

11.2.4.2 Request from Denmark to review environmental impact assessment of mussel fishery in the Limfjord

ICES Secretariat
17 December 2009

The following is an ICES Review Service. In September 2008 the Technical University of Denmark prepared an Environmental Impact Assessment (EIA) of Mussel Fishing in Lovns Bredning (LB) area of the Limfjord. Lovns Bredning is designated as a Natura 2000 site under the EU Birds and Habitats Directive. The EIA was subsequently submitted as a request from Denmark to ICES for review in October 2009.

ICES identified experts from Ireland and Netherlands that each provided a review (see below).

The EIA was prepared to identify the impact of mussel fishing on habitats and species in Lovns Bredning. The report has some redundancy partly due to a lack of detailed Natura 2000 maintenance objectives. The assessment is descriptive and no particular risk assessment methodology or framework is used. However, the reviewers found that the assessment is appropriate with respect to the requirements in Article 6 of the EU Habitats Directive.

The reviewers have listed many considerations which include:

- The description of the fishing activity is incomplete. Ideally the assessment would consider the impact of the proposed fishing activity in relation to specific conservation objectives for the designated features
- The hydrography, exposure and nutrient inputs should be described
- Although the area is designated for a number of bird species only golden-eye is described

One reviewer concludes that the report addresses a number of possible impacts of mussel fishery on various Natura 2000 parameters. Based on the report, the reviewer supports the overall conclusion that no negative impacts are expected.

Review by the Marine Institute in Ireland

Environmental Impact Assessment of Mussel Fishing in Lovns Bredning, Limsfjord, Denmark 2008/2009

The description of mussel fishing activities

Summary

1. Both mussels and oysters are fished in LB.
2. Fishing occurs from September to June.
3. A maximum of 30 vessels can be fishing concurrently.
4. A total quota of 6000 tonnes is planned but in addition 3500 tonnes of seed was taken earlier in 2008
5. Fishing for mussels may include fishing for spat and fishing mussels of commercial size.
6. Fishing will be directed to areas where mussel density is $>1 \text{ kg/m}^2$ and only in 8% of this area in reality
7. The location of fishing vessels is monitored every 30 minutes
8. The description of the permission (the fishing licence, Appendix I) is not given
9. Other rules are described which are self-managed. In particular
 - a. Dredging is banned in depths of less than 2m

Review

The description of the fishing activity is incomplete and a little unclear

1. The basis for the 3500 tonnes of seed quota, its origin and destination (for transplanting) is unclear. Have the 3500 tonnes been dredged and transplanted within LB or dredged from LB and transplanted elsewhere. Fig. 10 suggests that 2 areas in LB are designated for transfer of mussels in 2008. If this is the case the impact of this activity should be included in the assessment
2. The location and extent of oyster dredging is not presented. The effect of oyster dredging should be considered in combination with that of mussel dredging (and all other activities) in the assessment
3. The access routes, landing places for mussel and oyster dredgers and other inputs are not given
4. No information is presented on the amount of vessel activity (eg vessel days) that the fishery will generate
5. Research and development of new mussel fishing gear is described but it is not clear what types of gear will be used on the commercial vessels taking the 6000 tonnes of quota.
6. The fishery exploitation rate can be considered low
7. The table of mitigation measures presented to minimise potential interactions is appropriate. However, it should be presented after these interactions have been identified.

Description of the LB

Summary

1. The LB is described mainly from the point of view of mussel production

Review

1. The hydrography, exposure and other inputs to LB such as freshwater including nutrient inputs from this source could be described.
 - a. Hydrography and exposure is important in relation to the likelihood of natural disturbance and impacts on mussel populations and benthic habitats
 - b. Nutrient inputs from freshwater is a direct pressure on the LB ecosystem contributing significantly to oxygen demand and interacting with mussel production.

The EIA and Natura 2000

Summary

The EIA has been prepared to identify the impact of mussel fishing on habitats and species in Lovn Bredning designated under the Birds and Habitats Directives. As such the assessment is an appropriate assessment as required by Article 6 of the Habitats Directive.

Review

1. The steps in the assessment should be made clear including the process of screening for potential effects and secondly the assessment of the scale and level of impact of any significant effects together with mitigation proposals.
2. This EIA is in relation to a proposal to remove 6000 tonnes of mussels from LB in 2008–2009. Other activities related to mussel production, such as the removal of 3500 tonnes of seed in 2008, also occur in LB on an annual or other basis. As it appears, therefore, that separate mussel related activities have occurred recently the current assessment in relation to removal of 6000 tonnes can only be viewed as a partial assessment of the effects of the mussel industry on the LB ecosystem. As the fishing for mussels has been and is presumably planned to be an annual activity a longer term view of the impact of mussel fishing on the LB ecosystem is warranted. This can only be undertaken in the context of explicit conservation objectives being available for the site.
3. The in combination effects of all other activities in the LB have not been considered. In particular the assessment of the in combination effects of oyster production has not been included.
4. Ideally the assessment would consider the impact of the proposed fishing activity in relation to specific conservation objectives for the designated features. No such conservation objectives have been described other than the basis for the designations of the site.
5. No particular risk assessment methodology or framework is used. The approach is descriptive. Although the description is thorough in many respects a more structured matrix of assessment of activities, pressures (the mechanism by which the activity might cause impact), impacts (response to the pressures) and how the impacts are measured would be useful.
6. There is a lot of reference to information and data available for the site, as opposed to indirect inference from other sites. This has to be considered a strong point in the assessment although some more detail of that work could be presented in the assessment.
7. Better graphic representation of the spatial overlaps between fishing and other activities on the benthic biotopes including conservation areas of LB would provide for better visualisation of the potential interactions

Status of mussel populations and environment in LB

Summary

1. Mussel populations in the Limfjord declined during the period 1993–2007. Landings appear to have declined in approximate proportion to the decline in biomass.
2. Mussel populations in LB fluctuate but without trend
3. The reason(s) for mussel decline in Limfjord are not understood although oxygen depletion is implicated
4. Eel grass beds in the LB are declining
5. Severe oxygen depletion occurred in parts of the Limfjord and in LB during 2008
6. Large numbers of birds over-winter in the LB. The main species are Whooper Swan, merganser, red-breasted merganser and golden-eye.

Review

1. Although the LB is designated for, amongst others, Habitat 1160 (large shallow inlets and bays) no details regarding the composition and distribution of specific habitats or biotopes within LB is given other than the distribution of eelgrass.
2. Although the LB is designated for a number of bird species no spatial information on the distribution of these species and their habitat use requirements in LB is presented other than descriptively in the case of golden-eye.
3. Details of mussel surveys and maps of the current distribution of different size classes of mussels are not presented. Spatial distribution and segregation on the basis of size, which is taken into account in the fishing strategy, is important because birds which prey on mussels do so on particular size classes only

Impact of mussel dredging on the benthic and pelagic environment

Summary

1. Eelgrass
 - a. The distribution of eelgrass is contracting and in 2008 was restricted to water less than 2 m in depth
 - b. There is no overlap between the distribution of fishing (>2 m) and the distribution of eelgrass which occurs in depths of less than 2 m and no impact is anticipated

2. Water column
 - a. Turbidity: the post fishery mussel population can maintain full filtration capacity and therefore no changes in turbidity are envisaged
 - b. Oxygen depletion: The fishing for mussels can potentially increase oxygen demand in the water column but fishing will be suspended if oxygen concentration declines to < 4 mg/l.
 - c. Oxygen depletion: fishing for and removal of mussel biomass reduces the risk of oxygen depletion in areas where mussel biomass is high. The fishery therefore is seen as a remediation measure to stabilise the ecosystem by reducing risk of catastrophic oxygen depletion.
3. Benthic fauna
 - a. Mussel dredging will have a certain impact on the benthic habitat. This is presumed to be caused by the removal of substrate
 - b. The habitat will recover in less than 1–2 years. This assessment is based on indirect information or extrapolation from other studies at similar sites.
 - c. The presence of shell and stone is seen as important to future settlement success of mussels. The fishery removes a proportion of this substrate. Maintenance and restoration of substrate can be done by relaying substrate in areas where fishing has taken place.

Review

1. Eelgrass
 - a. Although the distribution of eelgrass and fishing will not overlap, fishing can occur up to the edge of current eelgrass distribution (the 2 m depth contour). Given that eel grass distribution has already contracted from the 3m contour, that fishing can now occur up to 2 m, that eelgrass distribution expands through the roots and that proliferation potential is slow, allowing fishing activity up to 2 m is not sufficiently conservative or precautionary. The need for additional verification that eelgrass is not present in the mussel landings shows that there is no *a priori* guarantee that the fishery is not going to encroach onto eelgrass. A buffer zone should be defined between the 2–3 m contour to allow eelgrass to expand again into this zone
 - b. No assessment of the potential effects of increased turbidity and siltation, caused by mussel dredging, close to eel grass beds is presented
2. Water column
 - a. Although the fishing quota is a relatively small proportion of the total biomass and the post-fishery population may be able to maintain the pre-fishery filtration capacity no account is taken of the effects of dredging on the mussels remaining after the fishery. Recovery of filtration capacity, mortality and sub-lethal effects caused by encounter with the dredge, increased likelihood of washout because the structure of the bed is weakened could alter the functioning of the mussel beds after exposure to the fishery. However, the fishery will only take place in a relatively limited part of the LB.
 - b. There are no data provided on the background turbidity levels in LB. In addition the cause of the turbidity is not indicated.
 - c. It is unclear what relevance the reference to Oxygen depletion has to turbidity except to remove mussels and their filtration capacity.
 - d. It is not clear if the LB is primarily a mixed or stratified system, this should be clarified. It would appear to be well mixed judging by the incidence of natural ‘whirling’ of sediments by wind etc..
 - e. The persistence of large commercial sized mussels (> 45 mm) in deeper waters would suggest that oxygen depletion was/is not as catastrophic as indicated. It has been well documented that mussels can withstand some degree of O₂ depletion for extended periods and can respire anaerobically (see review in De Zwaan and Mathieu 1992). (De Zwaan, A. E. and Mathieu, M. (1992). Cellular biochemistry and endocrinology. In *The Mussel Mytilus: Ecology, Physiology Genetics and Culture* (ed. E. Gosling). Amsterdam: Elsevier.)
3. Benthic habitat
 - a. The impact of mussel dredging on benthos may be partly due to removal of substrate but there are also additional biological effects. These include an immediate change in abundance of invertebrates, a potential change in substrate composition and as a consequence a potential change in the benthic community that subsequently re-colonises the impacted area.
 - b. The argument with respect to habitat recovery would appear to be redundant given that the fishery will be open from September to June and spatial rotation of fishing apparently does not occur. Rotational fishing may occur at a scale smaller than the production areas but there is no evidence of this. The vessel tracking systems should be capable of demonstrating whether or not rotation is occurring at a small spatial scale. If rotation is not practiced then the recovery period (July-August) is

insufficient and cumulative effects or progressive departures from baseline benthic conditions would occur over time due to the annual fishery. Previous descriptions of rotational fishing in Limfjord which allowed for approximately 2.5 yrs recovery (for mussels to settle and achieve commercial size) would allow for recovery of benthic habitat. Rotational fishing could be proposed as a mitigation measure.

- c. As the fishery is protracted in time and the fishery has some impact on benthic habitats these habitats are presumably in an altered state for the majority of the time. The significance of this can only be evaluated against specific conservation objectives for the benthic habitat. No conservation objectives have been provided.
- d. The active replacement of substrate into areas which have been fished is seen as a means of restoring the habitat. No description of this activity is presented. This activity is itself potentially impacting as it is highly unlikely that such intervention would return the habitat to a baseline condition.
- e. There is some potential contradiction in the objectives for maintaining ecosystem stability in LB. Commercial removal of mussels is seen as a stabilising influence on the environment because it reduces the risk of oxygen depletion but restoration of substrate is also seen as a positive step to ensure good recruitment of mussels. If the conservation objectives for the SAC were explicit this contradiction could be avoided.
- f. There is no proposal for monitoring of impacts during or before-after the fishery. A justification for not including such monitoring should at least be provided. Perhaps there is sufficient certainty and information regarding impacts and recovery from previous studies in the LB.
- g. The reference to comparative studies of fished and non-fished areas provide little information on the scale of fishing that might have occurred in the non-fished areas prior to commencement of the studies.
- h. Other impacts induced by dredging would be removal of soft bodied infauna which would leave them particularly vulnerable to predatory and scavenger species, alluded to in the document.

Impact of mussel dredging on water birds

Summary

1. The assessment concludes that the fishing for mussels is not expected to impact on bird populations in LB

Review

1. As no information on fishing vessel activity is presented the disturbance pressure and its impact (loss in foraging time and food intake) on waterbirds cannot be evaluated. The potential disturbance should be assessed by quantifying the spatial and temporal overlap between bird habitat use and fishing activity. A reference to bird disturbance in the Limfjord is presented however.
2. As the spatial distribution of different size classes of mussel is not presented it is not possible to evaluate how or if the spatial distribution of fishing activity will overlap the habitat use of golden-eye ducks which feed on smaller mussels.
3. The conclusion that the fishery will not generate any food shortages for birds appears to be justified from the information presented which is based on work conducted in the Limfjord.
4. The area is primarily used by non-breeding birds in winter. Three species may also be breeding in the area but this is unclear. Their status should be clarified.

Review by Aad Smaal, Netherlands (Imares)

Review of the report “Environmental impact assessment of mussel fishing in Lovns Bredning 2008/2009” by Dolmer *et al.*

The report, published September 2008, gives a description of possible impacts of fishery of mussel stocks from the bottom in a part of the Danish Limfjorden area, on birds, habitat 1160, eelgrass beds, turbidity in the water column, oxygen concentrations, sediment and benthos. Also possible cumulative effects were addressed. The EIS has been prepared to identify the impacts on Natura 2000 objectives, given the protected status of the area. The report does not give area specific Natura 2000 management objectives. In the report attention is given to the fishery methods and the measures of fishermen to avoid negative impacts.

General remarks

1. It is interesting to notice that the report addresses not only negative but also positive effects of mussel fishery on for example oxygen concentrations. Thinning out dense mussel beds will reduce oxygen consumption and hamper effects of oxygen depletion. Strictly speaking this is not relevant for an impact assessment in the Natura 2000 framework as only the absence of negative effects on the maintenance objectives needs to be addressed. However, the requirements for a Natura 2000 assessment are not explicitly addressed in the report and it remains rather unclear what the exact maintenance objectives are for the area. As a result the impact assessment lacks a clear reference framework and conclusions remain somewhat vague.
2. The report shows that there is no likely relationship between mussel fishery in the area and eelgrass beds as fishery occurs outside these habitats and is also carried out in layers deeper than 2 m. As long as there is a considerable distance between fishery and eelgrass effects are indeed unlikely. However, the report does not give details about the distances.
3. Possible impacts for birds regard the Goldeneye that forages on small mussels. It is therefore only relevant in the case of seed fishery but seed will be transplanted rather than extracted from the system. Moreover, total annual quantity of harvested mussels amounts appr 10 % of the stock and has no likely impact on the birds. This looks like a justified conclusion.
4. The impact of mussel fishery on turbidity regards the reduction of filtration capacity by removal of mussels, and resuspension of sediment by the fishing gear. The report doesn't address the relationship between turbidity and maintenance goals and it is also unclear what type of quantitative impacts on turbidity are to be expected. In my view this type of impact is redundant in the EIA as long as the relation with Natura 2000 objectives is not clear. In addition, I consider the statement that removal of mussels will not change the filtration rate rather speculative. This is only true under conditions of plankton depletion, but than the mussels will not be able to show good growth.
5. Harvesting mussels can be positive in reducing bottom oxygen demand. If this is the case mussel fishery is in fact a mitigation measure to reduce negative impacts of anoxia that apparently threatens the maintenance objectives. The reports shows that oxygen uptake by a dense mussel bed is > 10 times higher indeed than sediment without mussels. The reasoning that mussels at higher densities have a relatively high oxygen consumption is unclear to me. Food competition will result in lower ingestion rates but not in lower absorption rates. There is no obvious reason why in dense beds absorbed material will for the larger be spend on respiration in comparison with low density beds. So this argument remains speculative. However, the conclusion that removal of mussels will reduce oxygen demand remains valid. This is also true for the snow ball effect of oxygen depletion: benthic mortality is a self-reinforcing process.
6. The impact of mussel fishery on sediment and benthos has been specifically studied for the area. It was shown that infauna species richness effects were of a short duration (< 40 days). Significant epifauna effects (4 years) could not be detected for Logster Bredning (is not Lovns Bredning) and a long term study (30 yrs) showed that the area has a relatively poor benthic fauna in comparison to a reference site. This is ascribed to anoxia events although the more extensive mussel fishery may also have played a role. The report is not conclusive on this point.
7. The report pays much attention to the relation between mussel fishery, mussel recruitment and biomass and substrate availability. It may be questioned in how far this is related to Natura 2000 objectives. It is concluded for Lovns Breeding that there is no clear relationship between fishery, substrate and mussel biomass.

8. Despite the absence of a significant relationship the report gives a recommendation for a minimum amount of shells as substrate of 0.7 kg/m². In addition some measures by the farmers are addressed regarding the use of modified dredges and further studies in this field. I consider this part of the study as redundant for an EIA study.
9. The report states that cumulative effects of eutrophication and mussel fishery are not likely due to the limited harvest, but this is not consistent with the previous conclusion that mussel fishery might mitigate the change of anoxia. The fact that removal of mussels also removes nutrients in the form of biomass from the system is not mentioned. Both aspects are positive rather than insignificant.
10. In conclusion, the report addresses a number of possible impacts of mussel fishery on various Natura 2000 parameters. The report has some redundancy but this is partly due to a lack of detailed Natura 2000 maintenance objectives. The overall conclusion that no negative impacts are to be expected is sufficiently substantiated.