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Pilot Fish– challenges, opportunities, suitability for nutrient trading

Nutritrade – Nutrient Offsetting for the Baltic Sea

A Flagship project of the EU Baltic Sea region strategy

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SUMMARY

The Local Fish project was started by the John Nurminen Foundation in 2014 and implemented during 2015-2018 as Pilot Fish in Project NutriTrade, part-financed by the Interreg Central Baltic Programme. In the project, the cyprinid catches from the Baltic Sea area were commercialised for the first time in Finland and brought to consumers as ready-made products in 2017.

Targeted management fishing of undervalued fish such as cyprinid species was found an effective and ecologically sustainable method to circulate nutrients from the sea ecosystem to land and human consumption. It has been estimated by Finnish Natural Resources Institute that as much as twice the amount of the annual discharges from the wastewaters of the Turku region could be removed from the Archipelago Sea area with this method. During the Pilot Fish, altogether 4,6 tons of phosphorus was removed with the cyprinid catches during the four years of implementation, respectively.

When based on commercial production chains, the price for producing ecosystem services like removing nutrients from the watercourses by management fishing can be estimated to be negative and, on the contrary, such activity would potentially bring in revenues to fishermen and local production companies. Benefits can be shown for consumers as well, as cyprinid products are sustainable, ethical and healthy local food, which can be used to substitute less environmentally friendly products such as industrially produced meat or imported fish in one's diet.

BACKGROUND AND OBJECTIVES

One of the aims of Nutritrade Project was to pilot potential measures that remove nutrients from the Baltic Sea and utilizing such measures as part of the voluntary-based nutrient trading/offsetting. Pilot Fish was based on the idea of removing nutrients from the sea with catch of underutilized fish with no or only small commercial value, such as cyprinid fish (bream, roach) in Finland. Another aim of the pilot was to increase the utilization of these fish for human consumption, as local, sustainably caught fish would provide ecological and healthy low-fat source of proteins. As food production is one of the major sources of the nutrient load in the Baltic Sea and the Archipelago Sea, the pilot also aimed at increasing the consumers' awareness of the connection between food production and water protection.

Moreover, the project aimed to support local production of food through employment, income and increased investment in producing local fish products from cyprinid catches. In Finland, coastal fishing is a traditional livelihood and, as such, an important part of our cultural heritage. With the rising appreciation for cyprinid fish, the profitability of coastal professional fishing would have potential to increase.

IMPLEMENTATION OF THE PILOT ACTIVITIES - FISHING AND UTILIZATION OF CATCHES

Fishing in the project

The main fishing season for roach and bream in the Finnish archipelago is during the spring, when the fish come to coastal bays to spawn. The season is relatively short, only one month after the ice melt for roach and one to two months for bream right after the waters start to warm. The timing and duration of the season are also highly dependent on alteration in annual weather conditions.

Professional fishermen from the surrounding areas of Archipelago Sea were recruited to join the project via annual call in the beginning of the year. During the first season, 5 fishermen participated in the project, and by 2018, the number of participating fishermen was increased to 15.

All participating fishermen signed an agreement with John Nurminen Foundation, with special regulations concerning fishing in the project. The regulations were well accepted by the participating fishermen; however, these regulations were also found to be one of the most important obstacles for part of the fishermen to join the project.

Development of cyprinid products

In the first phase of the project in 2015-2016, a local production chain was established in Turku region in cooperation with local entrepreneurs Kala-Apu and Kalaliike S. Wallin, Arkea and the city of Turku. A fish patty was produced and delivered to Arkea's customers in Turku region and also some neighbouring smaller municipalities. After establishing the pilot production chain for Local Fish products in Turku region, meetings with institutional kitchens and municipalities were continued during the project for further marketing of the locally produced cyprinid products, especially targeted to coastal municipalities.

Cooperation with bigger companies in food productions, Kesko and Apetit, was established during 2016 and it resulted a launch of a consumer product in April 2017, made of Archipelago Sea bream, Pirkka Saaristolaiskalapihvi which also was selected as one of the finalists of "the action for sustainability of the year 2017" in Kesko Awards competition. Another new Saaristolaiskalapihvi -product was also launched by Kesko in May 2018.

In addition, direct contacts were established between local producers (such as JärkiSärki, Helsingin Kalatalo, SärkiFood) and fishermen via personal discussions and in project meetings, events and workshops to increase the availability of fish for the small producers and on the other hand to increase the number of buyers of the cyprinid catch for the fishermen.

Ecological preconditions and fish stock management

All stakeholders who participated in the project were committed to the principles of sustainable fish stock management: The fishing activities in the project were targeted to underutilized cyprinid fish, and all other catch, such as endangered species and predatory fish, were obliged to be freed from traps alive. There were also regulations related to the location of the traps as they were to be placed so that the ascents of migratory fish are not endangered.

In addition to the preconditions, the fishermen were committed to report all their catches to John Nurminen Foundation, including both cyprinids and all released individuals of any other species. An inspector was hired to monitor the fish catches and the placement of fish traps. The progress of the project was communicated regularly to key stakeholders and general public.

To follow the impact of the fishing on the cyprinid stocks in the Archipelago Sea and neighboring regions, the Natural Resources Institute (Luke) took samples from the fishermen's catches. In addition, similar sampling has taken place also before the start of the project. The samples have been analyzed by the researchers in Luke, however, no results were yet available when compiling this report.

PILOT RESULTS

Phosphorus reduction from the Archipelago Sea

During the 5 fishing seasons within the project, in 2015-2018, total cyprinid catch of 530000 kg of bream and roach was caught, corresponding to total phosphorus reduction of 4,2 tons altogether (with P content of approx 0,8% in cyprinid biomass), which falls behind the original target value of 5-8 tons. In total, the catches remained smaller than was originally estimated, however the last fishing season was better than the previous ones. The catches are highly dependent on weather, and as the first two spring seasons were unusually cold in Finnish Archipelago, also catches of cyprinids remained smaller than was expected.

Because of these weather-dependent fluctuations, some effort was also put in studying the possibilities to expand the fishing activities to other areas e.g. in the eastern Gulf of Finland as the stock of cyprinid fish is strong also there. Unfortunately, it was found out that there are not yet sufficient possibilities for utilizing the catches in the region and transferring the catches elsewhere for processing would be too expensive. Thus, it was decided to continue the fishing in the area of the Archipelago Sea and put more effort on attracting more fishermen to join the project.

A transparent framework for measuring cost efficiency of nutrient reduction efforts

One of targets of the NutriTrade Project was establishing a transparent framework for measuring cost efficiency (€/kg) nutrient reduction efforts and identifying new innovative reduction methods. In Pilot Fish, a simple mechanism to verify the amount of phosphorus (P) removed with the fish catch was developed, based on reporting and monitoring of cyprinid catches. The P reduction was then calculated by using an estimate of 0,8% P content in the fish (wet weight), based on literature and results from previous studies by e.g. Setälä et al. (2012). In the pilot, the cost for phosphorus removed from the Archipelago Sea was approximately 66€/kg, respectively.

Utilization of cyprinids for human food and business opportunities for local producers

Despite some still remaining bottlenecks, one of the main achievements of the Pilot Fish was establishing relatively stable production chains and demand for cyprinid fish for human consumption. Thus, if the demand will stay on the current level, it will result in constant phosphorus reduction from the Archipelago Sea also in the future. This target has mainly been enabled by the cooperation with municipalities, institutional kitchens, SMEs and the launch of consumer products in cooperation with Kesko company.

Due to the current, stabilized and functioning production chain and growing demand, local fishermen participating the project have been encouraged to develop further methods of catching and utilizing cyprinid fish. One fisherman has also started a family business, producing own products made of cyprinid species during the pilot.

Challenges faced during the pilot

The biggest challenges during the pilot were faced in establishing a stable and reliable production for consumer market, as the season for fishing cyprinids during the spring is relatively short and, thus, the amount of raw material needed for the production for whole year should be estimated before the season. Also, the local companies acting as the first buyers of the catches are relatively small, and they are bearing a substantial risk when buying large amount of low valued fish without knowing the demand for the fish beforehand. Permanent solutions for solving these uncertainties were not yet identified during the Nutritrade project, thus, this work still continues by the John Nurminen Foundation during 2019.

Another natural challenge in planning and implementing Pilot Fish was related to fishing and the nature itself, e.g. weather conditions affecting the catches. Because of couple of unusually cold spring seasons in the beginning of the project resulted in a remarkably smaller catches than was estimated beforehand. Therefore, also the removal of phosphorus from the Archipelago Sea remained modest in those years.

To tackle the challenges, the only solution would have been increasing the number of participating fishermen and cooperation companies, however, from the point of view of the fishermen or the small cooperation companies, being on hold and acting as a buffer would not have been a sustainable solution. Despite there are still some bottlenecks to be solved in the production chains, it seems that the market can develop and survive further without external support.

IMPACTS OF THE PILOT

Environmental impacts of targeted fishing of cyprinids

In recent years, the cyprinid fish stocks of the Finnish coastline have grown, most likely partly due to the eutrophication of the coastal waters. Fishing is an efficient way of recycling nutrients from the watercourses - it has been estimated by Finnish Natural Resources Institute (LUKE) that in total, approximately 600 tonnes of eutrophication phosphorus is annually recycled from the Finnish waterways to land by fishing. Thus, large-scale removal of cyprinid fish has not only a direct effect on nutrients in the watercourses but also some indirect effects on eutrophication which are, however, difficult to estimate.

The direct impact can be easily verified by the amount of nitrogen and phosphorus that is removed from the sea with the biomass of fish catches. Nutrient content in fish varies between different species, whereas the variation within one species is usually small (Hendrixon et al., 2007; Sterner & George, 2000). For estimating the nutrient content of cyprinids in the Pilot Fish, results from recent studies and literature sources were utilized. Nutrient content in cyprinid fish is quite well known, so the uncertainty regarding the amount of nutrients removed with the biomass of cyprinids is relatively low. (Setälä et al. 2012, Setälä 2015). Much larger phosphorus contents of species belonging to the same family (*Cyprinidae*) also have been presented, however outside the Baltic Sea (Sterner & George, 2000). For nitrogen, the amount in cyprinids is estimated to be 3% (Sandström, 2011).

The indirect effects on eutrophication can be achieved from biomanipulation of coastal food-webs and from the usage of the catches. Cyprinid fish compete for nutrition and living space with other, more financially important fish species. The efficient fishing of cyprinid fish species predated on bottom animals can reduce symptoms of eutrophication and can improve fish growth, and, also, give more room for predatory fish, thus balancing out the structure of the fish stock. Consequently, in addition to removing nutrients with cyprinid catches,

increasing the catches and restoring their populations closer to their natural level could, in the long run, potentially have positive effects also on the coastal food-webs. (Eriksson et al, 2009, Lappalainen et al. 2005, Östman et al. 2016).

Also, if used for human consumption or animal feed, the cyprinid fish would partly replace other protein sources and nutrient inputs to the system which would eventually have a positive effect which, however, remains relatively small and thus hard to measure.

Advancing of utilization of cyprinids for human consumption

During the WP Pilot Fish, establishment of new cooperation chains and relationships have strengthened networks between local actors and created new ways of utilizing cyprinid catches. These have resulted in increased availability of business opportunities for the small producers and on the other hand also the number of buyers of the cyprinid catch for the fishermen, creating assurance within the local production chains and among key stakeholders, e.g. the fishermen. In addition, most important bottlenecks in utilizing cyprinids for human food have been identified, which enables further development of the local businesses towards more stable production and, thus, strengthens prosperity of local livelihoods of fishermen and local producers.

Furthermore, during the project, the potential of commercializing the management fishing of coastal area and lakes in Finland have also been recognized by the Ministry of environment of Finland, as in the recent call for projects for implementation of Finland's action plan for marine and water protection and the programme to promote the recycling of nutrient and improve the ecological status of the Archipelago Sea (FMoE, Raki II Programme 2016-2019) one of the priorities for financing was commercializing possibilities of management fishing.

Communications and visibility

As the Pilot has had many different target groups, also different communication channels and activities have been utilized in reaching the target groups. For reaching local stakeholders (e.g. fishermen, SMEs, municipalities), the most efficient way has been utilizing personal contacts and arranging targeted events, e.g. workshops, but also other communication channels (e.g. professional networks, professional magazines or local channels) have been used to reach targeted stakeholder groups. At the same time, visibility in social media and in national or local media (newspapers, tv) has been an efficient way of reaching the general public. In addition, the activities and achievements of the pilot have been presented also BSR wide in international workshops and events.

Pilot Fish results, especially the products made of cyprinids, have had good visibility in local and national media. Thus, the environmental awareness of consumers, the end users of these products, has increased especially on the relation between water protection and food production. The consumers have also got more familiar with eating bream and roach, as they are now available in several schools, canteens, nursery homes and also in grocery stores in Finland.

CONCLUSIONS AND FURTHER STEPS

Based on scientific literature, it can be stated that for every kilo of cyprinid fish removed from the Baltic Sea, 8 grams of phosphorus will be removed from the ecosystem (Setälä et al. 2012). Furthermore, in the Finnish coastal waters, the Finnish Natural Resources Institute (Setälä et al., 2012) has estimated that the potential for the amount of phosphorus removed by sustainable management fishing of roach and bream is up to at least 8 tons annually (with catch of million kg), based on the estimate of the total biomass of cyprinid stocks in the Finnish coast of approximately 30 – 40 million kg, respectively (Setälä et al. 2012). In Pilot Fish, the annual catch of 200 000 kg was reached at largest.

The NutriTrade Pilot Fish has set an example on a nutrient reduction measure that is potentially applicable anywhere in the Baltic Sea region. Removal of nutrients by management fishing of low-valued species was found out to be very cost efficient when compared to other phosphorus reduction measures. Via crowd funding (e.g. Nutribute platform: www.nutribute.org), the measure could also be utilized by local actors in circumstances where there is not yet functioning market for products made of such fish. Thus, the concept is well transferable anywhere in the BSR, e.g. also in lake regions in Finland and Sweden. The partnership of the project has also supported spreading the example from Finland to Sweden.

Business relationships established during the project for cooperation between different actors in the production chains that utilize cyprinids for human food remain and the production of different cyprinid products has good potential to continue also after the project lifetime. In addition, as one of the goals of the project has also been enhancing circular economy by advancing the utilization of these fish for human consumption, the John Nurminen Foundation will put effort on spreading the concept of a sustainable production chain for utilizing cyprinids further, e.g. to Åland and Sweden, and cooperation with local stakeholders is already currently under development.

Results and outputs of Pilot fish can be accessed at project's website www.nutritradebaltic.eu. In addition, the cooperation concept used in Pilot fish can be studied at the JNF website, as well as all material produced in Pilot Fish in Finnish (for local stakeholders): workshop outcomes, preconditions created for sustainable fishing of cyprinids, catch reports etc. www.johnnurmisensaatio.fi

REFERENCES

Eriksson, B. K., Ljunggren, L., Sandström, A., Johanson, G., Mattila, J., Rubach, A., Råberg, S. & M. Snickars. 2009. Declines in predatory fish promote bloom-forming macroalgae. *Ecological Applications* 19(8):1975-1988.

Finnish Ministry of Environment: Raki II Programme. http://www.ymparisto.fi/FI/Luonto/Itameri_ja_merensuojelu/Ohjelmat_ja_strategiat/Ravinteiden_kierratyksen_edistamista_ja_Saaristomeren_tilan_parantamista_koskeva_ohjelma/Hankkeet

Hendrixon et al. 2007: Elemental stoichiometry of freshwater fishes in relation to phylogeny, allometry and ecology. *Journal of Fish Biology* 70,121-140
<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.552.9532&rep=rep1&type=pdf>

Lappalainen, A.; Westerbom, M.; Heikinheimo, O. 2005: Roach (*Rutilus rutilus*) as an important predator on blue mussel (*Mytilus edulis*) populations in a brackish water environment in the northern Baltic Sea. *Marine Biology* (2005) 147: 323-330.

Sandström, Olof 2011: RAPPORT 2011/2 REDUKTIONSFISKE som metod för att minska övergödningen i Östhammarsfjärdarna. Upplandsstiftelsen.

Setälä, Jari 2015: Rannikkovesien poistokalastus. Kannattava hoitokalastus -seminaari, Rauma 11.6. 2015.
<https://www.google.fi/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKewim98bdufDZAhUmyKYKHVW7AvAQFgglMAA&url=http%3A%2F%2Fwww.ymparisto.fi%2Fdownload%2Fnoname%2F%257B4BBF20D6-9D60-4BC8-B67B-6E69B7BEF7%257D%2F109799&usq=AQvVaw1vrbvWTEVSxEzvXYwwnVgs>

Setälä, Jari; Airaksinen, Susanna; Lilja, Juha; Raitaniemi, Jari 2012: Pilottihanke vajaan hyödynnetyn kalan käytön edistämiseksi : Loppuraportti. RKTL:n työraportteja 10/2012

Sterner, R. & George, N. 2000: Carbon, Nitrogen, and Phosphorus Stoichiometry of Cyprinid Fishes. *Ecology* 81(1):127-140.
https://www.researchgate.net/publication/241826505_Carbon_Nitrogen_and_Phosphorus_Stoichiometry_of_Cyprinid_Fishes

Östman Ö, Eklöf J, Eriksson K, Moksnes P, Olsson J, Bergström U. 2016: Meta-analysis reveals top-down processes are as strong as bottom-up effects in coastal food-webs. *Journal of Applied Ecology*: 1138-1147.