Note

Submerged Grove in Lake Onogawa*

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Abstract

The first record by ultrasonic echo sounding on the distribution of the submerged standing trees on the bottom of Lake Onogawa is presented. Lake Onogawa is a dammed lake formed at the time of the eruption of the volcano Mt. Bandai in 1888. Since then the original vegetation of the dammed valley has remained submerged.

Many submerged standing trees are distributed on the bottom within about 600 m from the northeast end of the lake. The density of the trees in this area is sufficient to call them a submerged lake grove. The trees are sparsely distributed on the bottom of the central part of the lake, where residential and cultivated land of the submerged Onogawa Village had been located. There are no submerged trees on the bottom of the shallow southwest part of the lake, where the mudflows seem to have been deposited.

The vast surface of the submerged trees may serve as substrates and substrata for attached algae, bacteria, fungi and other organisms. The respiration of these attached organisms may accelerate the oxygen consumption, which in turn may accelerate many other anoxic processes such as denitrification, manganese and iron reductions.

Key words: Lake Onogawa, dammed lake, submerged trees, ultrasonic echo sounding

Lake Onogawa lies on the Urabandai plateau (Fukushima, Japan, 37°40'N, 140°6'E) at an altitude of 794 m above mean sea level. The lake covers 1.4 km² and has maximum depth of 21 m (HORIE, 1962). The water volume is calculated by us to be 0.014 km³ from the bathymetric map of the lake published by the Japan Geographical Survey Institute. Consequently, the mean depth is calculated to be 10 m. The lake was formed at the time of the eruption of the volcano Mt. Bandai in 1888. The major part of the summit of the volcano, 1.7 km³ in volume, was blown away by the eruption (MURAYAMA, 1973). Large scale mudflows caused by the eruption have dammed the valleys of many rivers and have formed many lake basins including Lake Onogawa. The vegetation of the dammed valleys was submerged as the valleys filled with water. This note is the first record on the distribution

of the submerged standing trees on the bottom of Lake Onogawa.

Some evidence on the presence of submerged standing trees has existed. An anchor rope of a boat and ropes of water or sediment samplers were often caught by something at various depths of the water column and it required strong force to pull them out. Once we got a branch of a submerged tree from the depths of the lake. At first our anchor rope entangled in a branch of a submerged standing tree, and then we broke the branch and finally pulled it out. The branch was about 5 cm in diameter and 2.5 m in length. The surface, about 5 mm in thickness at its cut end, was soft and dark brown in color. The core of the cut end was the color of fresh wood, suggesting the branch was broken just before it was pulled out.

To make clear the distribution of submerged

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standing trees ultrasonic echo sounding was conducted. Sounding tracks are shown in Figure 1. The echoes of sounding charts which rise from the lake bottom were assigned to be submerged standing trees (typical echoes are indicated with arrows in Figs. 2-4). The longitudinal sounding section (track 1 in Fig. 1) shows that the distribution of the dense stand of sub-

merged trees is limited to about 600 m from the northeast end of the lake (Fig. 2). Many shadows up to as high as 10 m can be seen in this area. The sounding sections made in various directions in this area also show many standing trees. An example is given in Figure 3 (track 2). The density of the submerged trees in this area allows us to call them a submerged lake grove. The area enclosed by the thickest line in Figure 1 shows the extent of the submerged grove. The submerged trees are sparsely distributed within the area enclosed by the line of middle thickness in Figure 1. This area had been the residential and cultivated land of the now submerged Onogawa Village (personal communication with a local historian). The number of trees in this area might have been limited before the formation of the lake. Figure 4 shows a typical sounding section of this area (track 3). There seemed to be no submerged trees in the area enclosed by the thin line in Figure 1. The boundary between the sparse submerged tree area and the area with no trees is ambiguous because of the limitations of the sounding track. We tentatively assigned track 4 as the boundary. The area without submerged trees is shallow, less than 5 m, with many islets. The islets are mounds of the mudflows from Mt. Bandai at the time of the eruption

Fig. 1. Map showing the tracks of ultrasonic echo sounding and distribution of submerged standing trees. The thickest line shows a densely distributed area, the line of middle thickness shows a sparsely distributed area and the thin line shows an area without submerged trees. The numbers from 1 to 4 are track numbers cited in the text.

Fig. 2. Section of longitudinal ultrasonic echo sounding along track 1. Typical echoes from submerged standing trees are indicated with arrows.

Fig. 3. Transect of ultrasonic echo sounding along track 2. Typical echoes from submerged standing trees are indicated with arrows.

Fig. 4. Transect of ultrasonic echo sounding along track 3. A typical echo from submerged standing trees is indicated with an arrow.

(MURAYAMA, 1972). These facts indicate that the mudflows filled in the valley of this area. Even if there were trees in this area before the eruption the trees might be buried in the mudflows.

Some submerged standing trees of lakes are known. Lake Ashinoko (Kanagawa, Japan, 35° 13'N, 139°00'E) has submerged Japanese cedars. They have been grouped into 3 generations by the carbon 14 dating method: they were submerged 1,100, 1,600 and 2,100 years ago. The land and vegetation of the slope around the lake probably slid into the lake at the time when big earthquakes, of magnitude 8 or so, occurred (OUKI, 1991). Lake Shinseiko (Kanagawa, Japan, 35°21'N, 139°13'E) also has submerged trees on the lake bottom. The lake basin was formed at the time of a big earthquake in 1923 (SUZUKI, 1994). Trees have remained submerged since then. Lakes Hibara, Akimoto and Sohara are sister lakes of Lake Onogawa, and so were also formed at the time of the eruption of the volcano Mt. Bandai. Probably they also have submerged standing trees.

A submarine forest is known on the bottom of Toyama Bay. Based on FUJII and NASU (1988)

the submarine forest is distributed in 20 to 40 m of water depth. They submerged from 8,000 to 10,000 years ago as a consequence of rising sea level during the age of glacial retreat. However, only trunks of 30–40 cm height and their roots now remain. They are thought to have been buried in the bottom sediment for a long time and appeared recently because of the removal of the overlying sediment by the erosion of submarine valleys. A freshwater environment preserves wood much better than a marine environment, because submarine forests suffer from shipworms (FUJII and NASU, 1988). Thus, the submerged trees on the bottom of Lake Onogawa should remain intact for a long time in the future, as happened with the Japanese cedars of Lake Ashinoko.

The possible importance of a lake grove to the substance metabolism of a lake is that it serves as substrates and substrata to a variety of attached organisms. The thin, soft, dark brown surface of the branch of the submerged tree broken by us indicates that wood is being decomposed gradually, possibly by microbes, though the long existence of submerged lake

trees suggests that they are poor substrates. The vast surface of the submerged trees may serve as a substratum for attached algae, bacteria, fungi and other organisms. The hypolimnetic oxygen consumption rate in water columns with or without lake groves may be different to each other: the respiration of attached organisms on the vast surface of the submerged trees may accelerate the oxygen consumption, which in turn may accelerate many other anoxic processes such as denitrification, manganese and iron reduction. This speculation remains to be confirmed.

摘 要

小野川湖の湖中林

裏磐梯の小野川湖の水没林の分布を、超音波測深で初めて明らかにした。同湖は、1888年の磐梯山噴火の際発生した大規模な泥流が、小野川水系をせき止め形成された。その時水没した立ち木が、未だ湖底に立っている。

水没した木は、湖の北西端から600 m以内の地域に集中的に分布する。この地域の水没した木は、湖中林と呼べるほどの密度である。湖の中央部における水没した木の分布はまばらで、湖の南西部には存在しない。中央部は、水没前、集落が存在していた場所で、水没前に既に立ち木は少なかったと考えられる。南西部は浅く、点々と小島が存在する。これら小島は、「流山」と呼ばれ、押し寄せた泥流が盛り上がってきた。流山が存在し、水深が浅いと言うことは、湖の南西部は泥流の埋め立てを受けたことを示唆する。この地域では、

たとえ、水没以前に立ち木が存在していたとしても、それらは泥流に埋まってしまったと考えられる。

湖中林の莫大な表面は、付着生物のよい基層となるであろう。湖中林のある水柱ではない水柱に比べ、これら付着生物の呼吸により溶存酸素の消費が促進され、順次、脱窒や、マンガン、鉄の還元等の嫌氣的諸過程も影響を受けるであろう。

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Received : 7 November 1994

Accepted : 8 January 1995