Vulnerability assessment of ecosystem services for climate change impacts and adaptation (VACCIA)

Action 8: Vulnerability and adaptation of catchment areas and lakes for climate change impacts

Foto: Ilpo Hakala

Report on data collection in the Lammi LTER area in 2010

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Life VACCIA

Tiivistelmä

EU:n LIFE+ -ohjelmaan kuuluva VACCIA-hanke (Luonnon tarjoamien palveluiden haavoittuvuusarviointi ja sopeutuminen muuttuvaan ilmastoon) alkoi tammikuussa 2009. Työpaketti 8 tehtävänä on Lammin LTER alueelta kerättyjä lyhyt- ja pitkäaikaisia seuranta-aineistoja analysoimalla arvioida valuma-alueiden ja järvien herkkyyttä ilmastonmuutoksen vaikutuksille, sekä pyrkiä löytämään valuma-alueille ja järville toimivia hoito- ja sopeutumistapoja.

Lammin LTER alueella pitkäaikaista ekologista tutkimusta on tehty useilla eri alueilla ja paikoilla ja käynnissä on useita seurantaohjelmia. Pääjärven alueella järveen tulevaa kuormitusta sekä järven vedenlaatua ja biologiaa on seurattu Lammin biologisen aseman toimesta säännöllisesti vuodesta 1993 lähtien. Pääjärveen laskevien purojen vedenlaadun viikoittaista seurantaa viidellä osavaluma-alueella jatkettiin myös vuonna 2010. Myös Pääjärven vedenlaadun sekä kasvi- ja eläinplanktonyhteisön koostumuksen kuukausittaista seurantaa huhtikuusta marraskuuhun järven syvännehavaintopaikalla jatkettiin vuonna 2010.

Evon alueella Valkea-Kotisen vedenlaatua ja biologiaa on seurattu Lammin biologisen aseman toimesta vuodesta 1990 lähtien. Valkea-Kotisen seurantaa jatkettiin vuonna 2010 ja näytteitä kerättiin joka toinen viikko huhtikuusta lokakuuhun. Vedenlaadun sekä kasvi-, bakteeri- ja eläinplanktonyhteisön koostumuksen seurannan lisäksi myös järven perustuotantoa mitattiin. Lisäksi Evon alueella on vuodesta 1977 alkaen seurattu 24 pienen metsäjärven vedenlaatua. Vuodesta 1988 lähtien seurantaohjelmaan on kuulunut yli 30 järveä. Näytteenottoa jatkettiin vuonna 2010 ja vesinäytteet otettiin järvistä sekä kevättalvella että syksyllä.

Tulosten perusteella jääpeitteinen aika on lyhentynyt viimeisten 20 vuoden aikana sekä Pääjärvessä että Valkea-Kotisessa. Pääjärven kohdalla jäätymisajankohta on siirtynyt viime vuosina usein tammikuun alkupuolelle, mikä on noin kuukauden keskimääräistä jäätymisajankohtaa myöhempi. Valkea-Kotinen puolestaan on viime vuosina jäätynyt ja sulanut kahteen tai kolmeen kertaan syksyllä, mikä on uusi ilmiö.

Pääjärven ravinnepitoisuudet kasvoivat 1990-luvun loppupuolelle asti, jonka jälkeen erityisesti kokonaisfosforipitoisuus on laskenut ja on nykyään alle 10 µg/l. Erityisesti sadannan vaikutukset näkyvät ravinnepitoisuuksissa, koska kuormitus on sateisina vuosina suurempi kuin vähäsateisina vuosina. Kokonaisfosforipitoisuuden lasku selittyy paljolti maankäytössä tapahtuneilla muutoksilla kuten vähentyneellä lannoitteiden käytöllä.

Seurantaohjelmien tuottamia aineistoja tullaan käyttämään hyödyksi mm. seminaareissa ja VACCIA-hankkeen loppuraportissa. Sopeutumistapojen sekä valuma-alueille ja järville suunnattujen uusien toimenpiteiden ja hoitotapojen toimivuutta tullaan arvioimaan kriittisesti olemassa olevaan tietoon perustuen. Pitkäaikaiset seuranta-aineistot ovat osoittautuneet tässä yhteydessä äärimmäisen arvokkaiksi. Tärkeimmistä tuloksista Valkea-Kotisen 20 vuoden seuranta-aineistojen osalta tullaan julkaisemaan laajalle yleisölle suunnattu raportti osana VACCIA-hankkeen raportointia vuoden 2011 loppuun mennessä. Muut tärkeimmät tulokset tullaan välittämään alueellisille toimijoille ja yleisölle työpajoissa, seminaareissa, tulevissa raporteissa sekä muissa yleisölle suunnatuissa viestimissä.

1. Introduction

EU Life+ funded project “Vulnerability assessment of ecosystem services for climate change impacts and adaptation (VACCIA)” started in January 2009. Part of the project Action 8 focuses on the vulnerability of catchment areas and lakes to climate change impacts, and related adaptation measures. Analyses are based on short-term and long-term data sets from Lammi LTER area, which is one site of the Finnish Long-Term Socio-Ecological Research Network (FinLTSER).

The Lammi LTER area in southern Häme consists of several core sites and areas. The Evo Forest and Lake Area (EVO) is the largest one of the areas and has a special value in terms of long-term ecological studies. One of the core sites of the Evo is Kotinen nature reserve area and the intensively studied Lake Valkea-Kotinen therein. Lake Pääjärvi and its catchment area in the southern parts of the Lammi LTER area is another one of the intensively studied areas.

The aim of this report is to describe the data collection in the Lammi LTER area in 2010. Another aim of this report is to present few key results, which based on long-term data sets, as an example for vulnerability assessment purposes of catchment areas and lakes to climate change impacts and related adaptation measures.

Foto: Lammi Biological Station

2. Data collection and monitoring programs in Lake Pääjärvi area

2.1. Monitoring of loading to Lake Pääjärvi

Water chemistry sampling in five inflowing rivers were continued in 2010 on the weekly basis. The rivers are the main outflows of the five sub-catchments, and altogether correspond >80 % of the total catchment area of Lake Pääjärvi. The water chemistry sampling has continued on the regular basis since 1993.

The water chemistry samples have been analysed at the laboratory of Lammi Biological Station, University of Helsinki. The laboratory takes part annually in the inter-calibration measures organised by the Finnish Environment Institute, an assurance action which proves the high quality of the measurements. In addition to the laboratory measurements also *in situ* water temperature, pH, conductivity and CDOM were measured in the field.

In addition to the chemistry measurements also hydrological data in terms of daily discharge is available from three of the five rivers, namely from River Mustajoki, River Haarajoki and River Löyttynoja. The hydrological data is gathered by the Finnish Environment Institute (SYKE), and can be downloaded from the Hertta database.

2.2. Monitoring of lake physics, water chemistry and biology in Lake Pääjärvi

Lake physics, water chemistry and plankton sampling in Lake Pääjärvi was carried out in 2010 on monthly basis since April till November. Sampling depths were 0-5 m, 5-10 m, 10-15 m, 20 m and 30 m. The water samples were analysed at the laboratory of the Lammi Biological Station, University of Helsinki. In addition, *in situ* water temperature and oxygen profiles were measured in the field from the entire water column (0-80 m) in the deepest point of lake. Plankton sampling comprised both phytoplankton and zooplankton. Similar sampling program has been continued since 1993.

Foto: Lauri Arvola

3. Data collection and monitoring programs in Evo forest and lake area

3.1. Monitoring of lake physics, water chemistry and biology in Lake Valkea-Kotinen

Water chemistry and plankton sampling in Lake Valkea-Kotinen was carried out in 2010 on biweekly basis since April till October. Sampling covers the uppermost 0-5 m water column. In addition, water temperature and oxygen concentration were measured from the entire water column (0-6 m) in the deepest point of lake. Similar sampling program has been continued in the lake since 1990 except that during the previous 20 years the sampling frequency was once a week. Plankton sampling comprised phytoplankton, bacterioplankton and zooplankton. Also primary productivity and community respiration were measured. Besides these measurements, the data basis consists of continuous discharge information from the outflow of Lake Valkea-Kotinen. This hydrological data is also available in the Hertta database of SYKE.

3.2. Water quality monitoring of 34 small forest lakes in Evo area

Small forest lakes in the Evo area have been monitored since 1977. Today 34 small forest lakes are included in the monitoring program. The lakes are sampled in March at the end of the winter and before the ice and snow are thawing, and in late October during the autumnal mixing period. In spring samples are taken from the surface and 1 m above the bottom, and in autumn only from the surface. Besides the in situ measurements of water temperature and oxygen concentration also alkalinity, electrical conductivity, colour, total and inorganic nutrients as well as cations are measured. Since 1988 all the 34 lakes have been sampled twice a year. Before a smaller number of lakes (altogether 24 lakes) were included in the sampling program, and only few lakes were sampled in winter. In 2010 the sampling program was continued, and winter and autumn samples from 34 lakes were collected and analysed.

4. Examples of the important key results

4.1. Length of the ice-season in Lake Pääjärvi and Lake Valkea-Kotinen

During the last two decades the length of the ice-season has decreased in Lake Pääjärvi and Lake Valkea-Kotinen (Fig. 1). However, the annual variability in the length of the ice-season has been quite large. The date of the ice-on has quite often delayed especially in Lake Pääjärvi and taken place in January instead of early December which is the long-term average freezing date. In Lake Valkea-Kotinen the freezing takes place earlier than in the larger and deeper Lake Pääjärvi, and on average the freezing takes place in early November. During the latest years Lake Valkea-Kotinen has freezed and melted two to three times in autumn which is a new phenomenon. The date of the ice break-up has taken place in both lakes at the end of April, and during the latest years at the same time while before Lake Valkea-Kotinen had ice-off later than Lake Pääjärvi.

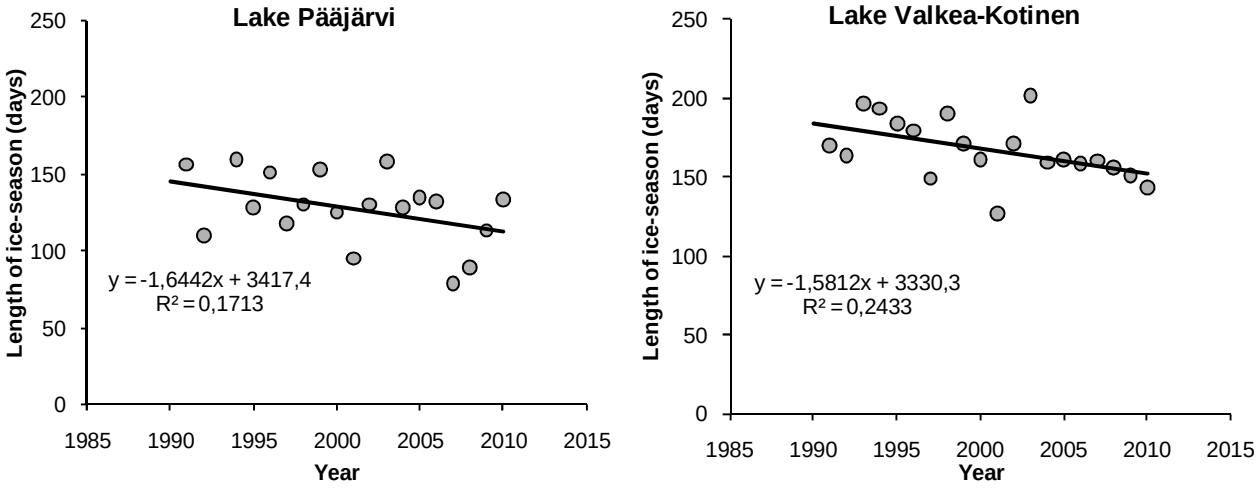

Figure 1. The length of ice-season in Lake Pääjärvi and Lake Valkea-Kotinen during 1990-2010.

4.2. Nutrient concentrations in Lake Pääjärvi

Long-term total phosphorus and total nitrogen concentrations in Lake Pääjärvi increased till the end of 1990´s but thereafter especially total phosphorus concentration has declined quite clearly being today below 10 µg/l (Fig. 2). The impact of climate, especially precipitation, on the nutrient concentrations is evident because of higher loading during rainy years than during dry years. This was very clear in 2004 with exceptionally high summer precipitation and flooding in Lake Pääjärvi. Changes in land-use and use of less fertilizer nowadays explain why the total phosphorus concentration has started to decline in recent years.

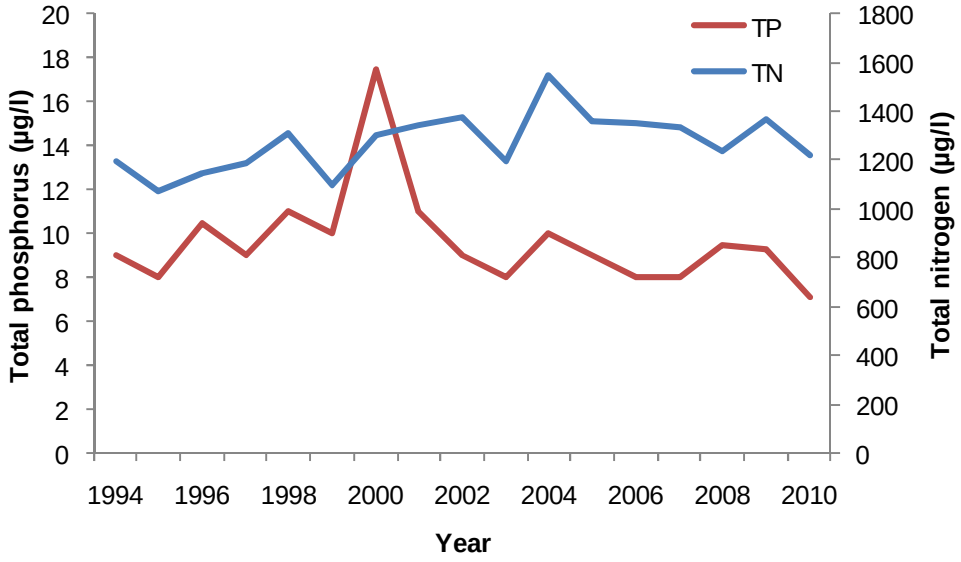

Figure 2. Total phosphorus and total nitrogen concentrations in Lake Pääjärvi in October-November during 1994-2010.

Foto: Lammi Biological Station

5. Summary and further aspects

This report describes the data collection in Lake Pääjärvi area and Evo forest and lake area in 2010. As an example few key results were also presented. Further the data from the monitoring programs will be used in End-User seminars as well as in the final reports of VACCIA-project when the adaptation strategies and new measures for management of catchment areas and lakes will be critically evaluated. The long-term data series have been proven to be extremely valuable in this context. The report on key results of the 20 year monitoring data sets from the Lake Valkea-Kotinen will be published for wide public as part of the VACCIA-project reporting until the end of year 2011. Other key results will be delivered for all participants and public in the workshops, seminars and forthcoming reports.