

Effects of transboundary air pollution on water chemistry around the source area of Hakusan–Tedori River

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In recent years, there have been increasing concerns on the effects of atmospheric deposition on forest ecosystems, particularly on areas along the Sea of Japan. On-site monitoring throughout the year is difficult in most of these areas because of heavy snow. We began monitoring the cycles of major and minor elements in a small forested watershed in the middle part of the Tedori River Basin, Ishikawa Prefecture, Japan, in 2013. Atmospheric nitrogen (N) deposition from rainfall and snowfall was more than $20 \text{ kg ha}^{-1} \text{ year}^{-1}$. Nitrogen input quantity was similar to or more than that reported in N-saturated forested areas of the Kanto district. Therefore, similar to that in the Kanto district, higher N deposition loads from the atmosphere could also be observed due to the effect of nitrogen dynamics and the increase in nitrogen efflux at these forest watersheds. This study aimed to (i) determine the nitrogen input and output at the upper reaches of the Tedori River, including the head waters area that is located at the top of Mt. Hakusan; (ii) reveal the element dynamics and input–output budgets within a forested watershed in a heavy snowy region; and (iii) understand the contribution of transboundary air pollution to the quantity of atmospheric deposition. Stream water and spring water samples ($n = 26$) were collected at the Hakusan mountainous region (altitude 2,000–2,500 m high) and the upper reaches of the Tedori, Ozoe, and Syou Rivers, which originate in Mt. Hakusan. Furthermore, we investigated stream water and ground water samples ($n = 10$) at the middle reaches of the Tedori River. The nitrate concentrations in all the samples ranged from 0.00 to 2.93 mg L^{-1} (median value: 0.69 mg L^{-1}). The stream water and spring water that were collected at the Hakusan mountainous region and the upper reaches of the three rivers showed significantly low nitrate concentrations ($0.00\text{--}1.58 \text{ mg L}^{-1}$, median value: 0.52 mg L^{-1}). At the middle reaches area, the nitrate concentrations of stream water samples ranged from 0.47 to 2.12 mg L^{-1} (median value: 1.13 mg L^{-1}). The nitrate concentrations of ground water samples in the middle and lower reaches of the Tedori River ranged from 1.92 to 2.93 mg L^{-1} (median value: 2.31 mg L^{-1}). In contrast, the nitrate concentrations of stream water in the Tsukuba experimental forest watershed, which is reported as a N-saturated forested area of the Kanto district, were much higher (average value: 7.56 mg L^{-1}) than those in the Tedori Basin. Compared with the input concentrations, the output concentrations of nitrate in the water samples were generally very low around the Hakusan–Tedori River Basin. Therefore, higher N depositions have not yet influenced the nitrate concentrations of the stream water in this area.

Discussions on the mechanism of soil-aggregate formation and stabilization

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To examine the effects of natural constituents on the stability of soil aggregates, phenolic acids or/and carbohydrates were mixed into several different types of soils. After a one-month incubation, the plot with applied phenolic acids showed the greatest mean weight diameter (MWD) of all the plots. For the treated soils before incubation, saturated water permeability was intermittently measured during continuous water percolation. The decline in water permeability was mitigated in the phenolic acids plot compared to the other plots for each soil. In order to determine the mechanism of aggregate stabilization by phenolic acids, they were added to synthetic soil aggregates using two methods (mixing and brushing), and the aggregates were then incubated for 153 days. The aggregate stability was greatest in the phenolic acid surface plots for the Andisol and the gray lowland soil and was most stable in the phenolics mix plot for the yellow soil. Aggregate stabilities in the carbohydrates plots and control plots were at lower levels. Phenolic acids were also found to have an effect on soil aggregate stability in sandy soil. The microbial activity alone could not explain the change in aggregate stability though it seemed more related to fungal number than bacterial number. In another similar experiment using the gray lowland soil, the liquid extracted from soil aggregates, to which p-coumaric acid had been added, was monitored using size exclusion chromatography. The p-coumaric acid-corresponding peak gradually disappeared, and larger substance-corresponding peaks had increased slightly by days 14 and 28, which was likely accompanied by an increase in aggregate stability.

Keywords: soil aggregation, phenolic acids, active iron and aluminum

The formation and decomposing processes of cryoconite granules on Urumqi Glacier No.1, in Tien Shan Mountains, China

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Cryoconite is the dark-colored surface dust called cryoconite covering the ablation ice of glaciers. Organic and inorganic particles in cryoconite often form spherical aggregations called cryoconite granules. Cryoconite granules can reduce surface albedo and accelerate the melting of glaciers. In addition, cryoconite granules washed out of glacier may contribute to forming organic soils downstream of the glacier. Thus, it is important to understand the forming and decomposing processes of cryoconite granules on and out of glaciers. In this study, we analyzed the size and organic matter content of cryoconite granules collected from various ice surfaces and from the bottom of discharge water stream in the glacial forefield of Urumqi Glacier No.1 in Tianshan Mountains in China, in order to study the forming, maintaining and decomposing processes of cryoconite granules.

Microscopic study revealed that cryoconite granules were observed in at all of the study sites on the glacier. The mean size of cryoconite granules were relatively smaller on the surface in the upper area, near the glacial margins and in the meltwater streams. The results suggest that the life span of granules was limited by low temperature in the upper area, by abundant supply of mineral particles from a rock cliff adjacent to the glacier, and by physical forces of water streams. Cryoconite collected from the discharge water stream in the glacial forefield revealed that cryoconite granules were deposited at the bottom of stream in the area from the terminus to the distance of 100 meters. However, the granules appeared to be the less microbial abundance on the surface of granules compared with that on the glacier. Moreover, the split granules were often observed in the samples away from the glacial terminus. These results suggest that cryoconite granules washed out of the glacier, were gradually decomposed as cryoconite granules were moved down to the downstream.

Keywords: cryoconite, organic matter, glacial forefield, soil

Discharge of suspended solids and radiocesium from a forested watershed before and after line thinning

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We compared suspended solids (SS) and radio cesium discharges from a forested watershed in Ibaraki Prefecture, Japan (N36° 31.1', E140° 18.7') before and after line thinning. The study watershed has a drainage area of about 59.9 ha and is around 120 km southwest of the Fukushima Daiichi Nuclear Power Station. The watershed is underlain with sedimentary rocks (sandstone and mudstone). The elevation ranges from 130 to 300 m and the lower and upper slopes are covered with plantation conifer trees (Japanese cedar) and deciduous trees, respectively. Line thinning was carried out at a thinning rate of 35% across about 20% of the northeastern part of the watershed in 2012 and across the remaining part in 2013. Spur roads, 3-m wide, were constructed along streams. According to the two times of thinning, the forest road density changed from 27 to 108 m ha⁻¹ corresponding to the two thinning periods. Logged trees were dragged and grappled by forest machinery and were transported along spur roads to timber yards by forwarder-type forestry vehicles. V-notch weir and a water level gauge were installed at the watershed outlet in 2000. Stream water was sampled twice a month during base flow. Stream water samples of 1 or 2 L were collected every hour with an automatic water sampler (ISCO, Model6712) during storm events. Water samples were filtered with glass fiber filters (0.5 μm) to obtain the SS concentrations. We collated SS concentration data for 21 floods that occurred before thinning from June 2010 to August 2012, with total rainfalls between 15 and 130 mm and maximum rainfall intensities between 3 and 39 mm h⁻¹, and for 13 floods that occurred after thinning from October 2013 to August 2015, with total rainfalls from 19 to 127 mm and maximum rainfall intensities between 5 and 39 mm h⁻¹. We installed an SS sampler (Koga et al., 2004) in the stream close to the weir and collected SS samples every 2 or 3 months and measured their Cs-137 concentrations. We compared SS concentrations before (from July 2010 to August 2012) and after thinning (from October 2013 to August 2015) under flood and base flow conditions. We found that, within the same runoff range, some of the flood flow SS concentrations were higher after thinning than before thinning. The maximum SS concentration before thinning, observed in an event with a total rainfall of 74 mm and a maximum rainfall intensity of 39 mm h⁻¹, was 211 mg L⁻¹. After thinning (October 2013), the maximum SS concentration, observed in an event that had a total rainfall of 127 mm and a maximum rainfall intensity of 19 mm h⁻¹, was 790 mg L⁻¹. In February 2014, 5 months after thinning, an SS concentration of 751 mg L⁻¹ was recorded in an event with a total rainfall of 123 mm and a maximum rainfall intensity of 22 mm h⁻¹. Some of the Σ Lss (the specific cumulative load of SS in a flood event) were higher after thinning than before thinning within almost the same Σ Q (the specific cumulative runoff in a flood event). We found that SS concentrations and Σ Lss increased after thinning and that thinning had an influence on the SS discharge. The newly-constructed spur roads and the land cleared along the streams to facilitate harvesting were possibly the main sources of SS. We investigated the Cs-137 concentrations of SS from February 2012 to June 2016. Cs-137 concentrations were not related to thinning and Cs-137 concentrations in SS dropped during large storms. With the exception of large storms, Cs-137 concentrations in SS did not increase during or after thinning but decreased gradually from February 2012 to June 2016. The rate of decrease in the Cs-137 concentrations of SS was greater than the decrease expected because of Cs-137 decay. After thinning, SS discharges increased but Cs-137 concentrations in SS decreased in flood events. Therefore, Cs-137

export from the forested watershed did not increase sharply because of the thinning. Also, for smaller areas of bare land, SS discharges and Cs-137 exports would decrease. The next step is to examine changes in SS and Cs-137 concentrations for the years since thinning.

Keywords: forest, thinning, radiocesium, suspended solid

Size distribution of soil particles containing phosphorus in forest and agricultural soils in a watershed draining to Lake Biwa

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Eutrophication of lakes and marshes is one of the important environmental issues for its influences on water quality and biological diversity. Phosphorus (P) is an essential nutrient for organisms and is often enriched in water systems due to human activities. Farmlands are potential sources of excess phosphorus in water systems because of receiving a lot of P as fertilizer for plant productivity. Phosphorus is typically observed in agricultural soils as phosphoric acid, which is easily adsorbed to soil minerals.

Therefore, agricultural soils generally contain a large amount of P. Such soils can be transported to aquatic area including lakes and marshes directly through rain and soil erosion. It has been suggested that P export from farmlands is greater than from forests and is mainly through particulate forms rather than dissolved forms. Thus, we hypothesized that size distribution of soil particles is associated with the difference in the amount of P export between agricultural and forest soils.

In this study, we collected soils from farmlands (paddy fields and crop fields) and a forest in a watershed draining to Lake Biwa, fractionated the soils in size, and compared size distribution of soil particles and their P concentrations among the land types. The size fractionation was carried out into five? particle sizes, 300 μm -2 mm(F1), 75 μm -300 μm (F2), 10 μm -75 μm (F3), and smaller than 10 μm (F4). These fractionated soils were processed to measure total P, organic P, and inorganic P.

The results showed that the agricultural soils showed higher percentage of small soil particles (F4), which are to be easily exported to streams, than those from forest soil. The total P concentrations in small particle fractions in agricultural soils were not significantly higher than those in forest soils.

Consequently, the total amount of P in small soil particle fractions in agricultural soils was estimated to surpass that of forest soil. These observations suggest that farmlands in the watershed have greater potential of particulate P export than forests, which would partly explain why farmlands supply greater amount of P to water systems than forests.

Keywords: Lake Biwa, particle size, phosphorus, agricultural soil, forest soil

Effects of application of composted aquatic macrophytes from Lake Biwa on chemical properties in soil

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Aquatic macrophytes expand their coverage rapidly in the southern part of Lake Biwa since 1994. To control the expansion, Shiga Prefectural government harvests them and exploit composted ones as manures. However, a limited knowledge is available regarding the effect of composted aquatic macrophytes on plant growth and chemical and microbiological properties in soils and soil water. In the present study, we performed cultivation experiments using Wagner pots to test the growth of Japanese mustard spinach (*Komatsuna*, *Brassica rapa* var. *perviridis*) and chemical properties of soil amended with aquatic macrophytes (composted for one year) singly or in mixture with an inorganic chemical fertilizer. Wagner pots were prepared to include either of two soils (soil A from a greenhouse supplied with chemical fertilizers repeatedly and soil B from a old riverbed field). Soils in the pots were amended with composted aquatic macrophytes (MK), a commercially available chemical fertilizer (CH), or a mixture of MK and CH (HK); some pots received no amendments (NN, as a control). In the half of the pots, Japanese mustard spinach was planted (P+), whereas no plantation was done in the other half (P-). Therefore, we have the factorial design of four amendments (MK, CH, HK, NN) × two plantations (P+ vs P-) for each of soil A and soil B. The pots were incubated in screen houses for 4 weeks from May to June 2013 (soil A) and 2014 (soil B) in an experimental field of Kyoto University in Otsu city, Shiga, Japan. Soil pH was significantly higher in soils with MK than in the other amendments, and was significantly lower in P+ of soil A and in CH of soil B. Total C, total N and Truog-P concentrations were increased significantly in soils with MK. Phosphate concentration in soil water showed no significant difference between NN and MK for both soil A and B.

Keywords: aquatic weed, phosphorus, nutrient cycling

Measurement of Radiocaesium in an Irrigation Pond in the Neighborhood of the TEPCO Fukushima Daiichi Nuclear Power Station

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1. Introduction

Fukushima Prefecture has about 3700 agricultural ponds, which serve the important purpose of supplying irrigation water for paddy fields. The discharge of radioactive substances, mainly radiocaesium, into agricultural reservoirs in the aftermath of the March 2011 accident at the Tokyo Electric Power Company's Fukushima Daiichi nuclear plant has caused significant pollution of these reservoirs. Dissolved radiocaesium is considered more harmful to rice cultivation than its other forms. Therefore, in order to ensure the safety of irrigation water, it is critical to understand the movement of dissolved radiocaesium. Relatively high concentrations of dissolved radiocaesium have been observed in ponds located in areas of Fukushima Prefecture that are known to exhibit large amounts of radiocaesium deposition, such as Okuma Town. This work aimed to study the characteristics of ponds exhibiting relatively high concentrations of dissolved radiocaesium. To this end, this report describes the results of a water quality survey in an irrigation pond located within 5 km from the nuclear power plant.

2. Methods

The target pond is located 5 km from the nuclear plant in Okuma town, Fukushima Prefecture. An airborne survey carried out in the area on April 29, 2011, shows a high Cs-137 deposition amount of about 3 MBq/m² in the vicinity of the reservoir body. The water quality survey was performed once or twice a month from March to November 2016. Water samples for Cs-137 analysis were pre-treated in situ by the filter cartridge method (FCM), and subsequently analyzed using a Ge semiconductor detector in the laboratory. A part of the water samples were transported to the laboratory and filtered using a membrane filter with a pore size of 0.45 μ m. This membrane filter method (MFM) is the standard pre-treatment method in the analysis of dissolved radiocaesium. Other water quality parameters, such as pH, electrical conductivity (EC), turbidity, temperature, major inorganic ions, total organic carbon (TOC), dissolved organic carbon (DOC), total nitrogen (TN), dissolved nitrogen (DN), fluorescent chlorophyll, etc. were also measured.

3. Results

The water quality survey was performed 14 times during the monitoring period. Concentrations of total Cs-137 (tCs-137) and dissolved Cs-137 (dCs-137), measured by FCM, were 2.3–53 Bq/L, and 1.2–6.7 Bq/L, respectively. Radiocaesium concentration was corrected to the concentration of the samples day. The errors of measurement for dCs-137 and pCs-137 were 1.3–6.1% and 2.6–6.3%, respectively. The feature of correlation coefficient between Cs-137 and other water quality parameters are as follows. Turbidity and suspended solids were extremely highly correlated with tCs-137 concentrations, which also showed correlation with chlorophyll fluorescence, blue-green algae, and TN. Turbidity and SS were also correlated with dCs-137, though not as strongly as with tCs-137. Further, the dCs-137 concentrations also showed correlation with water temperature, DN, TN, chlorophyll fluorescence, blue-green algae, and NH₄. Concentrations of dCs-137 obtained by the MFM were about 0.5 times those obtained by the FCM; dCs-137 concentrations were obviously low.

Keywords: radioactive substance, radiocaesium, irrigation pond

A review of SWAT model on application for estimating nutrient dynamics in agricultural watersheds

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Soil and Water Assessment Tool (SWAT) was developed in the early 1990s with a combination of previously published models for predicting the effect of management decisions on water, sediment, nutrient and pesticide yields with reasonable accuracy on large, ungaged river basins. The model grew up as one of the most accurate predictable model for nutrient flux in watershed-scale today because it has improved by many contributors with its opened source code. One of the advantages of using the model is to estimate of nutrient flux from non-point sources because it could consider various agricultural activities including plant nutrition. This is a reason that the model is able to simulate nutrient dynamics in watersheds, especially in agricultural watersheds, with reasonable accuracy. The model basically simulates dynamics of water and related substances using physically-based equations. However, some of empirical equations based on observation in U.S. are adopted as well. Hence, it is necessary to confirm capability of the model when it's applied outside U.S. The objective of this study was to reveal capability of SWAT on estimation of nutrient flux from watersheds outside U.S. We reviewed peer-reviewed papers published in international journals which targeted various conditions from mountainous and hilly area dominated watershed to relatively flat area such as typical continental watersheds.

Keywords: Soil and Water Assessment Tool, agricultural watersheds, nutrient flux, literature review

Sensitivity analysis of parameters in SWAT Model for estimation of water discharge and sediment yield in the Ota river watershed

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Watershed management is one of effort to protect and maintain water resources. A basic framework of watershed management can be affected by watershed characteristics. Watershed characteristics can be looked as a landscape, as a hydrological system, and as an ecosystem. As hydrological systems, a watershed has some functions as a recharge area, a store area, and a discharge area. The Ota River is the major river which flows through Hiroshima Prefecture and empties into the Seto Inland Sea which a large delta has formed at the river mouth. The Ota River water discharge is important to know for a better water-land management based on a watershed.

A water discharge analysis of the Ota River basin could be knowing by SWAT model. SWAT (Soil and Water Assessment Tool) is a model that can help to predict hydrological condition based on physical properties. SWAT Model has been implemented for watershed hydrology research widely. (Wellen et al.,2015). The research objective is to estimate the Ota River water discharge and sediment yield using SWAT Model and SWAT-CUP.

Keywords: SWAT Model, Water discharge, sediment yield, Ota river watershed, Sensitivity analysis



Effect of groundwater recycle system on nitrate load distribution in an agricultural area, Japan

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As one of the major elements for crops, nitrogen directly affects the agricultural production. However, the excess application of fertilizers leads to a lot of environmental problems such as groundwater and surface water contamination. Especially, groundwater contamination by nitrate (NO_3^-) has been an important issue in agriculture areas. Ikuchijima island, located on the Seto Inland Sea of western Japan is one of the most famous and important agricultural island in Japan, with citrus groves cover 42% of the island. Groundwater is one of important water resources in the area because of low annual rainfall and relatively high risk of drought in the area. To maintain and improve crop yields, nitrogen fertilizer is applied over the whole year at a rate of $\sim 2,400 \text{ kg ha}^{-1} \text{ yr}^{-1}$. Consequently, most of the groundwater of the agricultural area are significantly contaminated by NO_3^- , and are considered in “eutrophic” condition. Therefore, the recycle of high NO_3^- groundwater to the irrigation on the catchment scale is effective strategy for saving both fertilizer usage and groundwater resource in the area.

In this study, we estimated nitrogen load from the catchments in Ikuchijima island using the SWAT (Soil and Water Assessment Tool) model. Especially, we tried to simulate the effect of reducing fertilizer application on nitrogen load assumed the recycle of NO_3^- in groundwater. The results showed that NO_3^- loads were highest near the coastal areas, which is related to the distribution of citrus farms. 42% of nitrogen load was from citrus farms in the north region of the island, and it ups to 60 % in the south region. It indicates fertilizer is the major source of nitrogen load in the island. Higher average nitrogen loadings also occurred in high density of residential area. The total nitrogen load from whole island was estimated to be 82507kg/year when the annual nitrogen fertilizer application is 240kg/ha/year. However, it decreased to 42548kg/year when the fertilizer application was reduced to 160kg/ha/year.

Keywords: groundwater recycle, nitrate load, SWAT model

The community composition and diversity of epilithic bacterium and microalgae in a Japanese river system during irrigation season

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The surface of river stones serves bacterium, microalgae, protozoas, and insect larvae as one of the major habitats in a river. These organisms are exposed to running river water in which discharged water, sediments and allochthonous organic materials are induced from upper sites. We conducted a cooperative research of the riverine benthos to assess the possible effect of anthropogenic effect of land use on water quality and microflora of epilithic communities in the Yasu River watershed in late spring. This study examined the site-specific variability of the bacterial and algal composition using MiSeq 16S rRNA gene sequencing and cell counting. These data were compared with a set of environmental parameters and photosynthetic pigments by multivariate ordination analyses.

The sequence data of amplicons after amplification of 16S hypervariable regions 3 were obtained by a MiSeq (Illumina) sequencer to collate with SILVA database using the USEARCH package and the pipeline. The yield of the amplification was so low at one of the 30 sites that the analysis was made at 29 sites for the OTU analysis. Because cyanobacterial OTUs comprised 342 OTUs in a total of 5545 OTUs, the rests were assumed as heterotrophic bacterium and were grouped separately. As high as 180 species of microalgae were also discriminated by an optical microscopy. The spatial distribution of both bacterial OTUs and microalgae indicates a cluster of upper stream sites where the concentration of phycoerythrin seems to be high. So, some environmental gradient is supposed to induce such site-specific distribution of bacterium, microalgae and phycobilin pigments. Non-metric multidimensional scaling (NMDS) showed that the distribution of autotrophic microbes, that are cyanobacterium and microalgae, have a significant correlation with water temperature, dissolved organic carbon, altitude, water current, land use, and turbidity, though cyanobacterium also have a significant correlation with pH whereas microalgae has a significant correlation with DO. In addition to water temperature, dissolved organic carbon, altitude, water current, land use, and turbidity, the stream order is included in significant factors for the distribution of heterotrophic bacterium.

Keywords: bacterium, microalgae, 16S, MiSeq

Land use impact on benthic macroinvertebrate assemblages in selected lotic ecosystems in a government-declared protected landscape

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The Upper Marikina River Basin Protected Landscape (UMRBPL) was established to rehabilitate the Marikina watershed. However, these areas remain prominently residential and agricultural; which in turn may create disturbances to the ecosystem. One way to investigate the condition of the lotic systems is through the use of biomonitoring. In this research, ten sites (residential, agricultural, and combined land use) were sampled for physicochemical parameters and benthic macroinvertebrates. A total of 2,385 samples were identified belonging to 70 genera from 38 families of 12 orders. Principal component analysis determined the environmental gradients among sites. Hierarchical clustering analysis determined site clustering based on conductivity and taxa density, despite the difference in land use. Canonical correspondence analysis showed the affinity of *Paraleptophlebia* sp., *Sparsorythus* sp., *Afronurus* sp., *Acentrella* sp., and *Baetiella* sp. to temperature; *Baetiella* sp. and *Cheumatopsyche* sp. to pH; and *Caenis* spp. to DO. It also showed the sensitivity of *Ceratopsyche* sp. to DO and conductivity; *Thiara* sp., *Melanoides* spp., *Corbicula* sp., *Naucoris* sp., *Microcylloepus* sp., *Neoperla* sp., *Elodes* sp., *Parochlus* sp., *Chimarra* sp., and *Oestropsyche* sp. to conductivity. The study also found out that the presence of anthropogenic factors may be the leading cause to the changes in water quality, which, in the case of this study, shows that the rampant use of pesticides in the studied agricultural areas of the UMRBPL caused the water's acidic pH. This resulted to a negative impact on stream biodiversity as compared to residential and combined-use areas. It would therefore be necessary to assess the types and kinds of pesticides used in these agricultural areas as they have shown to decrease stream biodiversity.

Keywords: Upper Marikina River Basin Protected Landscape, Biomonitoring, Stream biodiversity

Stream Benthic Macroinvertebrates Response to Water Quality of Urban and Rural Areas of the Marikina Watershed

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The Marikina Watershed is located at the north-eastern part of the province of Rizal and is comprised of five municipalities: Antipolo, Baras, Rodriguez, San Mateo, and Tanay. But due to the rise of population and urbanization of the country, some of the areas of the Marikina Watershed were affected and the water quality has drastically changed. This study aims to evaluate the response of benthic macroinvertebrates to streams with different physicochemical conditions along the Marikina Watershed and to identify these benthic macroinvertebrates down to the lowest possible taxa. Sixteen sites were chosen for this study with sites U1-U8 near urban communities and sites R1-R8 near rural communities. The physicochemical parameters were tested on-site and benthic macroinvertebrates were sampled using a Surber Sampler. It was found that species from orders Ephemeroptera, Plecoptera, Trichoptera, and Coleoptera were more abundant in sites R1-R8 than sites U1-U8. Dipterans, such as chironomids and simuliids were more abundant in sites U1-U8 than sites R1-R8. This is due to the pollution tolerance of the benthic macroinvertebrates; dipterans are more resistant to pollution meaning that species under Ephemeroptera, Plecoptera, Trichoptera, and Coleoptera are good bioindicators for pollution. It was found that the increase in urban communities negatively influenced the benthic macroinvertebrate community and therefore poses a serious threat to the biodiversity of the organisms found in the inland water areas of the country.

Keywords: bioindicators, benthic macroinvertebrates, urbanization

Spatial Pattern of Ground Water Utilization in Silang-Santa Rosa Sub-watershed

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Ground water is one of the most important resources in Silang-Santa Rosa watershed in Phillipines. Population growth is now aheading, therefore the dependant on ground water gains much more speed in near future. This study will reveal and visualize how resients access, manage and utilize sharrow ground water through interview surveys. Taget gound water is 50, and the results will suppose construction of ground water governances.

Keywords: Ground water

Observation for the temporal variation of lacustrine groundwater discharge (LGD) in Lake Biwa

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Lacustrine groundwater discharge (LGD) is one of the potential nutrient paths from a catchment to a lake. Lake Biwa is the largest freshwater lake in Japan. Some researchers have pointed out the presence of LGD in littoral area of the lake. However, the temporal variation of LGD is not well evaluated in the previous studies. In the present research, we aimed to examine the temporal variation of LGD in Lake Biwa based on the results of continuous measurements at the littoral area.

We conducted the mooring observation for about 9 hours from morning to evening in July 2016. Water temperature, electric conductivity and radon (^{222}Rn) concentration in lake water were measured at the littoral areas near Hikone city. ^{222}Rn is a radioactive element of uranium (^{238}U) series with 3.8 day of half-life. ^{222}Rn is a useful tracer of groundwater discharge because it generally enriched in groundwater than surface water. We also measured flow velocity using ADCP (Acoustic Doppler Current Profiler). ^{222}Rn concentration in lake water was totally high compared with the offshore water. It suggests the nearshore water is influenced by LGD. Water level changed about 5 cm and observed maximum velocity was $\pm 0.2\sim 0.3 \text{ m}^3/\text{s}$ during the period. It indicates exchange process between nearshore water and offshore water occurred in the study area. ^{222}Rn concentration tended to decrease with the increase of water exchange.

Keywords: Lacustrine groundwater discharge, Temporal variation, Lake Biwa

Characteristic of oxygen isotope ratio of phosphate in endmember of Lake Biwa

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Lake eutrophication control and nutrient management are important to build up a sustainable safety water resources. Despite the nutrient discharge through rivers, Nutrient transport through sediment and lacustrine groundwater discharge could be an important internal nutrient resource. This research aims to clarify the dynamics of nutrient cycle in lake bed sediment, groundwater and overlying water using nutrient and phosphate oxygen isotope end-member analysis.

. We collected water and sediment samples from Lake Biwa during several field work in 2016. Sediment samples from 5m 10m and 20m depth were collected in Lake Biwa along the transactions from the east bank to central lake. Surface, bottom water samples as well as river water and groundwater were also collected simultaneously. Major nutrient, oxygen isotope, and phosphate oxygen isotope were also analyzed.

Results show the high P concentration in sediment pore water, ranging from 50-230 times of lake water. Indicates sediment recycled phosphorus would be an important resource contributing to lake nutrient cycle as Lake Biwa is considered as phosphorus limitation environment. High radon concentration in pore water at 5m and 20m proved the existence of deep LGD and shallow LGD. Oxygen isotope ratio of phosphate indicates shallow LGD may refer to recharged river water and groundwater near the eastern bank, while the much lower ratio in deep pore water may refer to other groundwater resources.

Keywords: nutrient, phosphate oxygen isotope, sediment

Migration routes of pelagic crucian carp "*Carassius auratus grandoculis*" endemic to Lake Biwa revealed by otolith Sr stable isotopes.

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1. Introduction

Paddy Fields have a function for the place as fish spawning and as fish juvenile growing. Therefore, it is positioned as an important habitat for conserving biodiversity of fish communities. Cyprinid fish are dominant species in the paddy field. Many fish species dependent on paddy field are threatened with extinction due to declined spawning habitat such as reed bed and lagoon and, disconnected paddy field and Lake. The information of history on the habitat of these fish is indispensable to restore the resource amount of these fish and conserve the habitat.

In recent study, analysis of otolith chemical composition such as Strontium isotope is often used to trace about the habitat use and conditioned behaviors of individuals (Kennedy et al., 2001). Strontium (Sr) stable isotope ratio ($^{87}\text{Sr}/^{86}\text{Sr}$) of fish otolith varies depending on environmental condition of habitat water. In addition, Nakano et al., 2008 reported that river water qualities around lake Biwa are reflected geological specificity, and are significant spatial variation in the elemental composition and $^{87}\text{Sr}/^{86}\text{Sr}$. In this study, we tried to trace migration history of fish spawning at paddy field, using $^{87}\text{Sr}/^{86}\text{Sr}$ of otolith and fish habitat water around Lake Biwa.

2. Material and Method

At Lake Biwa watershed, fish and habitat water sampling were conducted at paddy field and canal. This study focused on Nigorobuna *Carassius auratus grandoclis*. This fish is endemic subspecies in Lake Biwa, and is known to migrate between lake, paddy field and lagoon. In Shiga prefecture, as a resource growing project, Nigorobuna juveniles are stocked utilizing paddy field. In addition, a follow-up survey of juvenile is conducted. Juveniles were marked its otolith with alizarin complexone, and released into paddy field. In this study, we analyzed trace elements of otolith (lapillus), for marked individuals and for wild individuals collected at paddy fields and water way. Otolith samples are embedded by epoxy resin and grinded to make slice sections. Micro core samples were collected to drill 80 μm depth from otolith sections, from the center part (core) to margin along the ring pattern at intervals about 100 μm using micro sampling device (MicroMill, Electro Scientific Industries). Powder samples collected with micro sampling device were dissolved with distilled nitric acid. After measuring trace element of habitat water samples and micro-core samples using ICP-MS, $^{87}\text{Sr}/^{86}\text{Sr}$ was measured with thermal ionization mass spectrometry.

3. result and discussion.

The mean value (5 individuals) for $^{87}\text{Sr}/^{86}\text{Sr}$ of the otolith core for marked individuals was $0.71112 \pm 0.00003\text{SD}$. They were sampled at place where they were released. The $^{87}\text{Sr}/^{86}\text{Sr}$ value of the otolith core showed similar $^{87}\text{Sr}/^{86}\text{Sr}$ value (0.71108) in the lake water collected from the sampling site. Additionally, from the center part to the edge part of the otolith, $^{87}\text{Sr}/^{86}\text{Sr}$ values showed similarity to the $^{87}\text{Sr}/^{86}\text{Sr}$ value of the lake water collected from the sampling site. These results suggest that the marked individuals migrated around released-place and returned to spawn at sampling site without migration to the north part of the lake. This was confirmed because there were no signals detected from the otoliths that could

indicate they migrated to the north part of the lake. For wild individuals, the mean value (three individuals) for $^{87}\text{Sr}/^{86}\text{Sr}$ of the otolith core is 0.71184 ± 0.00009 which is also within the range $^{87}\text{Sr}/^{86}\text{Sr}$ values of the paddy field. $^{87}\text{Sr}/^{86}\text{Sr}$ values of otolith edge (0.71217-0.71236) was close to the $^{87}\text{Sr}/^{86}\text{Sr}$ values of south part (0.71221) and north part (0.71250) of the lake. These results suggest that the wild individuals return to the paddy field to spawn after migrating from the coast of Lake Biwa. The results of these preliminary analyses suggest the potential of the method using $^{87}\text{Sr}/^{86}\text{Sr}$ of the otolith micro-core in tracing migration history of freshwater fish.

Keywords: fish migration, Strontium isotope ratio, Lake Biwa, otolith, paddy field ecosystem

Estimation of recharge temperature, flow and denitrification in coastal groundwater, using dissolved gas.

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Nitrogen load to the groundwater by application of fertilizer in the farmlands has affected nitrogen cycle processes and water environment. Nitrate pollution occurs and denitrification process increases with producing N₂ and N₂O gas. In addition, recharge water in various altitudes converges in coastal groundwater and transports nitrate.

In this study, we examined to confirm recharge temperature, flow and denitrification in coastal groundwater, using dissolved N₂ and Ar gas. Our study site is located on a small and steep catchment covered by citrus grove of Ikuchi Island in Hiroshima prefecture, western Japan. We collected groundwater samples at the observation wells with the depth of 3m, 10m, 15m, 20m, 30m and 40m. After collecting without mixing of air, dissolved N₂ and Ar gas concentrations were analyzed by gas chromatography.

As a result, when the excessive amount of dissolved N₂ gas concentration was estimated from the groundwater temperature,

There was a negative correlation with dissolved oxygen content. It is thought that this is because denitrification -N₂ production is considered to be carried out so that there is less dissolved oxygen, suggesting the activity of anaerobic denitrifying bacteria.

This is also compatible with the results of previous studies, and it can be considered that the evaluation of denitrification state becomes possible by considering more diversely.

Sewage water impacts on groundwater and coastal canals in Osaka city; high nutrient and flood impacts

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Water pollution by domestic sewage is one of the critical environmental problems in the early stage of urbanization with significant growth of population. In case of Osaka metropolitan area in Japan, the pollution was significant until 1970s, while it has been improved by the development of sewage treatment systems. However, removal of nitrogen needs the advanced process therefore relatively large part of dissolved inorganic nitrogen (DIN) is usually discharged by treated sewage effluent. Besides, increase of sewage-derived pollutant loads through the combined sewage systems during rainfall events is recognized as a new problem in recent years. However, the impacts of sewage-derived loads on the water environment of river and coastal area have not been fully evaluated in previous studies. In the present research, we aimed to examine the dynamics of sewage-derived nutrients in highly urbanized coastal rivers. Study area is located on the coastal area of Osaka bay in Seto Inland Sea, western Japan. Treated sewage effluent is discharged from three sewage treatment plants (KH, SU and SA) to a river and channels. Water and sediment samples were collected and electric conductivity (EC), chlorophyll-a (Chl.-a) and dissolved oxygen concentration (DO) were measured from the discharging points to few kilometers offshore at 100-300 m intervals. Nutrients (nitrogen, phosphorus and silica), nitrogen and carbon contents and stable isotope ratios ($\delta^{15}\text{N}$ and $\delta^{13}\text{C}$) of particulate organic matter (POM) and sediment, nitrogen and oxygen stable isotope ratios ($\delta^{15}\text{N}$ and $\delta^{18}\text{O}$) in nitrate (NO_3^-) were measured. Nitrate-nitrogen (NO_3^- -N) concentration were significantly high near the discharging point then it decreased to offshore suggesting that impact zone of sewage effluent is about 1 km from the discharging point. Significant NO_3^- -N uptake by phytoplankton as well as dilution process were suggested in the area. However, the impact zone expanded more than twofold during the rainfall event ($>20\text{mm/h}$). Nutrient contents were significantly high both in the sediment and pore water near the discharging points and it caused relatively high diffusion flux to overlying water. It suggests nutrient regeneration process from the sediment is the secondary loading process in the study area.

Keywords: sewage, nutrient, coastal canal , urbanization, groundwater

Impacts of cold-water intrusion on coral reef ecosystems at Nanwan Bay of southern Taiwan

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This study under the support of the Kenting National Park Headquarters, conducted an on-line real time monitoring system of the water quality in coral reef ecosystem of the Nanwan Bay, southern Taiwan. The monitoring parameters include temperature, salinity, conductivity, dissolved oxygen, pH, turbidity. The monitoring provides useful information to the scientific community, serves as records of contamination events and baseline data for environmental conservation. Results showed that On-line real time monitoring have also helpful explanation for natural episodic events (e.g., cold water intrusion) in this coral reef ecosystem. We have also compared the physiological stress responses Induced by fluctuating temperature regime of upwelling and constantly elevated temperature in *Pocillopora damicornis*. The study is to establish the early warning systems for the conservation of coral reefs. After reviewing the CREWS and related references, we propose to use DHW (Degree Heating Weeks) as the indicator of coral bleaching. The program is not only successfully fitted in the bench top simulation, but also has a successful application in field work. The on-line real time monitoring results with emphasizing on the short time scale, e.g., hours to days, effects on coral reef ecosystem has also been discussed in this study.

Keywords: cold-water intrusion, coral reef; ecosystems, bleaching

Deep marine sedimentation off the “huge-dam free” Shimanto river mouth, SW Japan: comparison with other Japanese rivers

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It has been well known that dam construction on rivers can cause a decrease in sediment supply and serious coastal erosion (e.g., Stanley and Warne 1998), while influence of dams on the sedimentary environment beyond the coastal area has not been well known. Decrease in mass accumulation rate (MAR) during the middle 20th century based on excess Pb-210 activity were reported from the hemipelagic environment off Kumano (Shirai and Omura, 2016) and off Niigata (Shirai et al., 2017), central Japan, and these decreases in MAR were inferred to have been caused by entrapment of silt-clay grains in the huge dam reservoir.

MARs since middle 20th century of core samples obtained from off the Shimanto river mouth, SW Shikoku region, which does not have huge dam, were examined based on excess Pb-210 activity. The core samples were obtained with multiple corer (core length < 60 cm) during the R/V Hakuho-maru KH-15-2 cruise (Leg. 3).

Subsamples sliced with 1 cm thick were dried, crushed and measured by an ORTEC High Purity Ge gamma spectrometer housed in the Department of Geography, Tokyo Metropolitan University with a 48 hours counting. MAR was estimated from Pb-210 radioactivity concentration and mass depth of the core samples based on dry bulk density of other subsamples measured with the Accupyc 130 gas pycnometer housed in Atmosphere and Ocean Research Institute, the University of Tokyo.

In the off SW Shikoku region, MARs of investigated cores are almost constant during the upper half of the cores corresponding to mid to upper 20th century. Distinct contrast between the constant MAR off the huge-dam-free Shimanto River with decrease in MAR off the rivers blocked by huge dams (Shirai and Omura, 2016; Shirai et al., 2017) agrees well with the inference that deposition in dam-reservoir decrease in riverine sediment supply to deep marine hemipelagic environments. It is also necessary to be aware of the influence that dam construction and other human activities have not only on riverine to coastal environments but also on the unseen deep marine environment.

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Keywords: deep marine, river, dam, excess Pb-210, mass accumulation rate (MAR)