

# Chapter 4-3

## The Impact of Global Warming on Lake Biwa

### Abstract

Global warming is one of the most serious environmental problems in its temporal and spatial scale. In recent years, dissolved oxygen deficiency has been occurring on the deep lake bottom of Lake Biwa, leading to concerns about the impact on water quality and the ecosystem of the lake. Global warming is believed to be one of the causes of the dissolved oxygen deficiency.

**Keywords:** Global warming, Temperature increase, Dissolved oxygen deficiency

### 1. About Global Warming

Global warming is a phenomenon of average temperatures rising in the atmosphere and seas on the earth's surface in a long term. In the history of the earth, climate has changed from warming regimes to cooling regimes back and forth repeatedly, and this article will concentrate on the "Global Warming from the Second Half of the 20th Century" which has been observed recently and is expected to continue in the future (See Fig. 4-3-1).

### 2. Causes of Global Warming and Problems Caused by the Phenomenon

It is believed that the global warming occurring in the second half of the 20<sup>th</sup> century was caused by artificial greenhouse effect gases emitted in the process of human's industrial activities. It has been pointed out that global warming not only increases atmospheric and water temperatures, but also produces sea level rising, changes in the amount and patterns of rainfall (or snowfall), results in the increase and worsening of severe abnormal weathers, enlarges the scale of phenomena such as flooding, water shortages, extremely hot weather and large typhoons, and presents the possibility of large-scale extinction of biological species. In recent years, Shiga Prefecture has experienced extremely hot weather in summer, warm winters and abnormal water shortages in Lake Biwa.

### 3. Impact of Global Warming on Lake Biwa

A typical example of the impact of global warming on Shiga Prefecture is the change in the annual minimum of average temperature over a period of 118 years (1894-2011) observed by the Hikone Meteorological Observatory (Fig. 4-3-1). As opposed to the trend of an increase in the minimum temperature of 1.3 °C /100 years during the first 71 years of this period (1894-1964), the trend for the next 47 years (1965-2011) showed an increase to 4.3 °C /100 years, clearly indicated an accelerating rise in temperatures. In response to this rising, the lake stratification strength in every October in Lake Biwa calculated using the Schmidt Stability Index is increasing (Fig. 4-3-2). It is believed that these changes in the stratification structure of Lake Biwa and the beginning days of lake water stratification in spring are responsible for the increasing possibilities of dissolved oxygen deficiency on the deep lake bottom of the North Basin. In December 2007, Lake Biwa Environmental Research Institute observed, by an Autonomous Underwater Vehicle, Tantan, that species such as Isaza goby and shrimp had died on a wide scale on the lakebed of the First Lake Basin (North Basin) because of the dissolved oxygen deficiency on the deep lakebed, which indicated with no doubt that this deficiency was directly affecting organisms in the lake.

#### 4. Easing and Adaptation Measures to Global Warming

Easing measures to global warming refer to actions such as the reduction of greenhouse gas emissions, the realization of a recycling society and carbon fixation. On the other hand, the adaptation measures refer to measures for adapting the global warming before the easing measures become effective.

Shiga Prefecture, around Lake Biwa, has proclaimed easing measures of global warming with the goal of achieving a 50% reduction in greenhouse gas emissions in 2030 from levels in 1990 in its “Sustainable Shiga Society Vision” and the “Third Shiga Prefecture Comprehensive Environmental Plan”.

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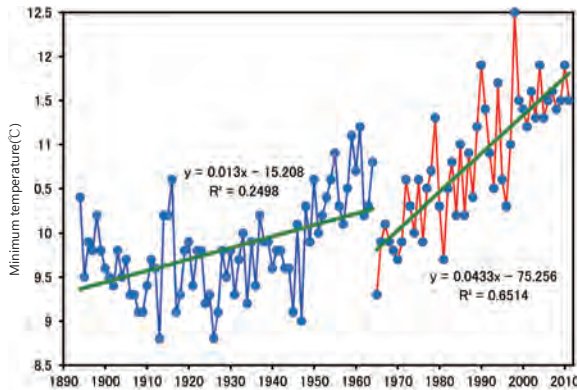


Fig. 4-3-1 Variations in the averaged annual minimum air temperature from 1894 by the Hikone Meteorological Observatory  
(Source: Meteorological Agency, <http://www.data.jma.go.jp/obd/stats/etrn/index.php>)

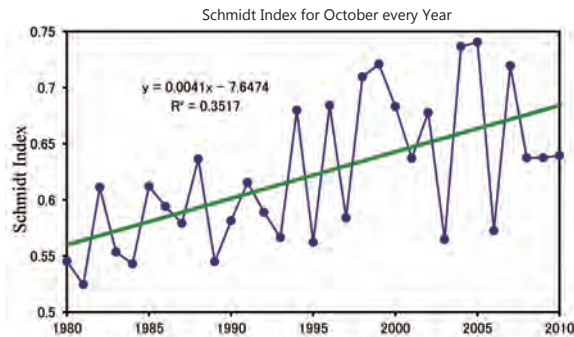


Fig. 4-3-2 Variation in the Schmidt Stability Index in the North Basin of Lake Biwa

**Schmidt Stability Index:** An index that indicates the strength of stratification or thermoclines in lake water. The index indicates the work required for mixture of the lake water from the stratified state to a uniform density distribution.