

COURSE MATERIAL

COMMENTS

REPORTS 146

RESEARCH REPORTS

Martti Komulainen, Anu Vähä-Heikkilä &
Jussi Hattara (eds.)

KEYS TO THE FUTURE

Environmental Expertise at
Turku University of Applied Sciences



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ENVIRONMENTAL EXPERTISE – KEYS TO THE FUTURE

Environmental problems are complex: in addition to technology, both informative and emotive guidance is needed. Such actions are essential on all levels from industry to individuals.

In 2007 Turku University of Applied Sciences (TUAS) launched the Environmental Expertise Programme (EEP) that has grown over the years into a significant national and international player in environmental expertise. Today the projects include a wide range of subjects from monitoring the environment to the reduction of emissions and from environmental communication to responsible business.

Multi-disciplinary environmental expertise is strongly connected with the activities of TUAS as a whole, although cooperation is as its closest with the Degree Programmes in Environmental Technology, Sustainable Development and Fisheries and Environmental Care. The contribution of accomplished students gives plenty of additional value to R&D projects. Respectively environmental projects offer challenging development projects to future environmental experts already during their studies.

EUTROPHICATION AND CLIMATE CHANGE CHALLENGE ENVIRONMENTAL EXPERTISE

Eutrophication of water systems is a direct consequence from the excess supply of nutrients, especially phosphorous and nitrogen. This nutrient pollution originates from many different sources with agriculture as the most significant. As for agriculture it has become clear that water conservation actions need customisation for each cultivated parcel. In addition to field block based planning, water conservation measures include e.g. buffer zones, wetlands and sedimentation basins. Nutrient retaining wetlands and sedimentation basins have already proven effective in many areas. Monitoring changes, even the rapid ones, in water quality is one of the strongest areas of expertise at TUAS. Conservation of the Archipelago Sea in its various forms is a key objective of EEP.

Many environmental issues are interconnected. Increased rainfall caused by climate change increases water and nutrient runoff. Climate change also causes many other global detriments such as an increase in extreme weather phenomena, changes in distribution of species, the extinction of species and rising sea levels. To combat these changes, the use of the best available techniques is needed (BAT principle). Improvements in energy efficiency, increased use of renewable energy sources, low emission technology and comprehensive community planning based on sustainable development are needed.

GROWING MARKETS OF ENVIRONMENTAL TECHNOLOGY

Challenges related to environmental problems place great expectations on environmental technology and open new possibilities for ecobusiness. There are growing global markets for environmental technology and cleantech know-how. In addition to environmental pollution, this development is fuelled by the energy crisis caused by decreasing fossil fuel resources, the need to develop low emission and energy efficient solutions as well as international treaties and commitments.

Environmental problems can also be seen as a possibility for new innovations, business models and employment – even as a kind of win-win situation, of which employment, economy and environment all benefit from.

THE SOCIAL DIMENSION OF ENVIRONMENTAL PROBLEMS HIGHLIGHTS THE IMPORTANCE OF COMMUNICATIONS

Environmental problems are not only ecological or technical, but also social. This highlights the importance of communications in solving them. Also the general increase in information and efforts to improve dialogue between researchers and the general public put communications in a new perspective.

Juha Kääriä, PhD

*Research and Development Manager of Faculty of Technology, Environment and Business
Head of Environmental Expertise Programme
Turku University of Applied Sciences*

The theme 'environmental communication' is focused on innovative information technologies to enhance the availability of environmental information and to raise the environmental awareness of the public.

ENVIRONMENTAL COMMUNICATION

PROMOTING NATURAL MATERIAL KNOW-HOW

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Outi Tuomela

Project Coordinator

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Faculty of Technology, Environment and Business

Project:

Promoting Natural Material Know-How (ProNatMat)

Duration:

1 September 2009 – 31 December 2012

Budget:

MEUR 1.1 (TUAS' share EUR 468 200)

Funding:

Central Baltic INTERREG IVA Programme 2007–2013

Regional Council of Southwest Finland

Partners:

SRIK – Information Centre for Sustainable Renovation, Tallinn

Åbo Akademi / Laboratory of Fibre and Cellulose Technology, Turku

Tallinn University, Tallinn

Tartu University / Viljandi Culture Academy, Tartu

Finnish Federation of the Visually Impaired / Sokeva-handicraft,
Vantaa

University of Turku / Brahea Centre for Training and Development,
Turku

Estonian University of Life Sciences, Tartu
South-Western Finland's Estonia Centre, Turku
City of Tartu / Turku Info Point, Tartu

Project status:

Ongoing



The structure of the economy has changed. The market economy with new technology has ignored traditional methods and local materials, transferring the production out of Europe. Our surroundings are full of renewable natural resources, i.e. materials coming from plants, animals or the ground, which can be used in a versatile manner.

The Promoting Natural Material Know-How project highlights local natural materials and improves the know-how of characteristics, availability and the uses of them. Increased knowledge and interest create possibilities for new entrepreneurs and ideas, which are further supported by the cooperation network formed during the project. The purpose behind this Finnish-Estonian project is to promote a sustainable way of living. The experiences so far show that people are interested in ecological materials and habits as various events have been popular.

BACKGROUND AND OBJECTIVES

Turku University of Applied Sciences (TUAS) has worked with natural materials for several years and the Information Centre for Sustainable Renovation (Tallinn SRIK) has experience from the year 2001. They have made preliminary studies in their natural material and restoration centre projects. The results addressed that promoting the use of natural material know-how is needed and actors in this branch are willing to develop themselves and the services. In Finland and Estonia, natural material know-how is strong and traditional. Because of the different history and background there are differences in the use of natural materials between these two countries, and this forms a fertile ground for a joint project. At the same time there is a need to develop new methods of working with natural materials and create innovations and modern techniques.

Natural materials also live in our cultural heritage as stories and customs. In the past people lived close to nature and respected its offerings. Nowadays the communal spirit is on the rise again, exemplified in residents' associations and eco-villages. Old wooden house areas are repaired and people pay more and more attention to the health and security of their neighbourhoods. Environmental education and information awake an ecological point of view in people. Residents' associations are also a good channel to disseminate information. Though Finland and Estonia have both common and different cultural heritage in the use of natural materials, a similar comprehensive study is still missing.

ProNatMat promotes, increases and strengthens the use of local natural materials and know-how in both Finland and Estonia, improving the exchange of research and knowledge between these countries. The aim is to increase awareness in all population groups.

The training focuses on raising the awareness and spreading know-how, emphasising the health and environmental benefits of using natural materials and local resources. This can provide employment opportunities and preserve cultural heritage.

The partners look for new ideas and solutions for marketing natural materials in cooperation. By creating a databank, information on old and new techniques, materials and ideas can be collected and stored in various formats such as short educational films. Furthermore, the project arranges training for experts and the general public to increase awareness among all population groups.

ProNatMat looks for new raw materials from local natural resources. The project will develop new and innovative ways for using them and provides more ecological and healthier materials to replace import from distant locations. Collecting and processing raw materials near end users improves local employment and decreases environmental load. In addition, the project gathers old and new knowledge of materials and their use into a databank.

The project introduces and documents both the traditional and modern techniques for handling natural materials, develops new and innovative methods and improves product development. The project arranges workshops, courses and events, which motivate people to acquire natural material know-how for their own well-being and for better environment. Activities create a permanent and active cooperation network between experts in Finland and Estonia.



PICTURE 1. *LUMO Centre is an ideal place for activities around natural materials.*
Photo: Outi Tuomela.

IMPLEMENTATION

ProNatMat is led by the Turku University of Applied Sciences (TUAS). Nine other universities and associations are cooperating in the project as partners. TUAS was selected for the lead partner because of its strong experience in project work and for its background in natural materials, design and restoration know-how in its degree programmes. Other partners are selected with special skills in natural material know-how or with interests to disseminate this knowledge.

TUAS's Sustainability Centre LUMO, together with Estonian Information Centre for Sustainable Renovation (Säästva Renoveerimise Infokeskus, SRIK), works at the grassroots level by arranging practical workshops, courses, seminars and events. The centres gather and share knowledge about natural materials and motivate people to live sustainably.



PICTURE 2. *The idea for organising the Winter Market at the LUMO Centre came from local artisans. Photo: Outi Tuomela.*

Scientific research such as chemical investigation and nano-analysis is carried out by the Laboratory of Fibre and Cellulose Technology at Åbo Akademi University, whereas the Department of Applied Creativity at Tallinn University conducts a study about the use of ecological materials in teaching and art therapy for toddlers. The Department of Estonian Native Crafts at University of Tartu Viljandi Culture Academy adapts and further develops the methods of cataloguing craftspeople and research on their skills and compiles information to a web-based databank. Estonian University of Life Sciences in Tartu does research on the insulation and mechanical properties of various local natural materials.

Specific roles of the University of Turku Brahea Centre for Training and Development are networking and promoting ecological building and handicraft know-how between the universities. Sokeva Handicrafts of the Finnish Federation of the Visually Impaired is aiming to find suitable materials and methods for visually impaired people to work with and to employ them.



PICTURE 3. *Cultural heritage and natural materials go hand in hand with working together. Photo: Outi Tuomela.*

The Estonia Centre of Southwest Finland takes care of communication between the residents' associations in the twin towns of Turku and Tartu and helps them exchange ideas on renovating old wooden houses. Turku Info in Tartu is compiling an Estonian–Finnish pocket dictionary of natural materials.

In addition, there are many private companies and communities involved in the project. These additional partners also have a very important role: they form the base for the network and their expertise is needed in the project. They also disseminate information further.

RESULTS

The main results will be the databank, the model of networking and the results of research on natural materials. The project gathers, stores and produces knowledge about old and new techniques, materials and ideas. All information will be stored in the databank at www.pronatmat.eu. The portal helps natural material and restoration experts in networking. The growing awareness and increasing possibilities for using the local natural materials create a demand for the market and new potential for entrepreneurship. The databank includes also short educational films about natural materials and traditions.

In order to make the cross-border cooperation long-term, a model of a natural material centre will be established. The cooperation between the restoration centres, universities and societies in Finland and Estonia will continue after the project.

Scientific results on clay and reed composites as well as chemical analyses at the molecular level will add more weight to use of natural materials.

Workshops, lectures, seminars and other events within the three natural material themes: (1) ecological building, (2) handicraft, design and art and (3) cultural heritage, are also results of the project, as are both the use of and information about natural materials will increase.



PICTURE 4. *Theme of 2011 was Wool. Here wool is processed to blankets with peg loom technique. Photo: Outi Tuomela.*

EFFECTIVENESS

Within the last two years, the project has reached quite a wide audience. There have been many participants in the workshops, lectures and events organised by the project. People want to know of opportunities for using local natural materials and they are willing to use them more. Communal activity has not disappeared; it just has to be found again. Ecological thinking should not be just a trend; it is a state of mind and creates sustainability in the world. For example, we are too dependent on oil. By using local natural materials, we can improve our self-sufficiency.

FUTURE PERSPECTIVES

LUMO Centre – The Sustainability Centre of Turku

As an old historical farm Koroinen offers inspiration stemming from 12 centuries. The history of its contemporary use starts from the year 2000 with studies arranged by the Degree Programme in Sustainable Development at TUAS. Since 2008 many kinds of activities for a larger crowd have been arranged. TUAS' activities in ProNatMat project are mostly organised in the LUMO centre. In the future, a wider range of activities can be targeted at an even broader audience. These may include:

Café and Gallery: Poetic Venue, Sharing inspiration and knowledge, Course Centre.

Permaculture Centre: Forest Gardens and Agroforestry, Traditional cultural practices and applied research of ecological farming, Ecosystem services, Study circles, Internships, International Voluntary service, Allotments.

Handicraft Centre: Wool school, Ancient and traditional techniques, Wood designs, Ceramics, Trading, Intuitive cooperative.

Material Bank of Natural and Restoration Materials: Ecological materials from the surrounding area, also reused old material gathering system and store.

Place for markets and festivals: Craft markets, Village Festivals, Thematic weekends for all.

PUBLICATIONS

Simi, P. & Tuomela, O. 2012. Promoting Natural Materials. Reports from Turku University of Applied Sciences 141.

INDUSTRIAL HEMP – NEW SUSTAINABLE OPPORTUNITIES FOR BUSINESS IN RURAL AREAS OF FINLAND

Noora Norokytö

Project Manager

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Faculty of Technology, Environment and Business

Project:

Industrial hemp – new sustainable opportunities for business in rural areas of Finland

Duration:

1 January 2011 – 31 December 2013

Budget:

EUR 149 603

Funding:

The Rural Development Programme for Mainland Finland 2007-2013 / Regional Rural Development Association (Southwest Finland's Riverside Partners) 90%

Private sector 10%

Contact person:

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Project status:

Ongoing



The European Agricultural Fund
for Rural Development:
Europe investing in rural areas



Hemp is a crop well suited to Finnish conditions that could bring new business opportunities to rural areas due to its versatility. Hemp, once a common crop, has not been widely cultivated in decades resulting in the loss of cultivation knowhow. In addition to trial cultivations, the Industrial Hemp project will advance the knowhow of the utilisation of hemp both as industrial raw material and as a food plant. Furthermore there is plenty of work in clearing the reputation of hemp because industrial hemp is often mixed with the varieties used to produce intoxicants. The project has already roused the attention of both the public and industry.

BACKGROUND AND OBJECTIVES

The Industrial Hemp project rose from the need for developing the Finnish countryside in a sustainable way. The countryside needs more alternatives to improve the economic situation. Hemp can be processed in several ways and therefore it can be raw-material for diverse business. Industrial hemp has a positive effect on the arable land, the yield is competitive when compared with the production of southern countries and it can be grown organically. These features make industrial hemp production a real option for supporting agriculture in Finland.

Unfortunately hemp has acquired a bad reputation during the last decades. Hemp has been grown for the fibre, seeds and drugs. There are several different varieties which have different features and can be selected for the best use. EU has a list of approved varieties that contain low levels of tetrahydrocannabinol and are safe in industrial use. Still people do not know the differences so well. For this reason one of the most important goals of this project is to increase awareness about the plant and its use. Hemp has been a common and important agricultural crop in Finland for centuries, but the knowhow has been lost during the last decades. Because of this, information about cultivation techniques and plant processing is needed. This project has as an aim, not only to reach farmers, but also to increase the public awareness of hemp as a sustainable material and healthy food source.

IMPLEMENTATION

The execution of the project started in the spring of 2011 with trial cultivations of oil hemp on two farms, one of which cultivates organically and the other with conventional methods. The area used for the trial cultivation is altogether two hectares. By conducting trial cultivations, the farmers will be able to get first-hand experience about the cultivation of oil hemp.

A part of this the project is putting a lot of effort on the improvement of the knowhow and awareness about oil hemp as an excellent food source, and hemp fibre as a versatile and strong material with a lot of possibilities. In practice this is done by taking part in different events and seminars around the project area. Already one field trip has been arranged to one of the most large-scale oil hemp cultivators in Finland. In events of this kind, farmers get basic information about cultivation techniques and processing the plant.

As this three-year project has a goal to increase the knowledge and break prejudices about industrial hemp, some publications will be published to reach as many people as possible. A booklet with all the main facts about hemp, some history and arguments against all the misconceptions about the plant as well as a guidebook about the cultivation of hemp are planned for publication.

RESULTS

The results of the project cannot be seen very clearly yet since such little time has passed since its beginning. A result to be mentioned is the attention this project has already roused. A lot of people from different fields have approached us, showing their interest in both cultivation and processing the plant. It has been shown that the information the project has been able to give has a real demand. The project has also drawn some media attention and several articles have been published about the cultivation and use of hemp.



PICTURE 1. *Project coordinator Noora Norokytö inspecting a trial cultivation field.
Photo: Jaana Kankaanpää.*

EFFECTIVENESS

The main aim of the project is to provide people with information about hemp as a cultivated and industrial crop. A further aim is to create a base for networking and new business opportunities within the project area and beyond. Since all the information produced during this project is public, it will benefit not only people in the project area but in the whole country.

FUTURE PERSPECTIVES

At this stage, the project has taken only its first steps. A handbook about the cultivation of hemp and a booklet containing the most important information about the plant will be published. The trial cultivation will also continue during the upcoming summers. Seminars, trips and events will be arranged to enhance the knowledge about hemp as an ecological and economical crop and raw material.



PICTURE 2. *Cultivation of oil hemp. Photo: Noora Norokytö.*

The interest in industrial hemp has increased and the construction industry is one field in which hemp could be used as a sustainable raw material. Hemp has an old tradition as building material and it has recently re-emerged in Western Europe and America. Experience and research show many benefits of hemp buildings e.g. its fire resistance, excellent thermal properties and high sound absorption capacity. Hemp buildings are also allergy free, healthy and environmentally friendly.

Because there is not that much experience of hemp buildings in the northern hemisphere, some research and development will be required.

PERSPECTIVES IN ENVIRONMENTAL COMMUNICATION: PUBLIC INVOLVEMENT AND THE BALTIC SEA

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Turku University of Applied Sciences

Faculty of Technology, Environment and Business

Projects:

NatureIT (2005–2007)

Archipelago Sea Theme Year 2006 (2005–2007)

Saaristomeri.info (2007–2009)

BalticSeaNow.info (2009–2013)

Duration:

2005–2013

Budget:

MEUR 1.8 (TUAS's share MEUR 1.1)

Funding:

EU Initiative 2

Central Baltic Interreg IV A 2007–2013 Programme

Regional development funds through the Regional Council of Southwest Finland

Partners:

Metsähallitus

Finnish Fisheries and Environment Institute

Nermec Oy

Archipelago Research Institute of the University of Turku

Centre for Economic Development, Transport and the Environment

Keep the Archipelago Tidy Association

Marine Systems Institute, Tallinn University of Technology (Estonia)

Estonian Fund for Nature (Estonia)

State Ltd. “Vides projekti” (Latvia)

SMHI – Swedish Meteorological and Hydrological Institute (Sweden)

Contact person:

Martti Komulainen – martti.komulainen@turkuamk.fi

Project status:

Ongoing



Improving the state of the Baltic Sea requires actions at many levels from nations to individual citizens. Communication measures are needed to raise environmental awareness and commitment of the wide public. Turku University of Applied Sciences (TUAS) has carried out a number of projects to develop innovative communication tools for raising environmental awareness and public involvement.

BACKGROUND AND OBJECTIVES

There is a general consensus that the state of the Baltic Sea is alarming. The most notable problem is eutrophication – a consequence of excessive amounts of nutrients – but also alien species, increasing marine traffic and climate change are threatening the sea ecosystem.

The concern on the poor state of the Baltic Sea has been shared among countries and actors bordering the sea, and many initiatives and protection plans have been launched (e.g. HELCOM, 2007). More concrete protection measures have been undertaken to prevent agricultural nutrient run-off, for example.

Our view is that despite unanimous concern, the discussion about the state and actions needed to improve the state of the Baltic Sea is more or less institutionalised, carried out at the level of official bodies.

In addition to this, the level of individual citizens has to be acknowledged. The role of citizens can be divided into consumer and active citizen roles. Awareness raising and participation is needed to promote the involvement of the general public, to bring forth everyday choices making a positive impact and to strengthen a common “Baltic Sea identity”. Not to mention the power citizens have when affecting the decision makers to take a step forward in the sea protection.

To meet the need for increased environmental awareness and commitment of the public, a whole continuum of projects have been planned and executed by TUAS aiming to:

- Develop communication tools for promoting public awareness of the Baltic Sea environment, and the commitment to protect it
- Bring the beauty of the Baltic Sea and its diverse nature available via new communication methods

- Improve the dialogue between the research community and the public
- Activate people to observe the state of environment and discuss it
- To strengthen the “Baltic Sea identity”.

The environmental communication projects summarised in this article are based, explicitly stated or not, on general conceptual models of environmental communication. Many of these models share similar elements, presented in Figure 1. Environmental sensitisation is a prerequisite for active involvement: people act only for issues which matter at a personal level. Environmental awareness emerges through deep understanding created by personal experiences and knowledge. Empowerment refers to confidence in an individual’s own capacity. These elements do not necessarily have a linear relation, but instead can be present simultaneously.

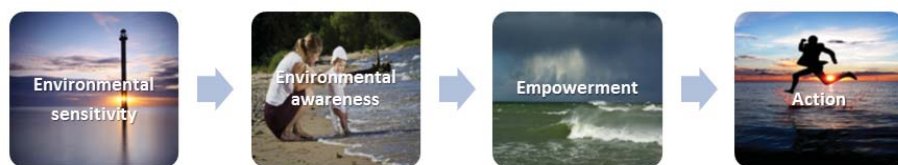


FIGURE 1. *Generalisation of several conceptual models of environmental education.*

IMPLEMENTATION

Case NatureIT

The NatureIT project (2005–2007) developed photo recording and data transfer techniques to improve the nature knowledge of the public, and to promote tourism of the Finnish archipelago.

The project built web camera connections to remote, but interesting nature sites, such as an osprey’s nest and a cormorant colony. One camera was installed under water and yet another camera was placed in a house populated by bats.

Besides offering imagery to a wide audience from remote sites, a goal was also to offer material for further studies, e.g. related to the diet of the animals observed (Enbäck, 2008).



PICTURE 1. *The osprey's nest web camera has gained huge success. Photo: TUAS.*

The cameras used were in principle standard surveillance cameras equipped with a power source (fixed electric source or solar panels and batteries) and wireless data connection. The data was collected to a server located in TUAS facilities.

Case Archipelago Sea Theme Year 2006

TUAS coordinated the multisectoral Archipelago Sea Theme Year 2006, dedicated to the nature, culture and future of the Archipelago Sea. The Theme Year comprised over 150 events, exhibitions and contests, collecting a wide audience. The Year was organised together with the Pro Saaristomeri Co-operation Programme and over 100 event organisers. The main objective was to boost the actions for a better future of the Archipelago Sea, reach the interest of the wide public and to activate discussion.

The effectiveness of the Theme Year was evaluated by Hallenberg (2008) by analysing the feedback from events, media coverage, portal statistics and by interviewing key stakeholders.

Case Saaristomeri.info

Saaristomeri.info (2007–2009), the idea of which arose from the experiences of the Archipelago Sea Theme Year 2006, aimed to increase environmental awareness and to activate discussion on the state of the Archipelago Sea, by offering web based discussion channels. The project implemented an Archipelago Sea portal which, in addition to discussion channels, consisted of basic information (ecological, cultural) and blogs representing different stakeholders. It continued to show web camera views from the archipelago, such as an osprey nest.

Case BalticSeaNow.info

The ongoing BalticSeaNow.info project (2009–2013) develops and introduces innovative communication tools for fostering information sharing and discussion about the Baltic Sea environment. The project is an international venture including partners from Finland, Sweden, Estonia and Latvia, representing universities, research institutions and NGOs.

The purpose of the BalticSeaNow.info is twofold. First it aims to activate discussion, raise awareness and commitment, even to "strengthen the Baltic Sea identity". Secondly, and maybe more importantly, it examines and develops communication methods for public involvement. These experiences can be used in other contexts.

In the core of the project is the BalticSeaNow.info web portal with web cameras, online environmental information, news, topical information, social media channels, discussion groups, and observations and stories produced by the public. In addition, interactive exhibits have been designed for public participation, and a number of events and exhibitions have been organised in partner countries.

RESULTS

The projects described above comprised web portals, events and other types of environmental awareness raising activities.

The *web environment* is a challenging channel. Basically, it is free and uncontrollable. Although the number of visitors was quite remarkable, the goal to activate discussion on the environmental problems of the Baltic Sea was not met that well.

The single most intriguing element has been the osprey's nest web camera which has gathered millions of visitors over the years. Web cameras have surely been the most effective in raising interest, but have not necessarily led to a general concern on environmental problems and needed protection measures. They have nevertheless offered the public an opportunity to peek into places and natural objects not so easily reached, and thus have increased the nature knowledge of the public. Interestingly they, the osprey's nest web camera in particular, have been even a community-forming factor: "osprey fans" communicate with each other also about other topics than ospreys or the Baltic Sea environment.

In addition to being "a sensitisation element" to hook people to visit the portal pages, the web cameras also served research purposes. The diet of osprey nestlings was studied using web camera material (Enbäck, 2008). Although representing only a single nest, the material was one of the few systematic diet analyses covering the whole nestling period of osprey.

The portal pages also showed several water quality parameters online, the data being from monitoring stations kept up by research institutions. Presenting online information in a public-friendly way, with clear and appealing graphical implementation and the data commented by experts, is one of the focuses in the future projects.

People were encouraged also to take a more concrete role – the BalticSeaNow.info recruited voluntary "Secchi" *observers* to monitor the water transparency which is a rough measure of water quality (a Secchi disk is a white disk immersed in the water, and used routinely by marine researchers). A few dozens of active observers produced weekly or monthly observations, and these were presented in the portal pages. Involving the public in environmental monitoring such as the Secchi project described above, opens promising perspectives in the science-public dialogue.

Besides recruiting observers, photo *contests* were also arranged. The latest of these popular contests "Baltic Sea in My Eyes" has attracted over 150 individuals to send over 700 photos to the contest. The contest was meant to be a participation method for people to analyse their views and the relation to the Baltic Sea.

A number of *events* were organised to raise awareness, the nature of which have varied from massive fairs and shopping centre events to seminars and more intimate discussion events e.g. in local pubs. Nearly 150 events including seminars, exhibitions, contests and other events were held during the Archipelago 2006 theme year and dozens more during the ongoing BalticSeaNow.info project. The number of entrants can be counted in tens of thousands. The importance of prestigious and widely known people must also be noted: the Archipelago Sea theme year's end seminar was attended by the President of the Republic of Finland Tarja Halonen, the patron of the theme year, clearly increasing the visibility of the project.



PICTURE 2. Archipelago Sea theme year's end seminar was attended by the President of the Republic of Finland Tarja Halonen. Photo: Tanja Hallenberg.

The more intimate the event, the more interactive and discussive it is. Experiences from "pub discussions" and field excursions are promising. Nevertheless, also mass events can be interactive; for example questionnaires can be organised. In the BalticSeaNow.info project an interactive exhibit "poll wall" was designed, where people were asked to vote for the most concerning environmental problems of the Baltic Sea (see Picture 3). The poll wall has proven to be an effective throw-in tool in fairs to raise interest, and when done in a concrete way, using plastic coins, differs from the modern IT-solutions: simple, concrete and illustrative elements work best.

In summary, the projects described above have resulted in wide visibility and raised awareness for the state of the Baltic Sea. The main criticism so far has focused on the events being held mostly in the Turku region and the scarcity of concrete measures and initiatives to protect the waterways. However, it must be noted that the main goal was not to launch concrete water protection investments, but rather to promote awareness and discussion.

EFFECTIVENESS

The effectiveness of the Archipelago Sea Theme Year 2006 was evaluated by Hallenberg (Hallenberg, 2008) concluding that the theme year was considered a success. It can be depicted as a "tour de force" of a number of actors for a better future for the Archipelago Sea. Public feedback on arrangements, organisation, and communication was mostly positive. The main criticism pointed out the lack of concrete measures and initiatives to protect the Archipelago Sea. Nevertheless, the Theme Year resulted in the establishment of the Archipelago Sea Protection Fund aiming to support concrete actions.

Since the alarming state of the Baltic Sea affects and is due to loads coming from all countries bordering the sea, joint actions are required. The geographical coverage of the projects extends to Finland, Sweden, Estonia and Latvia in the ongoing BalticSeaNow.info project.

The purpose of the projects presented in this article is twofold. First they aimed to activate discussion, raise awareness and commitment, and even to "strengthen the Baltic Sea identity". Secondly, and even more importantly, they have examined and developed communication methods for public involvement. These experiences can be used in other contexts. Through sharing good (and bad) experiences the effectiveness of the projects can be multiplied.



PICTURE 3. *“The poll wall” / “voting wall” interactive exhibit designed for gathering people’s views on different aspects related to the protection of the Baltic Sea. Photo: Martti Komulainen.*

FUTURE PERSPECTIVES

In future projects concerning the increasing of environmental awareness and public involvement, *a cross-sectional method* would be interesting to develop further. Some first experiments with "science meets art" approach were promising.

As regards communication technology, combining real-time environmental information with *mobile technology* in nature education opens inspiring views. Mobile technology could be used e.g. in information signs and nature paths, instead of physical information boards. A "mobile nature path" also enables tailoring the information to different target groups and offers the possibility for two-way interaction through platforms for personal observations and comments.

Effective awareness raising and public involvement actions have to be adjusted to the "trends" in communication in general. It seems that nowadays it is not so popular to engage in voluntary work anymore. Instead people are more individually oriented. The huge success of social media opens possibilities for environmental communication, too. How to turn the "light activism" represented by different fan pages in social media into more concrete actions, is a challenge for environmental communication.

When facing many extensive environmental problems, such as the eutrophication of the Baltic Sea, people may experience a "holistic paralysis" and are unable to see their role. The problems have therefore to be chipped into more meaningful and tangible pieces, to show directions for everyone to make their own share.

REFERENCES

Enbäck, L. 2008. Sääksen (*Pandion haliaetus*) ravinnon laji- ja kokoanalyysi Nature IT -kuvakoosteista vuonna 2006. Turku University of Applied Sciences. (In Finnish).

Hallenberg, T. 2008. Saaristomeri 2006 -teemavuoden arviointi. Turku University of Applied Sciences. (In Finnish).

HELCOM 2007. HELCOM Baltic Sea Action Plan. HELCOM.

PUBLICATIONS

Enbäck, L. 2008. Sääksen (Pandion haliaetus) ravinnon laji- ja kokoanalyysi Nature IT -kuvakoosteista vuonna 2006. Turku University of Applied Sciences. (In Finnish).

Hallenberg, T. 2008. Saaristomeri 2006 -teemavuoden arviointi. Turku University of Applied Sciences. (In Finnish).

Komulainen, Martti & Numminen, Samu 2007: Saaristomeren teemavuosi kohotti suojelutietoisuutta. Turun Sanomat 12.1.2007. (In Finnish).

Komulainen, Martti & Alanen, Salla-Maria (eds.) 2007: Saaristomeri 2006 – askelia Saaristomeren puolesta. Saaristomeri 2006 / Turku University of Applied Sciences ja Pro Saaristomeri programme. (In Finnish).

Hallenberg, Tanja, Alanen, Salla-Maria & Komulainen, Martti 2007: Saaristomeri 2006 – tiedosta tietoisuutta. Reports from Turku University of Applied Sciences 53, Turku University of Applied Sciences. (In Finnish).

Komulainen, Martti & Kiviluoto, Katariina 2011: Baltic Sea needs public involvement. Baltic Rim Economies No 2, 2011. Turku School of Economics and Business Administration. Pan-European Institute.

Komulainen, Martti 2010: Ikkunoita Itämerelle. BalticSeaNow.info kannustaa keskusteluun. Aurinkolaiva 2/2010. Turku University of Applied Sciences. (In Finnish).

Komulainen, M. 2012: Itämeri tarvitsee kansalaisiaan. Turun Sanomat Alio 9.1.2012. (In Finnish).

Kunnasvirta, A. & Komulainen, M. 2012: BalticSeaNow.info – Experiences in Public Involvement. Reports from Turku University of Applied Sciences 135, Turku University of Applied Sciences.

CARPOOL SERVICE FOR A MUNICIPALITY

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Project:

Carpool service for a municipality

Duration:

1 August 2009 – 30 June 2011

Budget:

EUR 21 000

Funding:

The Rural Development Programme for Mainland Finland 2007–
2013 / Regional Rural Development Association Ravakka

Private funding

Partners:

Municipality of Mynämäki

Anadium Group Oy

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Project status:

Completed



The European Agricultural Fund
for Rural Development:
Europe investing in rural areas



Carpool is one possibility to decrease the harmful effects of road traffic. The carpool project produced a service model which helps municipalities and other organisations to develop a web based carpool service for their needs and target groups. In addition the project aimed to raise people’s environmental awareness and make them to rethink their driving habits.

BACKGROUND AND OBJECTIVES

The distances are relatively long in Finland – especially if you live in the countryside. Because of inadequate public transport, driving your own car is a common way to travel to work and leisure activities. Furthermore, most of the people drive alone. Road traffic causes amongst other things carbon dioxide emissions which accelerate climate change. The more cars there are in traffic, the more harmful the effects.



PICTURE 1. *Carpools offer a cleaner way to commute especially in the countryside.*

Carpool is one possibility to reduce the amount of cars in traffic. Carpool means that at least two private persons drive the same trip in one car which they otherwise would drive in separate cars. If a group of people is, for example, using one car instead of four, it will diminish emissions, offer financial benefit and decrease traffic jams.

Web based applications have increased the favour of carpool and changes in legislation have made it possible to get legal financial compensation from offering a ride for someone else, as long as you are not doing business with it. Still, it is not very common to share your car with others in Finland.

The aim of the carpool project was to produce a model of a carpool service for a municipality. The idea was that when the service is tailor-made for a certain municipality, it is easier to start using the service because local people are the ones offering and looking for rides, people have similar travelling needs and the places where to pick up someone are familiar. In addition it is possible to take into account different target groups and focus the informing on these groups. The project developed the carpool service for a pilot municipality, but the objective was that after the project, any municipality can utilise the service model and remodel it for their own needs.

A significant part of the project was to raise environmental awareness and people's positive attitudes towards carpool.

IMPLEMENTATION

The municipality of Mynämäki was a pilot target area of the carpool project. It was suitable for the task because of the wide area and high amount of scattered settlements which make people use their own cars a lot. Mynämäki is also one of the municipalities involved in the national Carbon Neutral Municipalities project, so the idea of carpool supported the objectives of that project, too.

Another partner, Anadium Group Oy, had established a nationwide carpool service called kyydit.net in 2007. The project could utilise the technology and the layout of this existing service.

For the grounding of the project statistics and other material were first gathered. The attitudes towards carpool and willingness to share your own car with other people were figured out by a questionnaire. The next step was to formulate the service model and technical solutions. After that a test group composed of the inhabitants of the municipality was able to test the service and give feedback.

The carpool service was launched with versatile forms of communication (newsletters, press conferences, leaflets, articles in magazines etc.). In addition some inducements were created to encourage people to start using the service. A local petrol station, for example, promised to raffle 50 litres of fuel among those who have offered rides in the service and the municipality of Mynämäki promised to reward the most active users of the service.

RESULTS

As a result of the project, the carpool service of Mynämäki was produced. It can be found at <http://www.kyydit.net/mynamaki>. In the beginning the service was not a success but after making a few technical improvements and starting the marketing campaign, people were encouraged to visit the site and offer and search rides. Although the project has ended, the service is working and an active group of people who are offering rides has been formed.

Based on the experience and knowledge of developing and producing the service, a service model of carpool was established. It means that other municipalities and organisations can exploit the results of the project and get a similar service for their own needs without starting everything from zero. In fact, many organisations have already been interested in copying the service for their purposes.

It is difficult to say if the project raised people's environmental awareness or improved attitudes towards carpool. But it is certain that all the communication activities made the idea of the carpool service better known and people may have started to rethink their driving habits.

EFFECTIVENESS

Because there was an actual need for this project and the municipality of Mynämäki was a partner of the project, the results could be taken into use immediately. For the same reason the results of the project are in use although the project has ended. The project had specific target groups, so the efforts could be focused directly on them which improved the effectiveness.

Carpool seemed to be an interesting issue for the media, too, so the project got quite a lot of publicity. In addition, cooperation with certain organisations, such as the Service centre for sustainable development and energy issues in Southwest Finland (Valonia), eased the dissemination of the results. Valonia has a wide network and one of their duties is to disseminate good practices.

FUTURE PERSPECTIVES

The aroused interest among other organisations showed that there is a need for this kind of service. It is likely that based on the results of the project, new tailor-made carpool services will be developed.

PUBLICATIONS

Heikkilä, J. 2011. Mynämäki avasi kimppakyytipalvelun. Maaseutu Plus. Suomen kylätoiminta ry. (In Finnish)

Heikkilä, J. 2011. Mynämäki kimppakyydin edelläkävijäksi. Kuntalehti. KL-Kustannus Oy/Suomen Kuntaliitto ry. (In Finnish)

ENVIRONMENTAL EDUCATION AND DRY SANITATION IN SOUTHERN AFRICA

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Projects:

1. Msunduza Dry Sanitation Project
2. Environmental Health Education Project in Msunduza Township, Swaziland (EHEP)

Duration:

1. 2007–
2. 2004–2013

Budget:

1. EUR 234 000
2. EUR 65 000

Funding:

The Ministry for Foreign Affairs of Finland: The North South Programme under the Association of Finnish Local and Regional Authorities
Ministry for Foreign Affairs of Finland

Partners:

The Global Dry Toilet Association of Finland

The Salvation Army in Swaziland

The City Council of Mbabane

The City of Salo

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Project status:

Ongoing

The Environmental Health Education Project (EHEP) explores how environmental health and quality of life can be positively influenced by increasing education and implementing small scale practical interventions. The project is being implemented in Mbabane, the capital city of Swaziland. The most recent, and the biggest, achievement in the project has been the establishment of a Community Recycling Centre in Msunduzi, the largest informal residential area of Mbabane and the main project area. EHEP is a part of a cooperation project between the cities of Salo and Mbabane (Salo and Mbabane Developing Together).

An offspring of the EHEP, Msunduzi Dry Sanitation Project is concentrating on improving the sanitation in the same residential area. The project is being implemented in cooperation with the Global Dry Toilet Association of Finland, Turku University of Applied Sciences (TUAS) and the Salvation Army in Swaziland as a local partner. The project is funded by the Ministry for Foreign Affairs of Finland and is currently in its third and final phase. Thus far, the Msunduzi Dry Sanitation Project has funded the construction of 37 toilets, and the environmental and sanitation education provided by the project has reached the inhabitants of Msunduzi.

BACKGROUND AND OBJECTIVES

Swaziland is a small land-locked kingdom in southern Africa with a population of about 1.2 million people (UNdata 2009). The economy of Swaziland is based on a small but expanding export industry, though for the majority, agriculture is the main source of income (Ministry for Foreign Affairs of Finland 2008). The economic development of Swaziland is highly hindered by HIV/AIDS, which has been overtaking the country by storm since the beginning of the 1990s (Koivisto 2005, 33). Swaziland has an unfortunate lead in the HIV/AIDS statistics with the prevalence of 26% (USAID 2010). The high prevalence of HIV/AIDS together with opportunistic diseases and poverty are the main causes lowering the average life expectancy as low as to 32.5 years (Ministry for Foreign Affairs of Finland 2007).



PICTURE 1. Swaziland is located in the South-East Africa by the Mozambiqian and South-African border. Source: World Atlas. Map of Swaziland.

Besides that Swaziland has previously been considered comparatively rich by GNI per capita, the lack of democracy has resulted in less Official Development Aids (ODA) compared with most Sub-Saharan countries (UNDP 2009). However, approximately 69% of the population in Swaziland live under the national poverty line and the gap between the rich and poor is expanding constantly (Mwendera 2006, 683). The country is experiencing a rapid urbanisation as people are fleeing the rural poverty in hope to find a secured income and higher standard of living. Unfortunately many end up living in the informal areas around the cities facing urban poverty. (Akatama 2008, 30.)

Msunduzi is the oldest and a partially informal township in Mbabane. The township of about 16 000 people is located close to the city centre on steep hills. It is divided into six communities, which are led by community leaders and a common Central Committee. The main features of the area are very steep topography, inadequate infrastructure and petty road network. The plots are mainly tiny and houses shared by several people though parts of the area are peri-urban featuring small scale farming. The unemployment rate is very high and the informal sector (for example renting rooms and selling fruit) provides the main source of income for many. Due to the bad roads, challenging topography, the insufficient resources of the Mbabane City Council, and the informal status of the area, waste management services in Msunduzi are largely inadequate. Illegal dump sites are flourishing and burning or burying waste are common practices. In addition to household waste, also toilet waste ends up in the environment with no treatment. (Akatama 2008, 31.)

In Swaziland, only half of the population has decent sanitation and washing possibilities. The situation is particularly bad in the rural areas and in the poor communities of the cities. In the urban areas 59% of the population and in the rural areas 44% has access to improved sanitation (WHO/Unicef 2006). In Msunduzi, the solutions to sanitation are diverse. In the formal areas, approximately 70% of the households have water closets, which are connected to the sewer network. In the informal areas, only 10% have water closets whilst the rest are using a pit latrine or other less desired systems, such as a bucket or a “flying toilet”, where faeces are thrown into the environment in a plastic bag. (Koivisto 2005, 63.) In some areas wastewater from water closets is piped into septic tanks, which flood on to the yards and streets, when emptying the tanks fails. With children playing in the polluted streets, cholera and other diarrhoeal diseases prevail. The high price of water has made some change back to traditional pit latrines, which, however, can have negative impacts on health and the environment. (Akatama 2008, 30–31.)



PICTURE 2. *Selling necklaces and bowls made out of recycled paper. Photo: Jenni Koivisto.*

Due to insufficient sanitation and unclean water, parasites and diseases spread easily with severe impacts. Young children and the elderly, in particular, suffer from diarrhoeal diseases, which can be fatal to them. In addition to health problems, poor sanitation increases environmental problems as waste and nutrients flow into the ground and water. Social problems, affecting mainly women and girls, arise due to insufficient sanitation: long distances to toilets cause security risks for women during the night, because of the increased possibility to be sexually abused. (Koivisto 2005; 65, 80.)

Dry sanitation offers a sustainable solution for the improvement of sanitation for the disadvantaged. Conventional water closets consume a lot of fresh water for transportation and purifying wastewaters. Dry toilets function without water, which has become a scarcity in the regions battling with sanitation problems. (Zimbelman and Lehn 2006, 4.) Furthermore, as the need for an

artificial fertiliser has increased and people are not able to afford it, dry toilets provide a lucrative fertiliser turning waste into a resource (Guzha et al. 2005, 841; Zimbelman and Lehn 2006, 6).

Msunduzu Dry Sanitation Project was launched in 2007 to tackle the sanitation problems identified in the Environmental Health Education Project (EHEP). The main objective of the project is to improve the sanitation hygiene and the state of the environment in the area by building new and adequate toilets, by educating people on the construction and maintenance of adequate toilets and by increasing the knowledge about the linkage between hygiene and diseases. In the long run, the aim is to increase home gardening and furthermore, to improve the food security of households. A part of the education is about using the composted brown material from the dry toilets as a fertiliser in home gardens. In a very traditional and male-dominated culture, the project also aims to improve the position of the women and children in the community through environmental and hygiene education.

IMPLEMENTATION

In the beginning of EHEP, a baseline study on the status of the environment and health issues was carried out in the project area. A Healthy Committee of local volunteers was trained to educate local communities and schools on environmental issues. Together with the students from TUAS, the local actors have reached up to 2 500 pupils weekly and organised environmental days, clean-up campaigns and workshops. Additionally composting and small-scale gardening has been promoted. Msunduzu was selected as the “case” area for the project and most activities are being implemented there. The idea is, though, that the good practices will be replicated in other parts of Mbabane and more widely Swaziland.

The Msunduzu Dry Sanitation Project utilised a lot of the background information collected in EHEP. The information was combined with additional data collection in order to select the most vulnerable households in the pilot area in the most need of a dry toilet. A group of active members of the communities were trained as “Sanitation Experts” to educate and answer people’s questions about sanitation. A group of eight to twelve Experts have worked throughout the project educating people in homes, schools and in public events.

Both of the projects have put a special emphasis on the youth of Msunduzi. The Msunduzi Dry Sanitation Project has acted as a supporter for a youth group of one of the communities. During the projects, several workshops have been organised, where the local people have been able to learn about for example composting and organic gardening. The Sanitation Experts as well as the Environmental Educators in EHEP have regularly held morning assemblies and environmental health classes in the schools of Msunduzi. Representatives of the City Council, the Salvation Army and the Sanitation Experts have been able to visit Finland on field and study trips.

RESULTS

Despite some hindering factors, such as bureaucracy and geographical distance, both of the projects have started to show results.

In the Msunduzi Dry Sanitation Project, 37 dry toilets with hand washing devices have been funded. Toilets have been built in each of the six districts: for a primary school, to community meeting points, sports grounds and for most disadvantaged people. It is safe to say that all of Msunduzi's 16 000 people have been reached by the projects and have received environmental education concerning dry toilets and sanitation. Since 2010, the Sanitation Experts have expanded education also outside of Msunduzi.

In 2008, a Waste Information Centre was opened by the EHEP project in the centre of Mbabane. The purpose of the centre is to disseminate information and advice people on issues concerning waste, recycling, safe handling of waste and on sanitation. The biggest achievement of EHEP has been the launch of a Community Recycling Centre, which was opened in 2010 in Msunduzi. People of the communities, local schools and corporations sell their waste to the Centre where community volunteers separate the waste and sell it to local enterprises. Another example of a successful recycling practise launched in the project is School Recycling Points, built into some schools in Msunduzi to increase recycling, to improve the safety and cleanliness of the surrounding areas and to make environmental education more practical. This practice is now being copied also in other schools of Mbabane, and being funded by different organisations. Moreover, to promote waste re-use, a group of unemployed women in Msunduzi were trained to make jewellery from the collected waste.

Both the Waste Information Centre and the Community Recycling Centre have been established in order to increase general knowledge and to promote environmentally friendly practices in the project area and in the entire city.

The Sanitation Experts in the Msunduza Dry Sanitation Project and the Environmental Educators in EHEP, respectively, are of extreme importance for the project. They act as waste and sanitation advisors, educate on organic gardening and disseminate information about the linkage between hygiene and health. A lot of information in both English and siSwati (a local language) has been produced on various subjects. Different kinds of theme days, happenings and competitions such as an Environmental Day and the Healthiest School Competition, have been organised to get people to better acknowledge and comprehend the linkage between the environment and health and to disseminate information. Theme days have been welcomed with open arms: hundreds of people have been reached and the events have been well noticed by the local media, newspapers and TV alike, thus spreading the information throughout the country.



PICTURE 3. *A Sanitation Expert with an owner of a dry toilet. Photo: Jenni Koivisto.*

Schools have established tyre gardens, where waste recycling and food production have been combined. Together with the people and the students of the communities, clean-up campaigns have been organised and the schools have also been very active in coming up with their own ideas for new products and applications for recycled waste.

EFFECTIVENESS

Both the Msunduza Dry Sanitation Project and the environmental Health Education Project have brought hope and faith for the community. The hired Sanitation Experts and Environmental Educators have received information and experience by working for the project. They have not only gained financial support from it, but also a better self-esteem and appreciation in their communities. For the women and the youth, in particular, the chance to have their own income and more respect in the eyes of other community members has been empowering. Whilst making significant improvements for the state of the environment or the sanitation culture within a very limited timeframe is unrealistic, locally the projects have been able to increase knowledge and attract people's attention to some very essential problems.

The cooperation between the community members and leaders, the Salvation Army and the City Council has created a basis for community development by bringing important stakeholders to the same table. By getting youth groups and schools involved in community development activities, a foundation for future improvements in sanitation and environmental health has been established.

The projects have also increased the knowledge and experience of the Finnish counterparts. Students from the Degree Programme in Sustainable Development, Social Services and Environmental Engineering (HAMK University of Applied Sciences) working in the projects have all received a unique opportunity to work in an international project and in a very different culture, and gained valuable experience from development cooperation and environmental education in the grass roots level.

FUTURE PERSPECTIVES

At the end of 2011, Msunduzi Dry Sanitation Project was granted continuance from the Ministry for Foreign Affairs of Finland for 2012–2013. The ‘Msunduzi Dry Sanitation project – Phase III, Improving Sustainability and Withdrawing’ is planned to be the final phase to the project and will focus on capacity building in the community level and on creating a responsible exit strategy together with the local counterparts. During the third phase, the construction of new dry toilets will be reduced whilst education will be emphasised and spread more outside of Msunduzi. In order to spread the knowledge on safe and sustainable sanitation further and to reach other target groups, such as NGO representatives, university students and environmental officers, education and training activities will be organised jointly with the Department of Environmental Health at the University of Swaziland (UNISWA). Additionally, to enable knowledge and experience exchange, the project will bring counterparts from various dry sanitation projects in Swaziland and Zambia together.

The Environmental Health Education Project will continue until the end of 2013. EHEP will focus on ensuring the functionalities and success of the recently opened Community Recycling Centre and the Waste Information Centre. The Environmental Educators will continue their work of raising environmental awareness in Msunduzi. In the future, research and development may contribute more to the development of bio-fuel and renewable energy uses and practises in Mbabane, and assist City Council to benefit from the clean energy resources and markets and encourage domestic energy efficiency.

REFERENCES

- Akatama, L. (Ed.) (2008). *Experiences of Dry Sanitation in Southern Africa*. Reports from Turku University of Applied Sciences 78. Turku: Turku University of Applied Sciences.
- Guzha, E., Nhapi, I. and Rockstrom, J. (2005). An assessment of the effect of human faeces and urine on maize production and water productivity. *Physics and Chemistry of the Earth* 30. 840–845.

Koivisto, J. (2005). Ympäristöterveys kehitysyhteistyössä. Hankesuunnittelu ympäristöterveysprojektille (in Finnish). Environmental Health in Development Cooperation. Planning of an environmental health education project. Bachelor's Thesis, Turku University of Applied Sciences.

Ministry for Foreign Affairs of Finland (2007). Tietoa Swazimaasta. [Accessed 12.9.2011] www.finland.org.mz/public/default.aspx?contentid=143102

Ministry for Foreign Affairs of Finland (2008). Kauppaselvitys, Saharan eteläpuolinen Afrikka. [Accessed 12.9.2011] http://www.hyvinvointiklusteri.fi/tiedostot/File/Ulkoasiainministerio_kauppaselvitys_etelainen%20Afrikka_2008.pdf

Mwendera, E. J. (2006). Rural water supply and sanitation (RWSS) coverage in Swaziland: Toward achieving millennium development goals. *Physics and Chemistry of the Earth* 31, 681–689.

UNdata (2009). Country profile- Swaziland. [Accessed 21.3.2012] <http://data.un.org/CountryProfile.aspx?crName=Swaziland>

UNDP (2009). UNDP in Swaziland- Goal 8: Develop a global partnership for development. [Accessed 12.9.2011] http://www.undp.org.sz/index.php?option=com_content&view=article&id=45&Itemid=66

USAID (2010). USAID – Swaziland profile. [Accessed 12.9.2011]. www.usaid.gov/our_work/global_health/aids/.../swaziland_profile.pdf

WHO/UNICEF (2006). Meeting the MDG Drinking Water and Sanitation Target – The urban and rural challenge of the decade. WHO Library Cataloguing-in-Publication Dat. Switzerland.

World Atlas. Map of Swaziland. [Accessed 26.9.2011]

<http://www.worldatlas.com/webimage/countrys/africa/sz.htm>

Zimbelman, M. and Lehn, H. (2006). Contribution of dry sanitation to the MDGs and a sustainable development. Vortrag auf der 2nd International Dry Toilet Conference: Dry Toilet 2006. 16th – 19th of August 2006 Tampere, Finland.

PUBLICATIONS

Akatama, L. (Ed.) (2008). Experiences of Dry Sanitation in Southern Africa. Reports from Turku University of Applied Sciences 78. Turku: Turku University of Applied Sciences.

Antila, L. (2008). Swazimaa: Slummi siistiksi (in Finnish). Swaziland: Cleaning up the Slum. Kehitys- Utveckling 1/08. Ministry for Foreign Affairs of Finland.

Koivisto, J. (2007). Kestävää kehitystä Swazimaassa (in Finnish). Sustainable Development in Swaziland. In Koivuniemi, S. & Sairanen, R. (Ed.): *Maailma kotiovella 2*. Reports from Turku University of Applied Sciences 50. Turku: Turku University of Applied Sciences.

Koivisto, J. (2006). Looking for New Ways to Improve Waste Management. In Capellano dos Santos M.M. (Ed.): *Gestão e proteção do meio ambiente. Programa Alfa II Rede Jean Mermoz, Projeto Formação de Investigadores*. Universidade de Caxias do Sul, RS-Brazil. II – 0214-FI.

CONFERENCE PRESENTATIONS AND PUBLICATIONS

Koivisto J. (2010). Towards Sustainable Sanitation in Developing Countries - Case Msunduzi in Swaziland. Presented in the Eco Toilet Seminar on the 9th of November 2010, in Turku.

Koivisto, J. (2010). Towards Sustainable Sanitation in Southern Africa – Case Msunduzi in Swaziland. Presented in the '2nd International Congress on Technologies for the Environment' on the 30th of April 2010 in FIEMA Brazil.

Koivisto, J. (2006). How to Involve the Community to Development Projects – Experiences from an Environmental Health Project in Swaziland. IV Seminário Internacional e Ciclo de Videoconferências: “Resolução de Conflitos Ambientais” 7th-9th of June 2006 Caxias do Sul, Brazil. The article has been published in Préndez, M. (ed.) (2007): *Actas del Tercer Seminario Internacional Contaminación del Medio Físico. Programa ALFA – Red Jean Mermoz*. Santiago: Universidad de Chile.

Hietaranta, J. & Koivisto, J. (2005). Environmental Health Education Pilot Project in Msunduza Township, Swaziland. Conference publication. The article has been presented in the '11th Annual International Sustainable Development Research Conference', 6th-8th of June, 2005 in Helsinki.

POSTER PRESENTATIONS

Sini Haimi, Piet Thataetsile Semeno, Leena Akatama, Jari Hietaranta, Linda Rauta and Jenni Koivisto (2009). Community Challenges in Dry Sanitation – Swaziland. Presented in the Dry Toilet Conference 2009, 12th-15th of August, 2009 in Tampere.

THESES

Haimi, S. & Ranta, L. (2009). Helpotusta hätään kuivasanitaatiosta – tapaustutkimukset Sambia ja Swazimaa (in Finnish). Relief from Dry Sanitation – Cases Zambia and Swaziland. Bachelor Thesis, Turku University of Applied Sciences.

Koivisto, J. (2005). Ympäristöterveys kehitysyhteistyössä. Hankesuunnittelu ympäristöterveysprojektille (in Finnish). Environmental Health in Development Cooperation. Planning of an environmental health education project. Bachelor Thesis, Turku University of Applied Sciences.

Mustonen, P. (2010). Sukupuolinäkökulman huomioiminen sanitaatiohankkeessa – Case Msunduza (in Finnish). Acknowledgement of Gender Perspective in a Dry Sanitation Project. Bachelor Thesis, Turku University of Applied Sciences.

Oikarinen-Mapengo, J. (2011). Home gardens in Msunduza – Urban agriculture as a contribution to food security. Bachelor Thesis, Turku University of Applied Sciences.

SUSTAINABLE TOURISM DEVELOPMENT IN VIETNAM

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Essi Hillgren

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Faculty of Technology, Environment and Business

Project:

Turku–Haiphong for Cat Ba

Duration:

1 September 2009 – 31 August 2013

Budget:

EUR 173 000

Funding:

The Ministry of Foreign Affairs

CIMO

North-South-South Higher Education Institution
Network Programme

Contact person:

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Project status:

Ongoing



Tourism is one of the growing sectors in Vietnam, boosting economic growth. Tourism is becoming politically more important with effects on local economic growth, land-use management, use of natural resources and social development on the grassroots level. It also affects the state of environment, bringing some potential risks.

The growth of tourism in Haiphong and Cat Ba area has been remarkably fast during the past few years. Negative impacts on nature can already be seen and to avoid further degradation, preventative interventions are required. One aim of the Turku–Haiphong for Cat Ba project is to gather material and build a network for future cooperation and projects. Further, the goal is to develop a project concentrating on the development of sustainable tourism by covering economic, environmental and social aspects of growing tourism industry.

BACKGROUND AND OBJECTIVES

Turku–Haiphong for Cat Ba Network is a partnership between Turku University of Applied Sciences (TUAS) and Haiphong University (HPU) in Vietnam. The network works in close cooperation with Cat Ba Biosphere Reserve with an aim to develop ecologically, socially and economically sustainable tourism on Cat Ba Island.

The growth of tourism has brought some typical problems of mass tourism into Cat Ba Town, where tourism industry is the most intensive with hotels, restaurants, souvenir shops and other tourism related services. On the other hand, many parts of the island and its archipelago are less visited despite the potential of existing elements for tourist attraction. Another common feature is that most of the services for the tourists are provided by companies outside of Cat Ba Island leaving the local people without economic benefits from the tourism. The common denominator of both intensively and less intensively utilised areas is the lack of sustainability aspect in planning and managing of the services.

Turku–Haiphong for Cat Ba consortium has committed to a three-phase development process, with an overall objective to develop environmental management and sustainable livelihood on Cat Ba Island. The short term target is to build capacity and expertise within the network institutions in the areas of sustainable development and participation in local development.

IMPLEMENTATION

The first phase of the project took place during the years 2007–2008 as TUAS and HPU made joint efforts for project planning. The second phase consists of two components: North-South-South Mobility Component and TUAS Capacity Building and Research Components. These two components are implemented simultaneously supporting one another. The mobility component includes both teacher and student exchanges as well as joint intensive courses and network meetings. The third phase is an ecotourism project jointly with Cat Ba Biosphere Reserve.

The common theme, around which the cooperation is built, is ecotourism and sustainable tourism. Similar features can be found both in Southwest Finland (Archipelago Sea) and Northern Vietnam (Cat Ba Island and the archipelago, respectively). Common factors for these above mentioned areas are unique archipelagos which are partly protected and where the economic, natural and social values are conflicting. The research area Cat Ba Island offers an excellent opportunity to research the expansion of tourism, human and ecological resources and changes. The island has also been declared an UNESCO Man and Biosphere Reserve Area.

RESULTS

Currently, the second phase of the project is ongoing. Both components, student and teacher mobility and capacity building, have started and will continue until 2013. The idea is that the plan for the third phase will be finalised during the second phase allowing continuous cooperation between the universities and Cat Ba Biosphere Reserve in parallel with the ecotourism project. The idea is that future development and cooperation projects will be easier to implement once there is some common ground, common concepts and mutual trust, which can be achieved only when the partners know each other.



PICTURE 1. *Floating village in front of Cat Ba City. The traditional way of living contaminates water. On the other hand, this livelihood is important for the local people. Photo: Essi Hillgren.*

EFFECTIVENESS

The third phase of the project aims to develop cooperation and dialogue between the tourism developers, local authorities and communities concerning the growth of tourism in Haiphong and Cat Ba World Heritage site in particular. Tourism is a fast growing industry in Haiphong and whilst it has notable potential for economic development, it also has an impact on the environment, land-use, natural resources, and social development on the grassroots level.

Thus far the project has provided both students and teachers a unique opportunity to learn more about the Vietnamese (and Finnish, respectively) culture and environment, something that can be valuable in future life. It has

also created a more sustainable base for further cooperation, which hopefully in the future will turn into a research and development project with both interesting research outputs and practical implications.

FUTURE PERSPECTIVES

The long-term development objective of the Turku–Haiphong for Cat Ba project is that in the future, the tourism industry will grow in sustainable manner. It will be challenging yet intriguing to try to find ways to combine the protection of a fragile and unique environment, wellbeing and livelihood of the local people with tourism and economic growth. The commitment of local people and administration is vital in the development process. The tourism industry offers a lot of new business opportunities for the local people and actors but at the same time it decreases traditional livelihood opportunities.



PICTURE 2. *Participants of the intensive course explore an unofficial landfill, which pollutes soil and ruins the landscape. Photo: Essi Hillgren.*

PUBLICATIONS

Hietaranta, J. 2011. Ekomatkailun kehittämishanke Cat Ba:n saarella Pohjois-Vietnamissa. In: Maapallo – Kehityskaantiteellinen aikakauslehti. Kehityskaantiteiden yhdistys ry.

Hietaranta J. & Koivisto, J. 2012. Networking Globally for Sustainable Development – Small Actions in Finland, Swaziland, Vietnam and Brazil. In: Kettunen, J., Hyrkkänen, U. & Lehto A. (eds.) Applied Research and Professional Education – Proceedings from the first CARPE networking conference in Utrecht on 2–4 November 2011. Research Reports from Turku University of Applied Sciences 36. Turku University of Applied Sciences.

BENTHIC INVERTEBRATE COMMUNITIES REFLECT THE ECOLOGICAL CONDITION OF THE WATER ECOSYSTEMS

Arto Huhta

Principal lecturer

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Faculty of Technology, Environment and Business

Degree Programme in Fisheries and Environmental Care

Project:

Benthic invertebrate communities reflect the ecological condition of the water ecosystems

Duration:

1 January 2006 – 31 December 2007

Budget:

EUR 26 500

Funding:

The River Aurajoki Foundation

Fisheries District of Southwest Finland

Finnish Environment Institute

Partners:

Southwest Finland Centre for Economic Development, Transport and the Environment

University of Oulu

Finnish Environment Institute

Fisheries District of Southwest Finland

Contact person:

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Project status:

Completed

In the project 'The ecological status and the rehabilitation of the Aura River' the benthic invertebrate communities of the Aura River were studied extensively for the first time. River ecosystems of this kind, which are strongly affected by human activities, have not been studied much in Finland. The benthic invertebrate communities are good indicators of the ecological condition of the water ecosystems, and the need for more detailed information about the benthic communities has increased because of the Water Framework Directive of the European Union.



BACKGROUND AND OBJECTIVES

The ecological status of the rivers in southern Finland is not good. The water quality of the rivers in Finland has been monitored for decades because the water is important for humans. In any case, knowledge of the ecological condition and the factors affecting these heavily changed water ecosystems is scarce in Finland.

The Water Framework Directive of the European Union means that we have to improve the ecological condition of the water ecosystems. The external load of nutrients into the water bodies should be reduced and the ecological condition should be improved in the future. The benthic invertebrate communities were also important when authorities have classified our water ecosystems into different categories. Because the benthic invertebrate communities are a good indicator of the ecological condition of the water ecosystems, they should also be studied more in detail to find out how successful our water protection work has been.

This study is the first detailed study of benthic invertebrates of riffles in the Aura River basin. The information gathered can be used to map which areas of the river basin should be taken more carefully into account in water protection and rehabilitation work.

Objectives of the study

1. To study the benthic invertebrate communities and the environmental factors affecting them in the Aura River basin.
2. To study the ecological condition of the river ecosystem based in the state of benthic invertebrate communities.
3. To find out the factors and the areas in the catchment area, which are decreasing the ecological condition of the water ecosystem, and to find solutions to address these issues.

IMPLEMENTATION

Eleven riffles of the main stem and tributaries were chosen as study sites. Also a spring-fed stream close to the origin of the Aura River was studied. The benthic invertebrate communities were sampled and the water quality and other environmental factors were measured in the riffles of research area.

After benthic invertebrate sampling, the water quality and ecological parameters of the study site were measured. Also the land use close to the study sites were measured (e.g. the vegetation, the amount of agricultural areas and the buffer zones on the river banks). The features of catchment areas of the study sites and their possible impact on the water quality and the benthic invertebrate community were also analysed. Later, based on the patterns found in the benthic invertebrate communities in the riffles, the ecological condition can be measured more precisely and the areas of poor ecological condition in the water ecosystem can be found. Water protection and rehabilitation work is then easier to conduct in the areas where the ecological condition is not good.

RESULTS

The diversity of the benthic communities in the main stream was the highest in the riffles of the middle reach, like Riihikoski, Hypöistenkoski, Nautelankoski and Vierunkoski. The diversity of benthic community at the lower reach of the river in Halistenkoski was the poorest. The diversity of the benthic community indicated the eutrophic state of the water ecosystem at Halistenkoski and a slightly eutrophic state at all other study sites. The patterns observed in the

Aura River ecosystem were similar with other river ecosystems studied in Finland. Local and regional factors are important in affecting the benthic animal community and only some patterns of the community structure can be linked with water quality.

The diversity of benthic communities of Aura River's tributaries was the highest in Korvenoja, Savijoki, Järvijoki and Kaulajoki. The diversity was the poorest in Piipanoja and Jaaninoja. The trophic state of the water ecosystems in these streams was slightly eutrophic, except in Piipanoja and Pöhlhönjoki, where the trophic state was eutrophic. The only moss species growing at the bottom of this river ecosystem was common water moss (*Fontinalis antipyretica*). This species was not found at all study sites. It is an important species for the river ecosystem and it affects the benthic invertebrate community by e.g. increasing the amount of organic matter at the river bottom. Several benthic invertebrate species new to the Aura River ecosystem were found in this study.



PICTURE 1. *Erkka Tawast measuring the condition of a riffle in the Aura River.*
Photo: Arto Huhta.

EFFECTIVENESS

The main result of this project was the detailed picture of the ecological condition of the Aura River. Also the factors having an impact on the whole ecosystem were analysed in this study. The results will be useful in planning the rehabilitation of similar ecosystems affected by agriculture.

FUTURE PERSPECTIVES

The ecological status of benthic invertebrates is one of the best indicators when determining the state of a river ecosystem. Together with continuous monitoring of water quality, a good insight on the ecological status of an ecosystem can be obtained.

PUBLICATIONS

Tawast Erkkä 2006: Selvitys eräiden Aurajoen sivujokien pohjaeläimistöstä (in Finnish). Bachelor's thesis. Turku University of Applied Sciences. Degree Programme in Fisheries and environment.

Heino Tommi 2007: Aurajoen pääuoman koskien pohjaeläimistön kartoitus (in Finnish). Bachelor's thesis. Turku University of Applied Sciences. Degree Programme in Fisheries and environment.

TABLE 1. *The number of invertebrate taxon groups (species, genera or family) in the main channel of the river Aurajoki at study sites (Heino 2007).*

	Aura River headwaters	Koskelan-koski	Sipilän-koski	Kolkkisten-koski	Riihi-koski	Kuus-koski
Number of taxa						
Caddisflies (Trichoptera)	7	8	3	2	8	9
Mayflies (Ephemeroptera)	3	3	3	2	3	4
Stoneflies (Plecoptera)				1		1
Beetles (Coleoptera)			3		4	1
True flies (Diptera)	2	4	2	2	4	2
Others	4	6	7	5	7	6

	Hypöisten-koski	Leppä-koski	Nautelan-koski	Vierun-koski	Vääntelän-koski	Halisten-koski
Number of taxa						
Caddisflies (Trichoptera)	7	8	9	9	10	3
Mayflies (Ephemeroptera)	6	2	4	5	1	2
Stoneflies (Plecoptera)	1		1	1		
Beetles (Coleoptera)	1	3	1	4	2	
True flies (Diptera)	2	2	2	4	2	2
Others	6	7	6	5	3	2

TABLE 2. *The number of invertebrate taxon groups (species, genera or family) in the streams draining into the river Aurajoki at study sites (Tawast 2006).*

	Järvenoja	Korvenoja	Krotinpuro	Kaulajoki	Lahnaoja	Pölhönjoki
Number of taxa						
Caddisflies (Trichoptera)	5	8	4	11	6	7
Mayflies (Ephemeroptera)	2	1	1	2	2	3
Stoneflies (Plecoptera)	1	1	1	1	1	1
Beetles (Coleoptera)	3	6	1	2	1	
True flies (Diptera)	5	8	3	4	5	5
Others	3	6	7	6	4	3

	Järvijoki	Salmelanoja	Savijoki	Piipanoja	Jaaninoja
Number of taxa					
Caddisflies (Trichoptera)	11	3	11	1	4
Mayflies (Ephemeroptera)	2	2	3		
Stoneflies (Plecoptera)	1	1	1		
Beetles (Coleoptera)	2		7		
True flies (Diptera)	5	5	3	3	4
Others	5	4	5	4	8

LAMPREY POPULATIONS AND PRODUCTIVITY OF LAMPREY STOCKINGS IN IIJOKI

Arto Huhta

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Faculty of Technology, Environment and Business

Degree Programme in Fisheries and Environmental Care

Project:

Lamprey populations and productivity of lamprey stocking in the Iijoki

Duration:

1 January 2011 – 31 December 2012

Budget:

EUR 6660

Funding:

Iijoki Fishing District

Partners:

Iijoki Fishing District

Northern Ostrobothnia Centre for Economic Development,
Transport and the Environment

Contact person:

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Project status:

Ongoing

The lamprey catches have decreased in Iijoki during the last years. The project aims to find out possible explanations for the decrease and draw up guidelines for the management of lamprey populations. The students of Degree Programme in Fisheries and Environmental Care play an important role in implementation of the project.



BACKGROUND AND OBJECTIVES

The project's aim was to find out possible explanations for the decreased lamprey catches in the Iijoki Fishing District. Local fishermen have noticed that lamprey catches have decreased significantly during the last five years and that the lamprey stockings have not been productive. The Fishing District wanted to know whether the stocking areas for lamprey larvae are good habitats for the survival of larvae and where the most suitable habitats for stockings could be found in future. Without recommendations for the management of lamprey populations, the locally important fishing industry is threatened. Local fishermen were also interviewed to find their explanations for the decreasing lamprey population.

The Iijoki Fishing District and local fishermen wanted answers to the following questions:

1. Why the lamprey larvae stockings in Iijoki did not have a good yield?
2. Are the prevailing stocking areas good for the survival of lamprey larvae?
3. What kind of habitats are the best for the stocking of lamprey larvae?
4. Where, in this water ecosystem, are the most suitable stocking areas for the lamprey larvae?
5. The lamprey catch in the Iijoki Fishing District has decreased remarkably during the last five years. What are the possible reasons for this phenomenon?



PICTURE 1. *Henri Turpeinen sampling a possible lamprey larvae habitat in a small stream draining into the river Iijoki. Photo: Arto Huhta.*

IMPLEMENTATION

During the field work, students sampled the areas close to the stocking areas of larvae and made detailed descriptions of the areas where the lamprey larvae were found. The impact of fish predation on the lamprey population was also estimated by studying the contents of fish guts in the river.

RESULTS

The amount and type of organic material on the bottom was the most important factor explaining the survival of lamprey larvae. If suitable habitats for the lamprey larvae cannot be found near the stocking areas, the survival of the larvae and productivity of the stockings will be low. The sampling methods of this project are commonly used in this kind of research, but during the

project, students found new methods for sampling. In this study, students learned how to conduct a field study and how it is possible to manage an important animal species for fisheries industry in future. The final report of the project will be published in the autumn of 2012.

EFFECTIVENESS

The project will give detailed information about the density of the lamprey larvae population in areas close to stocking areas and the fishing district can limit stockings to the most productive areas in the future. Those areas, which are not good habitats for the lamprey larvae, will not be used for stocking purposes in the future. The fishing district will get useful information about the prevailing fish population in the stocking areas and it can plan the management of the fish populations so that fish population will not have remarkable predation impact on the lamprey populations in the future.



PICTURE 2. *Liesoja draining into the Bothnian Bay is a suitable habitat for lamprey larvae. Photo: Arto Huhta.*

FUTURE PERSPECTIVES

The fishing district is planning to continue the lamprey research in this water system to study the lamprey populations also in the other areas of Iijoki.

PUBLICATIONS

Turpeinen Henri (2012). Nahkiaisen toukan esiintyminen Iijoessa ja sen lähialueen virtavesissä (in Finnish). Bachelor's thesis. Turku University of Applied Sciences. Degree Programme in Fisheries and Environment.

MONITORING OF COASTAL FISH IN THE INNER ARCHIPELAGO SEA

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Project Manager

Tero Kalliomäki

Student Assistant

Turku University of Applied Sciences

Faculty of Technology, Environment and Business

Degree Programme in Fisheries and Environmental Care

Project:

International coastal fish inventory

Duration:

2005 –

Budget:

EUR 28 000

Funding:

Fishing permit funds (Centre for Economic Development, Transport and the Environment)

Partners:

City of Kaarina, City of Väståboland, Fishing Districts of Paimionselkä and Parainen, City of Turku, Game and Fisheries Research Institute of Finland

Contact person:

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Project status:

Ongoing

Turku University of Applied Sciences (TUAS) is carrying out fish monitoring in the inner Archipelago Sea as part of the international coastal fish monitoring programme of the Baltic Sea. The inventory results can be used in assessing the state of the environment, in planning the use of fish stocks and in the impact assessments of different environmental accidents.



PICTURE 1. *Lifting the prove nets. Photo: Raisa Kääriä.*

BACKGROUND AND OBJECTIVES

Fish monitoring has been performed in Kaitvesi, in the inner Archipelago Sea, and in Kaarina and Pargas, since 2005. The monitoring is a part of Baltic Sea Coastal Fish Monitoring, coordinated by HELCOM (Baltic Marine Environment Protection Commission) (Figure 1). The monitoring area of TUAS is the only area representing an inner archipelago (Figure 2). The survey gives important knowledge about changes in the Baltic ecosystems.

The other survey areas in Finland are monitored by the Finnish Game and Fisheries Research Institute and the Government of Åland.



FIGURE 1. *Coastal fish monitoring areas in the Baltic Sea (HELCOM).*

IMPLEMENTATION

The methods used in the survey are described in detail e.g. by Ådjers et al (2006). (Naturvårdsverket 2008, HELCOM 2005, Ådjers et al. 2006.) The survey is performed by using standardised coastal survey nets. The nets consist of nine different mesh sizes (10–60 mm), they are 45 m long and 1.8 m high bottom nets. The nets are set in the afternoon at 14:00–17:00 and taken up the next morning between 07:00–10:00. The places of the nets have been selected randomly from four different depth zones and every year the same places are used. The survey has included 39–44 nets annually and it has been performed in the beginning of September (Table 1).

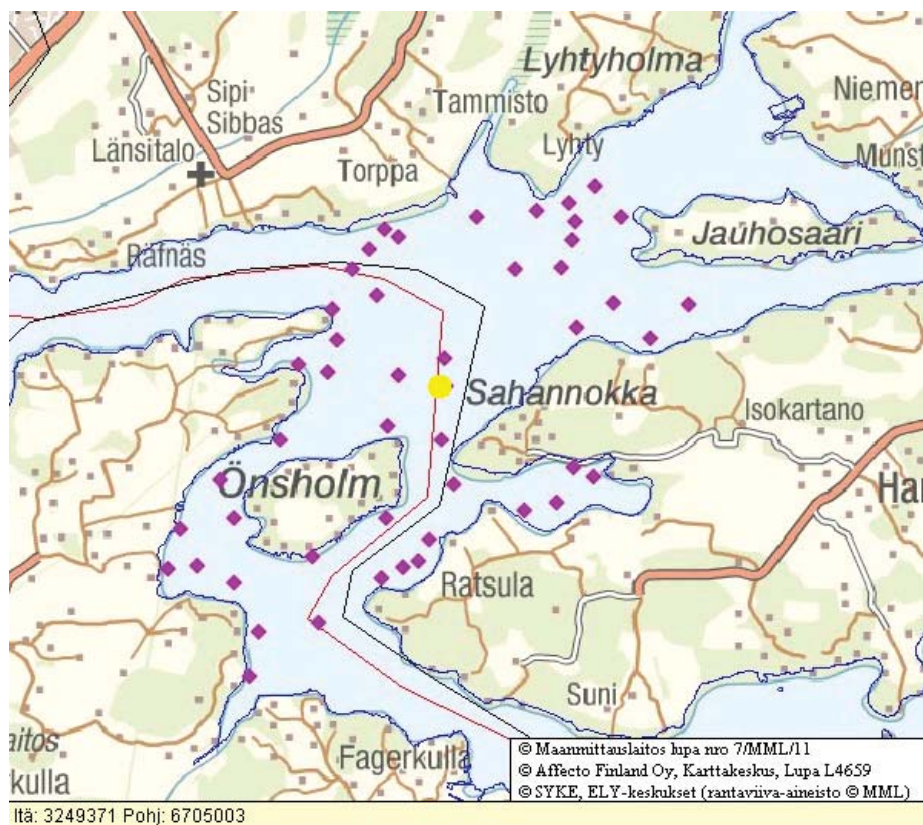


FIGURE 2. Places of nets in Kaitvesi (Finnish Game and Fisheries Research Institute).

TABLE 1. Dates of fishing, water temperature, secchi depth and the number of nets for each year.

	2005	2006	2007	2008	2009	2010	2011
dates of test fishing	24.8–5.9	28.8–7.9	10.9–18.9	1.9–10.9	7.9–17.9	7.9–15.9	5.9–9.9
water temperature (°C)	15.8–20.4	17.0–21.0	14.5–16.1	14.8–15.5	15.5–17.6	14.4–16.4	18,2–19,0
secchi depth (m)	0.9–1.1	1.2–1.7	1.0–1.2	1.6–1.7	1.0–1.8	1.2–1.7	0,8–1,2
number of nets	39	44	44	43	44	45	44

RESULTS

Altogether 12 fish species were caught in 2010. 17 different species were caught during the whole study period (2005–2010) (Table 2). The catches consisted mostly of Cyprinidae (Figure 3), but also perch (*Perca fluviatilis*), ruffe (*Gymnocephalus cernuus*) and zander (pike-perch, *Sander lucioperca*) are common in the area. (Figures 4-6).

TABLE 2. *Catch (numbers) in years 2005–2011.*

species	2005	2006	2007	2008	2009	2010	2011
perch (<i>Perca fluviatilis</i>)	249	463	286	304	474	779	526
pike (<i>Esox Lucius</i>)	3	1	5	3	7	11	9
flounder (<i>Platichthys flesus</i>)	1						
ruffe (<i>Gymnocephalus cernuus</i>)	202	241	244	98	223	164	241
sprat (<i>Sprattus sprattus</i>)			1	1	1		4
bullhead (<i>Cottus gobio</i>)		1					
pike-perch (<i>Sander lucioperca</i>)	104	164	175	47	120	129	221
smelt (<i>Osmerus eperlanus</i>)	1			2	2		2
bream (<i>Abramis brama</i>)	9	21	4	1	6	11	14
black goby (<i>Gobius niger</i>)					1		
silver bream (<i>Abramis bjoerkna</i>)	738	935	702	352	862	741	933
bleak (<i>Alburnus alburnus</i>)	453	174	62	24	114	289	499
baltic herring (<i>Clupea harengus membras</i>)	2		15	9	9	33	10
rudd (<i>Scardinius erythrophthalmus</i>)	21	6	6	20	3	3	95
tentch (<i>Tinca tinca</i>)		1		2	2	1	1
roach (<i>Rutilus rutilus</i>)	457	244	305	239	428	375	778
ide (<i>Leuciscus idus</i>)			1	2		1	
total	2240	2251	1806	1104	2252	2537	3333

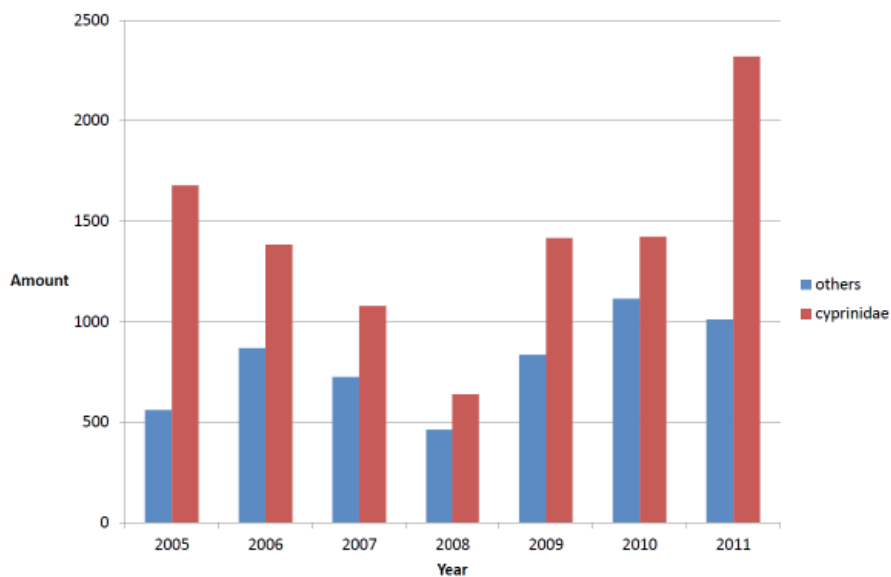


FIGURE 3. *The amount of cyprinids (Cyprinidae) in 2005–2011 in the research area.*

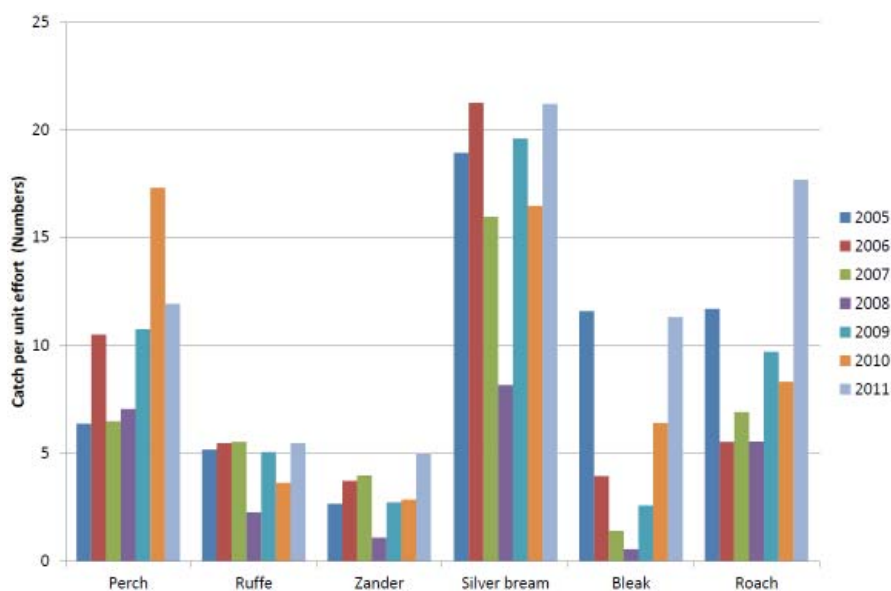


FIGURE 4. *Total catch (Catch per unit effort) of the most common species in 2005–2011.*

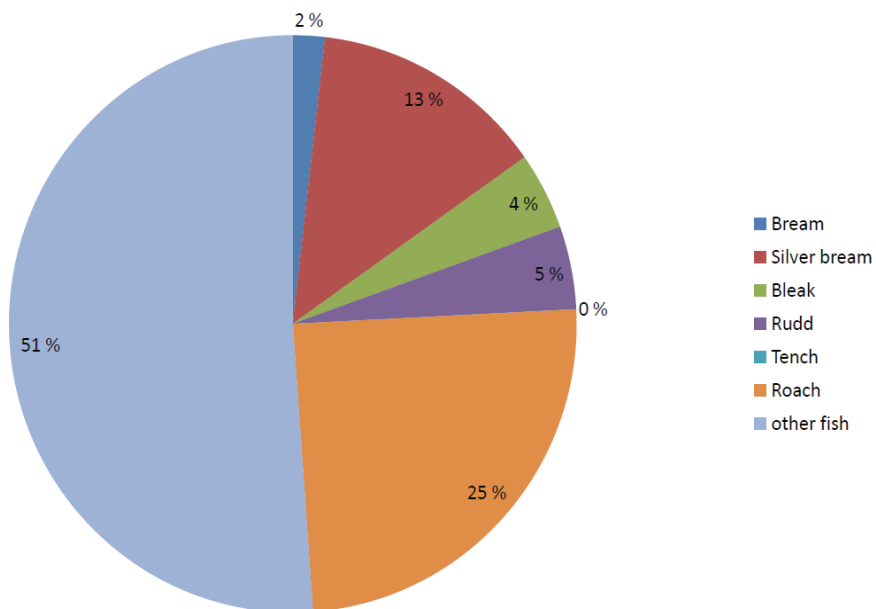


FIGURE 5. *Proportion of Cyprinidae species in the catch in 2011.*

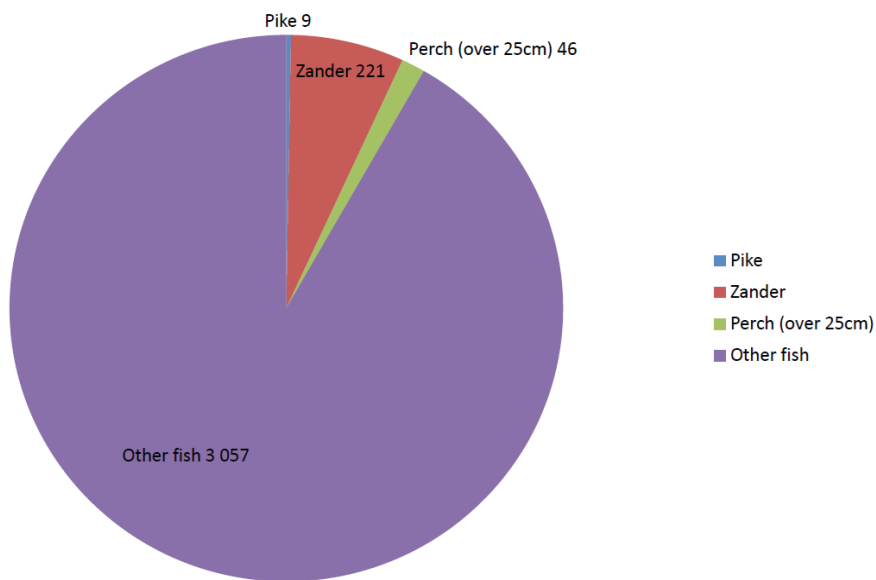


FIGURE 6. *The proportion of predatory fish compared to other fish in numbers in 2011. Pikes, zanders and perches over 25 cm in length are considered predatory fish.*

EFFECTIVENESS

Students get on average 30 credits per year completing courses and working in the project. In addition Bachelor's Theses are written approximately once every three years. The aim is to collect long-term data on the fish population in the inner Archipelago Sea.

FUTURE PERSPECTIVES

The monitoring will go on yearly. In 2012 one Bachelor's Thesis is done from the data collected in the project. The methods are discussed and improved in the HELCOM group and published in professional magazines and in the HELCOM series together with other monitoring sites.

PUBLICATIONS

Kääriä, R. 2008: Kaitveden koeverkkokalastukset Paimionselän kalastusalueella vuonna 2007. Kalahaavi.

Ådjers, K. Kääriä, R.; Lappalainen, A.; Raitaniemi, J. & Saulamo, K. 2009: Fångster av mindre utnyttjade arter i provfisket på Åland och i södra Finland. Fiskeritidskrift för Finland, Suomen kalatalouden keskusliitto.

Ådjers, K.; Kääriä, R.; Lappalainen, A.; Raitaniemi, J. & Saulamo, K. 2009: Vähempiarvoiset kalalajit levittäytyneet rannikkoalueellamme. Suomen kalastuslehti.

BACHELOR'S THESES

Salmi, Juhani A. 2007: Kuhan ravinto Saaristomeren sisäosissa kasvukauden aikana. The diet of pikeperch in inner parts of the Archipelago sea during a growth period. Bachelors thesis, Turku University of Applied Sciences. English summary.

Vatanen, Heidi 2008: Kalaston rakenne ja ahvenen (*Perca fluviatilis*) kasvu sisäsaaristossa Kaitveden tutkimusalueella. The structure of fish fauna and the growth of perch (*Perca fluviatilis*) in the inner archipelago area called Kaitvesi. Bachelors thesis, Turku University of Applied Sciences. English summary.

The projects involved in the theme 'Corporate responsibility' aim for networking and cooperation between universities and companies, taking the perspective of responsible business into account in all R&D activities, developing the SME sector's environmental expertise, disseminating information relevant to these topics as well as organizing seminars and educational events.

CORPORATE RESPONSIBILITY

eGreenNet – NETWORK OF ENVIRONMENTAL KNOWHOW

Piia Nurmi

Project Manager

Turku University of Applied Sciences

Faculty of Technology, Environment and Business

Project:

eGreenNet – Network of environmental knowhow

Duration:

1 April 2010 – 31 December 2013

Budget:

EUR 592 036

Funding:

European Social Fund

Contact person:

Piia Nurmi – piia.nurmi@turkuamk.fi

Project status:

Ongoing



Leverage from
the EU
2007–2013

Nowadays environmental aspects are seen as “business as usual” or even as a business opportunity. Companies are doing a lot but the eGreenNet project aims to help them to do even better. The purpose of the project is to strengthen and develop the network of environmental know-how and expertise in the Southwest Finland area. This is accomplished by creating clear and cost-efficient models and platforms of cooperation.

BACKGROUND AND OBJECTIVES

Recently, there has been more and more interest in green business and eco-innovations. Green business or eco-innovation (also referred to as sustainability innovations, ecodesign, ecopreneurship, greentech or cleantech) has been proposed as a source for “environmentally benign growth” as well as the beginning of the “next industrial revolution”. (CSR-driven innovation 2008.)

In the European Union, eco-industry is one of Europe’s biggest industrial sectors with an annual turnover of more than 300 billion euros (2.5% of GDP) and about 3.4 million directly employed (1.5% of all employed). Venture capital investments in clean technologies in Europe rose continuously in recent years to around a quarter of total investments. (EU initiatives on... 2011.)

In Finland, the total turnover of enterprises operating in the environmental goods and services sector was 1.61 billion euros in 2009. By this, Statistics Finland refers to economic activity related to production that is based on environmental pollution prevention or the saving of natural resources. (Statistics: Environmental goods... 2011.)

Here, it is important to notice that it is really difficult to measure the volume of green economy as there are so many different titles and aspects to it. Still, these figures give some idea.

Traditionally environmental aspects were seen more as a burden to companies, but nowadays they are seen more as “business as usual” or even as a business opportunity.

The eGreenNet project focuses on the local, i.e. Southwest Finland area, green cluster. The aim of the project is to strengthen and develop the network of environmental know-how and expertise in Southwest Finland. This is accomplished by creating clear and cost-efficient models and platforms of cooperation.

The partners in cooperation are Centre for Economic Development, Transport and the Environment of Southwest Finland, Business Service Center Potkuri, companies, Regional Organisation of Enterprises in the South-West Region, Ukipolis Ltd, Vakka-Suomi, Loimaa subregion, Salo subregion, Turunmaa subregion, Turku Region Development Centre, Valonia – Service Centre for Sustainable Development and Energy of Southwest Finland, University of Turku, Abo Akademi University, Novia University of Applied Sciences, Turku Science Park, Turku Chamber of Commerce, Federation of Finnish Technology Industries, Regional Council of Southwest Finland, Confederation of Finnish Industries EK, Enterprise Europe Network, different networks such as Turku Green KnowHow, a large regional and national network.

IMPLEMENTATION

The eGreenNet project consists of two phases. In the first phase, from April 2010 to June 2011, the network and framework were built and background information was gathered. In the second phase that continues until December 2013, the network of environmental know-how and expertise is strengthened, focusing on creating new business activity on environmental know-how. Also some support instruments for all small and medium-sized enterprises (SMEs), such as environmental management tools, will be promoted.

There are some very important principles incorporated in the project. First, the project will not create new institutions – rather the aim is to strengthen the existing organisations and to create an atmosphere of inspiration. Second, learning from others is important – the project operates in a large network. Third, companies are already doing amazing things – we do not intend to teach them but rather aim to help them do even better.

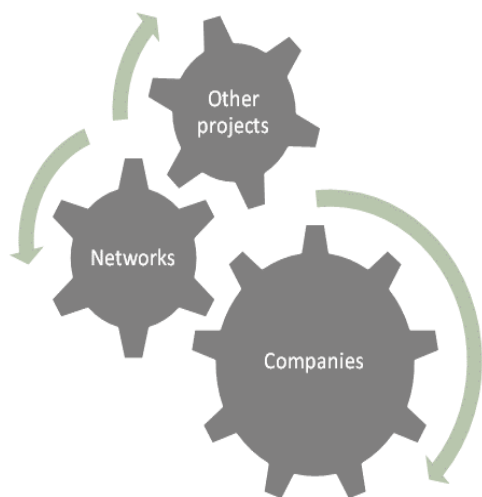


FIGURE 1. *The focus areas of the project.*

RESULTS

The eGreenNet project will strengthen and develop the local network of the environmental knowhow. It will link experts together and help develop both demand and supply. The potential and diversity of the sector will be recognised by more people, as green business becomes regionally more successful. The project will also support instruments that are accessible for local SMEs. Also all the models and processes developed in the project will be written down in publications and relevant partners, both nationally and internationally, will be made familiar with the work through active publicity and dissemination.

EFFECTIVENESS

The project area is Southwest Finland and thus the project aims for greater effectiveness locally. The project aims to strengthen and develop the network of environmental know-how and expertise in Southwest Finland. Especially the aim is to strengthen the green business sector.



PICTURE 1. *A workshop organised by the project. Photo: Pii Nurmi.*

FUTURE PERSPECTIVES

There are three main points we would like to emphasise at this point, regarding the future development and plans in green business:

1. Local cluster! The project focuses on the local Southwest Finland green cluster. This of course means – in today’s global environment – that we have excellent national and global cooperation and networks. The local cluster has capabilities to become a really important and valuable business sector locally.
2. Business as usual! The green business is very similar to other sectors. Business processes are built on the same principles as those used in other industries. However, particularly as the environmental industry is a young and growing sector, there are some specific needs in the companies. However, the main needs are the same as in all companies: marketing, contacts, financing etc. (Aarras, Nurmi, Stenholm & Heinonen 2008.)

3. Definitions! The environmental business is difficult to define comprehensively and clearly. The environmental business is a group of activities carried out in very diverse sectors. It includes clean technologies and the production of environmentally friendly products as well as auxiliary services such as waste management and recycling and related construction activities. (Hernesniemi & Sundquist 2007.) Despite this, a definition is needed as we e.g. need to be able to know how important this sector is in the local and national business environment.

REFERENCES

Aarras, N.; Nurmi, P.; Stenholm, P.; Heinonen, J. (2008) Energia- ja ympäristötoimialojen pk-yritysten liiketoimintaosaamisen kehittämistarpeet. Tekesin katsaus 237/2008, Tekes, Helsinki 2008.

CSR-driven innovation. Towards the Social Purpose Business (2008) Main Authors: Kai Hockerts, Mette Morsing, Jonas Eder Hansen, Per Krull, Atle Midttun, Minna Halme, Susanne Sweet, Pall Davidsson, Thröstur Olaf Sigurjónsson, Piia Nurmi. Access: http://www.csrgov.dk/graphics/Samfundsansvar.dk/csrinnovation/Dokumenter/csr-di-report_final.pdf

EU initiatives on resource efficiency and eco-innovation (2011) Presentation by Timo Mäkelä, Director Environment Directorate-General, European Commission, EU-South Africa Green Growth Workshop. Pretoria, 16 February 2011.

Hernesniemi, H. & Sundquist, H. (2007) Rapidly growing environmental business needs monitoring.

Helsin, Sitra ja Etlatieto Oy, ISBN978-951-563-593-8.

Statistics: Environmental goods and services sector (2011) ISSN=1799-5108. Helsinki: Statistics Finland [referred: 14.11.2011]. Access: http://tilastokeskus.fi/til/ytl/index_en.html.

FUTURE MARINA – DEVELOPMENT OF THE COMPETITIVENESS OF MARINAS

Piia Nurmi

Project Manager

Turku University of Applied Sciences

Faculty of Technology, Environment and Business

Project:

Future Marina - Development of the competitiveness of marinas
(FUTUMA)

Duration:

1 June 2010 – 31 December 2012

Budget:

EUR 365 000 (TUAS' share EUR 182 500)

Funding:

Tekes – the Finnish Funding Agency for Technology and Innovation,
University of Turku, Ab Kasnasudden Oy, Ajolanranta Oy, Cursor Oy,
Galonis Oy Ab, City of Hanko, Municipality of Kimitoon, Strandbo
Group, Joint-Stock Property Company Meri-Teijo Marina, Kultaranta
Resort Oy, Marinetek Finland Oy, City of Naantali, City of Rauma,
RMR Oy Merirakenne/Uto Havshotel, Rymattylan Herrankukkaro
Oy, Turku Touring, City of Uusikaupunki

Partners:

University of Turku

Contact person:

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Project status:

Ongoing



The FUTUMA project aims to find new business opportunities for Finnish marinas by extending and expanding the activity outside the peak season. When developing marina activities sustainable development is taken into account. The project carries out the mapping of the current situation and pilots new business ideas.

BACKGROUND AND OBJECTIVES

The research project FUTUMA focuses on the development of marinas in Finland. The aim is to develop the business and competitiveness of the marina clusters. Marina cluster consists of the marina, retailing, tourism, travelling services and other relevant sectors. The marinas involved in the project generally employ 10–100 people during the high season. The main aim of the project is to extend and expand the operations and business activity season in marinas, as the high season in Finnish marinas is often shorter than two months during midsummer. Networks of the marinas and entrepreneurs are also a very important aspect in the project.



PICTURE 1. *Finnish marinas usually have a low season over winter. Photo: Piia Nurmi.*

The project aims to:

- Identify new business opportunities for marinas in Finland
- Develop new business models for marinas
- Pilot and model new business models.

IMPLEMENTATION

The project is divided into five work packages (WP), two of which are carried out by Turku University of Applied Sciences (TUAS). The project started with a WP mapping the present situation in the marinas, including a survey directed to their users. The fourth WP concentrates on piloting and began in December 2011. The fifth WP is management and dissemination. The two remaining WPs are the responsibility of University of Turku and they focus on the new business opportunities and models.

Sustainable development is taken into account when creating the new business ideas and models. Sustainable development is a very important topic in the marinas as they are located by the sea, lakes or other water areas, and as the nature is an important component of the service experience of the consumers of these services. All triple bottom line aspects are important here: business lays heavily on the economic success of the marinas, but social and environmental aspects are also very important.

RESULTS

The project will contribute to a more competitive marine cluster, helping to extend and expand the season in marinas. Figure 1 presents the services that were listed in the survey regarding to the consumers of marina services.

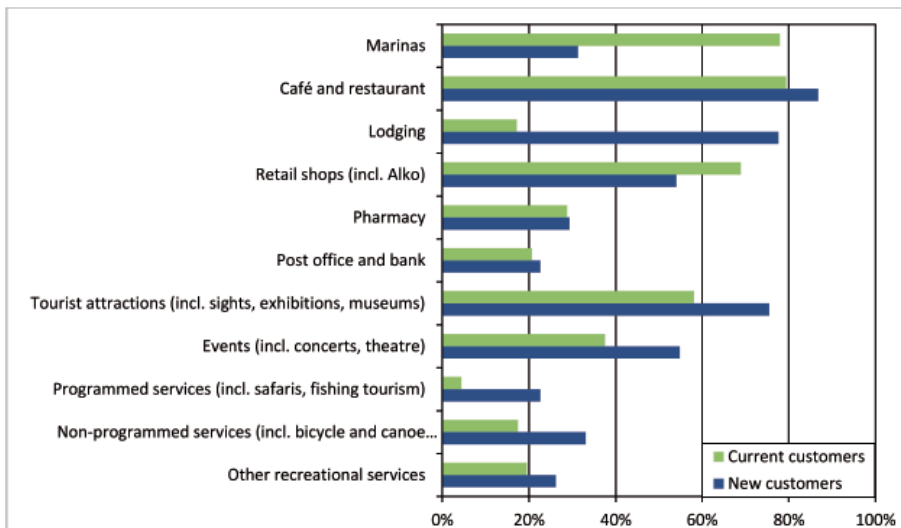


FIGURE 1. *Services appreciated by marina customers. (Source: Saaristosatamien... 2011)*

EFFECTIVENESS

The project is part of Tekes's Tourism and Leisure Services 2006–2012 programme. This programme encourages R&D activities by companies producing leisure services. The development focuses on new service concepts, new ways of producing services and the creation of new spatial concepts.

FUTURE PERSPECTIVES

The project has generated a lot of interest among the entrepreneurs in the marinas as well as the cities and municipalities participating in the project.

REFERENCES

Saaristosatamien käyttäjien tulevaisuuden tarpeet (2011) Future Marina project. Access: <http://www.futuremarina.fi/images/stories/valokuvat/saaristosatamien%20kyttjien%20tulevaisuuden%20tarpeet.pdf>

The theme 'Environmental technology' is focused on projects including the monitoring systems of the state of water, improvement of waters, low-emission motors, biofuels, eco-efficient construction and energy production technologies.

ENVIRONMENTAL TECHNOLOGY

LOW-EMISSION ENGINES FOR VARIOUS FUELS

Seppo Niemi

Principal Lecturer, Docent

Pekka Nousiainen

Senior Lecturer

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Faculty of Technology, Environment and Business

Projects:

Reduction of the exhaust emissions and improvement of the energy economy of marine and power plant engines

Energy efficient diesel engines for the 2010s

Modelling and simulation of internal combustion engines

Particle filter study

TREAM - Trends in real-world particle emissions of diesel and gasoline vehicles

Duration:

January 2010 –

Budget:

MEUR 1.08 (all four projects)

Funding:

Tekes, AGCO Power Inc., Wärtsilä Finland Oy, Ecocat Ltd., Turun Pari Oy, Greenfield Consulting Ltd., Ab Nanol Technologies Oy, Valtra Inc., Henry Ford

Partners:

University of Vaasa

University of Oulu

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Project Manager Mika Laurén – mika.lauren@turkuamk.fi

Project status:

Ongoing

The emissions legislation of internal combustion engines becomes stricter all the time. Along with emissions reductions, the energy economy of the engines must be kept at as high a level as possible since the fuel prices increase. Experimental research has been performed a number of years in the Internal Combustion Engine (ICE) Laboratory of Turku University of Applied Sciences (TUAS), to develop low-emission, high-efficiency engines and to study new fuels to make them compatible with the engines.

BACKGROUND AND OBJECTIVES

The emissions legislation of internal combustion engines becomes stricter all the time. In diesel engines, the main challenge is to reduce the emissions of nitrogen oxides (NO_x) and particulate matter (PM). In marine applications when burning heavy fuel oils sulphur oxides should also be reduced. For on- and non-road engines, steady cycle measurements are no longer sufficient, but transient cycles must also be run and passed through.

Along with the emissions reductions, the energy economy of the engines must be kept at as high a level as possible since the fuel prices increase. High efficiency also means that the CO_2 emissions can be limited. Furthermore, new fuel alternatives must be found because the fossil fuel resources are limited.

The R&D work of Turku University of Applied Sciences (TUAS) concentrates just on the above themes. Low-emission, high-efficiency engines are developed, new fuels are studied and the engines are made compatible with these fuels. Different exhaust after-treatment systems are also investigated for non-road and marine engines. About the latter, there is a separate chapter in this publication, titled Marine exhaust gas scrubbers.

Several in-cylinder means are applied in engine R&D. The injection and turbocharging systems are optimised, the combustion chamber shape is developed, exhaust gas recirculation (EGR) is studied, the valve timing is optimised and engine thermal management is examined.

Moreover, exhaust after-treatment systems are investigated and fitted in the engine applications. New fuels, fuel additives, and lubricating oil additives are studied. Modelling and simulation work supports the experimental R&D.

IMPLEMENTATION

Experimental research is performed in the Internal Combustion Engine (ICE) Laboratory of TUAS. Currently, there are four engine test benches available. Two of them are also ready for transient measurements, so non-road transient cycle (NRTC) studies are also conducted.

The test benches are equipped with modern data acquisition systems. The regulated gaseous exhaust emissions are measured with analysers accordant with the emissions legislation. An FTIR instrument is also available for unregulated emissions, e.g. ammonia, methane, nitrous oxide and aldehydes.

The exhaust smoke is determined according to the international practice. The PM mass can be measured by means of mass impactors, and the PM number emissions are recorded with an ELPI or a Pegasor instruments. Different exhaust dilution systems are available.

In addition to the engine research in the laboratory, R&D of engines and after-treatment systems is also conducted outside TUAS. Emissions measurements are made in the facilities of the customers, and an exhaust scrubber is developed in close co-operation with a large engine manufacturer in a real marine and power plant environment (see Chapter “Marine exhaust gas scrubbers”).

In the ICE laboratory, each test bench is managed by a Senior Research Engineer (Picture 1) assisted by a student. The laboratory manager is responsible for laboratory development and the instrument overhaul. Principal and senior lecturers plan and sell research projects, apply for funding, supervise R&D work and participate in the measurements and results analyses. They also publish results when permitted by the customers.

Within the projects, Bachelor's and Master's theses are produced.



PICTURE 1. *Senior Research Engineer in the ICE Laboratory at TUAS. Photo: Martti Komulainen.*

RESULTS

In general, the results are confidential. Below a few results are however presented. Proper permissions have been received from the partners.

Non-road diesel engines

One of the biggest problems with exhaust after-treatment systems is the low exhaust temperature of the high-efficiency engines. Several catalysts demand a certain temperature level in order to light off and to operate appropriately. In one project at TUAS, several methods were studied to increase the average exhaust temperature during the NRTC. The results are illustrated in Figure 1.

Compared with the standard solution (std), especially method No. 3 shortened the duration time of minor exhaust temperatures and increased the duration time of temperatures of above 300 °C, thus improving the operation conditions of the catalyst installed downstream the turbocharger turbine.

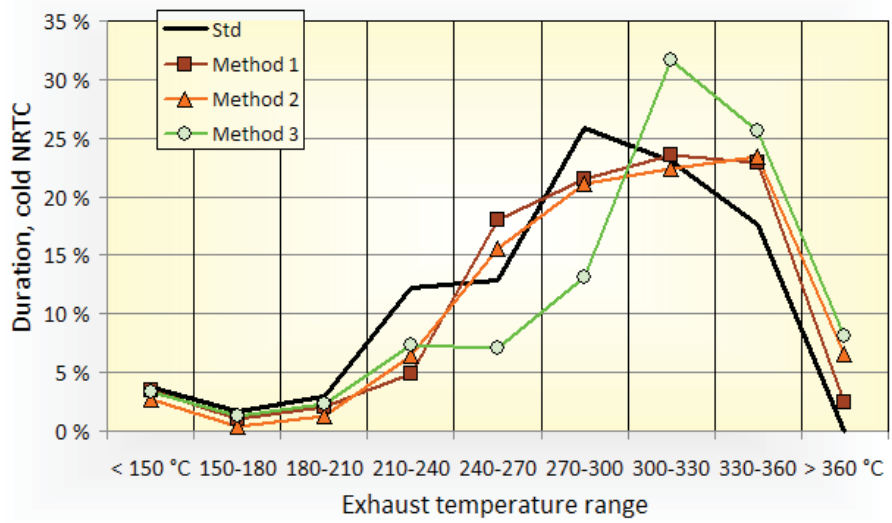


FIGURE 1. Duration of certain exhaust temperature ranges during NRTC operation.

Method No. 3 also made the charge pressure increase faster during NRTC driving, Figure 2. As a result, the momentary particulate matter (PM) peak decreased substantially also reducing, most probably, the instant visible smoke and the total PM emissions of the NRTC cycle.

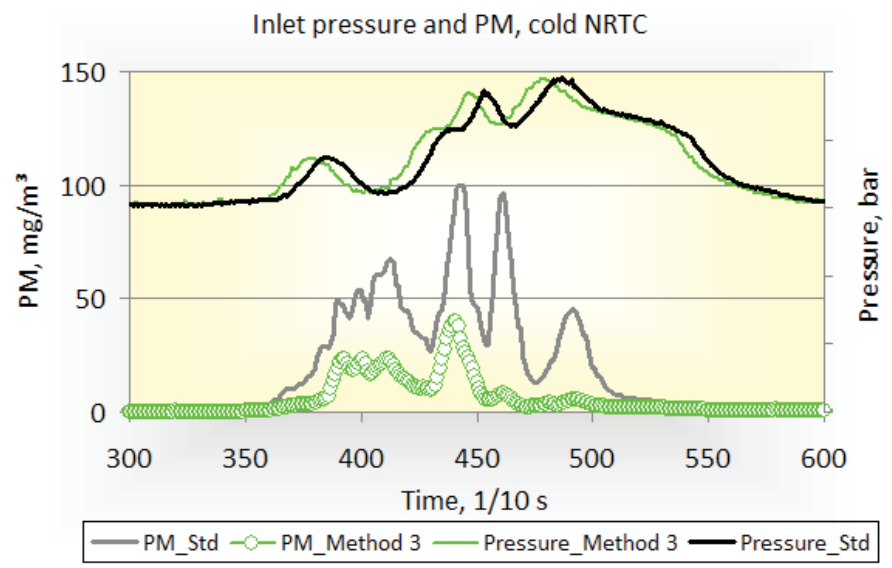


FIGURE 2. Inlet manifold pressure and exhaust PM concentration during an acceleration phase of the NRTC.

One of the non-road engine studies at TUAS concentrated on the simultaneous optimisation of the exhaust gas recirculation (EGR) quantity, injection pressure and injection timing. As a result of a large number of experiments, both NO_x and smoke emissions were managed to decrease with a slight fuel penalty, see Figure 3 below.

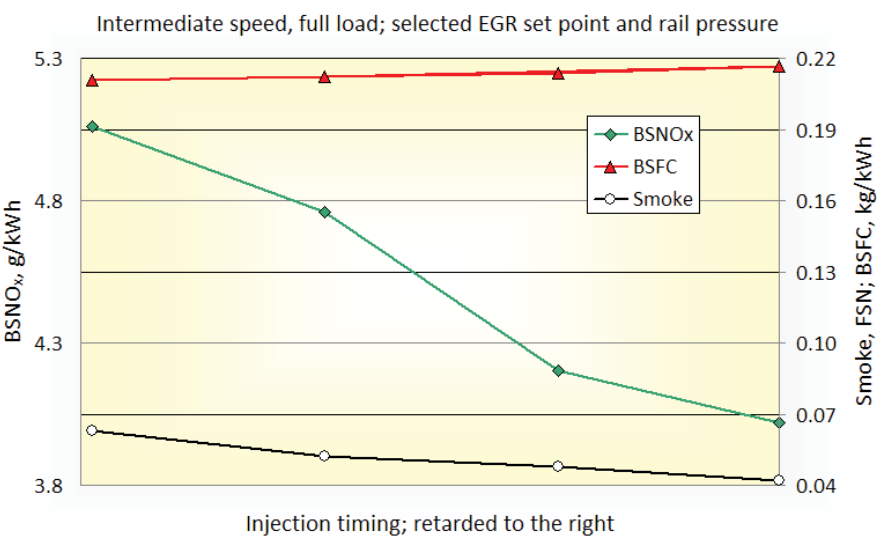


FIGURE 3. *Effect of injection timing on fuel consumption (BSFC) plus NO_x and smoke emissions; optimised EGR and injection pressure.*

Biofuel research

The viscosity of crude, unrefined bio-oils is higher by one order of magnitude compared with biodiesels or fossil diesel fuel oil. Consequently, the injection pressure tends to increase, particularly at the pump end of the high-pressure injection pipe. Within biofuel projects, injection pressures were recorded at both ends of the high-pressure pipe with different fuels. Figure 4 depicts the injection pressure at the injector end for three fuels, mustard seed oil (MSO), rape seed methyl ester (RME) and ordinary diesel fuel oil (DFO). A small amount of RME was blended with MSO in order to reduce deposit formation in the combustion chamber. The share of RME was 5 mass-%.

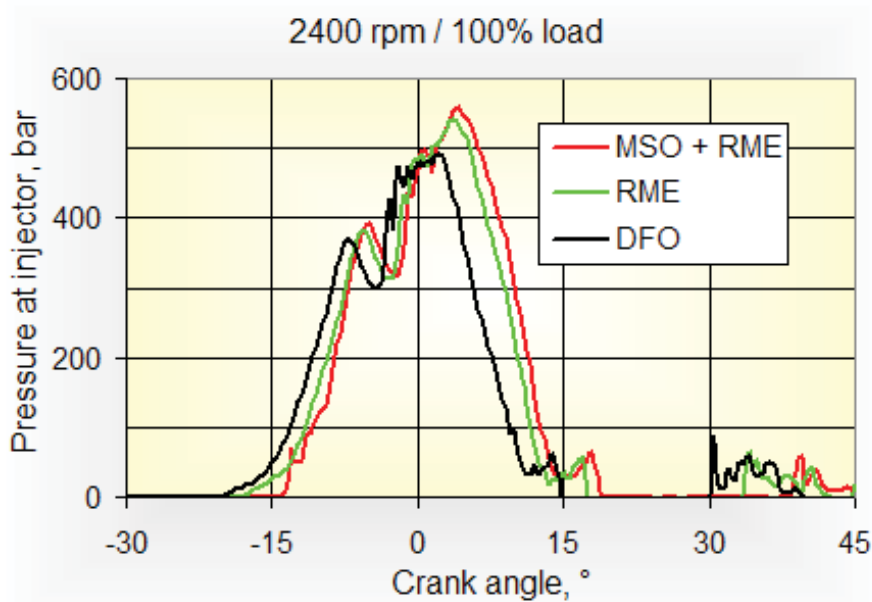


FIGURE 4. *Injection pressure versus crank angle at full load at rated speed for three fuels.*

As can be seen in Figure 4, the maximum injection pressure with MSO was the highest even at the injector end, the difference being app. 60 bar relative to DFO. Biofuels were injected slightly later than DFO since biofuel combustion had been observed to be more rapid.

In another biofuel project at TUAS, two crude animal fat derived bio-oils were studied. One was chicken oil (CO) from a poultry factory, the other originated from fur farming wastes (FO). Relative to DFO, the use of both bio-oils reduced the hydrocarbon (HC) emissions of the high-speed non-road test engine at high loads, Figure 5.

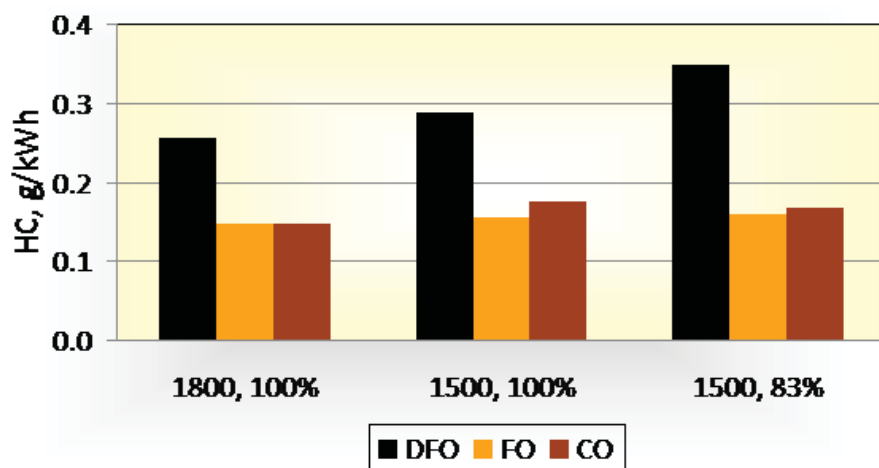


FIGURE 5. *Hydrocarbon emissions at three loads for DFO and two bio-oils.*

Modelling and simulation of internal combustion engines

The progressively tightening exhaust emission legislation creates challenges for internal combustion engine research and development. The products should be in the market faster and always better than earlier models. Parallel the basic goal, which is fulfilling the exhaust emission targets, the performance of the engines should be better and fuel consumption lower.

Nowadays, different simulation tools are used as an additional help to fulfil the demanding requirements of the markets and customers. They can replace some parts of the experimental laboratory tests by giving guidance which components and parameters would be suitable for testing. Therefore some experimental test rounds can be bypassed and the development projects will speed up.

The simulation tools for internal combustion engines are typically 1D or 3D ones. 1D tools are suitable for gas exchange process and pipe flow simulations, while more sophisticated 3D -tools will be typically used for engine in-cylinder flow and air/fuel mixing simulations. There are some open source tools available; however, the most popular ones are typically offered by big, global software companies.

In Finland, engine manufacturers, Wärtsilä Inc. and AGCO Sisu Power Inc., are using similar tools as a part of their R&D work. Star CD and GT-Suite are some examples of these tools.

Turku University of Applied Sciences (TUAS) has started to create expertise for this increasingly important field. The license for the GT-Power tool from Gamma Technologies has been bought in spring 2011 and the target is to start using it as a standard tool for engine research projects and education. GT-Power, an engine performance subtool of GT-Suite, requires lots of experimental test data to verify the simulation results. This is suitably supported by the ICE Laboratory of TUAS.

The AGCO Sisu Power 44 CWA off-road diesel engine (Picture 2) was selected as the first simulation subject. The work started by creating the basic model of the engine (Figure 6) by entering all the required dimensions and parameters to the programme.



PICTURE 2. *Sisu Diesel 44 CWA off-road engine. Photo: Pekka Nousiainen.*

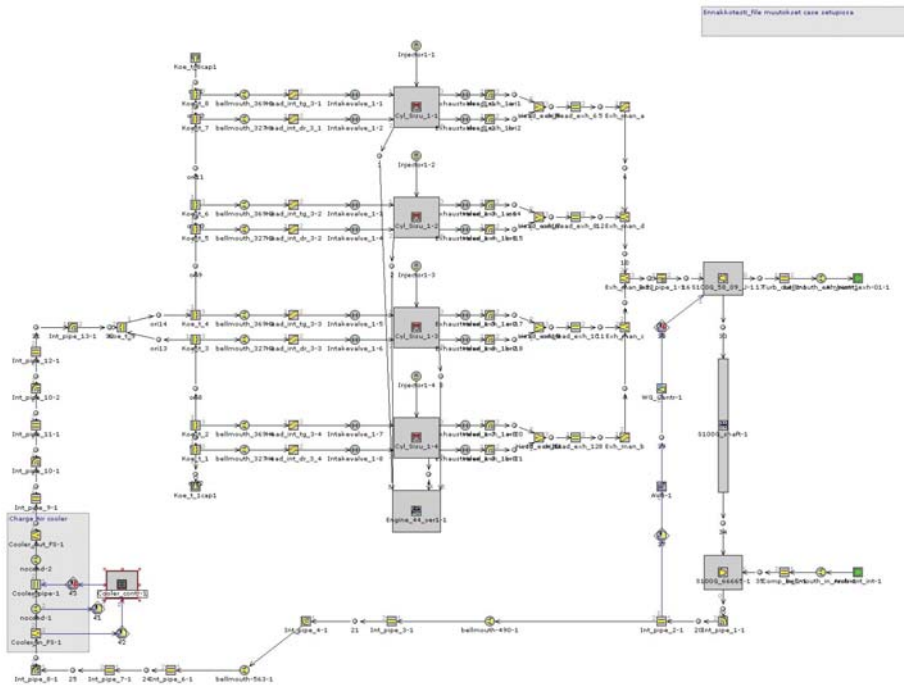


FIGURE 6. *The simulation model for Sisu Diesel 44 CWA engine.*

The accuracy of the first model was improved by some experimental tests in the laboratory, for instance cylinder pressure measurements. Some of the first performance data examples can be seen in figures 7 and 8. The simulated curves are promisingly already quite close to real values.

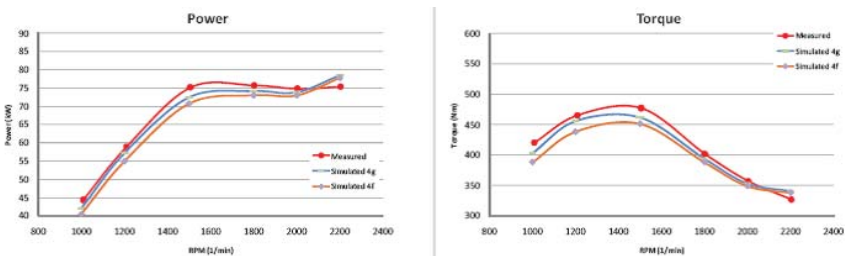


FIGURE 7. *Full load power and torque curves for two engine model versions (the red line is the measured result).*

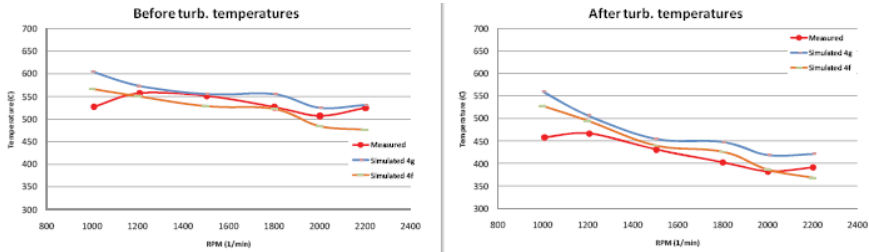


FIGURE 8. Full load exhaust gas temperatures before and after the turbocharger (the red line is the measured result).

The improvement of the model is still going on. After the engine model is accurate enough, some component and parameter optimisations can be utilised.

Trends in real-world particle emissions of diesel and gasoline vehicles (TREAM)

TUAS will also participate in a 3-year project which tries to find out new information for mechanisms that form nanoparticles (particles having a diameter less than 100 nanometres) and effective methods to control the levels of those. The official emission legislation will control the amounts of particles larger than 23 nm in diameter; however, according to some latest research results smaller particles might create higher health risks for humans. This area is in focus in this project. Figure 9 shows examples of particle size distributions for a non-road diesel engine.

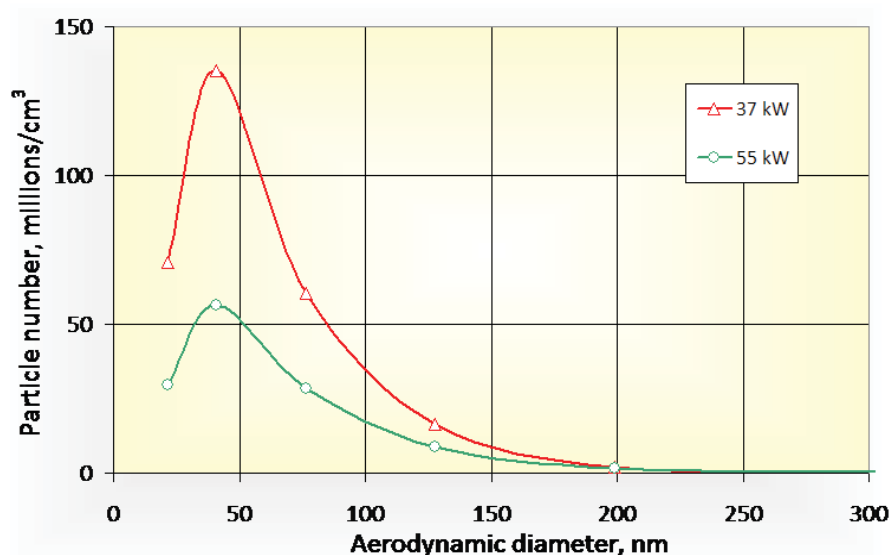


FIGURE 9. *Measured particle size distributions of a non-road diesel engine at two rated power levels (BSPM, brake specific particulate matter).*

Nanoparticles are formed for example in the diesel engine combustion, from vehicle tires and brakes, and from fine sand and rocks on the street. Especially in urban areas the amounts are often high and will be linked to a large section of the population – that is why the research is vital. In any case, it will be very important to know methods how to affect these issues.

The TREAM project aims to clarify the effects of long-time trends on the real-world particle emissions of diesel and gasoline engine and vehicles. To accomplish that, the project utilises databases produced in other projects in addition to the other published emission data. To answer the open questions related to the real-world exhaust particle amounts, size distributions and characteristics, the real-world emissions of gasoline and diesel passenger cars and heavy duty diesel trucks will be studied on the road at normal driving conditions using the laboratory vehicle. Additionally, laboratory studies will be performed for passenger cars and heavy duty engines using sampling and dilution systems capable to mimic the real-world particle formation and characteristics and using instruments capable of measuring nanoparticle emissions. The studies cover the effects of lubricant oils, engine parameters, after-treatment and fuel on the particle emission.

The project partners come mainly from Finnish industry and universities; however, there are also some foreign partners. The project is supported by Tekes. Participating research institutes form a high-profile project organisation having significant experience in the research field covering instrument development, emission modelling, experimental emission studies and engine development. This work is strongly supported by the knowledge of Finnish companies allowing the effective utilisation of the results. International co-operation and PhD student exchange fulfils the knowledge of Finnish research partners.

The role of TUAS in TREAM is to carry out laboratory tests for a modern off-road diesel engine and trying to find out technology strategies, components and parameters which will have the greatest effect on decreasing nanoparticle emissions. At the same time, the effect of these issues on other exhaust emissions and fuel consumption of engines will be investigated. The TUAS laboratory project starts in the autumn of 2012 and will be finished by spring 2014.

EFFECTIVENESS

The research customers utilise the results in their R&D operation, when configuring the engines for various applications, and for defining the subjects of further research. Moreover, the customers have recruited graduated students who have participated in the projects at TUAS. The biofuel research is put to use for example when selecting feedstock for fuels. Fuels are also further refined for engine use based on the achieved results. Additionally, the exhaust gas scrubber is being commercialised within the marine R&D sector.

FUTURE PERSPECTIVES

At TUAS, the ICE Laboratory is developed constantly, as the facilities must meet the needs of partners. Currently, a new laboratory is planned and designed, and construction work starts very soon. At the same time, the number of test benches will be increased to five or six, depending on the size of the largest bench.

The possibilities to run transient cycles are improved and new instruments are acquired, particularly for measuring unregulated gaseous emissions and fine particles. Waste heat recovery systems will also be developed in order to improve the utilisation of waste heat for electricity production and heating.

At the same time, new projects are offered and sold to the customers. Furthermore, new publicly funded projects are planned.

PUBLICATIONS

Niemi, S., Nousiainen, P., Lassila, P., Tikkanen, V. and Ekman, K. (2010). Effects of Miller timing on the performance and exhaust emissions of a non-road diesel engine. CIMAC Congress 2010 Bergen, Paper No. 52, 10 p.

Niemi, S. (2010). Reduction of ship and power plant engine emissions. – Biofuels in engines. – HC-SCR catalyst development. Off-road diesel engine research. In: Antila, E. (ed.). Energy 2009. Smart Energy Vaasa. Tampere, Finland: University of Vaasa. ISBN 978-952-476-296-0. P. 17–24.

Niemi, S., Uuppo, M., Virtanen, S., Karhu, T., Ekman, K., Svahn, A., Vauhkonen, V., Agrawal, A. and Hiltunen, E. (2011). Animal Fat Based Raw Bio-Oils in a Non-Road Diesel Engine Equipped with a Diesel Particulate Filter. 8th International Colloquium Fuels; Conventional and Future Energy for Automobiles. Ostfildern, Germany: Technische Akademie Esslingen. P. 517–528.

Niemi, S. (2011). Fuel and Non-Road Diesel Engine Studies at the University of Vaasa and at Turku University of Applied Sciences. Seminar on Internal Combustion Engine Technology: “Future Engine and Fuel Technologies”. May 5, 2011, Espoo, Finland: The Federation of Finnish Technology Industries. (In Finnish.)

Vauhkonen, V., Sirviö, K., Svahn, A. and Niemi, S. (2011). A comparative study of the antioxidant effect on the autoxidation stability of estertype biodiesels and source oils. International Conference on Clean Electrical Power, Renewable Energy Resources Impact (IEEE), Ischia, Italy, 14th-16th June 2011. P. 211–215. 978-1-4244-8927-5X.

Plus several reports written by Niemi, S., Nousiainen, P. and Laurén, M. within the FCEP research program in 2010 and 2011, becoming public after the completion of the program in 2014.

MARINE EXHAUST GAS SCRUBBERS

Jari Lahtinen

Principal Lecturer

Turku University of Applied Sciences

Faculty of Technology, Environment and Business

Projects:

Industrialisation of closed-loop fresh water scrubber

Development and testing of hybrid scrubber

Duration:

January 2011 –

Budget:

Confidential

Partners:

Wärtsilä

University of Vaasa

Contact persons:

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Jari Lahtinen – jari.lahtinen@turkuamk.fi

Project status:

Ongoing

In order to meet the emission legislation of marine traffic, the sulphur content of fuels will have to be highly reduced. The other option is to use exhaust gas scrubbers to remove sulphur from exhaust gas. TUAS is conducting testing of gas scrubbers in cooperation with Wärtsilä.

BACKGROUND AND OBJECTIVES

The emissions legislation of marine traffic becomes stricter all the time. In the near future the allowed sulphur content of fuels will be highly reduced, making the use of conventional high sulphur heavy fuels in practice impossible. The future solution for shipping companies is to use high-priced good quality distillate fuels in their vessels.

Exhaust gas scrubbers can efficiently remove sulphur from exhaust gas offering an economically attractive option to continue the burning of heavy fuels in ships. Scrubber technology is well known and widely used in land based installations. However, the marine use of scrubbers is challenging; issues, such as sea conditions, size and weight limitations, tank capacities, effluent treatment technology, chemicals, safety, interfaces with other machinery, reliability, maintenance, retrofit installations, overall economy, etc. must be solved. Solutions to these problems are sought after in the marine scrubber projects managed by Wärtsilä.

IMPLEMENTATION

Projects are executed in cooperation with Wärtsilä personnel. Other companies are connected to this cooperation as their expertise is needed. Both office work and practical testing are conducted. Visits to manufacturing industry and vessels in operation are also important. Creating new innovations is an important part of development work targeting to compact size scrubber solutions.

Several theses connected to marine scrubbers are in progress.

RESULTS

A closed-loop exhaust gas scrubber is developed and installed on board Containerships VII, and is now in use.

Also the installation work of a new hybrid scrubber prototype has started. Mv “Grande Scandinavia” is selected to operate as a test platform. It operates in the Mediterranean and in the North Sea.

In these projects, several research and design documents are produced. However most of these papers are confidential.

EFFECTIVENESS

New marine solutions for scrubber technology are developed in these projects. This work results in new jobs in engineering companies and the manufacturing industry. In addition, scrubber technology for ships offers an option for Finnish shipping companies to survive economically in the hard competition at the Baltic Sea by using cheaper fuel.

FUTURE PERSPECTIVES

Wärtsilä is making a vigorous effort to launch new products to the marine scrubber market. This development work combined with strong marketing and partner networks offers further opportunities for consultation in future.

PUBLICATION

Lahtinen, J. and Saarinen, K. (2010). Engine Room Pressure Measurements onboard MT Suula. Vaasan yliopiston julkaisuja. Selvityksiä ja raportteja 162. 29 p. ISBN 978-952-476-327-1.

FACTORS BEHIND FUEL CONSUMPTION – VEHICLE, DRIVING CONDITIONS AND DRIVER BEHAVIOUR

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Degree Programme in Automotive and Transportation Engineering

Project:

Energy Usage of the Passenger Car and Energy Efficiency of Hybrid Technology

Duration:

2009–2011

Budget:

EUR 37 500

Funding:

TransEco Research Programme

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Project status:

Completed

trans^{eco}

Human generated carbon dioxide (CO₂) emissions are the main factor behind climate change. Road transportation is one of the main contributors to CO₂ emissions. The amount of transportation originated CO₂ depends directly on the amount of fossil carbon combusted, in practical terms, on the fuel consumption of vehicles. The main factors behind fuel consumption are, in addition to the vehicle itself, the driving conditions and especially the behaviour of the driver.

BACKGROUND AND OBJECTIVES

For each passenger car model sold in the EU, an official CO₂ emission value (g/km) has to be published in the technical information and sales promotion material. This value is the result of an official laboratory test driven under strictly controlled optimal conditions. However, under real-world situations, and especially if an uneconomical driving style is applied, the actual CO₂ emission of a given vehicle may be up to double the official value.

The general public seems to have quite little understanding about the fact that the actual CO₂ emission resulting from "my driving" depends on the fuel consumption resulting from the personal driving style and the prevailing driving conditions. Because the influence of the driver's behaviour on fuel consumption may be up to ±15%, the driver's possibilities to influence CO₂ emissions are significant.

Moreover, even if the driver is not interested in the environmental effects of driving, one would imagine that the driver would be interested in the amount of money spent on fuel. However, this does not seem to be the case. Quite few drivers appear to realise that they could reduce their driving cost considerably, if they were willing to learn and apply a more economical driving style.

If a gasoline station posted up a sign indicating a 20% discount on fuel price, there would be a rush of motorists lining up to fill up their tanks. However, if they are told that they could possibly save even a greater amount of money constantly by implementing an economical driving style, very few motorists would seem to be interested.

The objective of this study was to analyse how the fuel consumption of a vehicle is divided into different factors and what is the significance of each factor. Based on this information, the influence of the vehicle itself, the driving conditions, and the driver's behaviour on fuel consumption were analysed in detail. The aim was to understand how much fuel can be saved by different means, especially those under the control of the driver.

Sample calculations related to fuel consumption were prepared. The objective of this was to increase the understanding and determine the magnitude of each different way to reduce fuel consumption. As a part of the study, detailed instructions for drivers were prepared about how to drive economically without compromising safety, comfort or travel time.

IMPLEMENTATION

The work was implemented mostly as a theoretical study with some practical measurements. Most of the research was carried out by analysing and organising the previous knowledge and experience of the author, combined with newly gained information from several relevant sources.

Moreover, plenty of sample calculations related to fuel consumption were performed. The aim of the calculations was to find out the significance of each factor having influence on fuel consumption. By recognising and analysing the importance and magnitude of each different factor behind the vehicle fuel consumption, it is possible to find out the potential ways to reduce the fuel consumption of vehicles.

The fuel consumption calculations were based on the properties of a particular, common and European made passenger car model, Volkswagen Golf. The properties used as starting values for calculations were the mass and the driving resistance values of the vehicle, combined with the energy conversion efficiency of the powertrain at different driving and load conditions.

In addition to the vehicle itself, the influence of driving conditions was investigated as well. The driving condition factors investigated included traffic flow, ambient temperature, the frequency of cold starts, the frequency of brakings and stops, driving speed, the speed and direction of wind, altitude

changes along the route driven etc. The influence of each factor on consumption was determined and calculations on the savings potential of each factor were performed.

Special attention was paid and particular emphasis was put on the possibilities of the driver to reduce fuel consumption. The influence of different details related to the driving style was investigated. Different driving situations like acceleration, cruising, coasting and braking were examined. As a result, detailed instructions for drivers, i.e. how to drive economically in each driving situation, were prepared.

RESULTS

General

Basically, the fuel consumption of a vehicle over a particular trip depends on two factors. These are the energy (or work, in kWh) required from the engine via the driving wheels, and the average brake specific fuel consumption (BSFC in g/kWh) of the engine. When these two values are multiplied with each other, the end result is the amount of fuel (in grams) needed during the trip examined.

The first of the two elements mentioned above (work needed from the engine), is the function of three factors. These are the vehicle properties, which have been set by the vehicle manufacturer, but also the driving conditions and driver behaviour. To minimise fuel consumption, the driver should aim at requiring as low an amount of kilowatt-hours from the engine as possible.

The second element (specific fuel consumption) is the function of the properties of the engine, as well as of how the driver is operating the engine. The specific fuel consumption varies significantly between the different load levels and rotation speeds of the engine. Thus, to minimise fuel consumption, the driver should be aware of how to operate the engine as much as possible at the operating points, delivering the lowest possible g/kWh values.

Vehicle

The factors related to the vehicle itself, having an influence on the fuel consumption, are the mass and the road load values of the vehicle. The road load values are the combination of the rolling resistance and the air drag.

The factors behind the rolling resistance are the mass of the vehicle and the rolling resistance coefficient, which depends on the properties of the tyres and the road surface. The factors behind air drag are the air drag coefficient of the vehicle, depending on the body shape, and the frontal cross-sectional area of the vehicle body.

Besides the vehicle body itself, driving speed has a strong influence on the air drag of a vehicle. The air drag force is proportional to the second power of the speed and air drag power is proportional to the third power of driving speed. However, rolling resistance remains almost constant regardless of driving speed.

When the vehicle is accelerated or driven uphill, vehicle mass has a strong influence on the energy required and thus on fuel consumption.

Engine

The properties of the internal combustion engine are not optimally suited to operation in vehicles. This is due to the fact that the power needed from the engine varies quite significantly and rapidly in vehicle use. This results in great variations in engine efficiency from one driving situation to another. In typical driving, the internal combustion engine efficiency is as low as 10 to 30%.

The distribution of the fuel power, directed to the engine of the VW Golf 1.6 FSI (generation V, model years 2003...2008) at constant speed of 100 km/h, is presented in Figure 1. This vehicle incorporates a naturally aspirated gasoline powered engine with modern direct fuel injection.

Figure 1 indicates that in this driving situation, as much as 73% of the fuel power is wasted in the engine, and only 15 kW of the original fuel power of 58 kW will be available from the engine. At this driving speed (100 km/h), air resistance dominates over rolling resistance and absorbs 17% of the original fuel power, whereas the share of rolling resistance is only 6.5%.

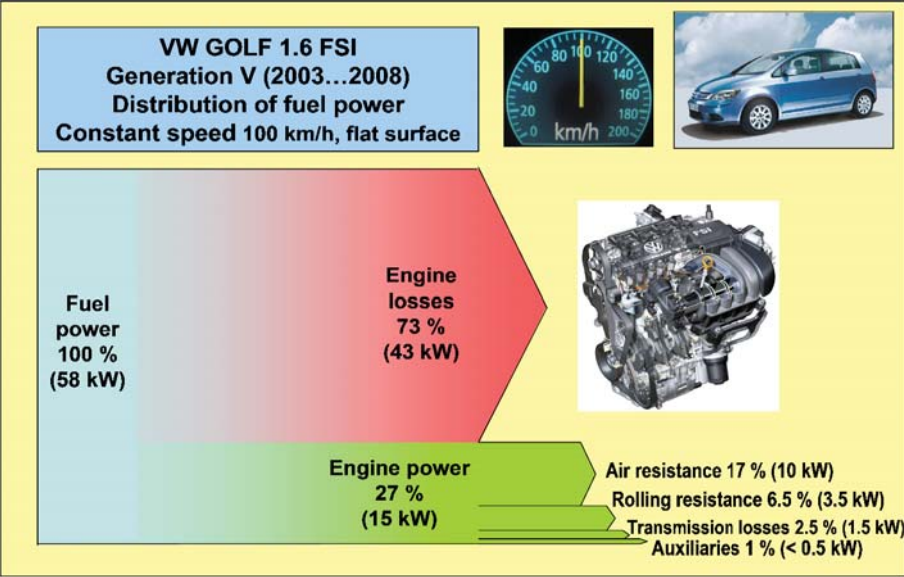


FIGURE 1. *Distribution of fuel power, VW Golf 1.6 FSI at 100 km/h.*

Driver behaviour

Utilising the findings regarding the different factors behind fuel consumption, a guide book to economical driving was prepared. Specific instructions were given on how the driver can minimise the fuel consumption by accelerating, cruising and decelerating the vehicle the correct way. Also, instructions were given on how the driver can minimise the fuel consumption increase caused by unfavourable driving conditions.

As a rule of thumb, which may sound surprising, it can be stated that in many cases the drivers tend to accelerate the vehicle too slowly, and they are prone to decelerate the speed too quickly.

For the guide book, illustrative guidelines of how to accelerate a vehicle economically were prepared. In terms of gaining kinetic energy, in other words, accelerating the vehicle speed, it makes no difference in terms of the amount of energy put to the system, whether the acceleration is performed slowly or quickly.

The energy needed for accelerating a certain mass to a certain speed is the product of power and time. If a quick acceleration is desired, high power is needed, but a short time is enough, and vice versa. This fact keeps the multiplication product of power and time constant. It may sound surprising, but the amount of energy needed to speed up the vehicle remains constant regardless of the rate of acceleration and the power used for it. The energy need depends only on the mass of the vehicle and the target speed.

Instead of thinking about theoretical kinetic energy, when the actual amount of fuel needed for acceleration is considered, the critical factor is not the acceleration speed as such, but the nature of engine load points utilised during acceleration. The vehicle should be accelerated by using high engine load levels (70...90% of maximum) at low engine speeds (20...40% of maximum) to achieve the lowest possible brake specific fuel consumption values during acceleration.

Using high engine load levels means in practice pressing the accelerator pedal relatively hard. When accelerating, it is preferable to press the pedal initially only moderately, but increase the amount the pedal is depressed along with increase in engine speed. On the other hand, operating the engine at low speeds requires switching to higher gears as early as possible.

Regarding deceleration of speed, braking and stopping should be avoided as much as possible. The inevitable consequence of stopping is the need for re-acceleration, which easily consumes double the amount of fuel compared with constant speed driving. Repeated need for regaining the kinetic energy lost in brakings significantly increases the work needed from the engine. If a stopping at a traffic light can be avoided by decreasing the speed a little as early as possible, the need of regaining the lost kinetic energy will be minimised and plenty of fuel will be saved.

Traffic planning

Traffic planning was found to be one of the critical factors regarding fuel consumption. If a fluent flow of traffic could be ensured, the need for frequent stopping of great amounts of vehicles would be avoided. This would result in significant reductions in fuel consumption and CO₂ emissions.

An interesting finding was the fact that in some cases safety and fuel economy are in harmony with each other, but in some cases they are in contradiction. In countryside driving, reducing driving speed gives benefits regarding both safety and fuel consumption. However, in city driving, forcing the traffic flow stop frequently is believed to increase safety, but it will absolutely increase fuel consumption.

Conclusions

Altogether it was concluded that by training drivers to drive economically, fuel savings up to 10...30% are possible to achieve. The final savings result depends on the starting level of each driver. The highest reductions in consumption can be seen with drivers having a very uneconomical driving style before the training.

A study comparing the fuel consumption results before and after eco-drive training was carried out in the traffic conditions of the city of Turku, Finland. Altogether 212 drivers took part in the activity. The consumption reductions varied from 0% to 54% between different drivers. On average, a reduction of 19% in fuel consumption was recorded. Of course, this type of a study, conducted among normal traffic stream, is somewhat affected by the varying traffic conditions. However, the large amount of participants makes the result relatively reliable.

In conclusion, estimations, targeted to be as realistic as possible, were generated for the fuel consumption and CO₂ reduction potential due to an economical driving style. The values were calculated for Finland and they were generated for both gasoline and diesel fuel. The average typical saving potential was estimated separately for the two types of fuel, because diesel fuel savings potential is somewhat lower. This is due to the fact that a significant part of diesel fuel is consumed in heavy-duty vehicles, which have a lower relative fuel savings potential than passenger cars.

The conclusion of the study indicated that in gasoline vehicles, an average reduction of 15% is realistic, and the corresponding value for diesel vehicles is 10%. To stay on the safe side, an assumption was made that only every other driver would be motivated enough to implement economical driving style on a permanent basis. Taking this into consideration, the final numbers of savings potential ended up to be half of those mentioned above.

EFFECTIVENESS

According to the statistics published by the Finnish Petroleum Federation (Öljyalan keskusliitto), the amount of gasoline consumed in Finland in 2010 was about 2.24 million m³. Calculated on the basis of 15% fuel savings as the result of eco-drive training, considering that every other driver would be motivated to maintain the newly learned driving style, this would result in about 168 000 m³ of annual gasoline savings (equals 7.5% of total consumption). Calculated with the fuel price of EUR 1.55 per litre, this would equal about 260 million euros. The corresponding reduction in CO₂ emissions would be close to 400 000 tonnes.

The diesel fuel consumption in Finland in 2010 was about 2.79 million m³. Calculated using the value 10% as the average savings potential, and with every other driver implementing economical driving style permanently, the savings in annual diesel consumption would be about 140 000 m³ (equals 5% of total consumption). Calculated with the fuel price of EUR 1.35 per litre, this would equal close to 190 million euros. The corresponding reduction in CO₂ emissions would be about 370 000 tonnes.

Calculating the annual gasoline and diesel savings together, we end up at over 300 000 m³ of fuel and about 450 million euros of money. The corresponding total reduction in CO₂ emissions would be close to 770 000 tonnes.

FUTURE PERSPECTIVES

More precise studies allocated to the details of driving behaviour in different driving situations would give answers to some frequently asked questions. For example, one of these is the following: What is the most economical way to reduce vehicle speed?

The modern engines feature the so-called fuel cut-off function, which cuts the fuel consumption temporarily down to zero during engine braking. However, at the same time, the kinetic energy of the vehicle is reduced significantly, and plenty of need for re-acceleration is generated.

Another possible way for speed reduction would be to coast the vehicle with the gearshift in neutral. In this case, the idling consumption of the engine would exist all the time, but more kinetic energy would be maintained. For the time being, there is no clear answer to the question of which of these two ways would be more economical.

MINIMISATION OF WASTEWATER LOADS AT SPARSELY POPULATED AREAS

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Project Manager

Ilpo Penttinen
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Faculty of Technology, Environment and Business

Project:

Minimisation of Wastewater Loads at Sparsely Populated Areas
(MINWA)

Duration:

1 January 2009 – 30 April 2012

Budget:

MEUR 1.3 (TUAS' share 451 200)

Funding:

Central Baltic Interreg IV A 2007–2013 Programme

Partners:

Valonia Service centre for sustainable development and energy issues
in Southwest Finland

University of Turku

University of Tartu

Association of Local Authorities of Järva County

Türi Vesi

aqua consult baltic

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Project status:

Completed



Untreated wastewaters from sparsely populated areas cause eutrophication and decrease water quality in Estonia and Finland. Efficient wastewater treatment will reduce the nutrient load and improve the hygienic quality in coastal and inland waters.

The MINWA project aimed to promote educational cooperation and exchange of the best practices and experience between Finland and Estonia. In addition, the monitoring systems and maintenance practices of small wastewater treatment plants were developed. Research regarding the effectiveness of different wastewater treatment systems was conducted for the whole duration of the project.

BACKGROUND AND OBJECTIVES

While the efficiency of wastewater treatment in municipal treatment plants has significantly improved during the last two decades, the wastewater treatment in sparsely populated areas is still mostly relying on septic tanks and obsolete leaching beds. In areas outside sewage systems, the influence of poorly purified domestic wastewater can be seen especially locally in the water quality of inland waters and coastal areas. Sometimes wastewaters from water closets may cause significant hygienic risks. Only in recent years have decision-makers begun to grasp the severity of this situation and the necessity of improving wastewater treatment in sparsely populated areas.

The aforementioned problems are emphasised in Estonia and Finland where a significant part of people live in sparsely populated areas not covered by municipal wastewater services. In Finland, 20% (1 million inhabitants) of the population live in sparsely populated areas, whereas in Estonia the percentage is even greater being around 30%. Leisure homes, which are often located by the waterside, are used mostly during the summer and thus increase the nutrient load to warm waters already prone to eutrophication.

Development of wastewater treatment in sparsely populated areas is essential in improving the water quality. Cooperation between the municipalities, local authorities, inhabitants of the sparsely populated areas and companies in the field needs to be enhanced to reach the goal of a safe and sound environment. Since the problems are similar in Finland and Estonia, cooperation and exchange of good practices is both well-founded and necessary. However, local conditions, focus areas and prevailing practices related to wastewater treatment differ between the two countries. In Finland, the focus of water protection is mainly in surface waters, whereas in Estonia the protection of groundwater is of primary importance for geological reasons.

Since package plants for wastewater treatment in individual households have only recently been developed, long-term user experiences on these systems are lacking. During recent years, many different package plants have entered the market, but still there is no reliable data available on their functionality in varying conditions. The level of necessary investments, the reliability of treatment plants and the organisation of servicing and maintenance of the treatment systems still need clarification.

The main objective of the project was to improve water quality in sparsely populated areas by decreasing the wastewater load from both permanent and leisure housing. Further, local improvements in water quality will contribute to the conservation of the Baltic Sea.

Central activities of the project

- Improvement and dissemination of knowledge and know-how concerning wastewater management.
- Exchange of best practices both within and between Finland and Estonia.
- Research on the effectiveness of wastewater treatment systems, especially package plants.
- Research on the possibilities of handling and utilising sludge from wastewater treatment plants.

IMPLEMENTATION

In addition to being the lead partner of the MINWA project, Turku University of Applied Sciences (TUAS) was responsible for the research on the effectiveness of the treatment systems, development of service and maintenance practices as well as for the development of educational materials and publications.

Research in TUAS focused particularly on studying the impacts of the users' actions on the purification performance of the package plants.

The treatment efficiency of the package plants was monitored by taking samples of both purified and unpurified wastewater. Continuous monitoring of treatment processes was done using multi-sensor devices.



PICTURE 1. *Taking samples & Adjusting continuous monitoring devices.*
Photos: Tero Kalliomäki.

RESULTS

MINWA project succeeded in reaching its targets. Disseminating information on wastewater treatment reached a substantial audience in Finland and Estonia, and even outside Europe through the minwa.info website.

- Educational materials on wastewater treatment efficiency, wastewater legislation and the effects of wastewaters on the environment were developed.
- Maintenance and installation demonstrations were organised for the public together with plant manufacturers.
- Meetings were organised at village level to inform the inhabitants on current wastewater issues.
- <http://minwa.info> website was developed and it reached numerous readers.

Research on the effectiveness of treatment systems produced new information on the functioning of package plants in real operating situations. The correct installation and regular maintenance emerged as the major factors that affect the purification efficiency of the package plants, whereas daily fluctuations in the quality and quantity of incoming wastewater were not reflected in the quality

of purified wastewater in well-functioning package plants. When properly installed and serviced, most package plants seem to treat wastewater efficiently and even tolerate occasional use of certain strong household chemicals.

The co-operation between Finland and Estonia proved to be effective in wastewater counselling. Especially Estonia benefitted from the experience and know-how collected in Finland, which has a longer history in wastewater counselling. Public interest on wastewater issues was much lower in Estonia than in Finland in the beginning of the project, but rose significantly during the project. The experiences collected in Estonia will also be of benefit in Finland in the future.

EFFECTIVENESS

The educational materials and information distributed by the project reached a wide audience and increased the knowledge on wastewater treatment in sparsely populated areas in Finland and Estonia and even outside Europe.

Numerous theses were produced on a variety of issues connected with the project and students acquired work experience that allowed them to easily find employment in companies and organisations working on related issues.

The results of the research have been published in professional journals and in a thematic seminar at the Finnish Environment Institute. The main conclusions were also communicated to the media through press releases.

FUTURE PERSPECTIVES

The team has gained strong experience on the functioning of the package plants during the MINWA project. They aim at utilising this experience in future projects, such as MASRA – Management System for Wastewater Treatment Plants in Rural Areas, which has been designed to continue the work.

PUBLICATIONS

Ahtiainen, L. 2010. Haja-asutusalueiden jätevesijärjestelmien huolto. Huoltotoimenpiteiden kartoitus Maskun Niemenkulman alueella. Bachelor's Thesis. Turku University of Applied Sciences.

Hannuksela, M. 2011. Haja-asutusalueiden pienpuhdistamoiden puhdistustehokkuus. Research report/ Bachelor's Thesis. Turku University of Applied Sciences.

Leskinen, P. 2012. Pienpuhdistamojen prosessin seuranta jatkuvatoimisilla mittalaitteilla. *Vesitalous* 3/2012, 38–43.

Leskinen, P., Heikkinen, J. & Kunnasvirta, A. 2012. Ihmisille tiedoksi: kokemuksia neuvontatyöstä MINWA-hankkeessa. *Ympäristö ja terveys* magazine 4:2012, 44–49.

Leskinen, P. & Hovirinta, S. (ed.) 2012. Haja-asutusalueiden jätevesipäästöjen vähentäminen: MINWA – Minimization of Wastewater Loads at Sparsely Populated Areas. Reports from Turku University of Applied Sciences 131.

Panula, E. 2010. Haja-asutusalueen saostuskaivolietteen kalkkistabilointi ja välivarastointi. Bachelor's Thesis. Turku University of Applied Sciences.

Poskiparta, L. 2011. Haja-asutusalueiden pienpuhdistamojärjestelmien huolto: huoltotoimenpiteet kiinteistön omistajan näkökulmasta. Bachelor's Thesis. Turku University of Applied Sciences.

Valo, A. 2010. Haja-asutusalueiden viemäriverkoston rahoitus. Bachelor's Thesis. Turku University of Applied Sciences.

GUIDANCE FOR TREATING WASTE WATERS IN SPARSELY POPULATED AREAS IN THE AURA RIVER BASIN

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Faculty of Technology, Environment and Business

Degree Programme in Civil Engineering

Project:

Waste Waters in Sparsely Populated Areas in the Aura River Basin

Duration:

1 January 2006 – 31 August 2008

Budget:

EUR 41 200

Funding:

EU Leader +

Aura River Foundation



Partners:

Aura River Foundation, Southwest Finland Regional Environment Centre, Municipality of Aura, Municipality of Pöytyä, Municipality of Oripää, Southwest Finland Riverside Partner's Association, Villages of Southwest Finland, Onninen Oy, Biota BD, Valonia

Contact person:

Heli Kanerva-Lehto

Project status:

Completed

Waste waters in sparsely populated areas burden water systems causing eutrophication and health risks. The tightened legislation provides workable waste water systems for sparsely populated areas. During this project a report on waste water management in sparsely populated areas was written and advisory meetings were organised in the municipalities of Oripää, Pöytyä and Aura.

BACKGROUND AND OBJECTIVES

During the past few years, several water protection actions and clarifications were carried out in the catchment area of the Aura River. Those actions have concentrated on the nutrient load that comes from agriculture, but also the burden from waste waters is significant for the water quality of the Aura River. In addition to the nutrient load, waste waters from sparsely populated areas cause hygienic damage, which impairs the recreational possibilities of the river.

The most important and latest regulations on waste water treatment are in a decree which came into operation on January 1, 2004. The changed legislation is causing uncertainty about the requirements among the property owners. Renovating waste water systems is also an economic burden and there are several alternatives to consider.

The goals in the project area were:

- to make a clarification about the condition of waste water treatment in the municipalities of Aura, Pöytyä and Oripää
- to inform the property owners about the requirements of the changed legislation
- to advise the property owners about waste water systems
- to estimate the waste water load in the catchment area of the Aura River
- to estimate the implementation possibilities and draw up a plan for waste water systems for several property owners or villages
- to organise work demonstrations in the project area in connection with building waste water systems
- to encourage the villages to work actively in benefit of water protection.

IMPLEMENTATION

Informative meetings and public events in waste water management were organised in the project area. Informational material and guidance were also given in the meetings. The meetings were carried out in co-operation with the local actors.

The following aspects were discussed in the meetings:

- the general status of waste water treatment in sparsely populated areas
- the waste water treatment methods in sparsely populated areas
- state of waste water treatment in each municipality
- how to establish a waste water cooperative
- pressure sewerage systems
- presentations of companies offering waste water solutions.

RESULTS

During the project, eleven meetings were organised in Aura, Pöytyä and Oripää in cooperation with partners. One waste water cooperative has been planned as a result of the meetings.

The goals of the project considering covering municipality-specific waste water plan clarifications were not fulfilled as planned. In sparsely populated areas, solutions related to waste waters and future scenarios are still in on uncertain basis because municipalities have not made decisions about their actions.

In cooperation with villages in Southwest Finland, an excursion was arranged to Kustavi to visit two locations where waste water systems were under construction.

Handouts were supplied by different partners and the project's goal to prepare informative material turned out to be unnecessary.

Information about the project and contact information of the project partners were published in the website of Aura River Foundation.

EFFECTIVENESS

In the meetings held in the beginning of the project, the main focus was to introduce various waste water systems, but during the project people showed more interest in systems and methods that cover whole villages. There was a reasonable amount of participants in the organised meetings. In the meetings held at the municipal centres of Aura and Pöytyä, a little over 40 people were in attendance. During the project, contacts were established with different actors and there was an intention to continue the collaboration.

FUTURE PERSPECTIVES

Project partner Valonia continues the guidance work on waste water systems in sparsely populated areas. As a continuation for the project, a new more extensive project for the EU Central Baltic Interreg IVA programme was started. The funding for the project, Minimization of Wastewater Loads at Sparsely Populated Areas (MINWA), was accepted on December 16, 2008. The project started in January 2009 and continued until April 2012.

NUTRIENT CATCHER – A POTENTIAL NEW METHOD FOR DECREASING THE NUTRIENT LOAD OF STREAMS

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Degree Programme in Civil Engineering

Project:

Nutrient Catcher

Duration:

1 January 2010 – 31 December 2013

Budget:

EUR 16 000

Funding:

Tekes – the Finnish Funding Agency for Technology and Innovation,
Tuli program

Water Protection Association of Southwest Finland

Partners:

Greif Flexibles Finland Oy

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Project status:

Ongoing



Turku University of Applied Sciences (TUAS) is studying the potential of a new innovative mechanical water protection measure, primarily targeting small streams. The idea of this innovation is to remove and re-use solids and nutrients of running surface waters.

BACKGROUND AND OBJECTIVES

During the last few decades, several water protection measures have been developed in order to decrease the nutrient loads polluting water systems. Discharges from industry and municipal waste waters have been reduced significantly within the last 20–30 years. In many cases, however, the non-point nutrient load has turned out to be difficult to control and reduce. Thus, new innovative and cost-effective measures are still needed to reduce the load from diffuse sources.

Agricultural nutrient releases account for more than half of all the nutrient discharges into water bodies in Finland. Thus the erosion control and reduction of nutrient runoff from agricultural areas are of great importance. Drainage waters from peat production areas again tend to have high organic load and therefore may lead to oxygen problems in the receiving water bodies.

The main goal of the ongoing project is to develop a new alternative water protection method which removes the suspended solids from running waters. The idea of the method is to mechanically catch eroded soil particles out of the water body and to enable the reuse of valuable nutrients attached to particles. By reducing the suspended solid load of the running surface waters, the nutrient load can be cut down significantly. This is the situation especially in running waters in agricultural areas where the majority of the nutrients are in particulate form.

IMPLEMENTATION

The project implementation is divided into a few phases and sub-targets. The planned project phases are:

- Research on the feasibility of filtration based mechanical water purification of running surface waters.
- Testing the method's possibilities and limitations.
- Development of the method into a water protective product.
- Realisation of an objective follow-up study on the method's efficiency.
- Market research.

Water protection measures, based on sedimentation, such as sedimentation ponds and wetlands, are commonly used to reduce the nutrient load. However, these measures require large areas in order to operate efficiently. Due to different land-use restrictions, wetlands and sedimentation ponds are occasionally found to be unfeasible. The new invention under study is less space consuming and based on filtration. The simplified idea is to use a fabric filter based structure which sieves and collects eroded particles. The structure of the system is planned as reusable and the cumulated material will be easy to empty.

The invention is patented and is at the moment under development. More information on the potential target waters for the nutrient catcher is needed. In addition, possible restrictions in the use of filtration based measures in surface waters have to be studied carefully.

According to preliminary assumptions, this new water protection measure should be targeted to drainage ditches of agricultural areas with a small catchment area. Runoff water from peat extraction areas and newly drained forests are also seen as potential sites for the method.

RESULTS

At this stage of the project, there are not enough results to make conclusions on the feasibility of the method. Preliminary results are expected to be available by the end of 2012.



PICTURE 1. *The filtration's effects on water flow were studied in laboratory conditions.*
Photo: Teemu Koski.

EFFECTIVENESS

The project collects and produces information on the feasibility and restrictions of filtration based surface water management. This knowledge may prove valuable in the development of new water rehabilitation methods. If proven feasible, the innovation can be used to enhance the quality of running surface waters.

FUTURE PERSPECTIVES

The Nutrient Catcher project aims to clarify the water protection potential of the new technique. If proven feasible and cost-efficient, Nutrient Catcher may become one of the alternative or complementary water protection measures.

RESTORATION OF STREAMS FOR DECREASING DIFFUSE NUTRIENT LOAD

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Degree Programme in Civil Engineering

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Degree Programme in Sustainable Development

Piia Leskinen

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Projects:

Wetlands and Bottom Dams in the Upstream Aura River

Restoration of Aura River for Reducing Stray Nutrient Loads

ACTIVE measures on WETLANDS for decreasing the nutrient load
in the Baltic Sea

Duration:

1 November 2005 – 31 December 2007:

Wetlands and Bottom Dams; Restoration of Aura River

1 January 2010 – 31 October 2012: Active Wetlands

Budget:

EUR 57 600 (Wetlands and Bottom Dams)

EUR 40 650 (Restoration of Aura River)

EUR 181 500 (Active Wetlands)

Funding:

Centre for Economic Development, Transport and the Environment
of Southwest Finland

EU Interreg IV A, Central Baltic

EU Leader+

EU Objective 2

Regional Council of Southwest Finland

The River Aurajoki foundation

Partners:

City of Turku, Environmental Protection Office

Estonian Fund for Nature (ELF)

Estonian University of Life Sciences, Institute of Forestry and Rural
Engineering

Finnish Environment Institute

MTT Agrifood Research Finland

Port of Turku

Regional Council of Southwest Finland

The River Aurajoki foundation

Southwest Finland Regional Environment Centre

Turku Municipal Waterworks Corporation

Turku University, Department of Geography and Geology

Water Protection Association of Southwest Finland

WWF Finland

Contact persons:

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Project status:

Completed / ongoing



The Baltic Sea and the majority of Finnish inland waters are suffering from eutrophication. Especially the Archipelago Sea and inland waters in southern and western Finland are facing this problem. The nutrient load leading to eutrophication originates to a great extent from nonpoint sources. This limits the choice of suitable water protection methods. Bottom dams, artificial wetlands and sedimentation ponds have proven to be feasible methods for retaining nutrients originating from agriculture. However, due to land-use restrictions, conservation structures cannot always be dimensioned optimally, which has in many cases led to poor efficiency in nutrient removal.

Turku University of Applied Sciences (TUAS) has constructed artificial wetlands and bottom dams in the catchment area of the Aura River. The effectiveness of these actions has been studied with an online water quality monitoring system. According to observations, all measures have not met their water conservation targets and thus need to be improved. One potential solution to this problem is to use chemicals in order to enhance phosphorus precipitation. The feasibility of this method is being investigated in the Active Wetlands project.

BACKGROUND AND OBJECTIVES

The nutrient load causing eutrophication originates from multiple sources, such as municipal and industrial waste waters, traffic and fish farming. Nevertheless, the majority of the nutrient load originates from agriculture. Improvement of water quality and meeting of the regional, national and international goals for controlling water pollution requires the reduction of the nutrient load from all sources. The efficient use of the agri-environmental aid in the construction of buffer zones, wetlands and sedimentation ponds is needed to restrict nutrient load from agriculture. This requires raising awareness on the agri-environmental aid and the importance of water protection methods. To achieve the maximum benefits from water conservation work, new research on more cost-efficient conservation methods and better allocation of conservation targets is needed.

According to previous studies, wetlands retain solid matter and soluble nutrients – if structures are planned, dimensioned and constructed properly. However, contradicting studies on the effectiveness of this method exist and

more research is needed. In many cases topography, the hydrology of fields and the land ownership situation on site can lead to circumstances where suitable structures cannot be properly dimensioned.

The sedimentation pools and wetlands with insufficient dimensioning can retain suspended solids only during dry seasons. Furthermore, solids which have already settled at the bottom of a sedimentation pond during low flow may be flushed away during a flood. In any case, methods based on sedimentation can only obtain nutrients bound to soil particles, while dissolved nutrients run on unhindered. In well operating water protection wetlands some soluble nutrients can even be bound by aquatic plants and nitrogen can be reduced by denitrification.

Nevertheless, the majority of all nonpoint nutrient loads comes during spring and autumn floods when wetland vegetation is not capable of retaining nutrients efficiently. Thus new methods are needed to improve the water protection capabilities of wetlands.

IMPLEMENTATION

In a preliminary study on the restoration of the Aura river, the conservational relevance of old dam areas was assessed by measuring the amount of accumulated solids with sounding and a ground radar. Restoration plans were drawn and implemented in eleven sites. The implemented restoration projects were experimental in nature and originated in part from local needs and interests. One of the restoration sites has a chemical phosphorus precipitation system based on the automatic addition of ferric sulphate in to ditch water. The site is one of the five Finnish Active Wetlands project pilot sites and it is the only one equipped with a continuous water quality monitoring system. Experiments with the system started in autumn 2010 and will continue through 2012.



PICTURE 1. *The ferric sulphate doser and the v-notch weir at Nautela. Iron chemical dissolves from a nylon netting cone at adjustable rate according to the flow conditions and precipitates phosphate from water in insoluble form. Photo: TUAS.*

RESULTS

The main conclusion of the preliminary study on the conservational relevance of old dam areas in Aura River was that they do not, with the exception of Halinen reservoir, collect significant amounts of suspended solids. Thus their significance in the retention of nutritious sediments is minimal.

According to water quality monitoring results, the restorations were not sufficient from a water conservational point of view. So far there are not enough results to make conclusions on the feasibility of the chemical phosphorus precipitation method studied in the Active Wetlands project. Based on assumptions and preliminary results, the method suits best sites with high phosphorus concentrations and low flow volumes.

EFFECTIVENESS

The selection and planning of water restoration sites should take the whole catchment area into account. The Aura River restoration projects were not planned in this manner because catchment area specific planning would have required significantly more resources. It has been found in several studies that wetlands, sedimentation ponds and chains of dams can effectively reduce diffuse loads of solid matter and nutrients. However, this requires appropriate dimensioning, careful planning and regular maintenance of sites. Also the level and quality of guidance directed at land owners should be emphasised along with new support opportunities and water conservation methods.

FUTURE PERSPECTIVES

The water conservation value of constructed sites has been examined by online water quality monitoring and sites have proved to be inadequately dimensioned. The ongoing Active Wetlands project is investigating the possibility of enhancing the nutrient retention ability of undersized wetlands by adding a chemical phosphorus precipitation unit to the site. If proven feasible and cost-efficient, chemical phosphorus precipitation can become one of the solutions reducing agricultural nutrient load.

PUBLICATIONS

Komulainen, Martti; Yliruusi, Hanna-Maria; Kanerva-Lehto, Heli; Kääriä, Juha & Pettay, Esko 2008: Aurajoen vesitaloudellinen kunnostus hajakuormituksen ravinnepäästöjen vähentämiseksi. Comments from Turku University of Applied Sciences 44. Turku: Turku University of Applied Sciences.

Komulainen, Martti & Yliruusi, Hannamaria & Kanerva-Lehto, Heli 2009: Hajakuormituksen ravinnepäästöt kuriin vesistökunnostuksilla. In: Komulainen, Martti (ed.), Monialaista ympäristöosaamista Turun ammattikorkeakoulussa. Katsaus ympäristöosaamisohjelman toimintaan 2007–2009. Reports from Turku University of Applied Sciences 90. Turku: Turku University of Applied Sciences. 63–68.

CONTINUOUS ON-LINE MONITORING OF WATER QUALITY IN DIFFERENT AQUATIC ENVIRONMENTS

Olli Loisa

Project Manager

Piia Leskinen

Project Manager

Juha Kääriä

Research and Development Manager

Turku University of Applied Sciences

Faculty of Technology, Environment and Business

Project:

Connected with MINWA, Balticseanow.info, Active Wetlands and several other projects

Duration:

Continuous

Funding:

City of Turku

City of Kaarina

City of Naantali

Lake Kaksikerranjärvi advisory board

Centre for Economic Development, Transport and the Environment,
Southwest Finland

Maa- ja vesitekniikan tuki ry

WWF Finland
European Union

Partners:

University of Turku
Luode Consulting Oy
GWM-engineering Oy

Contact person:

Piia Leskinen – piia.leskinen@turkuamk.fi

Project status:

Ongoing



Turku University of Applied Sciences (TUAS) has several years of experience in the field of developing, testing and implementing modern methods for monitoring the aquatic environment. Continuous on-line monitoring technology is used for producing accurate and extensive real-time information on the state and changes of water quality in different environments. Compared to traditional spot sampling methods, in situ measurement technology with automated data transfer enables remote monitoring of ongoing phenomena and rapid changes.

BACKGROUND AND OBJECTIVES

Aquatic ecosystems are simultaneously affected by a number of human-induced and natural processes, such as eutrophication, climate change and normal weather variations.

A better understanding of the dynamics of such processes is needed in planning and directing conservation efforts, which are aiming at minimising the human impact on ecosystems. Continuous monitoring technology combined with on-line data transfer makes real-time follow-up of water quality changes possible. Expectations from such technology are high and the markets for monitoring applications are expanding. Together with companies, research institutes and authorities TUAS' faculty of Technology, Environment and Business is actively developing modern methods for monitoring the aquatic environment. Several ongoing R&D projects focus on development of reliable and accurate methods for continuous on-line monitoring of environmental changes in different environments.

The diffuse load of nutrients and solids, originating mostly from forestry and agriculture, is a major driver of the eutrophication process in coastal and inland waters. In an attempt to reduce the nutrient load on coastal areas and lakes' wetlands, sedimentation ponds and bottom dams are commonly constructed in rivers and streams. However, the present knowledge on the efficiency of these water protection measures is not sufficient. In several ongoing research projects the impact of different water protection measures on water quality is monitored using continuous multiparameter sondes and their usefulness is evaluated based on monitoring results. Increasing knowledge and experience helps choosing and targeting the best and cost-efficient methods for remediation actions.

IMPLEMENTATION

Over the last ten years, TUAS has acquired a versatile battery of continuous monitoring devices, and developed a solid experience on their use in challenging conditions in aquatic environments from open sea to small ditches. Numerous chemical, physical and biological parameters are measured continuously in various environments and on-line transfer of readings enables real time monitoring of water quality changes. The equipment in use includes (but is not restricted to) YSI6000 multi-parameter sondes and an open sea buoy, S::can spectrometer probes and Keller water level sensors.

In many cases, the monitoring projects are planned together with a wide expert network of companies, authorities, researchers and NGOs.



PICTURE 1. *A profiling buoy has been used to monitor the vertical structure and properties of the water column in Airisto, Archipelago Sea. Photo: Teemu Lakka.*

RESULTS

In lakes and coastal areas, the data is collected both by automated monitoring stations and through traditional water sampling. An ongoing project, BalticSeaNow.info, which aims to enhance the environmental consciousness and citizen activity and participating, monitors the vertical structure and properties of the water column in Airisto, Archipelago Sea. The monitoring is done with an automated profiling buoy, which continuously measures the changes of e.g. the temperature, salinity and dissolved oxygen concentration in the water and presents the results on-line on internet pages.

TUAS also conducts follow-up and lake restoration monitoring studies in lakes and coastal areas. For example, in Lake Kakskerta in Turku, the effects of implemented lake restoration methods on the ecological conditions and water quality are monitored. The monitoring results help to evaluate the effectiveness of different conservation measures and form a basis for the optimisation of ongoing actions, like oxygenation of the bottom water by aeration.

The regional impact of the monitoring project has been high. The projects have been realised in close collaboration with municipalities, authorities, NGOs and land owners. TUAS' water team has established its place in a wide network of water quality monitoring experts. International collaborations have included, among others, USA, Iceland, Estonia and Japan. A number of TUAS students have participated in practical realisation of research projects in the form of thesis work or training.

FUTURE

Most of the current monitoring projects are based on wide collaboration and they span over several years in order to get long-term data from the sites of interest. New research projects are started regularly and developing the method is seen as a continuous process. The expertise developed in the team is actively marketed for potential collaborators.

PUBLICATIONS

Loisa, O. 2009. Kaksikerranjärven vedenlaadun tutkimukset 2008. Report. Turku University of Applied Sciences.

Loisa, O. 2005. Kaksikerranjärvi, vedenlaatumittaukset 2004–2005. Report. Turku University of Applied Sciences.

Niemi J., Kanerva-Lehto H. & Loisa O. 2008. Littoistenjärven pohjoisen valuma-alueen kosteikkosuunnitelma. Construction plan. Turku University of Applied Sciences.

BACHELOR'S THESES

Lakka T. 2010: Automaattinen vedenlaadun seuranta Etelä-Airistolla 2006-2009. BSc thesis. Degree programme of fisheries and environmental care. Turku University of Applied Sciences.

Piipanoja J 2010: Virtaaman sekä kiintoaine- ja ravinnekuormituksen mittaaminen virtaavissa vesissä jatkuvatoimisilla mittalaitteilla. BSc thesis. Degree programme of fisheries and environmental care. Turku University of Applied Sciences.

POSTER PRESENTATIONS

Kääriä, J., Yliruusi, H., Kanerva-Lehto, H., Loisa, O., Komulainen, M. 2007. Advantage of Real-Time Water Monitoring: Is it possible to reduce nutrients with constructing bottom dam systems? Wetland Pollutant Dynamics and Control WETPOL 2007. 16.–20.September 2007 Tartu, Estonia

Kääriä, J., Loisa, O., Yliruusi, H. & Hemmi, A. 2008. When size matters: wetland nutrient-retaining, efficiency and continuous monitoring. International Conference on Wetland Systems Technology on Water Pollution Control, Indore, India 1.–7.November 2008.

Loisa, O., Laaksonlaita, J., Leskinen, P., Kääriä, J. 2012. Buoy-based vertical profiler reveals dynamics of processes. XXVII Nordic Hydrological Conference 13.–15. August 2012 Oulu, Finland.

CONTINUOUS ONLINE MONITORING OF CYANOBACTERIA – CURRENT AND ACCURATE INFORMATION ON THE BLUE- GREEN ALGAE SITUATION

Olli Loisa

Project Manager

Turku University of Applied Sciences

Faculty of Technology, Environment and Business

Projects:

Cyanobacteria Early Warning System

Efficiency and effects of mechanical removal of cyanobacteria

Duration:

1 March 2006 –

Budget:

EUR 200 000

Funding:

Cities of Kaarina, Naantali, Pori, Raisio and Turku

Keep the Archipelago Tidy Association

Turun Osuuskauppa

Suur-Seudun Osuuskauppa

Osuuskauppa Varuboden

Maa- ja vesitekniikan tuki

Saloy Ltd.

Centre for Economic Development, Transport and the Environment
of Southwest Finland

European Union Objective 2 Programme

Loimaan seutukunnan kehittämiskeskus – Yrityskolmio ry (Loimaa
Regional Development Centre)

Partners:

Luode Consulting Ltd., University of Turku, Åbo Akademi University,
GWM-Engineering Ltd., Finnish Institute of Marine Research,
Pyhäjärvi Conservation Fund, Municipality of Nauvo, Turunmaan
Seutu Association

Contact person:

Olli Loisa – olli.loisa@turkuamk.fi

Project status:

Ongoing (Cyanobacteria Early Warning System)



Turku University of Applied Sciences has an active role in the field of developing and testing modern methods and applications for monitoring the aquatic environment. Since 2006 we have used fluorometer probes to monitor the cyanobacteria concentration. Online information from several beaches has been available for the public on the internet.

BACKGROUND AND OBJECTIVES

Cyanobacteria mass occurrences, or “blooms”, have become a major problem in eutrophicated water systems worldwide. In optimal growth conditions the biomass of cyanobacteria during the bloom can be extremely high, harming or even preventing water intake and the recreational use of waters. Many species of cyanobacteria can produce toxins of various types (e.g. neuro- and hepatotoxins), which can pose serious risks to human and animal health. During the cyanobacteria season, usually in late summer, the situation requires constant monitoring from the authorities to be able to minimise the harmful effects of toxic blooms.



PICTURE 1. *Cyanobacterial bloom in Lake Kuralanjärvi in Rymättylä, SW Finland.*
Photo: Jussi Niemi.

Traditional monitoring based on laboratory analysed water and algae samples is both time consuming and expensive. In the implemented projects, a novel real-time monitoring and early warning system of cyanobacteria has been applied. The system makes it possible to get current and accurate information about the cyanobacteria situation at beaches, water intakes and other similar areas. The system has been tested and developed to make it usable for both the authorities responsible for the use of water and the general public.

There have not been any usable means to collect cyanobacteria biomass from the water during bloom. The engineering company Saloy Ltd. has tested ways to filter out cyanobacteria from water. The basic methods tested in the projects included preventing the drifting of cyanobacteria with filter fabric fences and booms and also the removal of cyanobacterial masses from water systems with a vessel equipped with filter fabric. Modern measuring technology was used for quantifying the effectiveness of the removal methods tested.

The objectives of the projects have been:

- test and apply a low cost and nearly online method for accurate and reliable in situ quantifying of cyanobacteria biomass
- establish an early warning system with web-based dissemination
- raise public awareness of cyanobacteria and eutrophication issues in general
- study the effects of mechanical removal of cyanobacteria from waterways.

IMPLEMENTATION

The Cyanobacteria Early Warning System project has been implemented since 2006 in cooperation with municipalities, conservation organisations and companies from south-west Finland. Continuously operating measurement stations that record the cyanobacteria concentration and temperature hourly have been deployed in sites, mainly at beaches. The measuring technology is based on the optical properties of cyanobacteria; an optical sensor measures the fluorescence of phycocyanin, an accessory pigment present in cyanobacteria cells. The fluorescence results are then converted to concentration, which can be used as a risk level for potential harmful effects. Information is transmitted twice a day through a GSM connection and uploaded to a web server (<http://sinileva.natureit.net>). From the website, swimmers and other recreational users

of waters can have current and accurate information about the cyanobacteria situation. If needed, an automatic text message alert about the rising algae level can be sent to the mobile phone of a person responsible for the beach or water intake monitored. Monitoring has been carried out at several locations in SW Finland, for example in Lake Littoistenjärvi in Kaarina, Taimonlahti in Naantali, Kirjurinluoto in Pori and within the BalticSeaNow.info project in Ruissalo in Turku and southern Airisto in Parainen.



PICTURE 2. *Continuously operating cyanobacteria measurement station in Lake Littoistenjärvi in Kaarina. Photo: Martti Komulainen.*

In the mechanical removal studies, the same measuring technology was used to compare an area protected with filter fabric fences and a reference area representing the normal situation in the studied lake to assess the effectiveness of the removal measures. Other related water quality factors were also studied by taking water samples. Special focus was put on hepatotoxic cyanotoxins, mainly microcystins. Removal studies were primarily conducted in Lake Kuralanjärvi in Rymättylä and Lake Pyhäjärvi in Säkylä.



PICTURE 3. *Water containing cyanobacteria in a Limnos water sampler. Photo: Jussi Niemi.*

RESULTS

Automatic measuring stations equipped with optical sensors have proven to be a reliable and accurate way to monitor the cyanobacteria concentration directly from the field. Current information about the cyanobacteria situation at several busy beaches has been produced for recreational users on-line. With modern technology, the situation can be followed up nearly in real time and no slow and expensive water samples are necessarily needed for basic follow-up. However, the online results can also be used for example for correct timing of the sample, taking in other studies where more accurate data on e.g. phytoplankton species or cyanotoxins is needed.

During the removal studies we were able to follow up the immediate effects of different kind of filtering methods. The treated area was compared to the background levels of cyanobacteria concentration to quantify the impact and

the removal measures were then improved based on the results. After the studies implemented in 2006–2008 the company Saloy ltd has continued to develop the methods further.

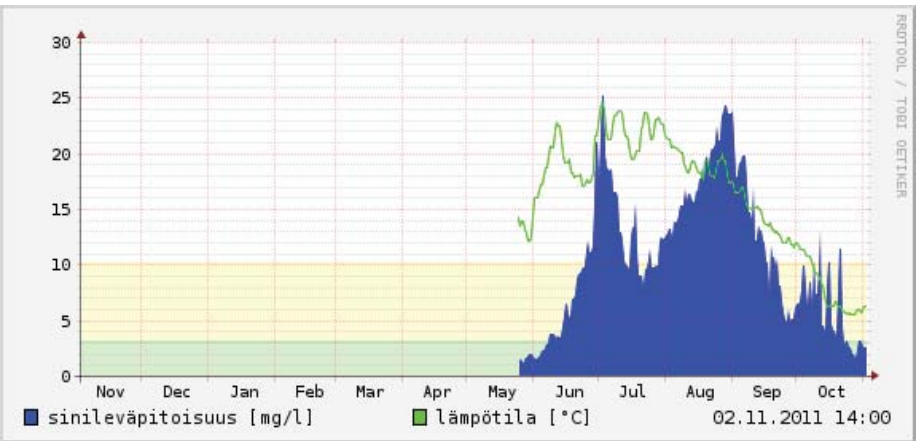


FIGURE 1. *Cyanobacteria concentration (blue) and water temperature (green) in Littoistenjärvi automatic monitoring station during the summer of 2011. The situation can be described as a cyanobacterial bloom when the cyanobacteria concentration is more than 10 mg/l.*

EFFECTIVENESS

From the point of view of regional effectiveness, the projects have been successful and they have been implemented with a wide co-operation network. During the 2011 season, the results from five different sites were available for the public online. The internet service has proven to be popular among the recreational users of the monitored beaches. The feedback received from the users has been almost exclusively positive. The annual number of visitors at the websites has been around 10 000. The busiest months have been July and August, overlapping the busiest swimming season, and also the high season for cyanobacteria blooms. The projects have received a wide coverage in media both locally and nationally. Several students from TUAS have participated in the projects as a part of their studies or as employed assistants.

FUTURE PERSPECTIVES

The early warning system for beaches continues in co-operation with municipalities. The method has now been properly tested and can be used in different kind of approaches when quick and continuous cyanobacteria biomass information is needed. The next studies will focus on more accurate biomass calibration for different monitoring sites and on the composition of cyanobacteria species.

PUBLICATIONS

Kyyhkynen M. 2008. Sinilevien (Cyanophyceae) sukkession fluorometrinen automaatioseuranta sekä kankaalla toteutetun kontrolloinnin vaikutukset lounaisen Suomen vesialueilla 2006 & 2007. Bachelor's thesis. Turku University of Applied Sciences, Turku, Finland.

Kääriä, J. and Loisa, O. 2008. Real-Time Monitoring of Blue-Green Algae Contents in Some Lakes and Sea Areas in Southwestern Finland. The 2008 North American Environmental Field Conference & Exposition. 14.-16. January 2008. Tampa, Florida, USA. Conference presentation and summary in the conference publication.

Loisa O. 2008. Littoistenjärven sinileväseuranta vuosina 2006–2007. Report. Turku University of Applied Sciences, Turku, Finland.

Loisa O. 2008. Naantalin Taimon uimarannan sinileväseuranta 2008. Report. Turku University of Applied Sciences, Turku, Finland.

Loisa O. 2008. Sinilevähaittojen vähentäminen Pyhäjärvellä, Loppuraportti 19.6.2006–29.2.2008. Report. Turku University of Applied Sciences, Turku, Finland.

Loisa O. 2008. Sinilevän torjunta ja poisto, Loppuraportti 17.3.2006–29.2.2008. Report. Turku University of Applied Sciences, Turku, Finland.

Loisa O. 2009. Sinilevän poistotoimien tehokkuus ja vaikutus pohjaeläin- ja eläinplanktonyhteisöihin Rymättylän Kuralanjärvellä. Report. Turku University of Applied Sciences, Turku, Finland.

SAMBAH – STATIC ACOUSTIC MONITORING OF THE BALTIC SEA HARBOUR PORPOISE

Olli Loisa

Project Manager

Turku University of Applied Sciences

Faculty of Technology, Environment and Business

Project:

SAMBAH – Static Acoustic Monitoring of the Baltic Sea Harbour Porpoise

Duration:

1 January 2010 – 31 December 2014

Budget:

MEUR 4.2 (Finland's share EUR 498 764)

Funding (Finland):

EU LIFE+

Ministry of the Environment

WWF Finland

Särkänniemi Dolphinarium

Partners:

SAMBAH involves partners, research organisations and governmental authorities, from eight countries surrounding the Baltic Sea (Sweden, Denmark, Germany, Poland, Finland, Estonia, Latvia and Lithuania) and from the United Kingdom.

Contact person:

Olli Loisa – olli.loisa@turkuamk.fi

Project status:

Ongoing



SAMBAH is an international EU LIFE+ funded project involving all EU countries around the Baltic Sea that monitors the abundance and density of the critically endangered Baltic Sea harbour porpoise, the only whale species in the Baltic Sea. The ultimate goal of the project is to secure the conservation of the Baltic Sea Harbour Porpoise.

BACKGROUND AND OBJECTIVES

The Baltic Sea subpopulation of the harbour porpoise (*Phocoena phocoena*) is small and has been drastically reduced during the last decades and it is now seen as critically endangered. The species is listed in EC Habitats Directive as well as in the national red lists of several EU Member States. Other international agreements also require strict protection of the species. In Finland, the species is now listed as regionally extinct.



PICTURE 1. *Harbour porpoise (Phocoena phocoena). Photo: Solvin Zankl / Fjord&Belt.*

Proper management of the population in the Baltic Sea is impeded as its present geographic distribution and habitat use are unknown, and the low density of animals makes traditional visual survey methods unlikely to provide data accurate enough to detect trends in abundance. The lack of knowledge on the number of animals and their habitat preferences makes effective conservation measures difficult. SAMBAH will demonstrate a cost-effective, robust and broad-scale method for estimating the densities of cetaceans in low density areas and provide information on important areas for harbour porpoises in the Baltic Sea, making it possible for a proper, ecosystem-based management of the species. More specifically, the SAMBAH objectives are:

- Estimate densities, produce distribution maps and estimate abundances of harbour porpoises within the project area in the Baltic Sea. The estimates and maps will be produced by season for the whole study area. Data on abundance is necessary to assess the conservation status of the subpopulation and the negative impact of anthropogenic activities such as fisheries bycatch.
- Identify possible hotspots, habitat preferences, and areas with a higher risk of conflicts with anthropogenic activities for the Baltic Sea harbour porpoise.
- Increase the knowledge about the Baltic Sea harbour porpoise among policymakers, managers, stakeholders, the users of the marine environment and the public, in the nations bordering the Baltic Sea and within the European Community. This is crucial to reach the ultimate aim of the project, a favourable conservation status of the Baltic Sea harbour porpoise.
- Implement best practice methods for the cost efficient, large scale surveillance of harbour porpoises in a low density area. The implementation of coherent methods throughout the distribution range of the Baltic Sea harbour porpoise will facilitate future monitoring actions to follow up the effects of conservations measures taken on a local, regional, national or transnational scale.

IMPLEMENTATION

In SAMBAH, 300 static acoustic monitoring devices, click detectors called C-PODs, will be used to record the natural underwater echolocation sounds emitted by harbour porpoises. The technique has been applied in a range of

studies investigating the presence or relative densities of cetaceans that emit these types of sounds, but hitherto it has not been applied in a broad scale or on a population level. Given the low density of harbour porpoises in the Baltic Sea, click detectors are considered the most cost-effective method for population monitoring.

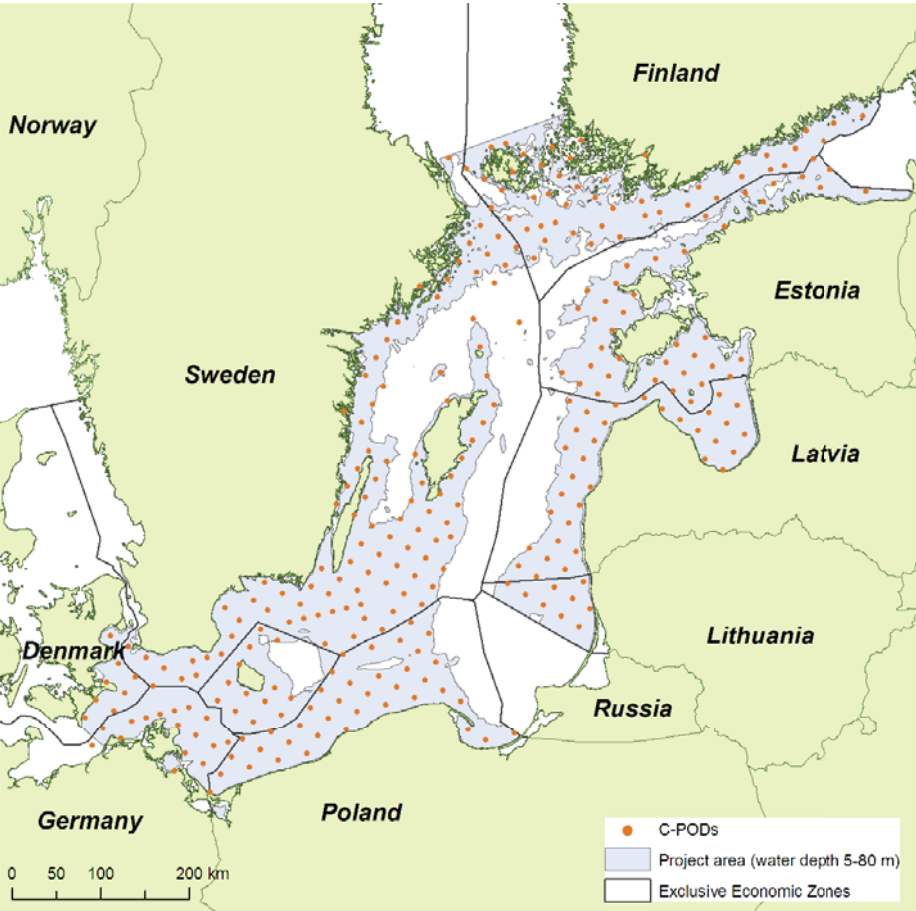


FIGURE 1. *SAMBAH project area and the location of click detectors (C-PODs).*

The study area stretches from the Darss and Limhamn ridges in the southwest to the northern border of the Åland archipelago in the north. The deployment of click detectors is restricted to area of water depth between 5 and 80 m. Click detectors have been deployed in the study area since May 2011. They will remain in operation until May 2013. The devices will be anchored two

meters off the sea floor. Acoustic data from the click detectors, combined with auxiliary data from, for example, visual sightings, designated surveys and tagged animals, will be analysed in 2013 and 2014 to produce seasonal and spatial distribution and density maps. Habitat use will be analysed by the spatial modelling of density variation of harbour porpoises in relation to quantified environmental variables like prey species, bottom substrate, depth and salinity, as well as data on fisheries, shipping and tourism.

RESULTS

By demonstrating the broad-scale use of a method for population monitoring of a marine top predator, SAMBAH contributes to developing the scientific basis for the implementation of the ecosystem approach into the management of the harbour porpoise, its natural environment and relevant stakeholders. SAMBAH will generate fundamental information that will help forecasting the impact of human activities on the dynamics of the species:

- maps of spatial and seasonal distribution,
- identification of important habitat parameters,
- maps of areas with higher risk of conflict,
- maps of areas of importance for harbour porpoises, i.e. potential Natura2000 sites or other types of marine protected areas.

EFFECTIVENESS

The results of SAMBAH will be widely disseminated to the larger community by direct cooperation with fishermen, an updated website, a custom-designed exhibition displayed at major tourist centres in four countries (more than 3 million visitors per year), and a final conference addressed to stakeholders, users and decision makers.

The development and implementation of management measures based on the results of SAMBAH is promoted by the involvement of national authorities and partners which act as advisers to international forums such as ASCOBANS (Agreement on the Conservation of Small Cetaceans in the Baltic and North Seas), HELCOM and ICES (International Council of the Exploration of the Seas).

Overall, the project is expected to provide a reliable basis for appropriate designation of protected areas and conservation measures. Altogether, the project results will be important for reaching the ultimate aim, a favourable conservation status of the Baltic Sea harbour porpoise.

FUTURE PERSPECTIVES

The project will continue to the end of 2014 when the results are published. After SAMBAH, the experiences and the best practice methodology developed in the project can be used as a baseline for future follow-up studies of endangered cetacean species.

PUBLICATIONS

Carlström, J., Amundin, M., Thomas, L., Tougaard, J., Teilmann, J., Koblitz, J., Tregenza, N., Carlén, I., Kyhn, L., Wennerberg, D., Loisa, O., Pawliczka, I., Ikauniece, A., Jüssi, I. and Visakavičius, E. (2012). SAMBAH: Static Acoustic Monitoring of the Baltic Sea Harbour Porpoise. Poster presentation. 26th European Cetacean Society Conference, 26th–28th March 2012, Galway, Ireland.

Carlström, J., Amundin, M., Thomas, Len., Tougaard, J., Teilmann, J., Tregenza, N., Carlén, I., Kyhn, L., Wennerberg, D., Loisa, O., Pawliczka, I., Ikauniece, A., Jüssi, I., Visakavičius, E. 2011. SAMBAH – Static Acoustic Monitoring of the Baltic Sea Harbour Porpoise. Poster presentation. 19th Biennial Conference on the Biology of Marine Mammals, Tampa, Florida, November 27 – December 2, 2011.

SURVEY ON STREAM RESTORATION OF RIVERS IN VAKKA-SUOMI AND TURKU AREA

Teemu Koski

Project Manager

Turku University of Applied Sciences

Duration:

2010–

Budget:

EUR 42 000

Funding:

Centre for Economic Development, Transport and the Environment of Southwest Finland, the Airisto–Velkua fishing region, Fishing region of Southwest Finland, Saaristomeren Uistelijat Ry, West Coast Trolling Team

Partners:

Centre for Economic Development, Transport and the Environment of Southwest Finland, the Airisto–Velkua fishing region, the fishing region of Southwest Finland, Saaristomeren Uistelijat Ry, West Coast Trolling Team

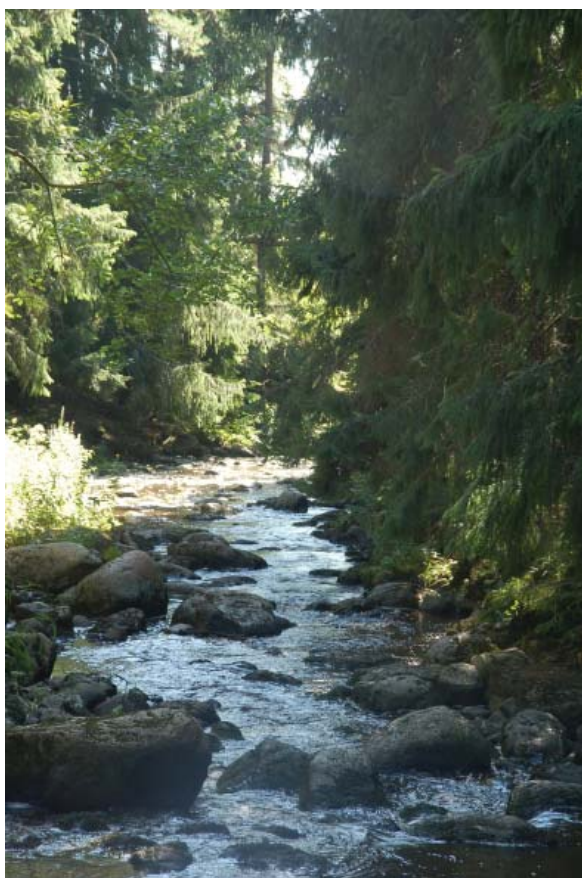
Contact person:

Raisa Kääriä – raisa.kaaria@turkuamk.fi

Project status:

Ongoing

Sea run brown trout (*Salmo trutta*) is critically endangered in Finland and the population is supported by stocking in marine areas. Restoration of streams can create conditions that also support the natural reproduction of brown trout. Turku University of Applied Sciences (TUAS) has started a project in cooperation with Southwest Finland Centre for Economic Development, Transport and the Environment, local fishing regions and trolling associations to create a basis to recreate the natural life cycle of sea run brown trout in the rivers in the area.



PICTURE 1. *Part of a tributary of Hirvijoki, which has not been dredged. Unfortunately there is an old mill and dam downstream which block migration. Photo: Teemu Koski.*

BACKGROUND AND OBJECTIVES

As a result of river dredging, damming, declined water quality, increased flow fluctuations and high fishing pressure, sea run brown trout have become critically endangered in Finland. Many rivers have been dammed because of various reasons and these dams prevent fish from migrating to spawning grounds. Dredging and damming in river basins and drainage areas have resulted in poor reproducing conditions. Therefore the original populations of sea run brown trout have vanished from most of these rivers. Stocks are kept up by stocking fish.



PICTURE 2. *One of the last survivors. "Organic" trout juvenile from Korvensuunkoski in Laajoki. Trout born in nature is called "organic". Photo: Teemu Koski.*

A basic survey on the streams in Vakka-Suomi and Turku Area is conducted during this project. Based on this survey the restoration actions can be better prioritised and targeted. The survey is directed at Aura River, Mynäjoki, Hirvijoki and Laajoki. In addition, other smaller streams that can serve as breeding grounds for sea run brown trout in the region will be taken into account. At the same time, public awareness of the alarming status of sea run brown trout is raised.

IMPLEMENTATION

Before conducting any restoration actions, it was necessary to gain a good view of the present conditions. The project found out the potential breeding grounds within the area and mapped out possible barriers to migration. This resulted in river system specific lists for suitable breeding grounds and primary restorative measures.

History of trout in the rivers in the research areas was used as base data. Earlier population introduction, test fishing and water quality data were combined. The research took into account earlier surveys and restoration measures.

This work resulted in an extensive idea of the conditions in these rivers. Based on this, it is possible to direct the effort where it is mostly needed.



PICTURE 3. *Gravel makes its way into Korvensuunkoski in a restoration bee. Gravel beds for spawning grounds are easy to construct manually. Photo: Jussi Aaltonen.*



PICTURE 4. *A brand new gravel bed waiting for trout. Photo: Jussi Aaltonen.*

Due to fish stocking, there are trout in the sea and the alarming status of the fish is ignored. The project has held seminars and conducted restoration bee where everybody was welcome. By this voluntary work, spawning grounds were improved and completely new gravel beds were made in rapid areas where trout are still found.

RESULTS

The restoration bee proved to be a simple and easy way of increasing the reproduction rate and they are suitable for voluntary work. In general, the participants were local landowners and concerned fishermen. The restoration bee was a good way of combining the increasing of environmental awareness and restoration actions.

Based on the completed restoration survey, Hirvijoki, Mynäjoki and Laajoki river systems have plenty of rapids suitable for reproduction environments with variable restoration needs. Some of the rapids are in such a good shape that there is no immediate need for machine assisted restoration. However,

continued appearance and successful reproduction in rivers is uncertain due to variations in flow rate and water quality. Nevertheless, in the river sections beneath Korvensuu in Laajoki, for example, an increase in trout reproduction has been observed and in the upper reaches of Mynäjoki a juvenile trout was caught during the restoration survey in summer 2012 although it was ten years since the last stocking. This indicates that the water quality and flow rate are good enough to support the population at least in some river sections.

Rivers have been stocked with trout juveniles at least twice during the 80's and 90's but the success of stockings is difficult to evaluate due to short stocking periods and patchy follow-up results. Before large scale restorations it is necessary to assess the sites more precisely to enable successful natural reproduction of trout in the rivers.

FUTURE PERSPECTIVES

Future plans for the project include proceeding to the actual restoration actions. There is a lot of work that needs to be done. The main prospect is to combine actions for improving water quality with work for increasing and restoring the ecological diversity of these rivers. A prospective project should reach from the plain river basin to the whole drainage area.

Additionally, in the long run, the goal is to revive the natural life-cycle of sea run brown trout in Laajoki, Mynäjoki, Hirvijoki and Aura River water systems.

CONCEPTS FOR USING REED BIOMASS AS LOCAL BIOENERGY AND BUILDING MATERIAL (COFREEN)

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Project:

Concepts for using reed biomass as local bioenergy and building material (COFREEN)

Duration:

1 May 2010 – 30 August 2013

Budget:

EUR 1 136 350, (TUAS' share EUR 420 000 as lead partner)

Funding:

EU Central Baltic INTERREG IVA Programme 2007–2013.
Centre for Economic Development, Transport and the Environment
of Southwest Finland

Partners:

Peimari Group for Further Education and Training, Livia College,
Finland

Centre for Economic Development, Transport and the Environment
of Southwest Finland, Finland

Tallinn University of Technology (TUT), Estonia

Estonian University of Life Sciences (EMÜ), Estonia

State ltd. "Vides Projekti" (Vides), Latvia

Additional partners:

City of Salo (Rauvolanniittu residential area)

City of Kaarina, environmental department (Kaarina–Piikkiö reed
beds; Tuorla)

Contact person:

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Project status:

Ongoing



The abundantly growing Common Reed which has taken over seaside bays and lake shores forms a local bioenergy potential. In addition to energy use, the reed can be used as a construction material. Turku University of Applied Sciences (TUAS) has carried out a number of projects to examine the utilisation and sustainable management of coastal reed beds. The proper management of reed beds leads to optimal and sustainable use of biomass, and in addition has positive effects on water quality, biodiversity and recreation.

BACKGROUND AND OBJECTIVES

The "Reed Strategy in Estonia and Finland" project brought out the concept of integrated coastal planning and Reed Strategy in 2007. It created a framework for the wider utilisation of coastal reed beds and gave an idea for the new project, which focuses on bioenergy production with reed, and looks for new ways to use reed in the construction industry. The COFREEN project delves deep into the utilisation theme and develops cooperation, knowhow and practices, which can be outright implemented. The objective of the project is to execute sustainable management of reed beds in southern Finland, Estonia and Latvia. In addition the project creates concepts for using reed biomass as a local source of bioenergy and construction material. Activities support ICZM (Integrated Coastal Zone Management).

The proper management of reed beds leads to optimal and sustainable use of biomass, and in addition has positive effects on water quality, biodiversity and recreation. This requires forward looking but also realistic attitudes, innovative methods and hard down-to-earth work.



PICTURE 1. *Green reed harvesting in Livonsaari, September 2010. Photo: Pekka Alho.*

IMPLEMENTATION

The concepts are created with the help of three different pilot cases, where the use of reed will be tested and developed. In Finland, Livia College executes one of the pilot cases with its own boiler house, a biogas plant and a local unused reed bed. Reed moulding tests and promoting construction use, like updating information concerning Reed in the Building Instruction Card in Finland, take place at TUAS. In Estonia, the pilot cases of TUT are located in Värskä and Muhu municipalities. Their focus is to find use for leftover material from reed roofs and to develop construction materials and bioenergy (burning winter reed in different forms and producing biogas from green summer reed). EMU in Tartu, Estonia does research on a reed test house, where they test the thermal insulation capacity of various reed wall structures. In Latvia there is a large conservation area, Lake Pape, where reed is cut, but is not further processed. Solutions will be sought after a large scale testing in harvesting, storage, transportation and processing of the reed, and with feasibility studies

performed by Vides Projekti. The ELY (Economic Development, Transport and the Environment) Centre of Southwest Finland coordinates integrated coastal management issues, which are always present when planning to harvest reed in very sensitive coastal areas.

Several seminars and excursions are organised during the project, bringing people together to discuss reed and find ways to cooperate and develop new innovations and business possibilities.



PICTURE 2. *Reed beds in Piikkiö, Kaarina form the Finnish pilot area. Reed will be harvested according to management plan and the best way to use it for bioenergy production is developed. Photo: Tuomo Mäkeläinen.*

A pilot area in Piikkiö, Kaarina will act as a model for reed based economy. First of all, integrated coastal management is applied to the planning of reed harvesting. Extensive reed growth along the coast line enables harvesting in summer and thus, producing bioenergy in the new biogas station at Countryside college in Tuorla. Reed is also harvested in the winter time e.g. for study purposes. Different machinery is tested in varying conditions to meet the particular expectations of harvested reed quality and quantity and further processing, and on the other hand, assuring the reed root survival for future biomass production and keeping up biodiversity.



PICTURE 3. *Winter reed harvesting in Tuorla: Machinery development day at Cofreen International Seminar held in March 2011. Photo: Sirpa Lehti-Koivunen.*

RESULTS

The project works to find practical solutions how reed can be utilised as a cost-efficient source of renewable energy and construction material. One goal is to promote the reed harvesting subsidy based on reed as an energy plant and a bioenergy curriculum is developed for educational institutes. Events are organised to increase the awareness of reed utilisation possibilities among the general public.

EFFECTIVENESS

Concepts for reed utilisation are widely applicable to any particular location; they are just modified according to the local conditions and possible restrictions. Reed can increase the local share of energy produced from renewable sources.

Reed is also a sustainable and durable construction material. The sustainable harvesting of reed beds in coastal areas according to an accepted plan affects the environment by opening waters, increasing diversity of the area and decreasing nutrient load from rotting reed.

FUTURE PERSPECTIVES

Work to promote the use of reed can be foreseen to continue after this project.

PUBLICATIONS

Jan Bergholm 2012. The microbe sensitivity of common reed and other construction materials. BSc thesis. (in Finnish)

Laura Poskiparta 2010. Ruoko – käytön yleistymisen edellytykset rakentamisessa (in Finnish).

Mikko Moisalo 2011. Järviruo'on talvilaadun hyödyntäminen paikallisena bioenergiana. BSc thesis. (in Finnish)

Solja Helle 2011. Using a Decommissioned Waste Water Treatment Facility in Reed Pelleting (in Finnish).

Hemmi, A. & Kääriä, J. 2011. Poster and oral presentations in IWA (International Water Association) DIPCON International Conference in September 2011: Multifunctional water management concept in natural reed beds).

ALTERNATIVES IN UTILISATION OF HORSE MANURE

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Project:

Alternatives in utilisation of horse manure

Duration:

1 January – 31 December 2010

Budget:

EUR 35 000

Funding:

EU LEADER / Local Action Group Varsin Hyvä

Turun Hippos ry (Turku Trotting and Breeding Association)

Partners:

Biolan Oy

Lokapelletti Oy

Mepu Oy

Central Union of Agricultural Producers and Forest Owners (MTK)

Turun Hippos ry (Turku Trotting and Breeding Association)

City of Turku

Ukipolis Oy

Contact person:

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Project status:

Completed



Horse manure is quite useable material both as fertiliser and energy source. The utilisation of manure is regulated by both the European Union regulations and several national laws and decrees. The strict national interpretations of laws make the utilisation of horse manure as energy source more difficult although, on the other hand, increasing the portion of renewable energy sources is strongly pursued.

As the number of horses in Finland increases new solutions are required, because the new generation stables are often located near settlements without arable land that could be fertilised with manure. Suitable utilisation models for horse manure in Southwest Finland were sought in the project. Metsämäki Trotting Track acted as a model case.

BACKGROUND AND OBJECTIVES

In the past horse manure was a valuable natural resource. It was known as a productive fertiliser and even used as a feed additive for pigs. Each household had its own fields and domestic animals to secure the basic livelihood and the use of manure for fertilisation was taken for granted. Later on, after the Second World War, the number of horses slowly collapsed and by the early 1980s there were not many horses visible in the Finnish countryside. Sport was almost the sole use for horses.

A new period begun as riding and horse keeping became a popular hobby and livelihood. From 2000 to 2010 the number of horses in Finland has almost doubled. Nowadays up to 70 000 horses are registered in Finland. This situation has caused problems that were earlier completely unknown. These modern horse stables are often established close to the population centres, and near customers. Many of them do not have any fields to set manure or any connection to traditional agriculture at all. Together with the tightening environmental requirements, this has created a need for alternatives in the utilisation of horse manure.

CASE METSÄMÄKI

The Metsämäki Trotting Track is located in the northern part of the City of Turku, near the municipal border with Lieto. Turun Hippos is responsible for activities at Metsämäki Trotting Track. About fifty horses live permanently in three stables, producing approximately 590 m³ of litter per year. Additionally dozens of horses use the track daily for practice. 34 races are organised annually, with even more horses visiting the track. The horse management in the area is expected to grow further and this is also noted in the land use planning of the involved municipalities.

At the moment, Metsämäki Trotting Track takes manure free of charge to the nearby dump, where the City of Turku has its composting fields and uses the composted horse manure for gardening. However, the present environmental permission was closed in 2011 and the preliminary application for new permission suggests that in future less material is taken in. Therefore new alternatives may be needed soon.

IMPLEMENTATION

From this basis, with the initiative from Metsämäki Trotting Track in Turku, a survey was made by Turku University of Applied Sciences. The project was co-financed by the Local Action Group Varsin Hyvä, which is a regional tool for managing the development programme for the countryside, governed by the Ministry of Agriculture and Forestry. The survey was carried out in co-operation with these three actors. Available expertise related to the subject was gathered to form a steering group, which held several rewarding meetings and made excursions to key targets. The project mapped different possibilities and made cost benefit analyses and development scenarios in using the horse manure of Turku region. Having Metsämäki Trotting Track with surrounding stables as a case study, a modelling was done for different options. This report also included finding out good practices from other EU countries, highlighting the requirements set by national and EU laws and their interpretations, and exploring the capabilities of local companies and entrepreneurs.

RESULTS

There are three main ways to utilise horse manure:

1. fertiliser
2. incineration
3. biogasification of manure, after which the remaining manure can be used as fertiliser.

All these options were studied in the project both generally and from the viewpoint of the Metsämäki case.

Present use of horse manure

According to EU Regulation regarding animal by-products (EC 1774/2002), manure is classified as an animal based by-product, which must be handled according to regulations. The Finnish Waste Act (1072/1993) defines horse manure as animal based biowaste that should primarily be used as a fertiliser or soil enrichment component and alternatively to produce energy. The second recommendation is partly controversial, because in practice the legislation

forbids perhaps the most natural and efficient way to use horse manure – incineration in farm scale units. The issue has been a hot topic among people in the horse business and is covered in more detail later on.

On average one horse produces 12 m³ of litter annually, which in Finland means some 700 000 – 800 000 m³ of litter annually. Most of the Finnish horse manure is used in farms as a fertiliser or soil enrichment agent. Recently, some companies have introduced horse manure based gardening products to consumer markets. However, to build up a separate production line under the strict requirements of legislation, investing in composting, packaging and marketing etc. would still be too big a challenge for most of the manure producers and therefore it is not a solution.

Importance of bedding

The bedding used determines the processability of litter. The most common types of bedding used in Finland are woodchips, straw and peat. At the Metsämäki stables, peat is used because of its good absorbance capacity of ammonium and moisture. Another advantage of peat is the characteristically quick decomposition in the composting process (Table 1.). In many European countries, peat is not as easily available and therefore straw is more widely used. The quality of straw is remarkably better in central and southern Europe, whereas the Finnish straw tends to be too wet because of intense humidity in autumn. Many other alternative beddings are also used, but not considered efficient. Bedding can also be in the form of pellets, pressed from wood based materials such as sawdust.

TABLE 1. *Composting time of horse litter and effect on husbandry (Airaksinen 2006).*

Bedding	Composting rate	Ease of utilisation for plants
Peat	Fast	Easy
Straw	Rather quick	Quite easy
Hemp	Rather quick	Quite easy
Flax	Rather quick	Quite easy
Cutter chip	Slow	Problematic
Sawdust	Slow	Problematic
Paper chaff	Slow	Problematic

Potential as energy resource

Horse manure could be used as an energy source primarily in two ways: by incineration and by gasifying. Both options are in principle possible in the study area but in practice rather challenging.

Incineration

Incinerating the manure is regulated by the EU Directive on the incineration of waste (2000/76/EC), implemented in Finnish national legislation in the Government Waste Incineration Decree (362/2003). According to the Finnish interpretation of the law, manure can be incinerated if continuous monitoring is performed on the exhaust gas. In practice the requirement of continuous monitoring is practically impossible for normal farm-size incineration units due to prohibitive costs. The cost of measuring equipment for continuous monitoring starts from EUR 100 000 (in 2010).

Recently, strong demands have been expressed to change the legislation. One of the best ways for handling horse manure in bigger farms, stables and race tracks such as Metsämäki, would probably be to incinerate it to produce energy and heat. Horse keepers could become at least partly self-sufficient on energy, fossil fuels would be spared and the share of renewable energy increased as laid out in the energy policy of the European Union. Calculations performed during this project also revealed that Metsämäki could very well produce heating for the whole horse keeping area and investments could be covered within a reasonable timeframe, if farm scale incineration would be allowed.

On the other hand, the City of Turku has a large scale waste burning unit relatively near, where the manure could be incinerated – in theory. In practice the full capacity of the plant is already in use. A new unit is being planned in the region, but it will take years before it will be in use.

Compared with many other similar biomaterials, horse manure is relatively dry, mainly “processed” hay. This is why horse manure differs significantly from pig sludge for example. When incinerated, moisture often causes undesirable emissions. This is the case also with wood, which is nevertheless widely used in all kinds of incinerators. Earlier surveys on horse manure and bedding revealed that incineration experiments have been conducted, but mostly with horse litter that had been only slightly pre-processed or was in various mixtures

with other materials. The relatively high moisture content was seen as elevated emissions in these surveys. Few studies even included a reference that further experiments should be conducted with dried material.

The thought of drying horse manure litter for energy use began to sound feasible when a company interested in drying the manure-litter was found. An idea about a production unit that would pelletise dried litter was presented in the project. Some of the horse manure pellets could be used as an energy source for drying litter in the unit. However, as this project was only a preliminary study and did not have resources for investments or wider experiments, no additional development was performed. Nevertheless, pelleting experiments with horse manure were performed. According to the pellet manufacturer Lokapelletti Ltd, the pellets made of dried material were even better than expected. The structure of the pellets was firm and durable.

Biogas

A new biogas plant was recently built near Metsämäki Trotting Track. The plant would present a wonderful opportunity for processing horse manure, but it lacks the required environmental permission. Horse manure with peat litter could be used for the biogas process although it is not particularly productive as a raw material for biogas production. In addition, the longer remnant fibres from straw (small amounts of straw is used as litter alongside with peat) may cause problems in the process, not to mention the gate fee of EUR 40 per tonne. It is still a fairly reasonable alternative, if the city composting unit will stop taking manure. On the other hand, the cost of building a biogas plant would require large investments and with the current feed-in tariff the cost-effectiveness could be questioned, even if all the litter from nearby stables could be acquired for processing.

Horse manure as a fertiliser

Post-processing horse manure to fertiliser sounds like an alternative worth consideration. However, after a careful study, it becomes apparent that being familiar with both the Fertiliser Product Law (539/2006) and EU Regulation regarding animal by-products (EC 1774/2002) is important. Composting is regulated by local authorities, various permissions and investments are required, product descriptions and sampling programmes have to be compiled, the

traceability of products must be arranged – just to mention some obligations. The amount of regulations makes it difficult for a non-dedicated actor to conduct such an operation.



PICTURE 1. *Horse manure and peat compost at Biolan's composting facility. Photo: Pekka Alho.*

EFFECTIVENESS

The group of experts in the project agreed with the horse business in that the terms for farm scale incineration are set unnecessarily high and that the Finnish interpretation of legislation is too strict in comparison with many other EU members. In Sweden and Germany, the issue is solved more reasonably under the same legislation. One good solution is the type approval of certain incinerator models. If the incinerator passes the emission requirements, it could be accepted and used for incinerating horse manure. Another solution could be to allow the pelletising of horse manure to change its status from waste to fuel.

In the case of Metsämäki Trotting Track there are many alternatives. However, some of them are not immediately available. There are several issues that will affect the decision on what to do with horse litter: what will the Turku region decide on the new incinerator or their gardening unit, will the biogas plant also apply for the use of horse manure, will Metsämäki's vision of a major horse business centre come true and double the number of horses, will the production line for fertiliser seem profitable, will there be changes to the legislation? If the legislation would allow it, would Metsämäki be ready to invest in its own fuel and become self-sufficient in energy and even become a local energy supplier? There is no right answer but rather every case should be judged on its own merits. In any case the reports compiled during the project will support the decision-making when it is time to choose from options.

FUTURE PERSPECTIVES

The common goal to increase the share of renewable energy will not be achieved, if alternative renewable resources are treated as meaningless. Sticking to the old attitudes without questioning them rarely leads anywhere. New alternatives – including horse manure – should be tried out in earnest.

On the basis of earlier studies and the reports compiled during the project, an idea to research and develop dehydration and pelletising concepts for the manure came up. The funding for this project idea is being sought after in cooperation with a group of companies.

PUBLICATIONS

Alho, P., Halonen, S., Matilainen, H. ja Kuuluvainen, M. 2010: Hevosenlannan hyötykäytön kehittäminen. Reports from Turku University of Applied Sciences 106. Turku: Turku University of Applied Sciences.

CONTINGENCY PLAN TO MINIMISE NEGATIVE IMPACTS CAUSED BY OIL SPILLS AND TO PROTECT CRUCIAL SITES (SULKU)

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Project Coordinator

Tuomas Valve
Project Engineer

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Project:

Contingency plan to minimize negative impacts caused by oil spill and to protect crucial sites (SULKU)

Duration:

1 August 2012 – 31 December 2013

Budget:

EUR 30 350

Funding:

Regional Council of Southwest Finland, Oil Pollution Fund, City of Turku

Contact person:

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Project status:

Ongoing

The Archipelago Sea is a challenging area in a case of an oil spill. Small islands are often located side by side and are only narrowly separated by shallow and rocky waters. The SULKU project aims to identify the most probable sites in the Archipelago Sea where oil spills may occur and identify the crucial sites which should be protected from oil or other negative effects caused by an oil spill. Based on the results of the project, more effective oil spill operations can be organised.

BACKGROUND AND OBJECTIVES

Required clean-up and recovery activities in case of oil spills at sea are ruled by the Finnish Law and they will be put into effect by means of cooperation by various authorities.

The Ministry of the Environment is the authority responsible for the general coordination, monitoring and development of the oil spill response. Finnish Environment Institute is responsible, among other things, for the sufficient contingency for responding to the oil spills of seagoing vessels. The Local Centre for Economic Development, Transport and the Environment controls and monitors the organisation of the local oil spill response. Local Rescue Services, in turn, will carry out the actual work on the site of an accident. Civic authorities will be responsible for complementary responses in the area of the municipality after the incident. Furthermore, the Finnish Transport Safety Agency, Finnish Defence Forces and the Finnish Border Guard will take part in responding to the oil spill accidents at sea.

Southwest Finland Rescue Services' (SWFRS) sphere of oil spill operations covers the Archipelago Sea, which means that SWFRS operates in a 49 735 hectare area, of which 88% is covered by water and where over 40 000 islands of different sizes are located.

There are several fairways cutting through the Archipelago Sea, but only one fairway for big tankers. The so-called Naantali fairway from Utö to Naantali refinery harbour is 120 km in length and has a draught of 15.3 metres. Tankers of 100 thousand tonnes (dwt) are able to operate through it and berth in Naantali refinery harbour.

The Archipelago Sea is a challenging area in a case of an oil spill. Small islands are often located side by side and are only narrowly separated by shallow and rocky waters. Rescue and environment services' strategy in case of an oil spill is to respond as soon as possible at the open sea, because it is the most effective way to operate. It is also much cheaper to clean up oil slicks at sea than at very shallow water draughts or on the shore. At the open sea there is room to operate, and oil slicks' moves can be predicted by drift and transport models. In archipelagos, the response time at sea is limited before oil will reach the shore.

SWFRS is well aware of these challenges of Archipelago Sea. It is easy to understand why SWFRS very actively searches ways to improve its preparedness for and awareness of offshore oil spills. One of the improvements is the SULKU project, which aims to minimise the negative impacts caused by an oil spill and to protect crucial sites by making a plan for the location of fixed oil boom anchoring loops.

IMPLEMENTATION

The SULKU project identifies the most probable sites in the Archipelago Sea where oil spills may occur and identifies crucial sites which should be protected from oil or other negative effects caused by an oil spill. After the identification process, the specified crucial sites will be systematised according to natural and environmental, socio-economic and cultural value, achievable location, and a suitable location is confirmed by oil drift and transport models. Some of these identified sites will serve as a subject of planning where an elaborate plan will be made.

The plan will include a proposal for fixed anchoring loops where oil booms can be installed quickly in case of an incident. The SULKU project will make a plan for where anchoring loops and oil booms should be located, but the actual installation process is not part of the project. The project will be carried out in co-operation with SWFRS.



PICTURE 1. *The strand behind the oil booms is covered with an oil absorbent cover. Baltic Oil Spill Exercise BOILEX 2011, Nynäshamn, Sweden. Photo: Tanja Hallenberg.*

RESULTS

The project is a multiple level response to the concern that has been experienced about the state of the Archipelago Sea and it is considered essential, both by the public and local institutions.

The SULKU project responds to the Baltic Sea Challenge presented by the cities of Turku and Helsinki and the wish of a large majority of the public to guard the welfare of the people living in the Archipelago Sea area and more generally in the Baltic Sea area, during and after a potential oil disaster.

The attractiveness of the archipelago is based on the natural conditions and unique environment. A fresh and safe environment is essential for the success of not just tourism but also other industries, too. The risk of oil spills at sea is increasing with the traffic. The SULKU project aims at getting ready for this risk. The project also pays attention to the fact that the inhabitants, tourists and any people living and working in the area are entitled to a healthy and safe

environment after a potential oil disaster. The economic development of the archipelago is another subject of review. Sustainable development and all its aspects are considered in all parts of the project.

EFFECTIVENESS

After the SULKU project, SWFRS will have a plan for specified sites where anchoring loops and oil booms should be located. The plan helps SWFRS to organise oil spill response operations and gives it better preparedness for oil spill incidents in the Archipelago.

FUTURE PERSPECTIVES

Funding has been applied for a project titled ARCHOIL, which is an effort of four organisations from Finland, Åland and Sweden. ARCHOIL's objective is to reduce negative environmental and socio-economic impacts of an oil spill in archipelagos. The co-operation project is kept in operation level, that's why SWFRS is the most important partner in ARCHOIL project too.

PREVENTION OF AQUATIC FUNGI IN ROE HATCHING

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Student Assistant

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Faculty of Technology, Environment and Business

Degree Programme in Fisheries and Environment

Project:

Prevention of Aquatic Fungi in Hatching

Duration:

13 April 2011 – 30 June 2012

Budget:

EUR 15 000

Financing:

European Fisheries Fund (EFF)

Biomar Finland Oy

Partners:

Huutokosken Arvokala

Evira

Contact person:

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Project status:

Completed



EU invests in sustainable fishing industry

Aquatic fungi have caused significant economic problems for fish farming during the recent years. In this study, copper fibre and copper sulphide have been studied to prevent aquatic fungi infection in Salmonid eggs. It was found out that both copper sulphate and copper fibre seem to be useful in preventing aquatic fungi.

BACKGROUND AND OBJECTIVES

Aquatic fungi have caused significant economic problems for fish farming during the recent years. In hatcheries, dead eggs are susceptible to fungal infections and without fungicide treatment, live eggs may also be infected. Malachite green was an effective fungicide, but the carcinogenicity of malachite green has led to restrictions on its use since 2001. Formalin is nowadays used in hatcheries, but its environmental effects should be taken into account. Therefore there is a need to find a new way to prevent aquatic fungi.

In this study, copper fibre and copper sulphide were used to prevent aquatic fungi infection in Salmonid eggs. In Japan, for example, copper is used in many aquaculture farms.

IMPLEMENTATION

The experiments were made in Hollola in a fish farm of Huutokosken Arvokala, which uses ground water of quite neutral pH. The copper experiments were done in May–July 2011. The fibre is 0.002 mm thick; soft, cotton-like material. The fibre was set in a manger, made of galvanised steel, comprising of six sinks, with a 12 litres capacity each (Figure 1 and Picture 1). Additionally 2 control roe tubs without copper fibre were used. The water flow was 3.8 l/min in each sink.

The copper fibre was changed once during the experiment (after 26 days, because the breaking of the fibre causes increased copper dissolving). The copper sulphate experiment was done in May–June 2012, in a transparent plastic manger consisting of six sinks.

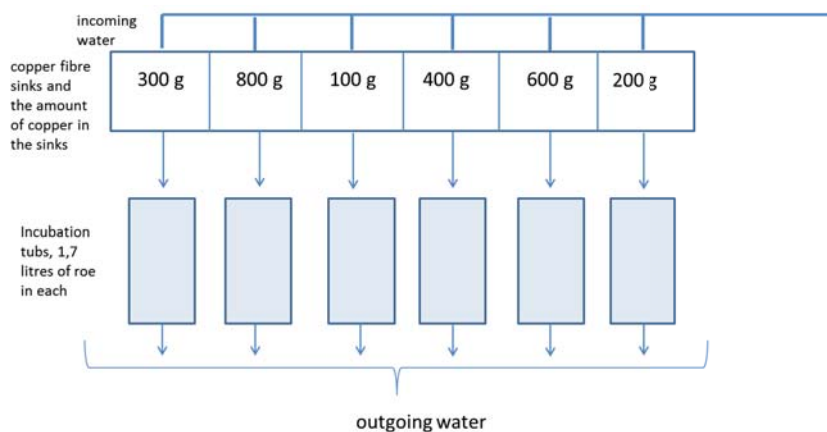


FIGURE 1. *The copper fibre experiment with the amount of copper used.*



PICTURE 1. *Photo of the copper fibre experiment. Photo: Raisa Kääriä.*

The water flow to each sink was 1 l/min. Two decilitres of fertilised rainbow trout (*Oncorhynchus mykiss*) roe was set to each sink. Sinks 1–4 were hosed

with 40 ml of copper sulphide solution with the following concentrations: 10 mg/l, 20 mg/l, 30 mg/l and 50 mg/l. Sinks 5 and 6 were control sinks without copper hosing.

RESULTS

The results show that when using copper fibre in the incoming water, the eggs of rainbow trout (*Oncorhynchus mykiss*) were not infected by aquatic fungi. The control eggs without copper fibre and eggs, where very little copper was used, did mould by aquatic fungi. The sufficient amount of copper fibre in this experiment was 300 g (with 3.8 l/min water flow).

In the copper sulphate experiment some moulding did occur in concentrations of 10 mg/l and 20 mg/l, but in concentrations of 30 mg/l and 50 mg/l no infection of aquatic fungi was noticed. The controls went completely mouldy. There were also differences in the hatching proportions (Table 1).

TABLE 1. *The hatched larvae in each concentration.*

concentration	10 mg/l	20 mg/l	30 mg/l	50 mg/l	0 mg/l	0 mg/l
hatched fry	1596	1791	1974	2191	0	0
%	64	69	77	84	0	0

EFFECTIVENESS

Aquatic fungi destroy a lot of eggs and fish and new prevention methods are more than welcome. Both copper sulphate and copper fibre seem to be useful in preventing aquatic fungi.

FUTURE PERSPECTIVES

After this preliminary project, the effect of copper and appropriate methods for using it should be continued. Preventing aquatic fungi not only in egg hatching, but also in parent fish farming, which cannot be treated with formalin, would be important.