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The social-ecological value of recreational fishing for sea trout; a potential for further development of the experience industry in AustAgder? (TROUTEXP)

Søknad i sammendrag

Kysten vår er et sammensatt økosystem og et viktig leveområde for mange fiskearter. Samtidig er kysten preget av et mangfold av menneskelige aktiviteter, som innebærer risiko for tap av naturverdier. Tapte naturverdier vil i neste omgang kunne gi redusert opplevelse kvalitet for mennesker som brukere av kystnatur. Sammenlignet med andre steder i Norge så er fiske turisme i Aust Agder relativt blygsam, det ligger altså en utviklings potensiale i denne typ av opplevelse turisme i regionen. Det er derfor viktig å lære mer om hvilke sosiale og økologiske faktorer som kan restaurere og opprettholde et robust kystøkosystem over tid. Fritidsfiske etter sjøørret er et eksempel på hvordan regionale naturverdier bidrar til livskvalitet. Sjøørreten er en typisk kystfisk som gjerne gyter i små bekker og bruker sjøen som beiteområde. Når sjøørreten er i sjøen på jakt etter mat blir den også selv jaktet av fritidsfiskere. Dette pilotprosjektet vil belyse hvordan man kan optimalisere trivselsfaktorene for både ørret og ørretfiskere. Hva er det som er viktig for at fiskerne blir fornøyd med sin fritidsaktivitet, og hva er viktig for å sikre robuste bestander av ørret over tid? Vi legger opp til en større EU-søknad omkring sosio-økologiske problemstillinger i kystsonen, med fokus på fritidsfiske og turisme.

Innledning

Coastal zones are complex social-ecological systems playing an important role in the economic, social and political development of many countries. However, they are amongst the areas of the world experiencing the highest rates of pressures^{5,7,8}. They concentrate high levels of population density, host many touristic areas (seasonal pressures) and the goods and services they provide are the base for numerous economic activities. This concentration of uses has serious implications for their own sustainability. On the one hand, uses at the base of these economic activities can be negative drivers of changes within the linked coastal social-ecological systems, potentially impairing the goods and services provided through decreased resilience or resulting in conflicts among users. On the other hand, regional and global changes can threaten these uses by speeding up the crossing of tipping points. In addition, these direct and indirect processes can interact and result in multiplicative negative effects. Therefore, in order to restore or maintain coastal ecosystem functioning and services to humans, it is of vital importance to identify what are the important drivers of resilience in such systems.

Recreational fishing for coastal fish is a widespread activity that that depends entirely on a well-functioning ecosystem. Unlike commercial fisheries, the success of recreational fisheries is not measured by economic gains but rather by the level of user satisfaction¹⁰. Satisfaction is the ultimate reward that recreational fishers gains from their activity, and could be used as a reference point for management. Intuitively, angler satisfaction is associated with high catch rate and large fish. However, the relative importance of these two factors is still very poorly understood across most species and angler types (Beardmore et al. 2015). This is unfortunate, because recreational fishing pressure can be considerable so as to have a significant impact on coastal fish populations. Also, the motivation to catch particular phenotypes, such as large fish, means that recreational fishers potentially remove the more productive and valuable individuals in a population. This is so because larger fish are much more fecund and typically produce higher-quality offspring compared to smaller fish. Therefore, particularly large fish are sometimes referred to as super-spawners. A potential impact of recreational fisheries is further strengthened by recent studies demonstrating that catchability is

related to specific behavioral traits (i.e. boldness and aggressiveness³). Moreover, these behavioral traits have, in turn, been linked to life history traits, such as growth rate and time to reach sexual maturation. In salmonide fishes, both boldness and aggressiveness is associated with an easily distinguishable characteristics; the density of eumelanin spots in the skin⁶ (Fig. 1). This provides an opportunity to classify the behavioral phenotype of fish, allowing investigation of if recreational fishing targets fish with specific behavioral and life history traits that are valuable for sustaining population productivity.



Fig 1. Differences in eumelanin skin spots in rainbow trout with contrasting behavioral profiles. LR being more bold and aggressive than HR trout.

In Skagerrak, the sea trout is a popular target species for recreational fishers. Sea trout refers to brown trout (*Salmo trutta*) that use the salt-water environment for feeding during parts of their life cycle (Fig. 2). The fish usually spawn in relatively small coastal streams, where the offspring may spend 1-3 years before moving to salt-water for the first time. At sea, the trout feed on a variety of prey such as sprat, gobies and shrimps and can grow rapidly to weigh several kilos. After maturation, the next generation of sea trout returns to their nursery stream to spawn. That sea trout has a social and a



Fig. 2. The sea trout

potential commercial value for the local recreational fishers as well as for tourism (for example see; <http://www.sportfiskeguide.se/spfguide/mapp1/guide17.htm>), emphasizes the need for a proper management of this resource. Moreover, sea lice infections are threatening natural sea trout populations in regions with high aquaculture activity⁴. In Agder, the activity of salmon aquaculture is relatively low and is concentrated to the western parts, leaving most of the region unaffected, accentuating the regional potential associated with recreational sea trout fishing in this part of Norway.

We aim to study the interaction between the sea trout and recreational fishers in Skagerrak, partly because this would be valuable for the region as such, and partly because we wish to lay the ground for a broader application to the EU on socio-ecological aspects of recreational fishing and tourism in the coastal zone. This pilot project would be valuable to the region because it can point towards important drivers of socio-ecological resilience in the coastal ecosystem in Skagerrak. It would provide basic knowledge about the recreational fishing for sea trout; what determines angler satisfaction and what is the willingness to pay for fishing sea trout. The sea trout fishers would be directly involved in the project through data collection (catches), questionnaires about their fishing activity, and in regular meetings with scientists throughout the project period. This interaction with the fishers would be extremely valuable when preparing for a wider EU-proposal. We need to establish such collaboration and discuss our ideas with the user groups so as to come up with the best possible working hypothesis to be tested in the main project. Also, we need to test whether our methods are working as expected, how they may be improved, and what sample sizes are required to answer the project objectives with adequate precision. The fishers would also be able to present their view of what is valuable about their fishing activity, and how they feel that the activity should be managed in the future. Moreover, we need to include representatives from the tourist business in a reference group, including representatives both from the public and the private sector, to discuss possible strategies for H 2020 applications aiming at stimulating growth in the sport fishing industry in the region. We wish to create this reference group in collaboration with the county-municipality.

This application has two main aims:

Networking: *To establish a regional reference group where recreational fishers, scientists and the tourist and sport fishing industry can coordinate their position activities toward EU-proposals.*

Research: *To study the interaction between sea trout and recreational fishers in Skagerrak, aiming to strengthen the socio-ecological resilience via specific management recommendations, and, further, to prepare for a wider EU application.*

The scientific main aim has the following sub goals:

- S1: To establish a working group where recreational fishers and scientists can agree on data collection and discuss potential hypotheses to be included in a wider EU-proposal.
- S2: To quantify the magnitude and composition of sea trout catches from the recreational fishery in Skagerrak, also involving an evaluation of whether recreational fishers are non-selective or target specific fish types associated with population productivity.
- M3: To analyse information on sea trout recreational fisher satisfaction, specifically the relative importance of catch rate and size of fish.
- S4: Leaning on M1 - M3, to develop plausible working hypotheses on what drives socio-ecological resilience in coastal ecosystems, to be elaborated in a wider EU-application.
- S5: Based on M2 - M4, to write one scientific paper to be submitted to a relevant journal such as *ICES Journal of Marine Science*, where socio-ecological results and management recommendations are presented.

1. Forskningsinnhold

The main scientific challenge in this project is to develop methods for data collection on sea trout ecology and recreational fishery. The recreational fishers will conduct most of the data collection, while the scientists will mainly conduct the data analyses. Thus, the two groups needs to work closely together.

P₁ This initial part of the project is essential because it determines the focus and quality of the collected data. Scientists and fishers will work closely together to agree on a reasonable workload for the fishers involved in data collection. We will consult relevant literature (e.g. Beardmore et al. 2015) when developing questionnaires to be handed out to fishers.

P₂ Specifically, we will quantify key life history traits of the sea trout captured by recreational fishers to test whether fishers are targeting more or less productive fish. There is a broad literature on life history variation in fishes and how this relates to population productivity. Where the preservation of old-growth age structure is considered to be particularly important for population productivity and the long-term maintenance of fisheries yields (Hixon et al. 2014). However, this hypothesis remains to be tested for most fisheries. In particular, small-scale coastal fisheries have received very little attention in the literature.

P₃ There is a knowledge gap on the relative importance of catch rate and fish size for angler satisfaction (Beardmore et al. 2015). We aim to produce specific knowledge about this for the recreational fishery for sea trout in Skagerrak.

P₄ We feel that a wider EU-application would benefit strongly from a pilot project where hypotheses can be discussed and specified, and where methods for measuring socio-ecological resilience can be developed and tuned to the ecosystems being studied (here: Skagerrak).

P₅ Even though we will be working with method development and pilot data collection, it is still our ambition to end up with a data set that is strong enough to be published in the primary literature. The focus here could indeed be on method development, in addition to specific management recommendations.

Prosjektgjennomføring

a. Informasjonsinnhenting/datainnsamling

Questionnaires about fisher satisfaction, including social aspects of the fishing trip (Beardmore et al. 2015) will be distributed to recreational fishers by Norges Jeger og Fiskerforbund (NJFF) Aust Agder. Moreover, Centre of Coastal Research (CCR) will arrange workshops in collaboration with NJFF Aust Agder to train recreational fishers to withdraw samples from cached sea trout. Samples will include weight and length and pictures, allowing for quantification of eumelanin skin spots, and otoliths and scales for age and growth rate estimations.

b. Analyse av data

Data analyses will be performed by CCR (NIVA and UiA), implementation of results and eventual management recommendations will be discussed with NJFF AustAgder. The questionnaires will be evaluated and the relative importance of cached fish will be weighed to social aspects of the fishing trip. Furthermore, growth rate and life history traits (i.e. time before emerging to sea, time spent in sea before returning to fresh water to spawn) in cached sea trout will be estimated by analyses of otoliths and scales (Volk et al., 2007). Moreover, growth rate, life history traits and skin spot density will be compared to data from beach seine surveys, a more nonspecific way to catch fish, to investigate if recreational sea trout fisheries targets individuals with specific behavioral profiles and life history traits.

c. Prosjektgruppe

Project manager/researcher: Senior Researcher Dr. Erik Höglund (NIVA region sør and CCR) will coordinate the project and be will be involved in the data analyses and be responsible for arranging training workshops for recreational fisheries together with NJFF Aust Agder. He has published 50+ papers in peer reviewed scientific Journals, and his main research area is mechanisms underlying phenotypic behavioral differences in fish. Recently he has taken up a position as senior researcher at NIVA-sør. During 2014-2015 he has been working as a senior research adviser at UiA, where he supported UiA, sørlandet sykehus, Agderforsk and Teknova in H 2020 related issues. Before that he held a senior research position at the Technical University of Denmark, where he have been coordinating international and national research project and networks. He will be involved in position activities towards H 2020.

Researcher: Professor Esben Moland Olsen (University of Agder, Institute of Marine research and CCR) will be involved in all major tasks, including research design, data collection, analyses, and dissemination of results. His primary research interest is life history evolution and conservation biology in aquatic systems. Further, life history traits are linked to behavioural traits such as home ranges and activity level. Hence, much of Olsen's later research effort has focussed on integrating the life history and behavioural perspective for a broader understanding of coastal fish biology and optimal management for user groups such as recreational fishers. Olsen has broad experience in leading research projects funded through the Research Council of Norway and the EU (INTERREG), his research group has been successful in disseminating key results to a broad non-scientific audience. For instance, recent projects have been presented two times on the national television news (NRK Lørdagsrevyen) and nature shows (NRK Ut i Naturen). Through ongoing fish tagging programmes at IMR, Olsen has substantial experience in collaborating with local commercial and recreational fishes, motivating them to send in reports about their reports of tagged fish.

NJFF AustAgder: Is a regional organization of recreational fishers and hunters. Nationally NJFF has 100 000 members. NJFF AustAgder consists of 16 local organizations and organizes courses and activities for its members. NJFF AustAgder will take part in discussions of implementation and eventual management recommendations of the results engage its members to contribute with sapling of sea trout and will take part in the networking activities towards H2020.

Reference group: Representatives from the tourist business in a reference group, including representatives both from the public and the private sector, to discuss possible strategies for H 2020 applications aiming at stimulating growth in the sport fishing and tourist industry in the region.

d. Tidsplan og milepæler

Project period: 2016-2017

January: Creation of the reference group

March: Start up Meeting and Training workshops with NJFF AustAgder

March-May: Data collection of recreational fishing

June: Fish otolith (ear bones) and scale analysis

August-November: Data analysis and writing of a scientific paper

December: Reference group meeting; discussion of results and evaluation of future collaborations and H 2020 strategies.

2016-2017: H 2020 networking activities

2. Budsjett og finansieringsplan

Budget:

Hourly based salary (1395 NOK) to Erik Höglund (NIVA): 173 000 NOK

Hourly based salary (789 NOK) to Esben Moland Olsen (UiA/CCR): 173 000 NOK

Training workshops, meetings and analyses of fish samples: 54 000 NOK

NIVA networking activities H2020: 50 000 NOK

UiA networking activities H2020: 50 000 NOK

NJFF Aust-Agder networking activities H2020: 50 000 NOK

Sum: 550 000 NOK

Own Funding: 275 000 NOK

From the county-municipality 275 000 NOK

The budget does not include costs associated with the reference group. This will be developed in collaboration with Aust Agder county-municipality.

3. Videreføring og utnyttelse av resultatene

Generally, the project establishes a working group ensuring stakeholder involvement in both research and management of coastal resources. Adding social values to the resilience of coastal systems is timely and important, which is reflected in both scoping papers and several calls of H 2020. Moreover, tourism and fisheries are highlighted as important sectors in blue growth; an initiative of the European Commission's to further harness the potential of oceans, seas and coasts:

http://ec.europa.eu/maritimeaffairs/policy/blue_growth/index_en.htm.

By participating in networking activities, arranged by blue growth and other key players in marine and coastal research of H 2020, we will position the TROUTEXP working group towards participation in H2020 projects. We will disseminate the projects results and activities through the homepages of involved partners. Information about the project will also be published in NJFF's magazine "Jagt tog Fiske". The scientific parts of the project will be published in peer reviewed scientific Journals.

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