plankton net sampling in the northern part of Lake Tonle Sap off Siem Reap.

Fish samplings in the northern part of the lake with them. Return to and stay in Siem Reap.

Araki: Plant ecological survey in the flooded forest area in the northern part of the lake off Siem Reap with Tomita and Powkhy. Stay in Siem Reap.

Oyagi: Transfer from Siem Reap to Chongkneas in the northern marginal part of Lake Tonle Sap with Ishikawa and Sakai. Water sampling and property measurements in the northern part of the lake with them. Return to and stay in Siem Reap.

Tsukawaki: Meetings and arrangements of the survey in the offices of APSARA and Sophia University. Stay in Siem Reap.



Photo 12: Collected fish samples from local markets and fishermen in Siem Reap.

4th August (Thu.)

Ishikawa: Transfer from Siem Reap to Chongkneas in the northern marginal part of Lake Tonle Sap with Oyagi and Sakai. Water and plankton samplings in the northern part of the lake with them. Return to and stay in Siem Reap.

Mukai: Transfer from Siem Reap to Chongkneas in the northern marginal part of Lake Tonle Sap with Motomura and Takeshita. Fish samplings in the northern part of the lake with them (Photo 12). Return to and stay in Siem Reap.

Araki: Plant ecological survey in the flooded forest area in the northern part of the lake off Siem Reap with Tomita and Powkhy. Stay in Siem Reap.

Oyagi: Transfer from Siem Reap to Chongkneas in the northern marginal part of Lake Tonle Sap with Ishikawa and Sakai. Water sampling and property measurements in the northern part of the lake with them. Return to and stay in Siem Reap.

Tsukawaki: Meetings and arrangements of the survey in the offices of APSARA and Sophia University. Stay in Siem Reap.

5th August (Fri.)

Ishikawa: Transfer from Siem Reap to Chongkneas in the northern marginal part of Lake Tonle Sap with Oyagi and Sakai. Water and plankton samplings in the northern part of the lake with them. Return to and stay in Siem Reap.

Mukai: Transfer from Siem Reap to Chongkneas in the northern marginal part of Lake Tonle Sap with Motomura and Takeshita. Fish samplings in the northern part of the lake with them. Return to and stay in Siem Reap.



Photo 13: Flooded forests in the northern marginal area of Lake Tonle Sap off Siem Reap.

Araki: Plant ecological survey in the flooded forest area in the northern part of the lake off Siem Reap with Tomita and Powkhy (Photo 13). Stay in Siem Reap.

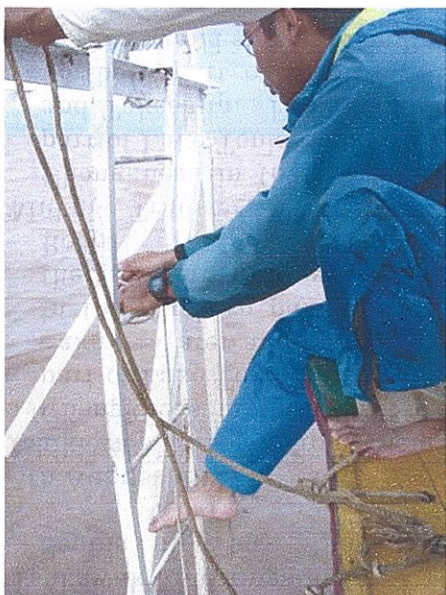


Photo 14: Settlement of water pressure meter in the northern part of Lake Tonle Sap off Siem Reap.

Oyagi: Transfer from Siem Reap to Chongkneas in the northern marginal part of Lake Tonle Sap with Ishikawa and Sakai. Water sampling and property measurements in the northern part of the lake with them (Photo 14). Return to and stay in Siem Reap.

Tsukawaki: Meetings and arrangements of the survey in the offices of APSARA and Sophia University. Stay in Siem Reap.

6th August (Sat.)

Ishikawa: Indoor sort out of specimen in a room of the hotel. Transfer from Siem Reap to Bangkok, Thailand. Transfer from Bangkok to Nagoya. Stay in the aeroplane.

Mukai: Transfer from Siem Reap to Battambang situating on the north of the lake with Oyagi by an automobile. Fish sampling on the way. Stay in Battambang.

Araki: Plant ecological survey in the flooded forest area in the northern part of the lake off Siem Reap with Tomita, Sakai, Motomura and Powkhy (Photo 15). Stay in Siem Reap.

Oyagi: Transfer from Siem Reap to Battambang situating on the north of the lake with Mukai by an automobile. River water sampling on the way. Stay in Battambang.

Tsukawaki: Transfer from Siem Reap to Phnom Penh by a coach with Takeshita. Stay in Phnom Penh.

7th August (Sun.)

Ishikawa: Transfer from Nagoya to Sapporo.

Mukai: Transfer from Battambang to Kompong Chhnang via Posat situating on the west of the lake with Oyagi. Fish sampling on the way. Stay in Kompong Chhnang.

Araki: Plant ecological survey in the flooded forest area in the northern part of the lake off Siem Reap with Tomita, Sakai and Powkhy. Stay in Siem Reap.

Oyagi: Transfer from Battambang to Kompong Chhnang via Posat situating on the west of the lake with Mukai. River water sampling on the way. Stay in Kompong Chhnang.

Tsukawaki: Preliminary survey of the river sediment of the Tonle Sap River with Takeshita. Stay in Phnom Penh.

Note: Motomura of the EMSB team left Siem Reap to Australia via Singapore. Hirabuki of the EMSB team arrived in and stay in Siem Reap.



Photo 15: Plant sampling in the flooded area of the lake off Siem Reap.



Photo 16: The Tonle Sap River near Phnom Penh. The river water flows strongly toward the Mekong River.

8th August (Mon.)

Mukai: Transfer from Kompong Chhnang to Phnom Penh with Oyagi. Fish sampling on the way. Stay in Phnom Penh.

Araki: Plant ecological survey in the flooded forest area in the northern part of the lake off Siem Reap with Hirabuki, Tomita, Sakai and Powkhy. Stay in Siem Reap.

Oyagi: Transfer from Kompong Chhnang to Phnom Penh with Mukai. River water sampling on the way. Stay in Phnom Penh.

Tsukawaki: Preliminary survey of the river sediment of the Tonle Sap River (Photo 16). Stay in Phnom Penh.

9th August (Tue.)

Mukai: A day trip to Kompong Thom situating on the northeast of the lake with Oyagi. Fish sampling on the way. Stay in Phnom Penh.

Araki: Plant ecological survey in the flooded forest area in the northern part of the lake off Siem Reap with Hirabuki, Tomita, Sakai and Powkhy. Stay in Siem Reap.

Oyagi: A day trip to Kompong Thom situating on the northeast of the lake with Oyagi. River water sampling on the way. Stay in Phnom Penh.

Tsukawaki: Survey on the utilisation of riverbanks of the Tonle Sap and Mekong Rivers with Takeshita. Stay in Phnom Penh.

10th August (Wed.)

Mukai: Fish samplings in markets in Phnom Penh, and the junction area of the rivers of the Mekong, Tonle Sap and Bassac. Stay in Phnom Penh.

Araki: Plant ecological survey in the flooded forest area in the northern part of the lake off Siem Reap with Hirabuki, Tomita and Powkhy. Stay in Siem Reap.

Oyagi: Water samplings of the junction area of the Mekong, Tonle Sap and Bassac Rivers in Phnom Penh. Recover of the water gauge of the National Institute of Education in Phnom Penh (Photo 17). Stay in Phnom Penh.

Tsukawaki: Survey on the utilisation of riverbanks of the Tonle Sap and Mekong Rivers with Takeshita. Stay in Phnom Penh.

Note: Sakai of the support party transfer from Siem Reap to Phnom Penh. Stay in Phnom Penh.



Photo 17: Water gauge settled in the National Institute of Education, Phnom Penh.

11th August (Thu.)

Mukai: Fish samplings in markets in Phnom Penh, and sample treatments in a room of the hotel in Phnom Penh. Stay in Phnom Penh.

Araki: Plant ecological survey in the flooded forest area in the northern part of the lake off Siem Reap with Hirabuki, Tomita and Powkhy. Stay in Siem Reap.

Oyagi: Transfer from Phnom Penh to Bangkok. Stay in Bangkok.

Tsukawaki: Survey on the utilisation of riverbanks of the Tonle Sap and Mekong Rivers with Sakai and Takeshita (Photo 18). Stay in Phnom Penh.

Note: Hirabuki of the EMSB team and Tomita of the support party left Siem Reap to Bangkok.



Photo 18: Visual observation of utilization of the riverbanks of the Tonle Sap River near Phnom Penh.

12th August (Fri.)

Mukai: Transfer from Phnom Penh to Bangkok. Stay in Bangkok.

Araki: Transfer from Siem Reap to Phnom Penh by a coach. Stay in Phnom Penh.

Oyagi: Investigation of documentary records in the Asian Institute of Technology in Bangkok. Stay in Bangkok.

Tsukawaki: Transfer from Phnom Penh to Bangkok. Stay in Bangkok.

Note: Support members Sakai and Takeshita transfer from Phnom Penh to Bangkok. Stay in Bangkok.

13th August (Sat.)

Mukai: Fish sampling in a brackish water area south of Bangkok with Sakai and Takeshita (Photo 19). Stay in Bangkok.

Araki: Sample treatments in a room of the hotel in Phnom Penh. Stay in Phnom Penh.

Oyagi: Investigation of documentary records in the Asian Institute of Technology in Bangkok. Transfer from Bangkok to Narita. Stay in the aeroplane.

Tsukawaki: Transfer from Bangkok to Kanazawa via Kansai.

Note: Support members, Sakai and Takeshita, transfer from Bangkok to Kansai. Stay in the aeroplane.



Photo 19: Fish sampling in a brackish water area in the Gulf of Thailand near Bangkok.

14th August (Sun.)

Mukai: Fish sampling in a brackish water area south of Bangkok. Stay in Bangkok.

Araki: Sample treatments in a room of the hotel in Phnom Penh. Stay in Phnom Penh.

Oyagi: Transfer from Narita to Kawasaki via Tokyo.

Note: Support members, Sakai and Takeshita, transfer from Kansai to Kanazawa.

15th August (Mon.)

Mukai: Sample treatment in a room of the hotel in Bangkok. Transfer from Bangkok to Chubu. Stay in the aeroplane.

Araki: Transfer from Phnom Penh to Bangkok. Stay in Bangkok.

16th August (Tue.)

Mukai: Transfer from Chubu to Gifu.

Araki: Investigation of documentary records in the Library of the Royal Forestry Department in Bangkok. Stay in Bangkok.

17th August (Wed.)

Araki: Investigation of documentary records in the Library of the Royal Forestry Department in Bangkok. Transfer from Bangkok to Narita. Stay in the aeroplane.

18th August. (Thu.)

Araki: Transfer from Narita to Yokohama via Tokyo.

4. Activities of Each Group

(1) Zoology Group (T. Ishikawa, T. Mukai, H. Motomura and B. Bunnarin)

To elucidate the water environment and structure of animal community at the rising water season of Lake Tonle Sap, the group investigated in the water areas of the lake and adjacent marshlands in both south off the city of Siem Reap in the north and north off the village of Chhnok Tru of Kompong Chhnang Province in the south of the lake. A Secchi disk, an Ekman-Birge bottom sampler, and a plankton net were utilized to measure bottom sediments and zoobenthos, and to transparency of the lake water, to collect zooplankton staying water column, respectively. Benthic and planktonic invertebrates and fishes were collected from several sites in the above-stated areas. The specimens collected during the survey have been under investigation in cooperation with specialists of respective taxonomic groups. In addition, the primary productivity of the lake was experimentally measured in both north and south of the lake (Photo 20).



Photo 20: Settlement of water sample in the northern part of Lake Tonle Sap for primary productivity measurement.



Photo 21: A local people collecting firewood in the shrub area on the north of Lake Tonle Sap near Siem Reap.

(2) Plant Ecology Group (Y. Araki, Y. Hirabuki, M. Tomita and D. Powkhy)

At the rising water season of Lake Tonle Sap, the group carried out floristic and vegetational researches, above all about vegetation recovery from human impact and distribution of *Barringtonia acutangula* (local name: reang) dominant tree in the floodplain forests both to the south of the city of Siem Reap along a certain number of traverse sections in the forests. Further, the group also interviewed with local people about local and/or regional use of plant resources attends to gather firewood, and collected some plant specimens in large area of the floodplain (Photo 21).

(3) Hydrology Group (H. Oyagi and K. Sakai)

The group carried out first transverse surveys of both northern and southern parts of Lake Tonle Sap on N-S and NW-SE directions using a multi-parameter water quality profiler, Alec Electronics Co. Ltd., type AQ1180, which measures vertical profile of dissolved oxygen (DO), hydrogen ion exponent (pH), chlorophyll concentrations, temperature, turbidity and conductivity of waters (Photo 22). Transverse surveys were also made in the junction area of the Mekong, Tonle Sap and Bassac Rivers off Phnom Penh, and the middle reaches of the Seng River in the city of Kompong Thom. The group also collected surface water samples along the transverse lines of both north and south lake, the major fluvial systems such as the Tonle Sap and Mekong Rivers, some tributaries of the lake, and rain water samples for measurements of their qualities and stable isotopic ratios of hydrogen and oxygen. Further, recovery and adjustment of water gauge and water thermometer installed on the observation towers in both north and south lake were carried out.



Photo 22: Water quality measurements in the southern part of Lake Tonle Sap off Chhnok Tru.



Photo 23: Visual observation and record of utilization of riverbanks of the Tonle Sap River in and around Phnom Penh.

riverbanks of the Tonle Sap River in order to grasp their influences for the sedimentary processes and sediment assemblages of the riverbed (Photo 23).

(4) Sedimentology Group (S. Tsukawaki, I. Sim and Y. Takeshita)

In spite of the group planned to carry out bottom sediment samplings in the Tonle Sap and Mekong Rivers in cooperation with Dr. H. Takebayashi of Tokushima University, Japan to clarify the distribution and composition of these sediments as an important source to Lake Tonle Sap, these activities had canceled due to the unusual fast water velocity of flowing water currents of the rivers. Accordingly, the group investigated visually utilization of the

Prepared by Dr. Shinji Tsukawaki
Date 31/08/2005

Report on the International Symposium on “Evaluation of Mechanisms Sustaining the Biodiversity in Lake Tonle Sap, Cambodia” organised by Tonle Sap EMSB Team (JSPS) and Tonle Sap EMSB-u32 Team (MAB-IHP Joint Programme Ecological and Hydrological Research and Training for Young Scientist in Tonle Sap Biosphere Reserve, Cambodia: Research and Training for Young Scientists) in Phnom Penh, Cambodia in December 2005, and Related Optional Research in Lake Tonle Sap and Adjacent Fluvial System in Cambodia

1 Introduction

The International Symposium on “Evaluation Mechanisms Sustaining the Biodiversity in Lake Tonle Sap, Cambodia” organised by Tonle Sap EMSB Team (JSPS) and Tonle Sap EMSB-u32 Team (MAB-IHP Joint Programme Ecological and Hydrological Research and Training for Young Scientist in Tonle Sap Biosphere Reserve, Cambodia: Research and Training for Young Scientists) was held at the seminar room of the Ministry of Industry, Mines and Energy, Kingdom of Cambodia of Phnom Penh, Cambodia on the 1st and the 2nd of December 2005. About eighty participants from seven countries, Cambodia, Singapore, Viet Nam, Finland, Thailand, Japan and Germany, attended the symposium on the 1st of December, and about twenty-five participants visited to the southwestern coast of Cambodia to observe its coastal topography, mangrove forest and geological strata, and so on. Further, taking the opportunity for visiting to Cambodia, a short optional research in both northern and southern parts of Lake Tonle Sap and related fluvial system was carried out mainly by the EMSB u32 team in December 2005.

2. List of Participants (Pre-registered)

Cambodia

BEN Bunnarin, Department of Geology, General Department of Mineral Resources, Ministry of Industry, Mines and Energy, Phnom Penh, Kingdom of Cambodia, geodept@online.com.kh

BUN Sunnaroth, Staff, Department of Water and Forestry, APSARA Authority, Siem Reap, Kingdom of Cambodia, Apsara_dwf@yahoo.com

CHEA Sieng Hong, Secretary of the State, Ministry of Industry, Mines and Energy, Kingdom of Cambodia

CHHAN Paul, Graduate Student, School of Sustainable Development, Asian Institute of Technology, Pathumthani, Thailand, chpaul@yahoo.com

Drowning Powkhy, Japanese Tour Guide, Peace-in Tour Angkor, Siem Reap, Kingdom of Cambodia

DY Bonna, Vice Director, National Institute of Education, Phnom Penh, Kingdom of Cambodia, monyrathboona@yahoo.com

EAR Punlork, Staff, Department of Water and Forestry, APSARA Authority, Siem Reap, Kingdom of Cambodia, Apsara_dwf@yahoo.com

EA Darith, Head of Ceramics Conservation Office, Department of Monument and Archaeology, APSARA Authority, Siem Reap, Kingdom of Cambodia, eadarith@yahoo.com

EM Sauth, Teacher Trainer, National Institute of Education, Phnom Penh, Kingdom of Cambodia

HANG Peou, Director, Department of Water and Forestry, APSARA Authority, Siem Reap, Kingdom of Cambodia, hangpeou@yahoo.com
HEP Sokhannaro, Graduate Student, School of Sustainable Development, Asian Institute of Technology, Pathumthani, Thailand, st101183@ait.ac.th
IM Sim, Department of Geology, General Department of Mineral Resources, Ministry of Industry, Mines and Energy, Phnom Penh, Kingdom of Cambodia, geodept@online.com.kh
KEO Nak, Manager, Estebell Beauty Spa Institute, Phnom Penh, Kingdom of Cambodia, babynak9999@yahoo.com
KONG Meng, Researcher, Department of Geology, General Department of Mineral Resources, Ministry of Industry, Mines and Energy, Phnom Penh, Kingdom of Cambodia
LIM Kannitha, Teacher Trainer, National Institute of Education, Phnom Penh, Kingdom of Cambodia
LY Vanna, Faculty of Archaeology, Royal University of Fine Arts, Phnom Penh, Kingdom of Cambodia, vnly47@yahoo.fr
MAK Sithirith, Executive Director, Fisheries Action, Coalition Team (FACT) in Cambodia, Phnom Penh, Kingdom of Cambodia, maksithrith@yahoo.com
SIENG Sotham, Director, Department of Geology, General Department of Mineral Resources, Ministry of Industry, Mines and Energy, Phnom Penh, Kingdom of Cambodia, geodept@online.com.kh
SO IM Monichoth, Deputy Director, Department of Hydrology and River Works, Ministry of Meteorology and Water Resources, Phnom Penh, Kingdom of Cambodia, simchoth@yahoo.com
SUY Sem, Minister, Ministry of Industry, Mines and Energy, Kingdom of Cambodia
TOUCH Sambath, Deputy Director, Department of Geology, General Department of Mineral Resources, Ministry of Industry, Mines and Energy, Phnom Penh, Kingdom of Cambodia, geodept@online.com.kh
TOUCH Seang Tana, H. E., Secretary of State, Office of the Council of Minister, Phnom Penh, Kingdom of Cambodia, seangtana@yahoo.com
VOEUN Vuthy, Archaeo-zoology Laboratory, Faculty of Archaeology, Royal University of Fine Arts, Phnom Penh, Kingdom of Cambodia, farchaeorufa@online.com.kh

Finland

KUMMU Matti, Researcher, MRCS/WUP-FIN Lower Mekong Modeling Project, Mekong River Commission Secretariat, Vientiane, 01000 Lao PDR, matti.Kummu@iki.fi

Germany

ULRICH Saint-Paul, Deputy Director, Centre for Marine Tropical Ecology, 28359 Bremen, Germany, ulrich.saint-paul@zmt.uni-bremen.de

Japan

ARAKI Yuji, Graduate Student, Graduate School of Environment and Information Sciences, Yokohama National University, Yokohama, 240-8501 Japan, 02td002@ynu.ac.jp

CHINO Hidekazu, Announcer, Japan Broadcasting Corporation (NHK), Tsu, Tsu, 514-8531 Japan, chino.h-hg@nhk.or.jp

ENDOH Shuichi, Professor, Department of Environmental Education, Faculty of Education, Shiga University, Otsu, 520-0862 Japan, endo@shiga-u.ac.jp

FUJITA Kosuke, Graduate Student, Graduate School of Education, Shiga University, Otsu, 520-0862 Japan, saigokara@hotmail.com

HIRABUKI Yoshihiko, Professor, Faculty of Liberal Arts, Tohoku Gakuin University,

Sendai, 981-3193 Japan, yhira@izcc.tohoku-gakuin.ac.jp
ISHIKAWA Toshiyuki, Researcher, Graduate School of Environmental Science,
Hokkaido University, Sapporo, 060-0810 Japan, t-ishi@ees.hokudai.ac.jp
KAMIYA Takahiro, Professor, Graduate School of Natural Science and Technology,
Kanazawa University, Kanazawa, 920-1192 Japan,
takamiya@kenroku.kanazawa-u.ac.jp
KANAMORI Masaomi, Advisor, National Institute of Education, Phnom Penh, Kingdom
of Cambodia, masaomikanamori@yahoo.co.jp
MOTOMURA Hiroyuki, Associate Professor, University Museum, Kagoshima
University, Kagoshima, 890-0065 Japan, motomura@kaum.kagoshima-u.ac.jp
MUKAI Takahiko, Assistant Professor, Faculty of Regional Studies, Gifu University,
Gifu, 501-1193 Japan, tmukai@cc.gifu-u.ac.jp
MURASE Takahiro, Graduate Student, Graduate School of Natural Science and
Technology, Kanazawa University, Kanazawa, 920-1192 Japan,
xnur_red0908@yahoo.co.jp
MURAYAMA Tetsuya, Advisor, National Institute of Education, Phnom Penh, Kingdom
of Cambodia, muray@mbh.nifty.com
NAKAI Satoko, Graduate Student, Graduate School of Education, Shiga University,
Otsu, 520-0862 Japan, dangoyachunkichi@hotmail.com
NARITA Tetsuya, Former Assistant Professor, Center for Ecological Research, Kyoto
University, 8-25-9 Sakamoto, Otsu, 520-0113 Japan, narita8259@ybb.ne.jp
OHTAKA Akifumi, Professor, Faculty of Education, Hirosaki University, Hirosaki,
036-8561 Japan, ohtaka@cc.hirosaki-u.ac.jp
OKUMURA Yasuaki, Associate Professor, Research Center for Physics and
Mathematics, Osaka Electro-Communication University, Neyagawa, 572-8530 Japan,
okumura@isc.osakac.ac.jp
OMURA Akio, Deputy President, Kanazawa University, Kanazawa, 920-1192 Japan,
akiomura@kenroku.kanazawa-u.ac.jp
OYAGI Hideo, Graduate Student, Graduate School of Integrated Basic Sciences, Nihon
University, Tokyo, 156-8550 Japan, oyagi@chs.nihon-u.ac.jp
SAKAI Kenichi, Undergraduate Student, Department of Civil Engineering, Faculty of
Engineering, Kanazawa University, Kanazawa, 920-1192 Japan,
k-sakai@ge.kanazawa-u.ac.jp
TAKEBAYASHI Hiroshi, Associate Professor, Department of Civil Engineering, Faculty
of Engineering, Tokushima University, Tokushima, 770-8506 Japan,
takeh@ce.tokushima-u.ac.jp
TSUKAWAKI Shinji, Associate Professor, Institute of Nature and Environmental
Technology, Kanazawa University, Kanazawa, 920-1192 Japan,
tukawaki@t.kanazawa-u.ac.jp

Singapore

Lu Xixi, Assistant Professor, Department of Geography, National University of
Singapore, Singapore 119260, geoluxx@nus.edu.sg

Viet Nam

LE Xuan Thuyen, Researcher, Sub-Institute of Geography, Vietnamese Academy of
Sciences and Technology, Ho Chi Minh City, Viet Nam, lexuanthuyen@hcm.vnn.vn

3. Schedule and Programme of the Symposium

(1) DAY 1: December 1, 2005

07:30 Registration

08:30 Opening Remarks (H. E. Mr. Suy Sem, Minister, Ministry of Industry, Mines and Energy, Kingdom of Cambodia)

08:45 Group Photo and Coffee Break



Photo 1: Group photograph of the symposium on the 1st of December 2005 at the seminar room of the Ministry of Industry, Mines and Energy, Kingdom of Cambodia.

I. Introduction & II. Geology (Chair: Mr. Sieng Sotham)

09:15 Tsukawaki, S. and Members of EMSB and EMSB-u32 Teams: *Introduction and Research activities of the EMSB and EMSB-u32 teams in Lake Tonle Sap, Cambodia in 2003-2005*

09:30 Tsukawaki, S., Sotham, S. and Members of Tonle Sap 21 Programme: *Formation of the present natural environment on Lake Tonle Sap and the lower courses of the Mekong River system in Cambodia: geological history of Cambodia during the last 20,000 years*

09:45 Tsukawaki, S., Sotham, S., Sim, I., Takebayashi, H., Ooji, A., Bunnarin, B. and Sambath, T.: *Lithological features of cored sediments from the southern part of Lake Tonle Sap and the Tonle Sap River*

III. Hydrology and Limnology (Chair: Prof. Akifumi Ohtaka)

10:00 Endoh, S., Fujita, K., Nakai, S., Okumura, Y., Oyagi, H., Fujii, T., Tsukawaki, S. and Monichoth, S. I.: *Continuous measurement of water temperature in Lake Tonle Sap*

10:15 Oyagi, H., Endoh, S., Okumura, Y., Monichoth, S. I., Tsukawaki, S., Ishikawa, T., Fujii, T., Fujita, K. and Mori, K.: *Seasonal*

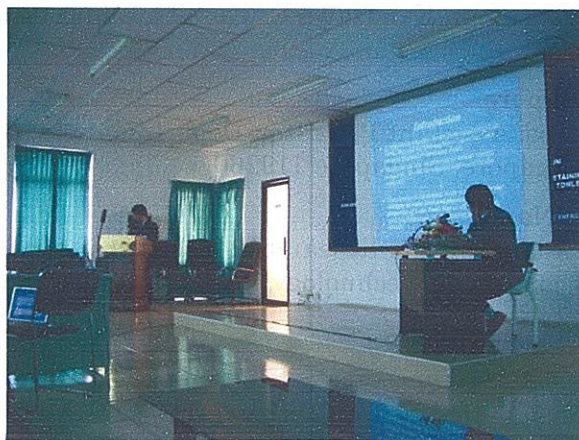


Photo 2: Oral presentation by Hideo Oyagi of EMSB-u32 Team.

changes in water level and water quality in Lake Tonle Sap, Cambodia

10:30 Sarkkula, J., Koponen, J. and Kumm, M.: *Flood pulsing and productivity factors in Tonle Sap system*

10:45 Mohanti, M. and Murray, A. S.: *Chilika Lake on the Bay of Bengal, Eastern India: towards a greater understanding of management of Asian lake system*

IV. Plant Ecology (Chair: Prof. Shuichi Endoh)

11:00 Araki, Y., Powkhy, D., Hirabuki, Y., Rachna, C., Tsukawaki, S., Tomita, M. and Suzuki, K.: *Floodplain vegetation under severe human impact: succession pattern and invasion of exotic mimosa in Lake Tonle Sap, Cambodia*

11:15 Vanna, L.: *Rice remains in the prehistoric pottery tempers of the shell midden site of Samrong Sen: implications for early rice cultivation in central Cambodia*

11:30 3-minute Poster Presentation (8 posters, Chair: Prof. Shuichi Endoh)

12:00 Lunch break

13:30 Poster Session

V. Civil Engineering (Chair: Prof. Yoshihiko Hirabuki)

14:30 Takebayashi, H., Luu, X. L., Egashira, S., Tsukawaki, S., Sim, I., Sambath, T., Sotham, S. and Ide, S.: *Flow pattern and size distribution of bed material at Chaktomuk in Cambodia*

VI. Zoology and Ichthyology (Chair: Prof. Yoshihiko Hirabuki)

14:45 Ishikawa, T., Oyagi, H., Ohtaka, A., Narita, T., Sim, I. and Tsukawaki, S.: *Primary production in Lake Tonle Sap*

15:00 Ohtaka, A., Katakura, H., Kamiya, T., Narita, T., Motomura, H., Ishikawa, T., Mukai, T., Kuwahara, Y., Tsukawaki, S., Sophorn, V., Rachna, C. and Vuthy, T.: *Diversity of aquatic invertebrates in Lake Tonle Sap*

15:15 Narita, T., Ohtaka, A., Motomura, H., Mukai, T., Ishikawa, T., Sophorn, V., Rachna, C. and Vuthy, T.: *Food web structure study by natural stable isotope in Lake Tonle Sap, Cambodia - a preliminary report -*

15:30 Sauth, E., Kannitha, L., Kanamori, M. and Murayama, T.:

Study tour in EMSB and the research of rainfall at NIE

15:30 Coffee Break

VII. Atmospheric Sciences (Chair: Dr. Shinji Tsukawaki)

15:45 Furuuchi, M., Murase, T., Tsukawaki, S., Sotham, S. and Peou, H.: *Air Pollution in Angkor Monuments Area in Cambodia*

16:00 Okumura, Y., Endoh, S., Darith, E. and Oyagi, H.: *Meteorological characteristics of Siem Reap City, Cambodia*



Photo 3: Oral presentation by Toshiyuki Ishikawa of EMSB-u32 Team.

16:15 Discussion (Chair: Dr. Shinji Tsukawaki)

16:45 Concluding Remarks (Dr. Shinji Tsukawaki: Head of the EMSB & EMSB-u32 Teams)

17:00 Closing Remarks (H. E. Mr. Chea Sieng Hong: Secretary of the State, Ministry of Industry, Mines and Energy, Kingdom of Cambodia)

POSTER

Le, X. T.: *Tonle Sap - Mekong River and the similar systems in the Southern Vietnam*

Hirabuki, Y., Araki, Y., Powkhy, D., Takehara, A., Tsukawaki, S., Suzuki, K., Sockrithy, I. and Rachna, C.: *Herbaceous water-plant vegetation in flooding Lake Tonle Sap, Cambodia: distributional pattern and ecological implications*

Watanabe, R., Ohtaka, A., Katakura, H., Kamiya, T., Narita, T., Motomura, H., Ishikawa, T., Mukai, T., Tsukawaki, S., Sophorn, V., Rachna, C. and Vuthy, T.: *Seasonal changes of net-plankton communities in Lake Tonle Sap*

Mukai, T., Motomura, H., Ishikawa, T., Oyagi, H., Araki, Y., Ohtaka, A., Narita, T., Tsukawaki, S., Sotham, S., Sambath, T., Bunnarin, B., Sim, I., Rachna, C. and Powkhy, D.: *DNA Analysis of Fishes in Lake Tonle Sap*

Motomura, H., Mukai, T., Ohtaka, A., Katakura, H., Kamiya, T., Narita, T., Ishikawa, T., Tsukawaki, S., Sotham, S., Sambath, T., Bunnarin, B., Sokhom, N., Rachna, C. and Powkhy D.: *Fishes of Lake Tonle Sap and Tonle Sap River, Cambodia*

Furuuchi, M., Murase, T., Tsukawaki, S., Sotham, S. and Yamashita, M.: *Air Pollution in Phnom Penh: Concentration and Chemical Compositions of Ambient Particles*

Furuuchi, M., Murase, T., Yamashita, M., Tsukawaki, S., Sotham, S., Jinno, T. and Sakai, K.: *Ambient Air Temperature Distribution in Phnom Penh: Influences of Land Use and Mekong and Tonle Sap Rivers*



Photo 4: 3-minute explanation of poster presentation by Takahiko Mukai of EMSB-u32 Team.

(2) DAY 2: December 2, 2005

Field Excursion to Southwest Coast of Cambodia

- 07:30 Departure at MIME
- 07:45 Departure at Diamond Hotel

- 09:30 Break
- 11:00 Visit Southwest Coast of Cambodia at Sihanuk Ville (Photo 5)
- 12:00 Lunch
- 13:00 Visit a Quarry (Photo 6)
- 14:00 Visit Mangrove (Photo 7)
- 15:00 Leave to Phnom Penh
- 16:30 Break
- 18:00 Arrival at Diamond Hotel
- 18:15 Arrival at MIME



Photo 5: Rocky beach of the Southwestern coast of Cambodia.

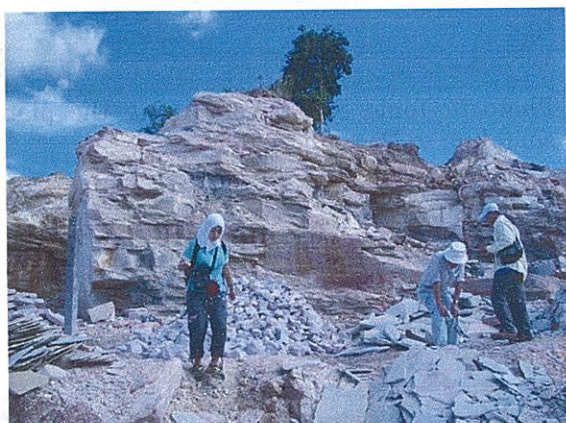


Photo 6: Strata of Cretaceous sandstone in Kompong Som Province, Southwest Cambodia.



Photo 7: Mangrove forest in Kompong Som Province, Southwest Cambodia.

4. Daily Record and Activities of EMSB-u32 Members

As mentioned above, all Japanese u32 members attended and presented their research results on the symposium. Two Cambodians, I. Sim of General Department of Mineral Resources and S. I. Monichoth of Department of Hydrology and Riverworks also attended the symposium. After the symposium, in spite of T. Mukai had to go back to Japan immediately, T. Ishikawa and Y. Oyagi carried out an optional research in the southern part of Lake Tonle Sap off Chhnok Tru with a support of Sim. Y. Araki attended other international conference with Tsukawaki. Then, Ishikawa, Oyagi, Araki and Tsukawaki carried out an optional research in the northern part of the lake off Siem Reap with the EMSB members. The daily records and research activities of all Japanese members are followings:

Toshiyuki ISHIKAWA (Zoology Group: plankton)

27th Nov. (Sun): Transfer from Sapporo to Nagoya. Stay in Nagoya.

28th Nov. (Mon.): Transfer from Nagoya to Phnom Penh via Bangkok. Stay in Phnom Penh.

29th Nov. (Tue.): Arrangements for the symposium in Phnom Penh. Stay in Phnom Penh.

30th Nov. (Wed.): Arrangements for the symposium in Phnom Penh. Stay in Phnom Penh.

1st Dec. (Thu.): Attending the symposium. Stay in Phnom Penh.

2nd Dec. (Fri.): Transfer from Phnom Penh to Kompong Chhnang with Oyagi and Sim. Zoological survey in the middle reach of the Tonle Sap River (Photo 8). Stay in Kompong Chhnang.

3rd Dec. (Sat.): Transfer from Kompong Chhnang to Chhnok Tru in the southern marginal part of Lake Tonle Sap with Oyagi and Sim. Water, fish and plankton samplings in the southern part of the lake. Return to and stay in Kompong Chhnang.

4th Dec. (Sun.): Transfer from Kompong Chhnang to Chhnok Tru in the southern marginal part of Lake Tonle Sap with Oyagi and Sim. Water, fish and plankton samplings in the southern part of the lake. Return to and stay in Kompong Chhnang.

5th Dec. (Mon.): Transfer from Kompong Chhnang to Phnom Penh. Sample sort out in the hotel. Stay in Phnom Penh.

6th Dec. (Tue.): Sample sort out in the hotel. Stay in Phnom Penh.

7th Dec. (Wed.): Transfer from Phnom Penh to Siem Reap by a coach with Oyagi. Stay in Siem Reap.

8th Dec. (Thu.): Transfer from Siem Reap to Chongkneas in the northern marginal part of Lake Tonle Sap with Oyagi. Water and plankton samplings in the northern part of the lake. Return to and stay in Siem Reap.

9th Dec. (Fri.): Transfer from Siem Reap to Chongkneas (Photo 9) in the northern marginal part of Lake Tonle Sap with Oyagi. Water and plankton samplings in the northern part of the lake. Return to and stay in Siem Reap.

10th Dec. (Sat.): Transfer from Siem Reap to Chongkneas in the northern marginal part of Lake Tonle Sap with Oyagi. Water and plankton samplings in the northern part of the lake. Return to and stay in Siem Reap.

11th Dec. (Sun.): Transfer from Siem Reap to Chongkneas in the northern marginal part

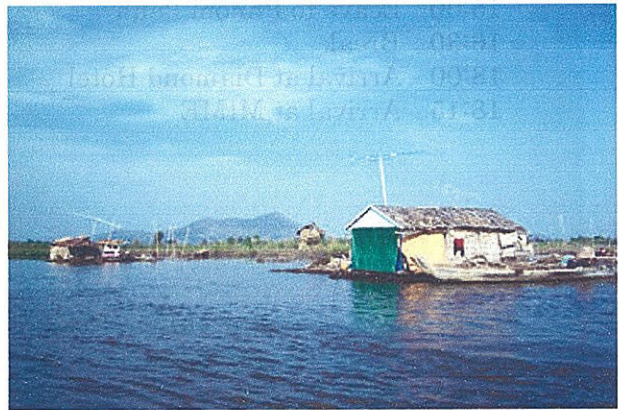


Photo 8: Tonle Sap River during the plankton sampling in December 2005.

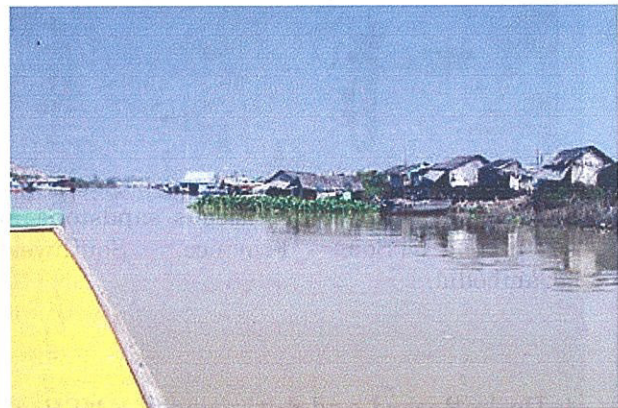


Photo 9: Floating village of Chongkneas in the northern marginal part of Lake Tonle Sap off Siem Reap during the research in December 2005.

- of Lake Tonle Sap with Oyagi. Water and plankton samplings in the northern part of the lake. Return to and stay in Siem Reap.
- 12th Dec (Mon.): Transfer from Siem Reap to Phnom Penh by a coach. Sample treatments in the hotel. Stay in Phnom Penh.
- 13th Dec. (Tue.): Presentation at the Office of the Council of Ministers in Phnom Penh with Tsukawaki and Oyagi. Stay in Phnom Penh.
- 14th Dec. (Wed.): Sample treatments in the hotel. Stay in Phnom Penh.
- 15th Dec. (Thu.): Sample treatments in the hotel. Transfer from Phnom Penh to Nagoya via Bangkok. Stay in the aeroplane.
- 16th Dec. (Fri.): Transfer from Nagoya to Sapporo.

Takahiko MUKAI (Zoology Group: fish)

- 29th Nov. (Mon.): Transfer from Gifu to Phnom Penh via Nagoya and Bangkok. Stay in Phnom Penh.
- 30th Nov. (Wed.): Arrangements for the symposium in Phnom Penh. Stay in Phnom Penh.
- 1st Dec. (Thu.): Attending the symposium. Stay in Phnom Penh.
- 2nd Dec. (Fri.): Fish samplings in the markets in Phnom Penh. Transfer from Phnom Penh to Nagoya via Bangkok. Stay in the aeroplane.
- 3rd Dec. (Sat.): Transfer from Nagoya to Gifu.

Yuji ARAKI (Plant Ecology Group)

- 28th Nov. (Mon.): Transfer from Yokohama to Phnom Penh via Narita and Bangkok. Stay in Phnom Penh.
- 29th Nov. (Tue.): Arrangements for the symposium in Phnom Penh. Stay in Phnom Penh.
- 30th Nov. (Wed.): Arrangements for the symposium in Phnom Penh. Stay in Phnom Penh.
- 1st Dec. (Thu.): Attending the symposium. Stay in Phnom Penh.
- 2nd Dec. (Fri.): Attending the one-day post symposium excursion to the southwestern coast of Cambodia. Stay in Phnom Penh.
- 3rd Dec. (Sat.): Sample sort out in the hotel. Stay in Phnom Penh.
- 4th Dec. (Sun.): Sample sort out and arrangements for an international conference in the hotel. Stay in Phnom Penh
- 5th Dec. (Mon.): Attend the international conference on “Forest Environment in Continental River Basins: with a Focus on the Mekong River” in Phnom Penh with Tsukawaki. Stay in Phnom Penh.
- 6th Dec. (Tue.): Attend the international conference on “Forest Environment in Continental River Basins: with a Focus on the Mekong River” in Phnom Penh with Tsukawaki. Stay in Phnom Penh.
- 7th Dec. (Wed.): Presentation in the international conference on “Forest Environment in Continental River Basins: with a

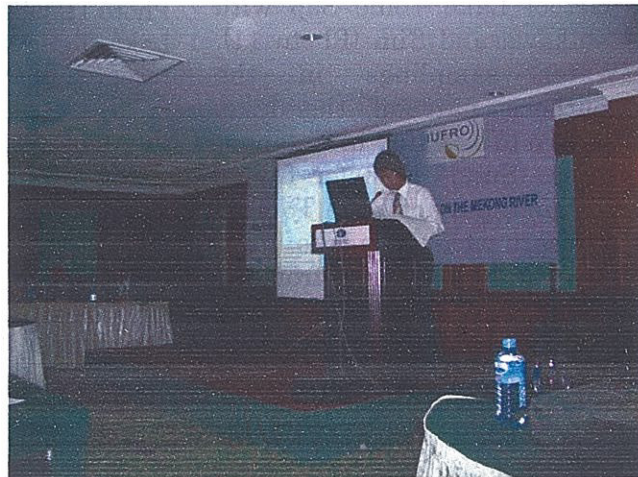


Photo 10: Oral presentation of Y. Araki at an international conference in Phnom Penh on the result of his research in Lake Tonle Sap.

- Focus on the Mekong River” in Phnom Penh (Photo 10). Stay in Phnom Penh.
- 8th Dec. (Thu.): Attend the post conference excursion of the international conference. Stay in Kompong Thom.
- 9th Dec. (Fri.): Attend the post conference excursion of the international conference. Stay in Siem Reap.
- 10th Dec. (Sat.): Attend the post conference excursion of the international conference. Stay in Siem Reap.
- 11th Dec. (Sun.): Sample sort out in the hotel. Stay in Siem Reap.
- 12th Dec. (Mon.): Sample sort out in the hotel. Transfer from Siem Reap to Narita via Bangkok. Stay in the aeroplane.
- 13th Dec. (Tue.): Transfer from Narita to Yokohama via Tokyo.

Hideo OYAGI (Hydrology Group)

- 27th Nov. (Sun.): Transfer from Kawasaki to Bangkok via Narita. Stay in Bangkok.
- 28th Nov. (Mon.): Investigation of documentary records in the Asian Institute of Technology in Bangkok. Stay in Bangkok.
- 29th Nov. (Tue.): Investigation of documentary records in the Asian Institute of Technology in Bangkok. Transfer from Bangkok to Phnom Penh. Stay in Phnom Penh.
- 30th Nov. (Wed.): Arrangements for the symposium in Phnom Penh. Stay in Phnom Penh.
- 1st Dec. (Thu.): Attending the symposium. Stay in Phnom Penh.
- 2nd Dec. (Fri.): Transfer from Phnom Penh to Kompong Chhnang with Ishikawa and Sim. Water samplings in the middle reach of the Tonle Sap River. Stay in Kompong Chhnang.
- 3rd Dec. (Sat.): Transfer from Kompong Chhnang to Chhnok Tru in the southern marginal part of Lake Tonle Sap with Ishikawa and Sim (Photo 11). Water samplings in the southern part of the lake. Return to and stay in Kompong Chhnang.
- 4th Dec. (Sun.): Transfer from Kompong Chhnang to Chhnok Tru in the southern marginal part of Lake Tonle Sap with Ishikawa and Sim. Water samplings in the southern part of the lake. Return to and stay in Kompong Chhnang.
- 5th Dec. (Mon.): Transfer from Kompong Chhnang to Phnom Penh. Sample treatments in the hotel. Stay in Phnom Penh.
- 6th Dec. (Tue.): Sample treatments in the hotel. Stay in Phnom Penh.
- 7th Dec. (Wed.): Transfer from Phnom Penh to Siem Reap by a coach with Ishikawa. Stay in Siem Reap.
- 8th Dec. (Thu.): Transfer from Siem Reap to Chongkneas in the northern marginal part of Lake Tonle Sap with Ishikawa. Water and plankton samplings in the northern part of the lake. Return to and stay in Siem Reap.
- 9th Dec. (Fri.): Transfer from Siem Reap to Chongkneas in the northern marginal part of Lake Tonle Sap with Ishikawa. Water and plankton samplings in the northern part



Photo 11: Observatory tower in the southern part of Lake Tonle Sap off Chhnok Tru at the time of research in December 2005.

of the lake. Return to and stay in Siem Reap.

10th Dec. (Sat.): Transfer from Siem Reap to Chongkneas in the northern marginal part of Lake Tonle Sap with Ishikawa (Photo 12). Water and plankton samplings in the northern part of the lake. Return to and stay in Siem Reap.

11th Dec. (Sun.): Transfer from Siem Reap to Chongkneas in the northern marginal part of Lake Tonle Sap with Ishikawa. Water and plankton samplings in the northern part of the lake. Return to and stay in Siem Reap.

12th Dec (Mon.): Transfer from Siem Reap to Phnom Penh by a coach. Sample treatments in the hotel. Stay in Phnom Penh.

13th Dec. (Tue.): Presentation at the Office of the Council of Ministers in Phnom Penh with Tsukawaki and Ishikawa. Transfer from Phnom Penh to Narita via Bangkok. Stay in the aeroplane.

14th Dec. (Wed.): Transfer from Narita to Kawasaki via Tokyo.



Photo 12: Northern part of Lake Tonle Sap during the research in December 2005.



Photo 13: Preliminary research on the present condition of the northern part of Lake Tonle Sap off Siem Reap in November 2005.

Shinji TSUKAWAKI (Head of the Team, Geology Group)

25th Nov. (Fri.): Transfer from Kanazawa to Osaka. Stay in Osaka.

26th Nov. (Sat.): Transfer from Osaka to Kansai, then Kansai to Siem Reap via Bangkok. Stay in Siem Reap.

27th Nov. (Sun.): Preliminary survey in the northern part of Lake Tonle Sap off Siem Reap (Photo 13). Stay in Siem Reap.

28th Nov. (Mon.): Transfer from Siem Reap to Phnom Penh by a coach. Stay in Phnom Penh.

29th Nov. (Tue.): Arrangements for the symposium in Phnom Penh. Stay in Phnom Penh.

30th Nov. (Wed.): Arrangements for the symposium in Phnom Penh. Stay in

Phnom Penh.

1st Dec. (Thu.): Attending the symposium. Stay in Phnom Penh.

2nd Dec. (Fri.): Attending the one-day post symposium excursion to the southwestern coast of Cambodia. Stay in Phnom Penh.

3rd Dec. (Sat.): Meetings for future research programmes at General Department of Mineral Resources, National Institute of Education in Phnom Penh. Stay in Phnom Penh.

4th Dec. (Sun.): Transfer from Phnom Penh to Siem Reap with the Hydrology and Zoology Groups of the EMSB team, and arrangements for their research in Siem Reap. Return and stay in Phnom Penh

5th Dec. (Mon.): Attend the international conference on "Forest Environment in Continental River Basins: with a Focus on the Mekong River" in Phnom Penh with Araki. Stay in Phnom Penh.

6th Dec. (Tue.): Attend the international conference on "Forest Environment in Continental River Basins: with a Focus on the Mekong River" in Phnom Penh with Araki. Stay in Phnom Penh.

7th Dec. (Wed.): Presentation in the international conference on "Forest Environment in Continental River Basins: with a Focus on the Mekong River" in Phnom Penh with Araki. Stay in Phnom Penh.

8th Dec. (Thu.): Transfer from Phnom Penh to Siem Reap. Preliminary research on the water of the northern part of Lake Tonle Sap. Stay in Siem Reap.

9th Dec. (Fri.): Meetings for future research programmes at the office of APSARA authority in Siem Reap. Stay in Siem Reap.

10th Dec. (Sat.): Lead the post conference excursion of the international conference with Araki. Stay in Siem Reap.

11th Dec. (Sun.): Meetings in the office of APSARA authority. Transfer from Siem Reap to Phnom Penh. Stay in Phnom Penh.

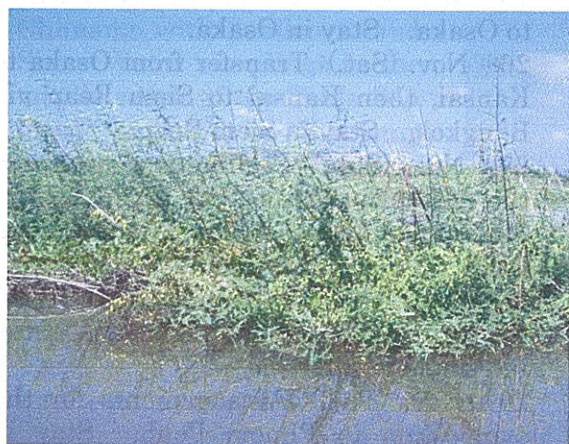


Photo 15: Leading the field excursion of International Conference of Forest Environment to the northern flooded forest area of Lake Tonle Sap with Araki.



Photo 14: Recovery of water pressure meter by EMSB team from the northern part of Lake Tonle Sap off Siem Reap on the 4th of December 2005

12th Dec (Mon.): Meetings in the offices of General Department of Mineral Resources, National Institute of Education and the Council of Ministers in Phnom Penh. Stay in Phnom Penh.

13th Dec. (Tue.): Presentation at the Office of the Council of Ministers in Phnom Penh with Ishikawa and Oyagi. Stay in Phnom Penh.

14th Dec. (Wed.): Transfer from Phnom Penh to Bangkok. Meeting in the office of CCOP in Bangkok. Stay in Bangkok.

15th Dec. (Thu.): Transfer from Bangkok to Kanazawa via Kansai.

Prepared by Dr. Shinji Tsukawaki
Date 25/12/2005