

Water quality improvement and biodiversity recovery in rivers, lakes and seas using Effective Microorganisms by citizens

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Abstract—United Networks for Earth Environment (U-net) is an authorized non-profit organization that actively solves the problem of environmental pollution, enriches the ecosystem, conserves biodiversity, and promotes the idea of coexistence using effective microorganisms (EM). The main activities of U-net are as follows: (1) supporting social contribution and environmental cleanup activities of its members such as creating a recycling-based society, promoting organic farming, and cleaning up rivers, lakes and seas using EM throughout Japan, (2) holding events and expanding the network, (3) providing public relations activities, (4) promoting environmental education such as cleaning swimming pools at school with EM, and (5) promoting projects and creating good models for the use of EM. We introduce case studies of water quality improvement and biodiversity recovery in rivers, lakes and seas using EM performed by citizens throughout the country.

1. Nihonbashi River, Tokyo

Nihonbashi River is a first-grade river that runs through Chiyoda city and Chuo city, Tokyo, and the entire river flows under the Metropolitan Expressway highway. Owing to the pollution, the Nihonbashi River had become a dead river with few fish and an offensive odor. With the cooperation of local volunteers, EM has been applied since the 35th cleanup event of the Nihonbashi Bridge and River in July 2005. Since that time, activated EM and EM mud balls have been regularly deposited into the river. In 2006, an activated EM production plant was installed in Chiyoda city, with the cooperation of the Chiyoda city government. Since that time, about 10 tons of activated EM has been applied weekly. The total amount of activated EM and EM mud balls used in the Nihonbashi River from December 2006 to December 2017 is 5,720 tons and 248,160 balls respectively. These activities not only reduced the bad odor and improved the water quality, but also led to the recovery of the ecosystem and biodiversity; for examples, schools of flathead mullet and Japanese sea bass are now often observed in the river. Further, the media has reported that Tokyo Bay, which the Nihonbashi River flows into, has water quality that has recovered to the extent that people can swim

without problems and that the richness of the fishing ground is increasing.

2. Asechi River, Mie Prefecture

Asechi River is approximately 5-km long and flows through the center of Yokkaichi City in Mie Prefecture. Previously, its water was used for agriculture. However, during a period of high economic growth, domestic wastewater poured into the river, and it steadily grew polluted with a large amount of sludge and offensive odors. Nearby residents often complained forcefully about the odor, and the city government removed the sludge at a cost of 20 - 30 million yen every three or four years. Local volunteers initiated cleanup of the river and began using activated EM and EM mud balls beginning in 2000. One year after their activities began, they had applied a total of 30 tons of activated EM. The next year, the sludge had decreased, and the unpleasant odor was alleviated. Concurrently, aquatic organisms returned to the river, and the variety and the number of organisms began to increase. In 2008, Ayu fish (sweetfish), fish that can live only in clean water, were seen heading upstream, which was reported by newspapers and TV news broadcasts. The total amount of EM applied from September 2000 to December 2017 was approximately 520 tons.

3. Owase Bay, Mie

Owase Bay was flourishing as a good natural harbor; however, since its peak in 1975, the marine industry has decreased owing to sludge accumulation and sea desertification. Therefore, in 2010, a local diver shop, Outside of the Gulf Fishery Cooperative Kishu South Branch, and Kihoku town EM volunteers began using EM for sludge reduction and revival of the seaweed beds. Thus far, approximately 100 tons of activated EM and 50,000 EM mud balls have been applied. In 2012, sludge reduction of up to approximately 20 cm was confirmed by overall fixed-point observation. Further, organisms such as shellfish (*Strombus luhuanus*) and seaweed (*Sargassum hemiphyllum*) of the Family *Sargassaceae*, which were not previously observed, were found indicating that the ecosystem had recovered.

4. Applying EM nationwide on Marine Day

Pollution accumulates in water and eventually flows into the ocean. With our regret that our daily lives are continually polluting the ocean, and with our appreciation of the sea, we

have considered National Marine Day to be “EM Day” since 2010, calling for simultaneous application of EM throughout Japan every year. U-net members nationwide perform environmental cleanup and apply EM to rivers, lakes and seas locally. In 2016, 409 groups, a total of 10,993 people, participated in this activity and applied 371,299 EM mud balls and 690,061L of activated EM.

Over the years, these activities by citizen volunteers in Japan have attracted international attention. As a result, this movement has spread to many other countries. Currently, volunteers in South Korea, Thailand, Malaysia, Philippines, Croatia, Russia, Greece, and Costa Rica perform environmental activities leading to water system improvement and biodiversity recovery.