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ASSESSMENT OF THE VENDACE POPULATION OF BASSENTHWAITE LAKE INCLUDING OBSERVATIONS ON VENDACE SPAWNING GROUNDS

PROGRESS REPORT FOR PERIOD AUGUST 2007 TO JANUARY 2008

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EXECUTIVE SUMMARY

1. Previous studies and a current monitoring programme have shown that the status of the vendace (*Coregonus albula*) in Bassenthwaite Lake in north-west England has now been poor for at least two decades. Furthermore, a survey gill-netting component of the monitoring programme has not recorded any biological specimens of vendace since 2000, although four individuals were recorded in 2001 during broodstock collection for a translocation programme. Such survey gill netting is undertaken at a relatively low level of effort because of its destructive nature and the fact that it catches appreciable numbers of several other fish species. Given this situation, it is now highly desirable to use other means to acquire a robust assessment of the continued presence or otherwise of the vendace in Bassenthwaite Lake

2. The primary objective of the present project was to attempt to produce unequivocal evidence of the continued presence of vendace in Bassenthwaite Lake by the use of underwater video and high-frequency hydroacoustics observations on a known vendace spawning ground, and by the deployment of a high sampling effort of customised gill nets in deep water. In addition, a secondary objective was to develop bottom-typing and macrophyte analyses of hydroacoustic recordings recently made on vendace spawning grounds in order to improve the assessment of their ecological conditions.

3. An underwater video system with colour and infra-red cameras was deployed on a known vendace spawning ground near Beck Wythop in Bassenthwaite Lake on the evenings of 22 November, 6 December and 12 December 2007, and for comparative purposes on a known vendace spawning ground near Calf Close Bay in Derwent Water on 11 December 2007. No

vendace were observed at either site, although large numbers of ruffe were observed at Bassenthwaite Lake. In addition, a high-frequency hydroacoustics DIDSON system was also deployed during the underwater video observations of 6 December at Bassenthwaite Lake. Although recordings have yet to be reviewed in detail, it is clear that this system also did not record any vendace. Thus, both types of observations failed to produce any sightings of vendace in Bassenthwaite Lake. Although disappointing, this finding does not itself constitute definitive evidence of the local extinction of vendace.

4. Other than arranging the construction and delivery of customised gill nets, no activity was undertaken in this area during the present reporting period.

5. Hydroacoustics recordings made previously on vendace spawning grounds in Bassenthwaite Lake and Derwent Water were explored with the developers of the analytical softwares VBT and EcoSAV, which are appropriate for bottom typing and macrophyte mapping, respectively. It appears that the collection of further ground-truthing data is likely to be necessary to complete the bottom typing of the recorded survey data, which may not be possible within the resources of the present project. Discussions and data explorations in this general field were also held with the developers of the analytical software Sonar5-Pro

6. Further work is planned for the remainder of the present project to continue examination and analyses of the above underwater video and high-frequency hydroacoustics recordings, to undertake customised gill netting including an examination of ruffe diet for vendace eggs, and to continue bottom-typing and macrophyte analyses of the previously collected hydroacoustic recordings as far as possible within the resources of the present project.

CHAPTER 1 INTRODUCTION

1.1 Background

Previous studies (Mubamba, 1989; Winfield *et al.*, 1994) and a current monitoring programme (Winfield *et al.*, 2007a) have shown that the status of the vendace (*Coregonus albula*) in Bassenthwaite Lake in north-west England has now been poor for at least two decades. Furthermore, a survey gill-netting component of the monitoring programme of Winfield *et al.* (2007a) has not recorded any biological specimens of vendace since 2000, although four individuals were recorded in 2001 during broodstock collection for a translocation programme. Although such survey gill netting is undertaken at a relatively low level of effort because of its destructive nature and the fact that it catches appreciable numbers of several other fish species, the recent persistent absence of vendace suggests that this species may now be locally extinct.

The vendace population of Bassenthwaite Lake faces a number of environmental threats including species introductions, eutrophication, climate change and sedimentation on its spawning grounds (Winfield *et al.*, 2004), but the latter problem currently appears to be the most severe. Extensive surveys of known and potential vendace spawning grounds in Bassenthwaite Lake and nearby Derwent Water, the only other U.K. lake with a surviving native vendace population, have observed widespread deposits of fine sediments in the former but not latter lake (Winfield *et al.*, 1998; Winfield *et al.*, 2007b). In anticipation of the potential consequences of the deteriorating environmental conditions in Bassenthwaite Lake, a refuge population of vendace originating from this water body has been established in

Loch Skeen (or Skene) in south-west Scotland (Lyle *et al.*, 1999; Maitland *et al.*, 2003) and is currently being assessed (Winfield et al., 2007c). This new population forms a potential source of vendace for future restocking into a restored Bassenthwaite Lake.

Given the above situation, it is now highly desirable to acquire a more robust assessment of the continued presence or otherwise of the vendace in Bassenthwaite Lake. Although the vendace monitoring programme described above continues, its biological sampling effort cannot be feasibly increased significantly due to its by-catch of other fish species. As a result, it is unlikely to record any vendace unless the local population increases significantly in abundance. At extremely low population densities, alternative sampling approaches are required in order to detect vendace unequivocally. Conversely, although it is impossible to prove a negative, if such techniques again fail to record vendace then this would add further weight to a hypothesis of local extinction.

1.2 Objectives

The primary objective of the present project was to attempt to produce unequivocal evidence of the continued presence of vendace in Bassenthwaite Lake by the use of underwater video and high-frequency hydroacoustics observations on a known vendace spawning ground, and by the deployment of a high sampling effort of customised gill nets in deep water. In addition, a secondary objective was to develop bottom-typing and macrophyte analyses of hydroacoustic recordings recently made on vendace spawning grounds in order to improve the assessment of their ecological conditions using this rapidly developing technique.

CHAPTER 2 UNDERWATER OBSERVATIONS ON VENDACE SPAWNING GROUNDS

A SeaViewer Underwater Video System with colour and infra-red cameras and integral lights (SeaViewer Cameras, Inc., Tampa, U.S.A., www.seaviewer.com) mounted to a static platform and recording digitally to an ARCHOS 604 Portable Multimedia Player (ARCHOS, Igny, France, www.archos.com) was used as the primary method of underwater observation (Fig. 1). This system was deployed on a known vendace spawning ground near Beck Wythop in Bassenthwaite Lake on the evenings of 22 November, 6 December and 12 December 2007, and for comparative purposes on a known vendace spawning ground near Calf Close Bay in Derwent Water on 11 December 2007. No vendace were observed at either site, although large numbers of ruffe (*Gymnocephalus cernuus*) were observed at Bassenthwaite Lake (Fig. 2).

In addition, a high-frequency hydroacoustics DIDSON system (Sound Metrics Corp., Washington, U.S.A., www.soundmetrics.com (see Moursunda *et al.* (2003)) owned and operated by the Environment Agency was also deployed during the underwater video observations of 6 December at Bassenthwaite Lake. Although recordings have yet to be reviewed in detail, it is clear that this system also did not record any vendace.

In summary, underwater video and high-frequency hydroacoustics observations over three evenings on a known vendace spawning ground in Bassenthwaite Lake failed to produce any sightings of this species. Although disappointing, this finding does not itself constitute definitive evidence of the local extinction of vendace as evidenced by its failure to record

specimens in Derwent Water, where the population is known to persist (Winfield *et al.*, 2007a).

CHAPTER 3 CUSTOMISED GILL NETTING IN DEEP WATER

Other than arranging the construction and delivery of the customised gill nets from a scientific supplier (Lundgrens Fiskredskap, Stockholm, Sweden, www.lundgrensfiske.com), no activity was undertaken in this area during the present reporting period.

CHAPTER 4 ECOLOGICAL CONDITIONS OF VENDACE SPAWNING GROUNDS

Hydroacoustics recordings made on vendace spawning grounds in Bassenthwaite Lake and Derwent Water during April 2007 by Winfield *et al.* (2007b) were explored during October 2007 with the developers (BioSonics Inc, Seattle, U.S.A., www.biosonicsinc.com) of the analytical softwares VBT and EcoSAV, which are appropriate for bottom typing and macrophyte mapping, respectively. It appears that the collection of further ground-truthing data is likely to be necessary to complete the bottom typing of the recorded survey data, which may not be possible within the resources of the present project.

In addition, during December 2007 discussions and data explorations in this general field were also held with the developers (Lindem Data Acquisition, Oslo, Norway, www.fys.uio.no/~hbalk/sonar4_5) of the analytical software Sonar5-Pro. Although this software was initially developed for the analysis of hydroacoustics data for fish, it now also contains a macrophyte analysis module and may be further developed in the near future for bottom-typing analyses of the kind required within the present study.

CHAPTER 5 RESEARCH PLANNED FOR NEXT REPORTING PERIOD

6.1 Underwater observations on vendace spawning grounds

Examination and analyses of underwater video and high-frequency hydroacoustics recordings made at Bassenthwaite Lake and Derwent Water during November and December 2007 will be completed.

6.2 Customised gill netting in deep water

Customised gill nets with a range of mesh sizes appropriate to adult vendace will be set at a series of deepwater sites in Bassenthwaite Lake at a sampling effort much greater than that of the current monitoring programme described by Winfield *et al.* (2007a). By appropriate net location and the careful selection of a restricted range of mesh sizes, by-catches of other species such as brown trout (*Salmo trutta*), perch (*Perca fluviatilis*), pike (*Esox lucius*), roach (*Rutilus rutilus*) and ruffe will be minimised. Netting will be continued through the project as resources and opportunities allow, but will be stopped if and when it has been established that a vendace population is still present in the lake. Any such specimens will be photographed and basic biological features measured following Winfield *et al.* (*op. cit.*), together with the preservation of a fin clip for potential genetic examination. Field work is currently planned to begin in the week of 11 February 2008.

In addition to the above direct search for vendace, evidence for their continued presence in the lake will also be sought by the examination of samples of ruffe taken during the same sampling for the presence of vendace eggs in their diet.

6.3 Ecological conditions of vendace spawning grounds

Bottom-typing and macrophyte analyses of the hydroacoustic recordings from Bassenthwaite Lake and Derwent Water will be continued as far as possible within the resources of the present project.

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Fig. 1. The SeaViewer Underwater Video System with colour and infra-red cameras and integral lights mounted to a static platform as used as the primary method of underwater observation on vendace spawning grounds in Bassenthwaite Lake and Derwent Water.

Fig. 2. Representative images taken from the underwater video recording on the vendace spawning ground near Beck Wythop in Bassenthwaite Lake on 22 November 2007 showing a ruffe approaching (upper image, visible as a pair of bright eyes) and then turning to the left (lower image, visible as a single bright eye and side of body). Note that time and date are given as Greenwich Mean Time and month-day-year format, respectively.