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Research, part of a Special Feature on A Systems Approach for Sustainable Development in Coastal Zones

Effects of Fishing Tourism in a Coastal Municipality: a Case Study from Risør, Norway

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ABSTRACT. Recreational fishing has become an important part of the Norwegian tourist industry. The coastal municipality of Risør, southern Norway, is considering further development of its marine fishing tourism to increase local economic benefits, but they also want to limit negative effects on the local ecosystem and for the inhabitants. We developed an integrated model with ecosystem and socioeconomic components to evaluate these trade-offs. We chose the status of the local cod (*Gadus morhua*) stock as an indicator of the marine ecosystem condition. Cod is a highly valued species in tourist and recreational fisheries throughout Norway, and also supports an important commercial fishery. Five management scenarios are presented and compared to the status quo. Our research illustrates how an ecosystem model can assist local authorities in making rational coastal zone management decisions. Our study also revealed a lack of management instruments for local authorities to develop natural resource-based tourism in Norway, and thus the need for the municipality to cooperate and coordinate with other management units and levels.

Key Words: *local cod stock; local economic benefits; local management instruments; marine fishing tourism; simulation model*

INTRODUCTION

Tourism may improve economic development in the coastal zone. During the 1990s, tourist fishing became an important part of the Norwegian tourist market and marine recreational fishing is the fastest growing part of this market. Prior studies have indicated that the economic value generated when a fish is caught by a tourist is 10 times higher than when caught by a commercial fisher (Cap Gemini Ernst & Young 2003). Tourist fishing may account for a significant portion of the fishing mortality of local fish stocks. In 2010, the Ministry of Fisheries and Coastal Affairs allocated a quota of 7000 metric tons of coastal cod to the recreational fisheries. Vølstad et al. (2011) estimated that approximately 1600 metric tons of cod were caught in the business sector of the marine fishing tourism in Norway during 2009. Their study focused on tourists who rented accommodation and boats through tourist fishing enterprises and did not include fishing tourists who booked private cottages directly from owners. Most cod are caught north of 62°N, but it is also a valued target species for fishing tourists in southern Norway.

Risør is a municipality with approximately 7000 inhabitants located on the south Norwegian Skagerrak coast. The region is popular among summer tourists. The municipality, which has about 1550 second homes, aims to improve the local economy by enhancing the tourism sector without harming the environment or causing other negative effects, e.g., overcrowding, for Risør's inhabitants. Which policy instruments, or combination of policies, are most effective for achieving this goal? We developed an integrated model with interlinked ecological, economic, and social components to aid the municipality in their decision making. The model can be used to assess the effects of different policies that may affect the local economy, the conflict level between tourists and local inhabitants,

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and the local ecosystem, including the abundance-at-age of the coastal cod (*Gadus morhua*) stock, which we selected as an indicator species for ecosystem health.

The number of tourist fishing operators in Risør is growing, and the local politicians recognize the potential of this industry to create new jobs and income. The most valued species for tourist anglers in the Risør fjords is the coastal cod, although saithe (*Pollachius virens*) and mackerel (*Scomber scombrus*) often dominate their catches in southern Norway (Vølstad et al. 2011). The coastal cod stocks are more stationary than those in the open sea, and the cod stocks in many fjords are genetically distinct from each other, and from those in the open sea (Knudsen et al. 2003). The long-term trend indicates a decreasing yield in the coastal cod fishery, causing concern for the sustainability of coastal cod stocks of Norway. Many factors may contribute to the decline, but it is likely that the overall fishing pressure is too high (Nedreaas et al. 2008). Predation by seals (*Phoca vitulina*) and cormorants (*Phalacroax carbo sinensis*) also contribute significantly to the natural mortality (Barrett et al. 1990, Bjørge et al. 2002).

We have three major objectives: (1) to present the socioeconomic and ecological setting and the problems and challenges as experienced by the municipality in context; (2) to present the integrated coastal zone model developed in the project (T. S. Hopkins, D. Bailly, and J. G. Støttrup, *unpublished manuscript*), as well as some of the obstacles met and trade-offs made in its development; and (3) to assess alternative management policies presented as five scenarios with different local economic outcome from marine fishing tourism.

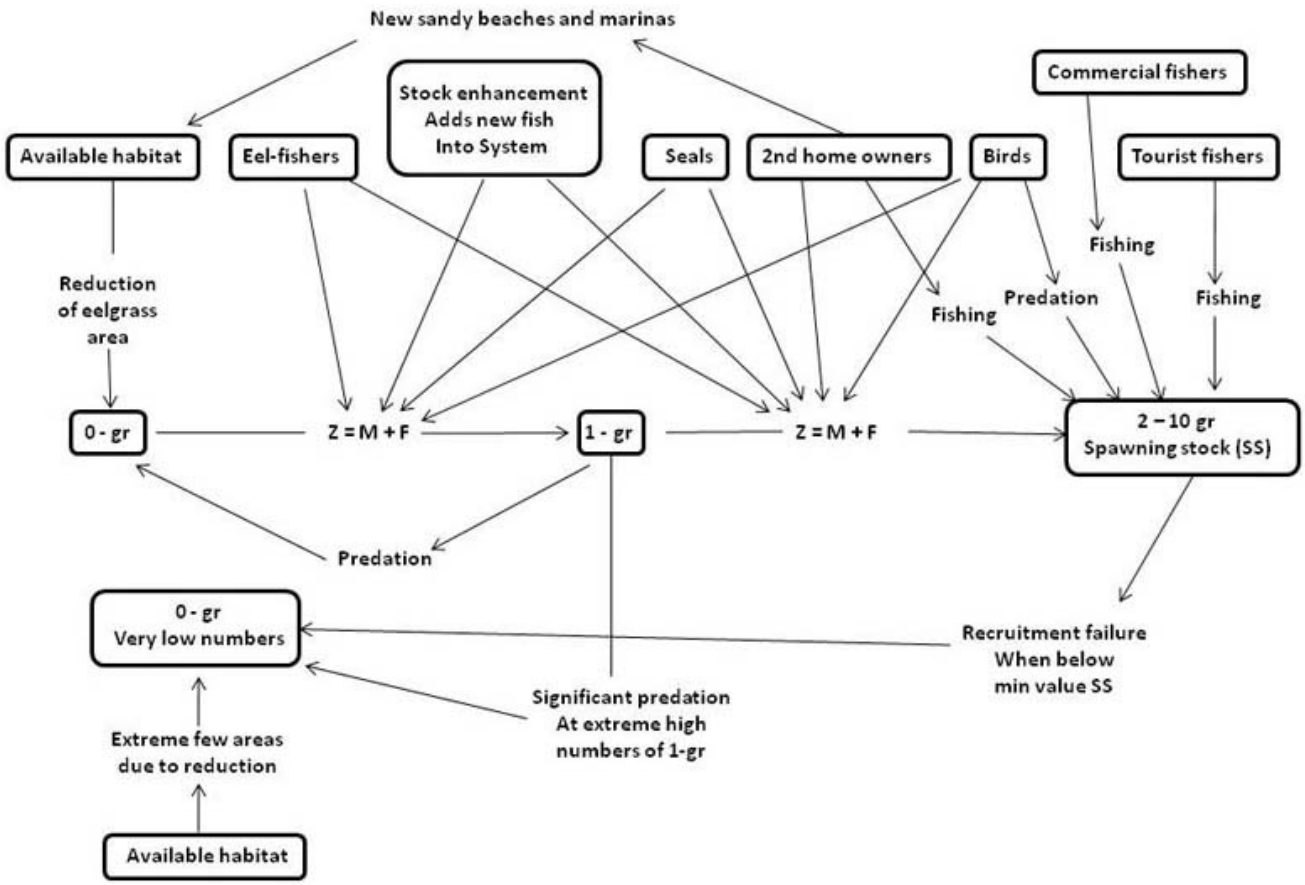
METHODS

The Søndeled fjord system is an important part of Risør geography and nature. It is separated from the open Skagerrak by islands and sounds with sills of 30 m or less. Inside the sills are sheltered fjord basins with depths of more than 180 m. Above the sill level, the fjord has an efficient water exchange with the open Skagerrak. A local cod stock spawns in the fjord system, and its shallow eel-grass (*Zostera marina*) areas are important nursery grounds for the 0-group (young-of-the-year) cod. The cod stock is affected by predation from older cod, birds, and seals, by fishing, (recreational, tourist, and commercial) and by change in available habitat (Fig. 1).

A model implemented in the software ExtendSim (www.extendsim.com) was used to forecast the environmental conditions and the resulting local economic benefits for the municipality under several management scenarios (www.spicosa.eu/sondeled/index.htm). There are no data available to do hind casting. The model has three interlinked major components, i.e., environmental, social, and economic, and was designed to evaluate management scenarios by comparing the status of the cod stock, the calculated economic output, and an indicator of conflict potential for each scenario with the present situation (baseline run) through simulations.

The environmental component is a demographic cod model that projects the abundance of the cod population in the fjord system in numbers-at-age (age group 0-10) forward in time (up to 50 years). Model runs with up to 100 simulations were conducted to account for the stochastic effects of the random annual cod recruitment. The annual recruitment distributions for fish are generally highly skewed. Hence, the stochastic annual recruitment of coastal cod (measured as abundance of age group 0) in each simulation run was generated by sampling randomly from a log-normal distribution fitted to empirical annual recruitment indices over 90 years (1918-2009) from the same fjord system. The recruitment in each year was obtained by back-transformation, taking into account a standard bias correction (Gilbert 1987). An average recruitment was used for the simulation results for each scenario, but our model-output for each scenario allows for the evaluation of uncertainty in predicted abundance-at-age because of recruitment variability. The starting population of cod is based on the relative strength between age-group 2-10 obtained from catch data from North Sea cod and the observed density of cod (1.0 to 1.83 tons km^2) in the North Sea (ICES 2007), assuming similar mortality rates of age 2+ cod in the North Sea and southern Norwegian fjord systems (Svåsand and Kristiansen 1990). The spawning population and the fishable stock are composed of age groups 4-10 and age groups 2-10, respectively. Data from a capture-recapture study on coastal cod conducted in the same fjord in 2005 (Espeland et al. 2008) were used to test if the abundance and

Fig. 1. Conceptual model of the cod life history, with the main factors affecting mortality. Z = total mortality, M = natural mortality, F = fishing mortality.



composition of the starting population that we constructed was reasonable.

Ecosystem component

Several factors influence the dynamics of the cod population. In the model the annual mortalities of age group 0 cod caused by cannibalism are estimated based on findings by Julliard et al. (2001). Predation from harbor seals and cormorants are based on findings by Bjørge et al. (2002) and Barrett et al. (1990), respectively. Accurate estimates of catches by recreational, tourist, and commercial fishers in the study area are not available. It is assumed that the amount harvested depends on the fishing effort by the different groups, and on the size of the cod stock. The bigger the cod stock, the more catch can be expected for a given fishing effort. In addition, the fishing effort or effectiveness depends on regulations. The fishing mortality accounted for by the different stakeholders was based on the Schaefer harvest function (Schaefer 1957). In its simplest form the Schaefer harvest function is a linear relationship between harvest and fishing effort, and between harvest and stock biomass. Normally the commercial fishery in the fjord is conducted with gill nets, with annual catches of three to four tons for each boat, totaling 12-15 tons per year.

Stock enhancement has been included as a scenario option in the model, because previous studies to evaluate the effects of stock enhancement

conducted in the study area indicated that release of cod of age groups 0-1 can have a significant impact on the total cod population over time (Danielssen and Gjøsæter 1994). A marine hatchery for juvenile cod and Atlantic halibut (*Hippoglossus hippoglossus)* is located in the area.

Socioeconomic component

To make a reasonable model of how tourism in the Risør municipality gives different economic effects under different public policies, we chose to operate with five categories of tourists: hotel tourists, camping tourists, second-home owners, second-home renters, and fishing tourists. The choice of categories was primarily based on availability of data on expenditure, season length and fishing pressure, knowledge and assumptions that the tourists in the different categories will respond differently to the public policies we wanted to consider, and that the tourists in the categories will have different motivations for coming to Risør, as well as different lengths of stay, expenditure patterns, impacts on nature, and interactions with local inhabitants. The local economic benefit (LEB) from tourism was mainly calculated by estimating the annual number of tourist days in each tourist category, multiplying it with tourists' daily expenditures, and calculating how this translates into direct and indirect local value-creation.

Based on literature and interviews with residents and stakeholders in the Risør area, the factors listed in Table 1 were selected to model the number of tourist days. A plus-sign for a tourist category and a factor means that increased value for that factor increases the number of tourists-days for that category. For example, the state of the coastal cod stock (row 10) affects positively the number of tourist days for second-home owners, second-home renters, and fishing tourists, but not tourists staying at hotels or camping. The actual numbers used to calculate the impact of the factors in Table 1 on tourist days for each of the categories of tourists is given in the detailed documentation of the model available at www.spicosa.eu/sondeled/index.htm.

Figures for daily expenditures (Table 2) are based on Ericsson and Grefsrud (2005), Dybedal (2006), Farstad and Rideng (2008), Auno and Sørensen (2009) and NORUT (2009). The LEB of these are calculated with estimates of local share of expenditures and multipliers based on Ericsson and Grefsrud (2005), Dybedal (2006), and Auno and Sørensen (2009). The economic effects of construction and maintenance of second homes are calculated separately, based on Ericsson and Grefsrud (2005).

The biggest challenge in the making of the economic component has been to calibrate the effects of the independent variables on the number of tourist days for the different tourist categories. In general, there have not been many previous studies on which to base this, and not much local data against which we can calibrate. Hence, the outcomes of our model must be used with caution.

A simple indicator of the potential conflict level has been included to measure how the local inhabitants consider the impacts of tourism. More tourists, in terms of total number of tourist days, increase the conflict indicator, whereas more LEB reduce it.

Calibrating the model

To examine the effects of different scenarios, the present baseline condition of the environment and economy must first be verified. The results of baseline runs mirror what we believe is the present number of tourists, the LEB, the effect on the cod stock by involved stakeholders, and the conflict factor. In the baseline runs the Søndeled Fjord was specified to have 10 birds, two seals, three eel (*Anguilla anguilla*) fishers, three commercial fishing boats, no regulations, no stock enhancement, and allowance of 500 new second homes in the area. Each run included 100 simulations and the results given in Table 3 are based on the average across simulations. Simulation runs of the baseline conditions showed little variation, indicating that the outputs in the model are stable. The estimated abundance of the local cod stock, i.e., the environmental indicator, in the baseline runs has been compared with estimates based on the 2005 capture-recapture study (Espeland et al. 2008), noting that the result should be interpreted with care because of the very small number of recaptures. Based on this, the number of age 1+ cod (1 year or older) in the total Risør fjord system was calculated both based on total fjord area (20,884 cod) and volume (49,343 cod). The number of age 1+ cod calculated during tuning of the baseline run of the model was 36,616, indicating that the results from these two approaches match reasonably well, and that the model is a reasonable representation of the present status of the local cod stock.

Table 1. How increased values of factors influence the number of tourist days per year in the different tourist categories.

Factor / Tourist category	Hotel tourists	Second-home owners	Fishing tourists	Second-home renters	Camping tourists
1. Total number of tourist days last year	–	–	–	–	–
2. Conflict potential indicator between tourists and locals	–	–	–	–	–
3. Accomodation capacity, second homes for rent			+	+	
4. Accomodation capacity dedicated for fishing tourists			+		
5. Quality of accomodation dedicated for fishing tourists			+		
6. Accomodation capacity, Hotel	+				
7. Accomodation capacity, Camping			+		+
8. Landscape and environmental quality index	+	+	+	+	+
9. Regulation on construction of second homes[†]		–			
10. Size of coastal cod stock		+	+	+	
11. Regulations on tourist fishing[‡]			–		
12. GDP growth in Norway	Growth in GDP above a certain level affects the total volume of tourists.				

[†] The total number of second homes allowed in the municipality.
[‡] More restrictive regulations affect tourist days negatively.

The number of tourists used as the baseline during the tuning of the model was compared to (1) official accommodation-data for 2007 for hotels and camping from statistics Norway (www.ssb.no), (2) second-home use estimates based on Ericsson and Grefsrud (2005), and (3) our own estimate of number of fishing tourists based on available accommodation capacity in Risør. Estimates of fishing pressure by different tourist groups were also facilitated by the tuning of the model to produce a stable baseline of number of tourists by category, as well as a stable cod stock. Our estimates of LEB and potential conflict level follows straightforward from tourist numbers and cod stock size.

MANAGEMENT SCENARIOS AND SIMULATION RESULTS

A total of five scenarios were chosen to represent management options in the model:

- Scenario 1: no birds, seals, or eel fishing (protecting 0- and 1 group cod)
- Scenario 2: no cod fishing at all (protecting cod all through the year)
- Scenario 3: no commercial cod fishing throughout the year
- Scenario 4: stock enhancement (annual release of 100,000 x 0- and 25,000 x 1-group cod)

Table 2. Data by tourist group used in the economical component of the model (NOK = Norwegian kroner; 1 € is approximately 8 NOK; LEB = local economic benefit).

Tourist group	Hotel tourists	Second-home owners	Fishing tourists	Second-home renters	Camping tourists
Average daily expenditure NOK	1206	100	556	716	396
Tourists per day in season 2007	150	3587	50	100	660
Season length (days) per year	95	46	180	45	90
Tourist days in 2007	14,250	165,000	9000	4500	59,400
LEB in baseline run (1000 NOK)†	18,447	14,218	2520	3332	26,796
Cod catch in baseline run (kg)‡	0	2498	2079	78	426

† Only based on daily expenditure. Construction of second homes and maintenance of second homes are not included. The LEB from these activities were, respectively, 152,000 and 7,579,000 NOK in the baseline run. For the commercial fishery, the LEB was 166,000 NOK in the baseline run.
‡ The commercial fishers caught 10,377 kg in the baseline run.

- Scenario 5: five star service level on accommodation dedicated to fishing tourists and allow 2500 new second homes

The results of the five scenarios are given in table 3 as percent deviation from the baseline run. Scenario 1, which reduces the mortality of age group 0 and 1 of the cod, resulted in a significant increase in cod biomass and total annual yield from the cod stock, including an increased number of fishing tourists and increased LEB both for this group and the commercial fishers. Scenario 2, which banned all fisheries on the cod stock, resulted in increased cod biomass, however, in the model the total cod biomass (age-classes 2-10) was limited to approximately twice the abundance of the baseline run. Fishing tourists would disappear from the area under a fishing ban, resulting in an overall reduction in total tourist days and LEB, but the conflict factor would likely increase. Scenario 3, which banned commercial fisheries on the cod stock, again resulted in increased cod biomass; however, the maximum biomass was regulated as in scenario 2. The scenario led to a small decrease in annual yield from the cod stock, and a large increase in the number of tourist days and LEB among fishing tourists, but only a limited increase in total tourist days and LEB. In Scenario 4 local cod (age groups 0 and 1) were produced in a local hatchery and the juveniles released in the fjord. This stocking of juveniles greatly increased the cod biomass and annual yield in the fisheries over time, and resulted in increased tourist days and LEB from the fishing tourists, but again only a limited effect on total tourist days and LEB. Finally, in Scenario 5 service level on accommodation dedicated to fishing tourists has been increased to the maximum, i.e., five stars, 40 beds, and the permit to construct new second homes has been increased five times, to 2500. Note that the investment costs of upgrading the fishing tourist accommodation have not been included in the analysis. The scenario had a positive effect on tourist days and LEB from the fishing tourists, however, only small effects could be seen for the other stakeholders.

DISCUSSION

This paper presents a quantitative model with both ecosystem and socioeconomic components. The model was useful to assess trade-offs faced by a Norwegian coastal municipality, Risør, in their

Table 3. Expected change (semiquantitative grading) in the dependent variables from baseline condition, based on model-runs where the independent variables are specified in five management scenarios. Grading: 'not important' (+/-), 'important' (++/--) , and 'very important ' (+++/---). In scenario 2 and 3 the cod stock (2-10 year-classes) are only allowed to approximately double its biomass. (NOK = Norwegian kroner; 1 € is approximately 8 NOK; LEB = local economic benefit).

Parameter	Baseline	Change from baseline (%)				
		Scenarios				
Cod stock (tons)		1	2	3	4	5
2-10 year class	30.6 t	++ (48)	+++ (97)	+++ (109)	++ (74)	-(-10)
Annual yield	20 t	++ (34)	--- (-89)	- (-5)	+++ (122)	-(-4)
Commercial fishers	10.4 t	++ (49)	--- (-100)	--- (-100)	++ (113)	-(-10)
Fishing tourists	2.1 t	++ (88)	--- (-100)	+++ (215)	+++ (222)	+ (33)
Conflict factor	3.5	- (-0.4)	+ (2.8)	-(-0.4)	- (-2.3)	+/- (0)
Tourist days						
Total	252,035	+ (0.8)	- (-1.2)	+ (3.1)	+ (2.0)	+ (0.9)
Second-home owners	167,267	+ (0.4)	+ (0.8)	+ (0.8)	+ (0.9)	-(-0.1)
Fishing tourists	5036	++ (25)	--- (-100)	+++ (55)	+++ (61)	+++ (52)
LEB	In NOK 1000					
Total	73.209	+ (1.2)	- (-2.8)	+ (2.2)	+ (4.4)	+ (1.6)
Second-home owners	14.218	- (0.4)	+ (0.8)	+ (0.8)	+ (0.9)	-(-0.1)
Fishing tourists	2.520	+ (25)	--- (-100)	+++ (55)	+++ (61)	+++ (52)
Commercial fishers	0.166	++ (49)	--- (-100)	--- (-100)	+++ (113)	-(-10)

ambitious effort to improve the local economy by stimulating tourism to improve development without causing harm to the environment or negative effects for the public.

In scenario 1 the costs of seal and bird hunting, and the losses associated with banning eel fishing were not included in the model because these are considered negligible compared with the estimated overall increase in local economic benefits. The local stock of seals is considered an important predator of small cod. In March 2010 the Mayor of Risør applied for permission to open up seal hunting for the public as a measure to decrease the predation on the cod population in the area. It is debated whether the seals in the case area are stationary or whether they are migrating along the coast. If most of them are migrating, local programs to control the seal population will have limited effect.

The regional fishermen's organization applied for permission to extend the hunting season for cormorants in 2007 and 2009 in an effort to reduce the mortality of the cod population, but did not succeed. In the county of Aust-Agder some 600 cormorants are reported shot every year (Directorate of Nature Management, Norway 2010, *personal communication*). Illegal hunting is considered to be negligible. There are no quotas on cormorants, but a general hunting license fee applies. The municipality may organize hunting to decrease the population, but has so far not done this. In conclusion, the municipality has some means to influence the local cormorant and seal populations and can thereby influence the local cod stock.

Marine protected areas (MPAs) have been introduced in Norway over the last decades, mainly to protect fish spawning grounds, and bottom habitats. It is also possible to prohibit fishing for specific species in MPAs, and scenarios 2 and 3 are examples of this. A strong model assumption in our study is that fishing tourists totally disappear if cod fishing is banned. As saithe and mackerel dominate catches taken by tourists in southern Norway (Vølstad et al. 2011), a ban on cod fishing in the Søndeled fjord system may have less impact on the local economy than we predict. A ban on only commercial fishing, as in scenario 3, is predicted to increase the local economic benefits from tourism far more than the losses from the commercial fishery. Despite significant uncertainty regarding how tourism is in fact affected by changes in the cod stock, we believe it can be concluded based on the modeling that a ban on the very limited commercial fishery in the study area will cause economic losses that clearly will be outweighed by positive effects from tourism. The municipalities do not have the legal power to implement MPAs in their coastal zone. These two scenarios can therefore only be introduced in cooperation with the fishery authorities. In general, the commercial fishers' right to fish is highly valued in the entire commercial fisheries sector, and only special circumstances will legitimate an infringement of their rights. Because the municipalities do not have the legal power to introduce MPAs in their coastal zone, they can only achieve change through lobbying, in collaboration with the fishing tourism sector.

The hatchery in Risør could support a local stock enhancement program as outlined in scenario 4, but this would be costly for the municipality. Although the scenario with stock enhancement is evaluated to give the largest increase in LEB, this result should not be taken as evidence that this is the most cost-effective measure among those considered in the scenarios because of the uncertainties in the model. Nevertheless, stock enhancement may be a good way of increasing the LEB from tourism.

Basically, in the model, the limit on construction of new second homes in scenario 5 does not limit the number of tourist days or the economic effects of tourism. The municipality has legal authority to control the number of second homes and number of beds in dedicated fishing tourists' accommodation. Up to now, however, Risør has practiced a conservative policy regarding the construction of new second homes compared with most other coastal municipalities in the region. However, this policy can be changed by a single decision in the municipality council. The quality and standard of dedicated accommodation for fishing tourists cannot be dictated by the municipalities because such accommodation is built by private entrepreneurs. However, the municipality can encourage the entrepreneurs to choose high quality standards, and entrepreneurs may also find themselves in a "quality-contest" if only a limited number of construction prospects will get municipal acceptance.

The introduction of new policy options based on new knowledge may challenge the hegemony of some user groups and interests both at the national and local municipal level. Reallocation of fish resources by increasing quotas to, in particular, foreign fishing tourists at the expense of local commercial and recreational fishermen may challenge the locals' sense of fairness and traditional rights, even if many locals may benefit economically through tourism-related incomes. This may increase the conflict level both between locals and tourists, and between different local groups. Although there is a potential for conflicts between commercial fishermen and tourist fishers, we have not explicitly modeled this into our conflict indicator. This is because, although commercial fishermen in general have a strong position regarding marine and fishing rights, the number of commercial fishermen is very small in the case area.

Model limitations and possibilities

A shortage of reliable data to model environmental, social, and economic conditions at a local scale is usually the norm because of small sample sizes. Surveys of fisheries and the environment are typically designed to provide estimates at larger spatial scales. Also, survey data on socioeconomic conditions are often aggregated to larger spatial scales because of confidentiality issues. We deliberately kept the model simple, with only one species of harvested fish. This parsimonious approach at the expense of realism was driven by the limited data available, and allowed a transparent modeling of the scenarios. However, because the tourist and recreational fishery might increase in the future, other key species could be introduced in the environmental component. This would make the model a more realistic representation of the dynamic system, but the added complexity could result in less predictive power because of an increase in number of parameters.

Estimating the number of tourist days is a crucial element of our model. Of the baseline figures used for tourist days (see Table 2), the estimates for second-home renters and fishing tourists are uncertain. For the other categories of tourists the estimates are based on official statistics and surveys. Of the different factors that are found to affect tourism to a specific destination in the literature, income, relative prices, travel costs, and major one-off events, like world financial crises, Asian flu, and destinations hosting Olympic games, are the most important ones (Crouch 1995, Lim 1997, Li et al. 2005). These determinants of tourism flows are of limited usefulness for the present case, with its focus on what the local municipality may do to affect tourism. Some previous studies have tried to explain the choice of tourist destination, and length of stay there, based on characteristics of the destination and/or tourist groups (Rugg 1973, Papatheodorou 2001, Klenosky 2002, Seddighi and Theocharous 2002, Huybers and Bennett 2003, Marcoullier and Prey 2005). The motivation of different tourist groups to visit destinations with specific qualities moderates the importance of income and cost factors (Nicolau and Más 2006). This means that destinations with unique qualities, attractive for special interest groups, are less sensitive to price changes than other destinations. It is a challenge to choose which characteristics of a destination to include when estimating the influence of destination qualities on tourism demand (Seddighi and Theocharous 2002). The landscape and environmental index we ended up with includes the density of second homes in the municipality, the number of birds and seals, and the state of the coastal cod stock. The more unspoiled the nature is, and the more wildlife there is, the more tourist days are generated. We assume this holds true for all the tourist categories, but not with equal strength. Second-home owners and camping tourists are for instance assumed to care more about this than hotel tourists. For all of the variables assumed to influence the number of tourist days the uncertainty is significant. Hence, more quantitative studies are necessary in this field.

It is possible that the demand for constructing new second homes in the Risør area is underestimated in the model. The economic effects of maintenance of second homes is substantial (estimated at around 7.5 million Norwegian kroners), and a large underestimate on the demand for new second homes would affect the overall efficiency and precision of the model substantially.

In our model we have chosen a very simple indicator of the potential conflict level between tourists and local residents. Tourism can have both negative and positive impacts in an area, on social, cultural, economic, and environmental dimensions (Ap and Crompton 1998). To what extent negative or positive effects of tourism either reduce or increase support for development of tourism and generate hostility toward tourists depends both on the type of effects and their magnitudes (Gursoy and Rutherford 2004). Residents are not a homogenous group, so perceptions of tourism and attitudes toward it will vary (Törn et al. 2007). Gursoy et al. (2009) investigated attitudes toward mass tourism and "alternative" tourism development, i.e., eco-tourism, cultural heritage tourism, and outdoor recreational tourism. They found it almost impossible to come up with a type of development that everyone will endorse. Sharma and Dyer (2009) found that those involved in and benefitting from tourism are more likely to be positive toward it. Residents worried about the state of the local economy are more supportive of tourism development and less likely to be troubled by its social cost, whereas those that use the same resources as tourists are more likely negative toward tourism (Gursoy et al. 2009). These cited works indicate that constructing a robust and simple indicator for potential conflict level is virtually impossible. The size of the LEB from tourism does

seem central though, and particularly in relation to the state of the economy in the municipality. The 2006 municipal plan for Risør states that the municipality lost a significant number of jobs in the early 2000s, only some of which have since been regained. Major local industries are seen as exposed to sharp competition from low-cost countries. Unemployment figures for 2005-2009 are, however, fairly low, indicating no crisis.

CONCLUSION

The model presented here is a first attempt at an integrated quantitative approach toward understanding the interactions between economic, ecological, and social aspects of nature-based tourism in a Norwegian coastal municipality. The study has highlighted some challenges related to the development and implementation of the model, with its environmental component focused on different uses of the local cod stock. The effort particularly generated some interesting results related to the data requirements, interdisciplinary Coastal Zone Management (CZM) approaches, and the linking of science and policy. The results from running scenarios to evaluate municipality policy options for increasing the economic effects of tourism should be used cautiously, but indicate that increasing the availability of coastal cod for tourists is a possible strategy. Several measures for implementing such a strategy have been explored.

In data poor environments, which seems to be the general case for local CZM, the models and their input and output figures may be a tool for managers to evaluate qualitative estimates of important linkages between ecological, economic, and social variables based on an integrated approach. This can help them make useful rules-of-thumb based on a quantitative sense of the order of magnitude of change under each management scenario. Where stakeholders have some useful data, the models may help them identify which other data should be prioritized for collection, should they choose to use limited resources to gather more data.

The data requirements of even a small-scale modeling project like this are almost insurmountable. However, that this case experienced a more serious lack of data on the economic side rather than on the biological is probably mainly a reflection of the especially good availability of biological data in this particular case.

On the one hand, the methodology applied here with focus on quantitative modeling makes these shortcomings even more serious because it also leaves out valuable, but not quantifiable, variables and information. The methodology and design of the approach should therefore be more open where qualitative approaches should also be included in a larger interdisciplinary CZM toolbox. This is perhaps most obvious for the analysis of the potential conflict level between locals and tourists. On the other hand, the relations and knowledge provided by the model are general enough to be of some value in other coastal areas as well, comparable to the one in Risør.

The project has also revealed some dilemmas related to the municipality's possibility of translating the provided knowledge into policy measures. First, some of the policy instruments suggested by the knowledge and the scenarios must be implemented by regional or national authorities because the municipalities do not have the necessary authority, e.g., in fisheries. Second, measures that are not in line with locals' conceptions of fairness and rights may not receive enough support in the municipal council, both for measures that the municipality can introduce on its own and those it must ask others to implement. Third, just raising some of these issues may initiate or increase conflicts between local stakeholders, or between locals and tourists.

Responses to this article can be read online at:
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