Metadata

Life-history data on Hunder brown trout (Salmo trutta) from Lake Mjøsa, Norway

General information

name of the dataset:

full name of the dataset: *Life-history data on Hunder brown trout (Salmo trutta) from Lake Mjøsa, Norway*

dataset short name: *Life-history data on Hunder trout*

type of dataset (more information): *species (taxonomic group) per site database including environmental information*

specify: *Life-history (age, growth, migration, spawning)*

data type: *point data/observation data, descriptive data*

short description of the dataset/summary:

The dataset contains individual data for almost 8,000 brown trout (Salmo trutta L., 1758) captured during their spawning migration from Lake Mjøsa to the main tributary River Gudbrandsdalslågen in Norway during the period 1966 to 2005. These individuals belong to the large-sized piscivorous population of brown trout named Hunderørret (Hunder brown trout). A majority of these trout spawn upstream the waterfall Hunderfossen. Ascending this large waterfall, the migration length and characteristics of the spawning areas, are probably selection drivers for the large body sizes this population achieves compared to any other populations of piscivorous brown trout spawning in other rivers draining to Lake Mjøsa.

A hydropower dam was established at Hunderfossen between 1961 and 1964, causing a migration barrier for the Hunder brown trout. A fish ladder was also built, making the ascent possible from 1966, but not without negative effects (Aass 1990). The functionality seems to vary due to water temperature and water flow (Jensen & Aass 1995). The body size seems to affect the success of both entering and ascending the ladder. Additionally, the dam reduced survival of both smolt and kelt, due to predation in the dammed area and turbine passage mortality during downstream migration. The damming also reduced the areas of productive fish habitats in the river both upstream and downstream the dam (Aass et al. 1989).

When the fish ladder was opened, allowing the spawners to pass the dam, a capture-mark-recapture program was initiated. Trap capture, individual measurements, tagging, scale sampling and registration of recaptured repeated spawners in the fish ladder, were then implemented in a monitoring program. All spawners caught in the trap were individually measured and tagged with numbered Carlin tags (Carlin 1955).

To abate the reduced natural production of Hunder brown trout in the regulated river, a stocking program was initiated during the mid-1960s. The

stocked fish are mainly released as 2-years old both in the river and directly into the lake (15,000-20,000 individuals per year). The stocked fish also returns to the river on spawning runs as mature adults. This long-time data series has been continued more or less unchanged until it was terminated in 2016. All stocked brown trout were tagged by cutting the adipose fin prior to release. To evaluate and optimize the stocking strategy, a large number of stocked smolt individuals were also tagged. Hence more than 30,000 individuals (both wild and stocked, spawners and smolts) have been marked individually with Carlin tags before release both upstream and downstream the Hunderfossen dam during 1966-2015. For a subset of these fish, approximately 8,000 individuals who climbed the fish ladder between 1966 and 2005, information on age, growth, time of migration and spawning history has been obtained from schlerochronological analysis of the sampled scales. This data has also been used to back-calculate yearly growth and to identify important life-history information such as hatching year, growth in river, age and size at smoltification, growth in lake, age and size at sexual maturation, and number of spawning events (e.g. Haugen et al. 2008).

Based on the 1966-2005 data the Hunder brown trout typically spend their first three to five years as parr in the river before migrating downstream to Lake Mjøsa (corresponding to smoltification and seaward migration in anadromous salmon and trout). In the lake they typically prey on fish for two to four years before maturation and migration back to the river to spawn. The Hunder brown trout typically perform biennial spawning runs and average age at first spawning run is ca. 7 years. Average size at first spawning run is ca. 3.5 kg and 65 cm. The Hunder brown trout seem to have a potential maximum life span of 15-20 years and a potential maximum size of 15-20 kg and >100 cm. However, less than 10% of the spawners reach age above 10 years, and less than 1% of the spawners reach weight above 10 kg.

keywords according to GCMD**:**

topic: *Agriculture, Biosphere, Biological Classification, Climate Indicators, Human Dimensions, Terrestrial Hydrosphere*

ISO topic category according to ISO 19115**:**

Farming, Biota, Climatology/Meteorology/Atmosphere, Economy, Elevation, Environment, Inland Waters, Location, Society, Structure, Utilities/Communications

INSPIRE keywords according to GEMET**:**

own science keywords: *lake, brown trout, Salmo trutta, hydropower dam, migration, growth, spawning, capture-mark-recapture, schlerochronology, scales, smoltification, monitoring, fishing, Hunderfossen, Hunder trout, age*

Technical and administrative specifications

data format:	*Access*
operating system:	*all Windows systems*
data language:	*English*
specify:	*Originally Norwegian, translated to English.*
current access level:	*restricted access*
others/details:	*The dataset is currently not publicly available, but may be obtained on request, on certain conditions.*
currently available through GBIF:	*no*
exchange planned:	*no*
data in data repository:	*no*
Do you plan to publish the data on the Freshwater Biodiversity Data Portal:	*no*
update level:	*update planned*
others/details:	*The life-history data are obtained from fish scale samples during 1966-2005. A large amount of additional scales have been sampled and stored, but not yet analysed (2006-2015).*
documentation:	
type:	*internal description*
others/details:	*More information is also available in various reports (in Norwegian).*
language:	*English*

contact details:

metadata contact person:	
first, last name:	*Atle Rustadbakken*
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email:	*per.aass@nhm.uio.no*

comments: *Per Aass is retired, but affiliated at the Zoological Museum of the University of Oslo.*

Intellectual property rights and citation

(if the dataset is already published):

dataset creator (data compiler):

contact name:	*Atle Rustadbakken*
contact email:	*atle@rustadbakken.no*
contact institution:	*The Environment Agency, County Governor of Hedmark*

data contributors to/owners of this dataset:

	multiple
number:	*2*

provider 1:

provider institute:	*County Governor of Hedmark*
contact name:	*Atle Rustadbakken*
contact email:	*atle@rustadbakken.no*
criteria for using the data in a publication/scientific analysis:	
	The dataset needs to be requested from dataset creator with specific conditions of use.
comments:	*The Norwegian Institute for Water Research (NIVA) by Jannicke Moe has been given the administrator rights for a period of five years (2016-2020) with option for prolongation.*

provider 2:

provider institute:	*University of Oslo*
contact name:	*Per Aass*
contact email:	*per.aass@nhm.uio.no*
criteria for using the data in a publication/scientific analysis:	
	The dataset needs to be requested from dataset creator with specific conditions of use.
comments:	*As for data contributor/owner 1.*

citation of this dataset:

author(s):	*Aass, P. & Rustadbakken, A.*
title and journal (name, number, pages):	
	Life-history data on Hunder brown trout (Salmo trutta) from Lake Mjøsa, Norway (dataset)
year:	*2017*
version (if applicable):	*1*

citation of the metadata:

General data specifications

regional coverage of the dataset:

spatial extent of the dataset:	*catchment*
continents:	*Europe*

spatial extent (bounding coordinates):

southernmost latitude [°]:	*60.400*
northernmost latitude [°]:	*61.220*
westernmost longitude [°]:	*10.433*
easternmost longitude [°]:	*11.294*
minimum altitude:	*123 metres*
maximum altitude:	*175 metres*
countries:	*Europe: Norway*
comments:	*Capture, mark and recapture data of Hunder trout (without information on growth and spawning) are available for a larger number of individuals (30,000). These data will be described in a separate metadata paper.*

Site specifications

coordinate system/grid data:	*latitude/longitude, format: DD*
datum (e.g. WGS84):	*WGS84*
grid data available:	*no*
comments:	*For most data points a location is reported, but not coordinates.*
site coding available:	*no*
number of sites:	*<100*
comments:	*A large number of sites have been reported. In addition to the original site names, the sites are aggregated to larger regions (e.g. "lake", "river above dam" or "river below dam").*

Climate and environmental data

climate related data:

available per:	*site*
available parameters:	
	mean annual temperature January, July
	www.eklima.no data source:
	mean annual temperature for each month
	www.eklima.no data source:
	minimal, maximal and mean winter and summer temperatures
	www.eklima.no data source:
	daily air temperatures
	www.eklima.no data source:
	mean annual precipitation
	www.eklima.no data source:
	winter and summer precipitation
	www.eklima.no data source:
	mean discharge
	www.eklima.no data source:
comments:	*Daily meteorological data can be downloaded from eklima.met.no, stations Kise (12550) and Toten (11500).*

environmental data:

available parameters per catchment:	*catchment size*
	www.vannmiljo.no data source:
available parameters per catchment:	*catchment geology*
	www.ngu.no data source:
available parameters per catchment:	*catchment land cover/land use*
	Løvdata et al. 2016 data source:
available parameters per catchment:	*population density*
	Hobbie et al. 2012 data source:
available parameters per catchment:	*presence of barriers/dams/reservoirs (fragmentation)*
	www.nve.no data source:
available parameters per catchment:	*hydrological regime/flow regime*
	www.nve.no data source:
available parameters per site:	*catchment land use upstream of sampling site*
	Løvdata et al. 2016 data source:
available parameters per site:	*information on water uses (e.g., irrigation, fish ponds)*
	Løvdata et al. 2016 data source:
available parameters per site:	*distance to next migration barrier upstream*
	www.nve.no data source:
available parameters per site:	*distance to next migration barrier downstream*
	www.nve.no data source:
available parameters per site:	*distance to the next lake upstream*
	www.nve.no data source:
available parameters per site:	*distance to the next main village/town upstream*
	www.gulesider.no data source:
available parameters per site:	*river length*
	www.nve.no data source:

available parameters per site: *distance to source*
www.data.no data source:
available parameters per site: *distance to mouth*
www.data.no data source:
available parameters per site: *stream order (according to Strahler)*
www.data.no data source:
available parameters per site: *slope*
www.data.no data source:
available parameters per site: *altitude*
www.data.no data source:
available parameters per site: *hydrological regime/flow regime*
www.data.no data source:
available parameters per site: *discharge*
www.data.no data source:
available parameters per site: *maximum depth*
www.data.no data source not: *no*
available parameters per site: *mean depth*
www.data.no data source not: *no*

physico-chemical data: *Array, Array, Array, Array, Array, Array, Array, Array, Array, Array, Array, Array, Array*

other physico-chemical parameters: *Other environmental data are available from NIVA (described by Løvik & Moe 2016). Other parameters (lake data): E. coli (2009-2011), ice cover (1949-2009), primary production, SiO2, turbidity.*

availability of physico-chemical data, if there is more than one sample per site: *per sample*

stressors influencing the sites:

reference sites available: *no*

stressor	restored sites available	data before/after restoration available	stressor gradient available	comments
eutrophication	yes	yes	yes	
organic pollution	no	no	no	
toxic stress	no	no	no	
hydrologic stress (e.g. impoundment, flow velocity reduction, hydropeaking, water abstraction, flow velocity increase, etc.)	yes	no	yes	Hunderfossen dam constructed in 1961-1964
thermal stress	yes	no	yes	Lake temperature has increased during the monitoring period.

Biological data

biological data origin:	*from sampling,*
specify project:	*Monitoring program with annually registration and tagging of migrating trout in the fish ladder since 1966; various projects and funding sources.*
specify method:	
organism group addressed:	*fish*
comments:	*Data on other organism groups from Lake Mjøsa (phytoplankton, zooplankton) and River Gudbrandsdalslågen (phytobenthos, macroinvertebrates) are available from other sources (see Løvik et al. 2016, Løvik & Moe 2016).*

Sample specifications/sample resolution

fish:

sample information:

covered timeframe:

year from - to: *1966 - 2005*

historical data: *yes*

palaeo data: *no*

season: *autumn*

temporal resolution/frequency of sampling:

per year

time series data: *yes*

comments: *Most of the samples were taken in autumn, when fish are caught in the fish ladder during spawning migration.*
The data can be considered a time series since the same method has been applied to monitor a population over a long period of time.

taxonomic resolution:

percentage of species level data: *100*

comments: *All data are on one species (brown trout, Salmo trutta L.), from one population (Hunder brown trout).*

taxonomic coding:

coding system: *species name*

example: *Salmo trutta*

sample specifications:

replicate samples: *yes*

number of samples: *7381*

specification of method(s) used for sampling and sorting:

The fish were captured either in the fish ladder (and usually released), or by fishing (and usually killed). Information on capture location, date and method were reported for individually marked fish.

Ascending trout were trapped in the fish ladder at Hunderfossen hydropower dam on their spawning run. After registration of length and weight, some 4-6 scales were sampled with a small forceps. Scales were sampled from the area above the lateral line between the dorsal and the adipose fins. The fish were sexed based on secondary sex characteristics. The origin (wild or stocked) was registered based on whether the adipose fin was intact or not (removed = stocked). After registration and sampling, the fish were individually tagged with Carlin tags, consisting of a disc with information and a stainless steel thread to fix it to the fish (Carlin 1955). After tagging the fish were released into the fish ladder above the trap allowing them to pass the dam and migrate to their spawning areas. However, a number of fish were each year held in a river pool until time of spawning. These fish were used as brood fish in the stocking program and the fertilized eggs were placed in a hatchery located next to the dam.

The collected scales were stored dry in paper envelopes until preparation and reading. The majority of the scales were impressed on clear cellulose acetate plastic slides. These slides were analyzed on a microfilm projector. The last two years of available samples, 2004 and 2005, were digitized for computer-based reading and measuring.

The scales add sclerites as the fish grow. During periods of fast growth the distance between the sclerites are larger than during slow growth periods. Since fish are ectoterms, winter growth is considerably slower than summer growth at this latitude. Annuli are end-of-winter checks that represents the start of a new growth season. The age of the fish was determined by counting the number of annuli in the scales.

Based on the assumption that scale radius growth is linearly correlated to the body growth, it is possible to back-calculate the size of the fish during each year of its life. As annuli checks identifies seasonal patterns in the scales, the growth pattern can also reveal time of niche shifts. The age at migration from river to lake often corresponds to the shift between invertebrate and fish diet. Fish diet normally results in faster growth and the switch is therefore detectable in the sclerite pattern. Hence, age at smoltification can also be determined from scale reading. Finally, spawning also creates checks in the scale. The standard output from a scale analysis of the Hunder trout is therefore river age and lake age (which sum to total age), yearly river growth and yearly lake growth, age at smoltification, age at maturity and number and time of spawning runs.

citation: *Panfili et al. 2002*

sample type (e.g. habitat specific samples, composite samples etc.):

Capture of individual fish (capture-mark-recapture).

specific sample location (e.g. littoral, profundal, transect, shoreline, hyporheic zone, etc.):

Any location in Lake Mjøsa and its main tributary River Gudbrandsdalslågen, including the trap in the fish ladder in Hunderfossen waterfall.

other important sample related informations:

Annually tagging and registering of all upstream migrating spawners at Hunderfossen and typical biennial spawning have resulted in a number of individuals sampled for scales at several occasions together with individual measurements of body length. We can compare back-calculated length at a given year with manually measured body lengths that have been collected on earlier spawning runs of the same fish. We can also calculate the precision and variability of the back-calculated year-specific body lengths on a number of scales sampled at several spawning occasions. The amount of fish with repeated scale sampling and measurements in this dataset allows us to validate the back-calculations against ground truth data.

Other specifications

GIS layers, shape files related to the dataset:
no data available

availability of photos: *yes*

availability of maps: *yes*

quality control procedures:

Were any quality control procedures applied to your dataset?
no

comments: *The authors have contributed as follows:*
Per Aass initiated this important monitoring program when the dam was constructed, and was in charge of the tagging of fish in the fish ladder for several years. Tore Qvenild has supported with computer assistance, digitizing and establishing the first version of the database and early stage analysis of these data. Atle Rustadbakken has been responsible for data cleaning and data compilation. He has also worked closely together with P. Aass on the age and growth analyses of the scales from thousands of trout. Espen Lund has also been involved in the data cleaning process, developing digital documentation, the analysis process and reading growth structures from fish together with A. Rustadbakken. Jannicke Moe has been responsible for constructing a relational database structure in Microsoft Access, importing the data from various Microsoft Excel files, and exporting data for sharing with other researchers.