Data rescue—collection of precious and laborious in situ observed data

Underwater video and still-image dataset of fishes and other aquatic animals in Lake Biwa, Japan, observed via carp-mounted video loggers

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Funding information
JSPS KAKENHI, Grant/Award Number: JP15K07545; River Fund of the River Foundation, Grant/Award Number: 2018-5211-020; Zoshinkai Fund for Protection of Endangered Animal

Abstract
This is the first large dataset of underwater videos from which species occurrence and behavioral records of aquatic organisms were identified in Lake Biwa, the largest lake in Japan. We compiled 109 videos and 122 still-images of fishes, diving birds and shrimps. The images were cropped from videos taken underwater with animal-borne video cameras which were mounted on the backs of common carp (Cyprinus carpio). The attribute of each image and its occurrence of organisms were formatted according to the Darwin Core Archive which was developed by the Biodiversity Information Standards (TDWG), and the dataset is available via the Global Biodiversity Information Facility. Our dataset includes records of 10 species, 4 genera, 2 families and 1 infraorder which includes mostly fishes, several birds and a crustacean. The fish records include a threatened endemic fish, the “gengorou-buna” crucian carp (Carassius cuvieri), and two alien fishes, largemouth bass (Micropterus salmoides) and bluegill sunfish (Lepomis macrochirus). We confirmed several types of intraspecific and interspecific relationships between video-mounted carp and other organisms; for example, most video-mounted carp frequently approached or chased conspecifics upon encountering, which sometimes led to two carp feeding side by side. At least three avian species also appeared in the dataset: Eurasian coot (Fulica atra), little grebe (Tachybaptus ruficollis), great crested grebe (Podiceps cristatus), but there was no apparent interaction between carp and these birds. Our underwater videos reveal and highlight the rich biodiversity of the lake today, providing clear evidence for behavior of aquatic organisms under natural conditions.

The complete data set for this abstract published in the Data Paper section of the journal is available in electronic format in MetaCat in JaLTER at http://db.cger.nies.go.jp/JaLTER/metacat/metacat/ERDP-2020-18.1/jalter-en.

Keywords
alien species, ancient lake, bio-logging, endemic species, waterfowl
1 | INTRODUCTION

Lake Biwa is a representative ancient lake in East Asia and harbors more than a thousand animal and plant species, which includes 67 indigenous freshwater species/subspecies (Nishino, 2005), and has therefore been regarded as an important biodiversity hotspot (Okuda, Watanabe, Fukumori, Nakano, & Nakazawa, 2014). Its coastal areas are especially important for endemic fishes as most of them inhabit or migrate to those areas during their life cycle (Hosoya, 2005; Nishino, 2005). For example, several endemic cyprinid fishes such as the Japanese crucian carp “gengorou-buna” (Carassius cuvieri), the round crucian carp “nigoro-buna” (Carassius buergeri grandoculis) and the native Japanese strain of common carp (Cyprinus carpio subsp. has been proposed for it in Atsumi, Song, Senou, Inoue, and Mabuchi (2017)) utilize the aquatic plant zone, which includes the reed zone along lakeshore, as spawning and developmental habitat (Mabuchi, 2019; Suzuki, Kobayashi, & Ueno, 2008). In addition, many waterfowl migrate to its shore zone every year for either breeding or wintering and are provided with suitable habitat as well as rich and diverse aquatic fauna to feed on (Hattori & Mae, 2001). Due to its importance for a broad range of animal taxa, the lake has been a registered wetland of the Ramsar Convention since 1993 and is one of the key sites for several waterfowl species in the East Asian–Australasian Flyway (Miyabashy & Mundkur, 1999). Since the 1960s, the lake has suffered from several human-induced disturbances such as eutrophication, habitat alteration, introduction of exotic species and global warming (Okuda et al., 2014) due to its catchment which is the second greatest population density among the 29 ancient lakes in the world (Hampton et al., 2018). These anthropogenic threats, acting in combination, quickly deteriorated the lake’s ecosystem especially in the coastal areas, where human activities mainly occur. Collecting biological information of these areas is important for evaluating biodiversity in the lake and planning appropriate methods for its conservation.

Utilization of underwater images for environmental monitoring in the lake began in early 2000 using remote operating vehicles and an autonomous underwater vehicle called “Tantan” (Kumagai, Ura, Kuroda, & Walker, 2001). These robots were used to detect and monitor microorganisms such as harmful red tide algae (Ishikawa, Kumagai, & Ross, 2005) and swarms of an endemic freshwater amphipod (Ishikawa & Kumagai, 2014). Images of macroorganisms were also taken in a relatively static conditions: mass mortalities of benthic gobies and freshwater prawns that suffered from severe hypoxia were observed using the underwater vehicles in the deep waters of the lake in 2007 and 2008 (Kumagai, Ishikawa, & Tanaka, 2009). Although these observations in deep/offshore waters of the lake have brought us a unique and distinctive dataset, the dataset remains unpublished to date. Moreover, information on mobile macroorganisms, such as behavior of fishes under natural conditions, remains unknown because machine-caused disturbances (i.e., acoustic noise, artificial lighting turbulence) can easily disrupt “natural” behavior of animals and in the worst cases will cause animals to retreat from observable areas.

Recently, animal-borne devices such as data loggers have been widely used for marine environmental and biological observations (Fedak, 2013; Wilmers et al., 2015). Among these devices, video loggers have been regarded as powerful tools used to collect fine-scale animal behavior data and data on the surrounding environment by unhabituated, free-ranging animals under relatively undisturbed conditions (Moll, Millsbaugh, Beringer, Sartwell, & He, 2007; Thomson & Heithaus, 2014). In this study, we deployed video loggers via common carp (C. carpio including both native Japanese strain and non-native Eurasian strain), which is an ideal species to use as a remote sampling platform. Common carp is one of the largest fish species inhabiting Lake Biwa and its large body size (>50 cm in total length in present study) enabled us to attach data loggers with few disturbances. In addition, its non-piscivorous, omnivorous diet (Sibbing, Osse, & Terlouw, 1986; Sibbing 1988) enabled us to observe other fishes and their behavior under “natural” conditions without triggering nearby fish to escape.

Furthermore, as the native Japanese strain of the common carp is listed as an endangered local population (“LP”) in the fourth version of the Japanese Red Lists (Ministry of the Environment, Government of Japan, 2019), collecting fundamental information on the species is important for its effective conservation. The presented dataset is an archive of natural behaviors of fishes and birds observed underwater from a “carp’s-eye view,” providing presence (or distribution) information and behavioral snapshots of various aquatic organisms including the carp itself.

2 | DATA DESCRIPTION

2.1 | Identifier

ERDP-2020-18
2.2 | Contributor

2.2.1 | Dataset owner and contact person

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2.2.2 | Data management

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2.3 | Projects

2.3.1 | Title

Filming a documentary through carp-eyes: Observation of fish fauna in Lake Biwa using animal-borne video loggers.

2.3.2 | Personnel

Principal Investigator: Makoto A. Yoshida
Co-Investigator: Kohji Mabuchi, Katsufumi Sato

2.3.3 | Funding

The project was supported by the River Fund of the River Foundation, a grant-in-aid of The Zoshinkai Fund For Protection of Endangered Animals, Japan (both held by MAY), and JSPS KAKENHI Grant Number JP15K07545 (held by KM)

2.4 | Geographic coverage

The study area was located in the northern part of the North Basin of Lake Biwa, Japan, and was enclosed within the following coordinates: 35.287–35.454 N, 136.018–136.225 E (Figure 1).

2.5 | Temporal coverage

This study was conducted from October 2016 to December 2018. Samplings were made through five field experiments as follows: (a) an experiment in October 2016, (b) another experiment in November 2017 and (c) three experiments from November to December 2018.

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**FIGURE 1** Geographic information of present study. Location of our study site and the geographic coverage of current study shown (a). Current study was conducted in Northern part of the North basin of Lake Biwa (b). Filled circles indicate where video-mounted common carps were released; two fish were released near Chikubushima Island between 2016 and 2017, six fish were released at the river mouth of the Chounogi River in 2018 and one fish was released at Adogawahama beach in 2018. Black bars on the figure frame and a corresponding square with a dotted borderline indicate the geographic coverage of the study.
2.6 | Methods

2.6.1 | Study sites

Lake Biwa is the largest lake in Japan, having an area of 670 km². It is located in central Japan (Figure 1a) and has a catchment area of 3,848 km². The lake is divided into two areas: the North Basin and South Basin (Figure 1b). The North Basin is deep (average depth: 43 m, maximum depth: 104 m) and mesotrophic, while the south basin is shallow (mean depth: 4 m) and eutrophic.

2.6.2 | Sampling methods

Samplings were made through five field experiments using nine fish as follows: (a) an experiment using one fish in October 2016, (b) another experiment using one fish in November 2017 and (c) three experiments using six fish from November to December 2018. Animal-borne video loggers (DVL200L; 27 mm width, 116 mm length, 10 mm height and 57 g in air, or DVL400M130; 21 mm width, 68 mm length, 22 mm height and 47 g in air, Little Leonardo, Tokyo, Japan) were used to collect video footage underwater. The logger was molded into a float with an accelerometer (ORI400-D3GT; 12 mm diameter, 45 mm length and 9 g in air, or W190-PD3GT; 21 mm diameter, 116 mm length and 60 g in air, Little Leonardo), a VHF transmitter (MM-130B; 16 mm diameter, 60 mm length and 20 g in air, Advanced Telemetry Systems, MN) and a time-release system (RT4; 16 mm diameter, 25 mm length and 16 g in air, Little Leonardo), and was then mounted on the back of each carp using a plastic cable tie. The float was shaped to reduce drag and it provided just enough buoyancy to return the instrument package to the surface upon release. All carp were released near the site at which they were captured (Figure 1b). The video loggers were set to start recording in the morning (6:00 or 7:00 JST) three (or five) days after the fish’s release. The recording duration was 6 hr for DVL200L and 11–12 hr for DVL400M130. On the fourth (or sixth) day, the float detached from the fish, floated to the water surface, and was retrieved.

2.6.3 | Extraction of organisms from videos

The video data were formatted in MP4 (3 or 6 Mbps, 30 fps) format. A total of 64 hr of video was taken. Images that contained any aquatic animals were cropped

| TABLE 1 | Data file components |
|----------|----------------------|
| Data file name | Files included | Description |
| dwca-nies_biwakoi.zip | eml.xml | Metadata file of the dataset in ecological metadata language. |
| | meta.xml | XML descriptor file that defines Darwin Core formatted data columns. |
| | event.txt | Darwin Core formatted records of sampling events. |
| | extendedmeasurementorfact.txt | Darwin Core formatted records of environmental data including water temperature and water depth, as well as measurements of released individuals. |
| | multimedia.txt | Darwin Core formatted records of videos and images included in this dataset. |
| | occurrence.txt | Darwin Core formatted occurrence records of released individuals and their animal encounters which appeared in videos. |
from obtained video footage using iMovie software (ver.10.1.9, Apple, CA). Color values of the images were adjusted using the “Automatic Color Adjustment” tool in the software.

### 2.6.4 Taxonomy and systematics

All species were identified by the authors or by professional experts. If we could not obtain sufficient information to identify a species from the videos (e.g., a blurring due to fish movements), we classified the organism to a higher taxonomic level (e.g., order, class and family) that could be specified with certainty. Scientific names followed the Global Biodiversity Information Facility (GBIF) backbone taxonomy (https://www.gbif.org/species/) and the Hoshino et al., 2003. To identify avian species in the study area, daily occurrence reports of birds, provided by Kohoku Wild-Birds Center, (Bird News; http://www.biwa.ne.jp/~nio/newsindex.html) were used as a reference.

### 2.7 Data structure

#### 2.7.1 Data files

Data file components is shown in Table 1.

#### 2.7.2 File format

The data files are formatted according to the Darwin Core Archive which was developed by the Biodiversity Information Standards (TDWG). The Darwin Core is a standard file format for compiling biodiversity data used in GBIF. This sampling-event dataset contains an Event core with multiple extensions: an Occurrence, an Extended Measurement or Facts, and Audubon Media Description. The core and extensions are arranged in “star schema” (https://github.com/gbif/ipt/wiki/BestPracticesSamplingEventData#sampling-event-data) and the files are linked using an eventID (Figure 2). The data files are presented in a tab-delimited text file.
format and compressed into a ZIP file together with a metadata file and a descriptor file. All files are in UTF-8 encoding.

### 2.7.3 Data storage

Data can be downloaded from GBIF and the Japan Long-Term Ecological Research database. The dataset is published through GBIF (http://www.gbif.jp/ipt/resource?r=nies_biwakoi). Videos and images can be viewed at: https://www.nies.go.jp/biwakoi/index.html; the web database—“Lake Biwa Underwater-Video Archives: from a Carp’s-eye view”—provided by the Center for Environmental Biology and Ecosystem Studies, NIES, Japan.

### TABLE 3 Variables in “occurrence.txt”

| Variable name | Description |
|---------------|-------------|
| id            | An identifier for the set of information associated with a sampling event including fish release and underwater videos. This variable is automatically generated by GBIF IPT2 (https://www.gbif.org/ipt) referring to eventID. |
| modified      | The most recent date on which the occurrence record was changed. |
| institutionCode | The acronym of the institution having custody of the information referred to in the occurrence record. |
| collectionCode | The short name of the dataset of which the occurrence record was derived. |
| basisOfRecord | The specific nature of the occurrence record. |
| occurrenceID | An identifier for the occurrence record consisting of institutionCode, collectionCode and catalogNumber. |
| catalogNumber | An identifier for the occurrence record within the dataset. |
| occurrenceRemarks | Comments about the occurrence. |
| recordedBy | Person responsible for recording the original occurrence. |
| occurrenceStatus | A statement about the presence or absence of an organism at a location. |
| associatedMedia | A list of identifiers of multimedia associated with the occurrence. |
| associatedOccurrences | A list of identifiers of other occurrence records associated with this occurrence. |
| eventID | An identifier for the set of information associated with a sampling event including fish release and underwater videos. |
| identifiedBy | A list of names of people who assigned the taxon to the subject. |
| scientificName | The full scientific name in which the taxon is classified. |
| kingdom | The name of the kingdom in which the taxon is classified. |
| phylum | The name of the phylum in which the taxon is classified. |
| class | The name of the class in which the taxon is classified. |
| order | The name of the order in which the taxon is classified. |
| family | The name of the family in which the taxon is classified. |
| genus | The name of the genus in which the taxon is classified. |
| speciesEpithet | The name of the species epithet of the scientificName. |
| taxonRank | The taxonomic rank of the most specific name in the scientificName. |
| vernacularName | Japanese common name in which the taxon is classified. |
| taxonRemarks | Comments about the taxon. |

Abbreviation: GBIF, Global Biodiversity Information Facility.

### TABLE 4 Variables in “extendedmeasurementorfact.txt”

| Variable name | Description |
|---------------|-------------|
| id            | An identifier for the set of information associated with a sampling event including fish release and underwater videos, namely eventID. |
| occurrenceID | An identifier for the occurrence record consisting of institutionCode, collectionCode and catalogNumber. |
| measurementType | The nature of the measurement. |
| measurementValue | The value of the measurement. |
| measurementUnit | The unit associated with the measurement. |
| measurementMethod | A description of the method used to determine the measurement. |
| measurementRemarks | Comments about the measurement. |
2.7.4 | Data table descriptions

Data tables of each file are shown in Tables 2–5. Descriptions are referred from Darwin Core via the TDWG website (TDWG, 2019).

Table 2 shows the variable names of the data file named “event.txt”. The data file named “occurrence.txt” has the variable names as shown in Table 3.

The variable names of the data files named “extendedmeasurementorfact.txt” and “multimedia.txt” are shown in Table 4 and Table 5, respectively.

| Variable name | Description |
|---------------|-------------|
| id            | An identifier for the set of information associated with a sampling event including fish release and underwater videos, namely eventID. |
| identifier    | An identifier of the media resource (i.e., URL). |
| type          | The type of media resource. |
| title         | The title of the media resource. |
| modified      | The most recent date on which the media resource was altered. |
| metaDataLanguageLiteral | The ISO639-2, three-letter language code, of the language used in the resource metadata record. |
| rights        | Information about rights held in and over the media resource. |
| Owner         | A list of the names of the owners of the copyright. |
| UsageTerms    | The license statement defining how the media resource may be used. |
| creator       | The person responsible for creating the media resource. |
| providerLiteral | The organization responsible for presenting the media resource. |
| metaDataProviderLiteral | The organization responsible for providing the resource metadata record. |
| description   | The description of the media resource. |
| accessURL     | The URL of the media resource. |
| format        | The technical format of the media resource. |
| serviceExpectation | A term that describes what service expectations users may have of the accessURL (i.e., online). |

2.8 | Accessibility

2.8.1 | License and usage rights

Users can download the datasets via the internet under a Creative Commons attribution license CC-BY 4.0 International (https://creativecommons.org/license/by/4.0/legalcode).

2.8.2 | Location of storage

http://db.cger.nies.go.jp/JaLTER/metacat/metacat/ERDP-2020-18.1/jalter-en.

ACKNOWLEDGMENTS

The authors are deeply grateful to Mr Masatomi Matsuoka of the Asahi Fisheries Cooperative Association for providing the studied animals and assisting with the fieldwork. The authors appreciate Mr Jun Ueda of the Kohoku Wild Birds Center for his help in species identification of birds. The authors would also thank two anonymous reviewers for their valuable comments to improve the quality of the paper. This study was financially supported by the River Fund of the River Foundation, a grant-in-aid of The Zoshinkai Fund For Protection of Endangered Animals, Japan (both held by M. A. Y.) and JSPS KAKENHI Grant Number JP15K07545 (held by K. M.).

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**How to cite this article**: Yoshida MA, Totsu K, Sato K, Mabuchi K. Underwater video and still-image dataset of fishes and other aquatic animals in Lake Biwa, Japan, observed via carp-mounted video loggers. *Ecological Research*. 2020;35:1001–1008. https://doi.org/10.1111/1440-1703.12158