

**Limnological parameters in Sôya Coats lakes between the 55th and 56th**

**Japanese Antarctic Research Expeditions in 2014–2015**

**—Long-term monitoring study—**

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## **1. Introduction**

This is a report on the limnological parameters which were continuously recorded by means of mooring data-logger arrays in two Skarvsnes lakes, Oyako Ike, Naga Ike, and a lake in Langhovde, Nurume Ike ([Fig. 1](#)) during the 55th and 56th Japanese Antarctic Research Expedition (JARE) in 2014–2015. This study was a part of NIPR basic research observations entitled “Monitoring of terrestrial ecosystems (AMB06)”, that aimed to record of environmental conditions for terrestrial organisms living on ice-free areas in Syowa Oasis since 2010, under the umbrella of the VIII term of JARE plans. Water temperature, photosynthetically active radiation (PAR), chlorophyll fluorescence and turbidity, and water level in lakes were measured and recorded automatically at intervals of 10, 30 or 60 min. Similar continuous observation of limnological parameters in those lakes and some

shallow lakes in Skarvsnes using mooring arrays have been reported by Kudoh *et al.* (2003), Tanabe *et al.* (2008), Kudoh *et al.* (2009a, b), Tanabe *et al.* (2012a, b), and Kudoh and Tanabe (2015).

## 2. Materials and methods

*Design of the mooring array:* The mooring array consisted of temperature loggers (NWT, Nichiyu Giken Kogyo, or DEFI, JFE Advantech), PAR loggers (ALW-CMP, JFE Advantech), chlorophyll-turbidity loggers (ACLW-CMP, or ACLW2-USB, JFE Advantech), and a water level logger (Hobo U-20, Onset). These were attached at given depths of a rope which was connected to a plastic float and a steel sinker on both sides, as shown in [Fig. 2](#). The array was moored at the lake center where the nearly-maximum depth was detected. Depths at the mooring sites were ca. 8 m, 10 m, and 16 m in Oyako Ike, Naga Ike, and Nurume Ike, respectively. The positions measured by a portable GPS (GPSMAP 62s, Garmin) were 69°28.515'S, 39°36.151'E, 69°29.237'S, 39°35.850'E, and 69°13.390'S, 39°39.544'E, in Oyako Ike, Naga Ike, and Nurume Ike, respectively.

*Setting of the data loggers:* Water temperatures at 5 different depths using DEFI data loggers were recorded every 10 minutes from 11:00 (local time) on 11 January 2014 to 09:00 on 15 January 2015 in Oyako Ike, from 18:00 on 17 January 2014 to 21:00 on 16 January 2015 in Naga Ike. Water temperatures using NWT data loggers at 5 different depths in Nurume Ike were recorded every 30 minutes from 12:00 on 21 January 2014 to 09:00 on 26 January 2015. 10 times-repeats of PAR data, and 5 or 10 times repeats of chlorophyll & turbidity data were recorded at 60 minutes intervals during the same periods of the temperature loggers in the three lakes. And a water level data were recorded at 60 minutes intervals during the similar periods in Oyako Ike and Naga Ike, too. All loggers were pre- and post-calibrated by the manufacturers, who found no significant drifts in the measurements over the course of the study. Units of recorded data were °C and  $\mu\text{mol}/\text{m}^2/\text{s}$  for temperature and PAR, respectively. Fluorescence from chlorophyll *a* was recorded as relative intensity against fluorescein sodium (Uranine) concentration, and turbidity was recorded as Formazin Nephelometric Units (FTU). The unit of water level was meter, which was calibrated using the record of a same sensor on lake shore, and initial water levels at both lakes were adjusted to 0 m.

### 3. Data

Temperature data measured at 5 different depths in Oyako Ike with 10 minutes intervals were summarized and converted to a CSV file ([Oyako\\_WT\\_5depths\\_55-56.csv](#)). 10 times repeated PAR at 1.7 m, chlorophyll *a* and turbidity data at 1.6 m depth in Oyako Ike were averaged every 1 hour interval, and summarized in a CSV file ([Oyako\\_PAR\\_CHL\\_TURB\\_55-56.csv](#)), too. The data recorded from mid-July to early-December by the chlorophyll-turbidity logger had sometimes large noise due to reflection by ice crystal formation around the optical sensors. Water level data with 1 hour intervals in Oyako Ike were converted to a CSV file ([Oyako\\_WL\\_55-56.csv](#)).

Temperature data measured at 5 different depths in Naga Ike with 10 minutes intervals were summarized and converted to a CSV file ([Naga\\_WT\\_5depths\\_55-56.csv](#)). 10 times repeated PAR at 2.2 m and 7.7 m depths, chlorophyll *a* and turbidity data at 2.7 m and 8.4 m depths in Naga Ike were averaged every 1 hour interval, and summarized in a CSV file ([Naga\\_PAR\\_CHL\\_TURB\\_55-56.csv](#)). Water level data with 1 hour intervals in Naga Ike were converted to a CSV file ([Naga\\_WL\\_55-56.csv](#)).

Triplicate temperature data measured at 5 different depths in Nurume Ike with 30 minutes intervals were averaged, summarized and converted to a CSV file ([Nurume\\_WT\\_5depths\\_55-56.csv](#)). 10 times repeated PAR at 6.0 m depth, chlorophyll *a* and turbidity data at 2.9 m and 9.9 m depths in Nurume Ike were averaged every 1 hour interval, and summarized in a CSV file ([Nurume\\_PAR\\_CHL\\_TURB\\_55-56.csv](#)).

List of data files are as follows;

1. Data from Oyako Ike mooring array

[Oyako\\_WT\\_5depths\\_55-56.csv](#)

[Oyako\\_WL\\_55-56.csv](#)

[Oyako\\_PAR\\_CHL\\_TURB\\_55-56.csv](#)

2. Data from Naga Ike mooring array

[Naga\\_WT\\_5depths\\_55-56.csv](#)

[Naga\\_WL\\_55-56.csv](#)

[Naga\\_PAR\\_CHL\\_TURB\\_55-56.csv](#)

3. Data from Nurume Ike mooring array

[Nurume\\_WT\\_5depths\\_55-56.csv](#)

[Nurume\\_PAR\\_CHL\\_TURB\\_55-56.csv](#)

#### **4. Members who carried out the field study**

Installation of the mooring arrays was carried out by Sakae Kudoh, Kunio T. Takahashi, Tomoko Ishihara (the 55th JARE members) and Yusuke Kokubo (the 54th JARE member). And the retrievals and data acquisitions were carried through by Atsushi C. Suzuki, Megumu Tsujimoto and Ryosuke Nakai (the 56th JARE members).

#### **5. Data policy**

Before using the data for publication or presentation in any media, please request permission in writing. Inquiries should be addressed to:

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#### **Acknowledgements**

We thank all the members of JARE-54, JARE-55 and JARE-56 for their great supports and helps. We also wish to thank the officers and crews of the icebreaker *Shirase*.

#### **References**

Kudoh, S. and Tanabe, Y. (2015): Limnological parameters in Skarvsnes lakes between the 51st and 52nd Japanese Antarctic Research Expeditions in 2010–2011—Long-term monitoring study—. JARE data reports, **335**, (Terrestrial biology **10**), 6 p.

- Kudoh, S., Watanabe, K. and Imura, S. (2003): Ecological studies of aquatic moss pillars in Antarctic lakes 2. Temperature and light environment at the moss habitat. *Polar Biosci.* **16**, 23–32.
- Kudoh, S., Kasamatsu, N., Hoshino, T., Han, D.-H., Tanabe, Y. and Kanda, H. (2009a): Limnological parameters in Skarvsnes lakes between the 47th and 48th Japanese Antarctic Research Expedition in 2006–2007 —Long-term monitoring study—. *JARE data reports*, **309**, (Terrestrial biology **4**), 47 p.
- Kudoh, S., Tanabe, Y. and Kanda, H. (2009b): Limnological parameters in Skarvsnes lakes during the 48th and 49th Japanese Antarctic Research Expeditions in 2007–2008 —Long-term monitoring study—. *JARE data reports*, **310**, (Terrestrial biology **5**), 78 p.
- Tanabe, Y., Kudoh, S., Imura, S. and Fukuchi, M. (2008): Phytoplankton blooms under dim and cold conditions in freshwater lakes of East Antarctica. *Polar Biol.*, **31**, 199–208.
- Tanabe, Y., Uchida, M., Osono, T. and Kudoh, S. (2012a): Limnological parameters in Skarvsnes lakes between the 49th and 50th Japanese Antarctic Research Expedition in 2008–2009 —Long-term monitoring study—. *JARE data reports*, **322**, (Terrestrial biology **6**), 49 p.
- Tanabe, Y., Uchida, M., Osono, T. and Kudoh, S. (2012b): Limnological parameters in Skarvsnes lakes between the 50th and 51st Japanese Antarctic Research Expedition in 2009–2010 —Long-term monitoring study—. *JARE data reports*, **323**, (Terrestrial biology **7**), 53 p.

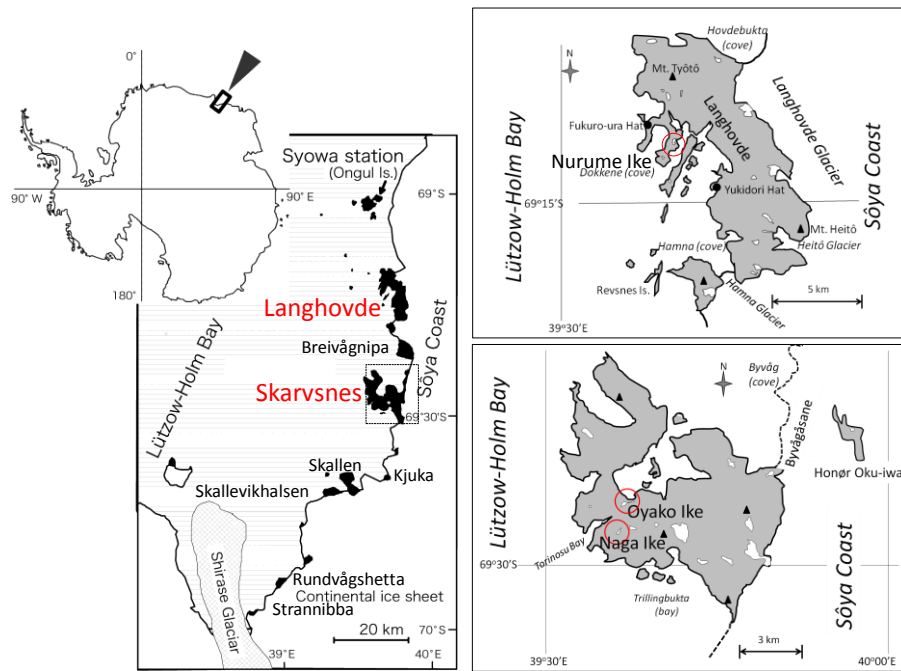


Fig. 1. Maps of ice-free areas in Sôya Coast (left) and studied lakes in Langhovde (right-upper), and Skarvsnes (right-lower).

## Mooring arrays during the JARE-55 and -56

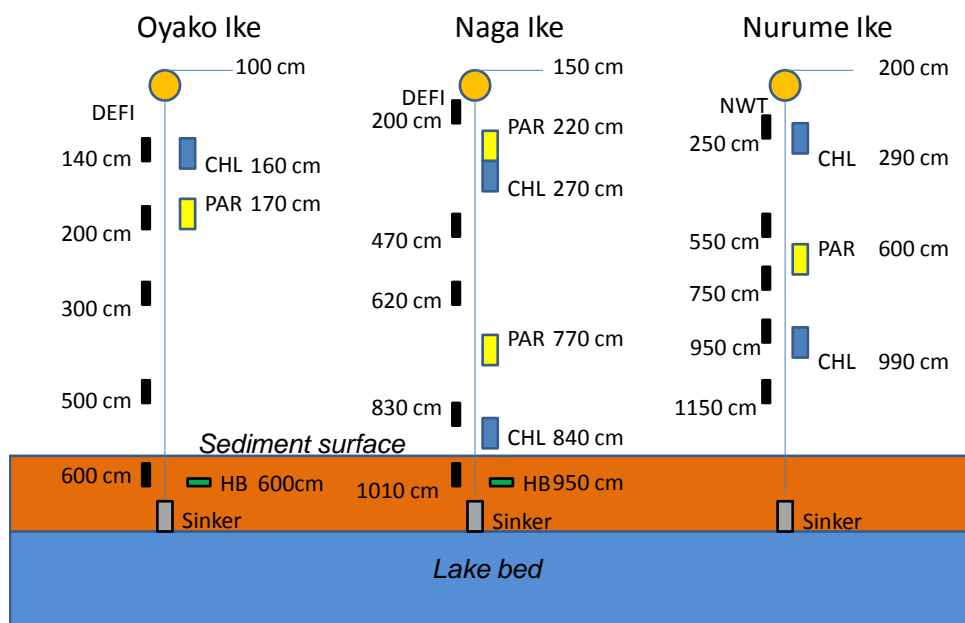


Fig. 2. Designs of mooring arrays set in Oyako Ike (left), Naga Ike (center), and Nurume Ike (right). Orange Circles on the top of each array indicate floats used for mooring. NWT and DEFI: Water temperature logger, CHL: Chlorophyll and turbidity logger, PAR: Photosynthetically active radiation logger, HB: Water level logger. Numbers with unit of cm indicate the position (depth) of each float and sensor.