INDAWGYI KAN (LAKE)

Ayeyarwaddy River Basin
Mogaung Chaung Sub Basin

Dates of Assessment: 21 - 24 January 2003
Method of Assessment: Boat surveys
Names of Assessors: Simba Chan, Jon Davies, U Thein Aung, U Khin Maung Hla, U Sein Htun, James Green, Joost van der Ven

GEOGRAPHICAL AND PHYSICAL INFORMATION

Location: The lake is c.180 km WSW of Myitkyina, the main town of Kachin State. It is accessible by road from Myitkyina, passing through Mogaung, then up the Namyin Chaung valley to Hopin, the closest major town to the lake. The lake is c.25 km NW of Hopin via a pass in the ridge which forms the eastern boundary of the catchment area.

Coordinates: N 25 deg 02.718'; E 96 deg 18.791'
Indawgyi Chaung: N 25 deg 13.955; E 96 deg 23.034'
Centroid: N 25 deg 08.918; E 96 deg 20.301

Administrative Region: Kachin State
Nearest Town/City: Hopin
Climate: Average annual rainfall at Myitkyina 1961-1990: 2,196 mm.
There is a dry season from November to including April. The driest months are December and January whilst the wettest months are June, July and August. Days are usually sunny during the dry season, whilst mist is common in the lake basin in the morning in the cool season, which depresses temperatures somewhat.

Altitude: c.175 m ASL
Area: 12,000 ha.

Lake Origin & Morphometry: The maximum north-south length is 23.8 km, from south to Nyaungbin in the north. Maximum width is c.10 km. The lake basin is slightly asymmetrical, with greater depths and steeper sides to the east. Figure A shows the location of transects for depth profiling and gathering of water quality data on the January 2003 survey. Figure B shows two depth profiles taken across the lake. The depth along the long axis of the lake varies between 15.88 to 22.19 m.

Seasonal Changes in Area and Volume: During the wet season, the lake probably expands appreciably to flood the low-lying areas surrounding the lake basin.

Major Inflows: As the map shows there are many inflows to the lake from the surrounding ridges. The major ones in terms of volume are:
Nanyinkha Chaung which flows into the southwest area of the lake and which has formed an extensive delta of marsh and floating vegetation;
Namsanda Chaung in the northwest south of Nyaungbin; and Nammu Chuang from the southeast. Other inflows are: Namtaungsal Chaung, Nammelaung Chaung, Nammale Chaung, Khagyi Chaung and Namtame Chaung.

Outflow: At northeast end of lake: Indawgyi Chaung, which flows for c.50 km northeast into Moguang Chaung.

Area of Catchment: c.82,500ha

Geology/Geomorphology: The lake lies in a N-S elongated basin with flat plains immediately surrounding the lake composed of alluvium brought down by rivers and streams draining the surrounding ridges.

Topography: The slopes are generally flat surrounding the lake, but these are surrounding by ridges. The ridge is uniform running along the eastern side of the lake, rising to 1,175 m ASL. The hills to the west and south are more extensive and irregular and rise to 1,180 m ASL in the west and 1,500 m ASL in the south.

Water Quality: The information belo w summarises the physico-chemical readings taken during the survey of 21-24 January 2003. The complete data are given below in the tables at the end of the data sheet.

Mean open water temperature at surface: 21.63 deg. C (n = 16)
Mean open water temperature at 1m depth: 20.4 deg. C (n = 10)
Mean open water temperature at 2m depth: 20.0 deg. C (n = 8)

Mean water temperature above macrophyte beds at surface: 20.85 deg. C (n = 7)
Mean water temperature above macrophyte beds at 1 m depth: 20.5 deg. C (n = 4)
Mean open water pH: 7.5 (n=17)
Mean pH over macrophyte beds: 7.65 (n=6)
Mean open water Dissolved Oxygen concentration at surface (mg/l): 4.82 mg/l (n=15)
Mean open water percentage saturation of Dissolved Oxygen at surface: 50.35% (n=15)
Mean open water Dissolved Oxygen concentration at I m depth: 4.71 mg/l (n = 15)
at 2m depth: 4.68 mg/l (n = 15)
at 3m depth: 4.66 mg/l (n = 15)

Mean Dissolved Oxygen concentration over macrophyte beds at surface: 6.79 mg/l (n = 7)
at 1 m depth: 6.83 mg/l (n = 3)
at 2 m depth: 8.86 mg/l (n = 3)
at 3 m depth: 9.5 mg/l (n = 2)

Mean transparency: 3.45 m (n=13)

Conductivity: uniform at 110 uS/cm, except one reading at 130 uS/cm over a macrophyte bed (n = 23)

Locals say that fish kills occur in certain parts of the lake during the cool season. This indicates that the lake may be stratified during the warmer months of the year with an anoxic hypolimnion, but that overturn may occur at the onset of cooler weather, bringing the anoxic water into the surface layers. This is borne out by Maung Khin (1948), who reported the issuance of "dead fish licences", which were issued along Indawgyi Chaung for collecting dead or stunned fish floating down the river from the lake.

BIOLOGICAL INFORMATION

Flora And Habitats: Lake habitats include: Open water, herbaceous marsh, floating mats, limited emergent beds and extensive areas of submerged macrophytes.

Due to the relatively high transparency of the water (c. 3.5 m), there are extensive beds of submerged and floating leaved macrophytes. In addition, there are extensive areas of herbaceous marsh grading into floating mats in certain parts, especially at the north end between Nyaungbin and the Indawgyi

Chaung outflow, at the southern end and around the major Nanyinkha Chaung inflow. The floating mats are dominated by *Salvinia*, *Eichhornia*, *Polygonum* and grasses. Beds of emergents are relatively few. The submerged macrophytes are dominated by *Vallisneria*, with *Ceratophyllum* common. Around the drying margins of the lake, a species of *Barringtonia* is common which presumably gets inundated in the wet season.

Macrophytes recorded are:
Amphibious: *Polygonum* spp.
Emergent: one Cyperaceae species dominant
Floating: *Eichhornia crassipes*, *Salvinia* sp., *Pistia stratiotes*, *Azolla* sp.
Floating leaved: *Trapa* sp., *Nymphoides* sp.
Submerged: *Vallisneria* sp., *Ceratophyllum* sp., *Potamogeton crispus*

Plankton:
Phytoplankton: Complex, with colonies of *Microcystis* visible in some places, and the extremely elongated desmid *Closterium aciculare* as a major component. Other desmids include *Staurastrum pingue* and *S. leptocladum*. *Ceratium* and *Merismopedia* are present in small amounts.

Zooplankton: Abundant, with two species of diaptomids, *Eodiaptomus* sp. and *Heliodiaptomus elegans*, and two main cyclopoids : *Thermocyclops crassus* and *Mesocyclops thermocyclopoides*. Six planktonic species of Cladocera, including *Daphnia lumholtzi* and two species of *Diaphanosoma*. Over sixty species of rotifers found, not all of which are planktonic.

Fauna:

***Avifauna*:**
Waterbirds: Spot-billed Pelican, Great Cormorant, Grey Heron, Great Egret, Intermediate Egret, Little Egret, Cattle Egret, pond heron species in winter plumage, Little Heron, Woolly-necked Stork, Lesser Adjutant Stork, Asian Openbill Stork, Greylag Goose, Bar-headed Goose, Lesser Whistling Duck, Ruddy Shelduck, Cotton Pygmy Goose, Mallard, Gadwall, Falcated Duck, Eurasian Wigeon, Northern Shoveler, Northern Pintail, Red-crested Pochard, Common Pochard, Ferruginous Pochard, Tufted Duck, Eurasian Crane, White-breasted Waterhen, Purple Swamphen, Moorhen, Coot, Bronze-winged Jacana, Pheasant-tailed Jacana, Little Ringed Plover, Grey-headed Lapwing, Red-wattled Lapwing, Bar-tailed Godwit, Wood Sandpiper, Common Sandpiper, Black-winged Stilt, Black-headed Gull, Brown-headed Gull, Black-bellied Tern. Total count of 13,550 birds of 59 species on 22 January 2003.

One of the most important sites for Spot-billed Pelican (47 birds), Oriental Darter (71 birds), Great Cormorant (262 birds), Little Cormorant (609 birds),

Purple Heron (78 birds), Lesser Adjutant (17 birds), Greylag Goose (406), Bar-headed Goose (164 birds), Lesser Whistling Duck (3,505 birds), Gadwall (468 birds), Common Pochard (720 birds), Ferruginous Pochard (809 birds), Tufted Duck (1,626 birds), Purple Swamphen (1,212 birds), Black-headed Gull (242 birds) and Brown-headed Gull (647 birds). Sarus Crane is reported to be regularly present, although not recorded on this survey. 8 birds in marshes surrounding the lake on 3/12/01 (van der Ven, 2001) and about 20 Sarus Cranes were reported to occur at Nyaung Pin on the western shore of the lake in late January 2003. However, the survey team failed to find the cranes because of recent agricultural activities at the site. Single individual of Black-necked Grebe on 2/12/01 is a new record for the country (van der Ven, 2001). A few Falcated Ducks appear to be regularly found at the lake.

Other Birds: Osprey, White-backed Vulture, Greater Spotted Eagle, Steppe Eagle, Grey-headed Fish Eagle, Black Kite, Brahminy Kite, Shikra, Oriental Honey Buzzard, Crested Serpent Eagle, Pied Harrier, Western Marsh Harrier, Collared Falconet, Blue-throated Barbet, Coppersmith Barbet, Oriental Pied Hornbill, Indian Roller, Common Kingfisher, Stork-billed Kingfisher, White-throated Kingfisher, Pied Kingfisher.

***Fishes*:** In the most extensive survey of the fishes to date, Prashad & Mukerji (1929) recorded 43 species of fish from the lake alone, excluding inflows. They considered that three of these species, *Barbus sewelli* (redescribed as *Puntius orphoides*), *Barbus myitkyinae* (redescribed as *Hypsibarbus myitkyinae* (Rainboth 1994)) and *Indostomus paradoxus* were endemic to the lake. However, all three of these species have now been found in other localities.
A total of 64 species were found in the Indawgyi Lake basin when inflowing streams and marshy areas are included. The only endemic species found in the lake (after further surveys and taxonomy changes) was the catfish *Akysis prashadi*. However, there are several endemics that Prashad & Mukerji recorded from the pools and streams in the Indawgyi Lake basin: *Gudusia variegata* (Clupiedae) which is mainly found in rivers in Myanmar, *Esomus altus* (Cyprinidae) and *Salmostoma sladoni* (Cyprinidae).

During the present survey, fishermen's catches at Hepu contained many Gudusia variegata which they say were caught in the lake.

During the 2003 wetland survey fishes were collected by fishermen and specimens were preserved and deposited in the Zoology Department of the University of Yangon to await identification to species. The following species were observed and confirmed on site from the lake during the 2003 survey:
Wallago attu, Labeo rohita, *Notopterus notopterus*, *Xenentodon cancila*, *Rasbora*

daniconius, *Tetraodon cutcutia*, *Channa striata*, *Channa marulia*, *Gudusia variegata.*

The following genera were observed, but have not been identified to species thus far: *Rasbora* sp., *Osteobrama* spp., *Puntius* spp. (2), *Aorichthys* sp., *Mastacembelus* sp., *Ompok* sp.

In addition, there are 7 species of Cyprinids yet to be identified and 2 species of Ambassidae. (25 species). *Indostomus paradoxus*, which was collected from the northwest parts of the lake by Prashad and Mukerji, was not present in catches during this survey, even though fine mesh baskets were used to trawl the macrophyte beds in the littoral zone. Fishermen said that it was not present in the lake. At Chaungwa, on the Indawgyi Chaung outflow, fishermen said it was present in certain parts of the Chaung and that it was being collected for the aquarium trade.

***Mammals*:** nd

Flora & Fauna Special Values:

***Bird Species of Global Conservation Concern*:** Spot-billed Pelican (VU), Oriental Darter (NT), Black-necked Stork (NT), Lesser Adjutant Stork (VU), Ferruginous Pochard (NT), Sarus Crane (VU), White-backed Vulture (CR), Greater Spotted Eagle (VU), Grey-headed Fish Eagle (NT), Lesser Fish Eagle (NT)Black-bellied Tern (NT).

The sanctuary protects populations of Asian Elephant *Elephas maximus*, Tiger *Panthera tigris*, Leopard *Panthera pardus*, Sambar Deer *Cervus unicolor*, Bear *Ursus* sp., Serow *Capricornis sumatrensis* and Gaur *Bos gaurus* (Thein Aung & Thet Htun, 2001).

There is a rich and abundant aquatic macrophyte flora which is vital for the maintenance of biodiversity of the lake and for fish spawning, nursery and feeding areas.

The total number of waterbird population in winter is likely to exceed 20,000 birds - the threshold set by the Ramsar Convention. Indawgyi Lake also supported at least 1% of the regional population of the following waterbird species: Ferruginous Pochard, Spot-billed Pelican, Oriental Darter, and Graylag Goose.

The fish fauna is diverse apparently without any introductions of alien species thus far. One Myanmar endemic, *Gudusia variegata* was recorded from the lake in this survey.

CULTURAL, HISTORICAL & SPIRITUAL VALUES

Shwe Myint Zu Pagoda is situated on the west side of the connected, connected to the shore by a boardwalk

DIRECT USES OF THE LAKE

Fishing: is one of the most important economic activates of the people who live around the lake. Fishing is carried out mainly with small non-motorised boats using gill nets with a variety of mesh sizes. Nets are set mainly between 1500-1700 and collected at midnight. In some cases, nets are set at 1600, collected at 2000, and then set again at 0400 and collected at 0800 (i.e., some are set twice nightly). There is little fishing activity during the day. They are mainly set in shallow portions of the lake. Baskets are used to catch smaller fishes such as *Rasbora daniconius* and *Puntius* spp. in the weedy margins.

Fishing pressure seems to be fairly low at present, with the use of non-motorised boats. Very large individuals of *Wallago attu* and *Labeo rohita* are commonly caught. *Wallago attu*, *Labeo rohita*, *Notopterus notopterus* are the species most commonly caught.

Many fish caught in gill nets are in bad condition (other than being dead) due to the puffer fish *Tetraodon cutcutia*, which eats the eyes and fins of fish caught in nets. This decreases their market price.

DESCRIPTION OF THE CATCHMENT

Original Vegetation Cover: Moist broadleaf forest with many teak (*Tectona grandis*) individuals. The seasonally inundated and waterlogged plains surrounding the lake were probably covered by herbaceous marsh and scrub swamp and swamp forest/woodland.

Land Use/Land Cover: The flat plains surrounding the lake have been mostly converted to rice fields except for the herbaceous marsh which undergoes more prolonged inundation closer to the open water of the lake. The ridges are still mostly forested, although there is appreciable logging of teak around the southern ridges.

PRESENT THREATS TO LAKE

Present threats to the lake seem to be few - there is a relatively low population pressure and fishing pressure, although illegal temporary settlements around the lake and Indawgyi Chaung have to be moved on.
There are no indications of pollution.

PRESENT THREATS TO CATCHMENT

During the 2003 survey, there seems to be substantial extraction of teak from the forests in the highlands at the south end of the lake.

POTENTIAL THREATS

Illegal settlements within the Wildlife Sanctuary, over-exploitation of forests on the steep ridges.

MANAGEMENT

Lake: The lake is managed by the Nature and Wildlife Conservation Division of the Forest Department. It is not clear how much jurisdiction the Fisheries Department has over the fish resources within the Wildlife Sanctuary.

Catchment: The National Wildlife and Conservation Division (NWCD) of the Forest Department manage both the lake and its catchment. The southern and eastern ridges of the catchment are protected under reserved forests: Nanyinkha R.F., Mainnaung R.F., Indawgyi R.F., Nanmun R.F. and Mokso R.F.

CONSERVATION MEASURES

Indawgyi Lake, its catchment and Indawgyi Chaung (?) are protected within the Indawgyi Lake Wildlife Sanctuary.

Constraints to Management/Conservation: Lack of budget is a great constraint for monitoring and patrolling the sanctuary. At present, few staff actually stay close to the lake and there is no boat for patrolling. There is an urgent need for capacity building in wetland ecology and management for the sanctuary staff.

RESEARCH AND EDUCATION

There has been little research on the lake to date. Prashad & Mukerji (1929) collected fishes from the lake and other areas in the Mogaung Chaung basin in 1928.

TOURISM

There is little tourism at present due to security considerations and difficulty of access. However, the area has extremely high tourism potential and will probably become one of Myanmar's prime tourist destinations in the future.

REFERENCES AND RESOURCE PERSONS

Sein Htun and staff of the Sanctuary, Thein Aung NWCD,

REFERENCES

Maung Khin (1948) *Fisheries in Burma*. Superintendent of Government Printing and Stationery, Rangoon, Government of the Union of Burma.

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Prashad, B. (1930) *Pelycypoda of the Indawgyi Lake and of its connected freshwater areas in the Myitkyina District, Upper Burma.* Records of the Indian Museum XXXII 247-255.

U Thein Aung and U Thet Htun (2001) *Migratory Waterbirds and Wetland Habitats in Myanmar.* Nature and Wildlife Conservation Division, Forest Department, Myanmar.

van der Ven, J. (2001) Myanmar Expedition 2001 Report.

SUMMARY OF VALUES

- Four endemic species of fish found in the lake basin
- 7 Threatened bird species of global conservation concern found during the 2003 survey
- 4 waterbird species meet the 1% regional population threshold.
- A relatively undisturbed lake ecosystem with no exotic fish introductions

Figure A: Indawgyi Lake showing transects along which depth and other physico-chemical readings were taken 21-24 January 2003

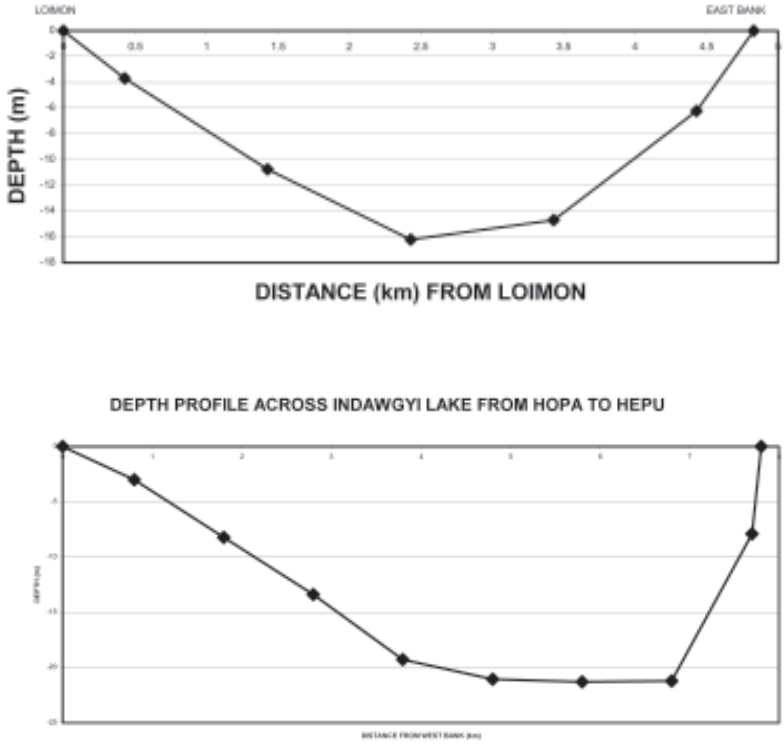

Figure B: Depth profiles across Indawgyi Lake; 22 and 23 January 2003

INDAWGYI LAKE 21 JANUARY 2003
TRANSECT ACROSS LAKE FROM HEPU TO HOPA (EAST TO WEST)
TOTAL DISTANCE = 7.08 km

	HOPA (W BANk)	STA 8	STA 7	STA 6	STA 5	STA 4	STA 3	STA 2	STA 1	HEPU (EAST BANK) WATER'S EDGE
DISTANCE FROM WEST BANK (KM)	0	0.7	1.8	2.8	3.8	4.8	5.8	6.8	7.07	7.08
COORDINATES N	25 deg 6.789'	25 deg 06.757'	25 deg 06.880'	25 deg 06.790'	25 deg 06.702'	25 deg 06.619'	25 deg 06.614'	25 deg 06.625'	25 deg 06.552'	25deg 06.517'
Deg min.min E	96 deg 17.158'	96 deg 17.546'	96 deg 18.041'	96 deg 18.696'	96 deg 19.293'	96 deg 19.869'	96 deg 20.473'	96 deg 21.057'	96 deg 21.660'	96 deg 21.730'
TIME	0945	1450	1430	1400	1330	1300	1230	1200	1130	1100
DEPTH (m)	1.5	2.99	8.2	13.4	19.28	21.05	21.3	21.2	7.9	0.5
TRANSPARENCY (m)	nd	Bottom	3.1	3.1	3.25	3.5	3.5	4.0	4.0	Nd
DISSOLVED OXYGEN (mg/l) PERCENTAGE SATURATION IS GIVEN IN PARENTHESES SURFACE	7.4 (80.4%) (over weed bed)	6.5 (73.9%)	5.1 (58.6%)	4.7 (54.0%)	4.8 (54.5%)	5.0 (56.8%)	4.3 (48.9%)	4.6 (51.1%)	nd	6.4 (71.1%) (In Vallisneria bed)
1 m depth		7.1 (80.7%)	5.9	4.5 (50.0%)	4.2	4.5	4.0	4.3		nd
2 m		10.1 (109.8%)	5.9	4.6	3.9	4.4	3.9	4.3		nd
3 m		nd	5.7	4.7	3.9	4.5	3.5	4.2		nd

	HOPA (W BANk)	STA 8	STA 7	STA 6	STA 5	STA 4	STA 3	STA 2	STA 1	HEPU (EAST BANK) WATER'S EDGE
TEMPERATURE deg C: SURFACE	20	22	23	23	22	22	22	21	21	21
1 m depth		21		21						nd
pH	7.6	7.6	7.5	7.4	7.35	7.4	7.4	7.4	7.4	7.6
CONDUCTIVITY (uS/cm)	110	110	110	110	110	110	110	110	110	110

NOTES: DO were readings fairly low over most of lake except for readings at station 8 which was over a macrophyte bed. Much higher DO readings at this point, especially close to the bottom, are probably a result of photosynthetic activity

INDAWGYI LAKE 22 JANUARY 2003
EAST - WEST TRANSECT ACROSS LAKE AT LOIMON
TOTAL LENGTH = 4.83 km

	LOIMON	SA 5	SA 4	SA 3	SA 2	SA 1 BANK	EAST
DISTANCE FROM WEST BANK (KM)	0	0.43	1.43	2.43	3.43	4.43	4.83
COORDINATES N	25 deg 10.924'	25 deg 11.126'	25 deg 11.121'	25 deg 11.112'	25 deg 11.084'	25 deg 10.983'	25 deg 10.970'
E	96 deg 18.736'	96 deg 18.579'	96 deg 19.552'	96 deg 20.111'	96 deg 20.742'	96 deg 21.356'	96 deg 21.611'
TIME	1415	1345	1325	1305	1245	1210	1145
DEPTH (m)		3.7	10.75	16.2	14.7	6.23	1.0
TRANSPARENCY (m)		3.5	3.3	3.5	3.3	3.3	bottom
DISSOLVED OXYGEN (mg/l) PERCENTAGE SATURATION IS GIVEN IN PARENTHESES SURFACE	nd	7.0 (79.5%) (over wee d bed)	5.0 (56.8%)	5.3 (60.2%)	5.0 (56.8%)	5.4 (60.0%)	5.8 (63.0) weed bed
1 m depth		7.9 (87.8%)	5.2 (57.8%)	5.2 (57.8%)	5.0 (55.6%)	5.4 (58.7%)	
2 m		9.2 (100%)	5.1 (55.4%)	5.1 (55.4%)	5.3 (57.6%)	5.5	
3 m		10.9 (>100%)	5.3	5.1	5.4	5.7	
TEMPERATURE deg C: SURFACE		22	22	22	22	21	20
1 m depth		21	21	21	21	20	
2m depth		20	20	20	20		
pH		7.6	7.4	7.5	7.6	7.6	7.6
CONDUCTIVITY (uS/cm)		110	110	110	110	110	130

MISCELLANEOUS PHYSICO-CHEMICAL READINGS FROM INDAWGYI LAKE

DATE	23 JAN	24 JAN	24 JAN	24 JAN	24 JAN	24 JAN	24 JAN
LOCATION	NEAR NAMSANDA CHAUNG INFLOW in sedge bed	SAMPLING POINT A2	SAMPLING POINT A3	SAMPLING POINT A5	SAMPLING POINT B1	SAMPLING POINT B3	SAMPLING POINT C2
COORDINATES N **E**	25 deg 14.166' 96 deg 21.161'	25 deg 05.555' 96 deg 20.194'	25 deg 05.012' 96 deg 20.147'	25 deg 03.914' 96 deg 20.202'	25 deg 04.031' 96 deg 18.902'	25 deg 05.113' 96 deg 18.645'	25 deg 05.601' 96 deg 17.620'
TIME	1020				1150	1208	1240
DEPTH (m)	0.8 - 1.0	19.07	16.83	4.02	10.97	14.38	3.5
TRANSPARENCY (m)	bottom		3.5	Nd			Bottom
DISSOLVED OXYGEN (mg/l) PERCENTAGE SATURATION IS GIVEN IN PARENTHESES SURFACE	7.3 (79.3%)	3.6 (40.0%)	3.9 (34.3%)	5.9 (65.5%)	4.4 (48.9%)	5.3 (58.9%)	7.1 (78.9%) (over *Ceratophyllum* bed)
1 m depth	6.3 (67.0%)	3.6 (39.1%)	3.7 (40.2%)	5.8 (63.0%)	4.3 (46.7%)	5.0 (54.3%)	7.1 (77.2%)
2 m		3.6 (39.1%)	3.6 (39.1%)	5.8 (63.0%)	4.2 (45.7%)	5.0 (54.3%)	7.3
3 m		3.5 (38.0%)	3.5 (38.0%)	5.9 (64.1%)	4.1 (44.6%)	4.9 (53.3%)	8.1
TEMPERATURE deg C: SURFACE	20	21	21	21	21	21	21
1 m depth	19	20	20	20	20	20	21
2m depth		20	20	20	20	20	
pH	7.7	7.4	7.4	7.6	7.5	7.5	7.8
CONDUCTIVITY (uS/cm)	110	110	110	110	110	110	110