

Final Report

**Programme 13: North Sea Whiting
Stomach Contents**

Prepared by:

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FISHERIES SCIENCE PARTNERSHIP: FSP (2006-7) (13) NORTH SEA WHITING STOMACH CONTENTS

Summary

A Fisheries Science Partnership survey was carried out in August and October 2006. The survey investigated stomach contents of whiting off the northeast coast of England and the southeast coast of Scotland, in particular the predation of whiting on juvenile cod was to be investigated. The trawler FV *Nimrod* was chartered to catch the whiting for stomach contents evaluation.

The amount of whiting caught varied considerably over the surveyed area, from >230 stone (>1500kg) of whiting to just four fish (<5kg) in an hour long haul. Commonly fished whiting grounds over soft sediment produced the biggest catches. Most whiting stomachs were empty ($\geq 50\%$). Where stomachs were not empty, the main contents were small crustaceans in August and fish in October. Fish consumed were often non-commercial prey species such as pipefish or hagfish, although gadoids and clupeoids were also consumed. Just 45 gadoids were found in whiting stomachs out of a total of more than 2,500 prey items, these were identified as whiting or poor cod. No cod were found in whiting stomachs, and this finding was likely to be influenced by the very low numbers of cod and codling in the surveyed area. The estimate of cod availability was judged from the catch composition, including catches where a shrimp mesh liner was fitted and thus any small cod would have been retained.

The data show changes from the 1981 and 1991 ICES 'year of the stomach' sampling exercises, when far more sandeel and clupeoids and far less crustaceans were consumed. However, catches of whiting in the Dogger Bank region, obtained from recent scientific surveys at comparable times of year, showed similar diet composition to the current survey. Changes in the distribution and abundance of both predators and prey since previous large-scale sampling programmes are the most likely reason for the differences in stomach contents.



Figure 1. Painting of the Nimrod

Introduction

The Fisheries Science Partnership (FSP) was established in 2003 to build relationships between fishermen and scientists, and to involve fishermen in the co-commissioning of science. The FSP is funded by the UK's Department for Environment, Food and Rural Affairs (Defra). Reports for FSP projects already completed are available on the FSP page of the Cefas web site (www.cef.co.uk).

Most projects in the FSP are a mixture of time-series surveys, fishing gear selectivity studies, and examinations of spatial patterns of catch compositions. This project, however, was designed explicitly as a 'one-off' project to investigate potential predation by whiting on recovering fish stocks, in particular cod. The issue has been important historically (see Horwood *et al.* 2006 for an overview) and recently has been raised again, due to large coastal whiting populations and good recruitment of juvenile cod off the coast of northeast England in 2005 (Armstrong *et al.* 2006).

The report details two cruises in summer and autumn 2006. The diet was investigated by looking at the stomach contents of the fish. This project, FSP 2006/2007 Programme 13, was conducted on board the commercial trawler FV *Nimrod* (Skipper David Handyside) between 21 August and 27 August and between 9 October and 16 October inclusive.

Objectives

The main objective of the project was to determine the recent diet of whiting off the coast of northeast England and southeast Scotland by investigation of their stomach contents. The data were also to be compared with historical stomach data sets from 15 and 25 years ago, as well as data from more recent, but more localised, scientific surveys, to identify potential changes in diet composition.

A detailed operation plan was discussed throughout July and August by correspondence and at a final meeting on 20 August 2006 between Cefas and David Handyside. The operational plan is given in Appendix 1.

Cruise narratives prepared by Cefas seagoing staff are reproduced in Appendix 2.

Methods

Vessel and trawl gear

FV *Nimrod* BH-227 is a wooden trawler of overall length 16.5m. The vessel deployed an otter trawl similar to a Whitby jet trawl (Figure 2). This was used to fish over both soft and hard substrata as required in the survey. Two nets were used during the survey, one with an 80mm codend and the other fitted with a 40mm shrimp mesh liner.

Both nets were fitted with 40' (12.2m) of 14" (355mm) hoppers and were spread by a set of No.8 Bison trawl doors. The nets had a headline height of 14' - 18' (4.3 - 5.5m). The bridle length was 25 fathom (45.7m) splits and 10 fathom (18.3m) single.

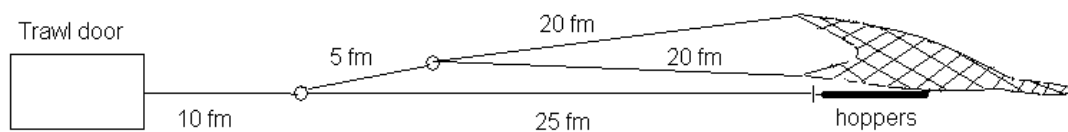


Figure 2. Diagram of the fishing gear used, adapted from a drawing by the skipper. Distances measured in fathoms (1 fathom = 1.83m).

Survey area

Fishing for the August survey was undertaken within British Fishery Limits in the North Sea between longitudes 2° W and 2° E, and bounded in the north by approx. 56.5° N and in the south by 53.5° N in ICES rectangles 36F0, 37E9, 37F0, 37F1, 38E9, 38F0, 38F1, 39E8, 39E9, 39F0, 40E8, 40E9, 41E8 and 41E9 (Figure 3). During the August survey, and in consultation with Cefas staff, an additional rectangle 38E8 was sampled once. This area was known to be a good fishing ground for whiting.

For the October survey a change to the locations surveyed was made to include two hour-long hauls in ICES rectangle 38E8 and to exclude all hauls from 39F0. This change was based on whiting catches during the first survey, which were high in 38E8 and low in 39F0.

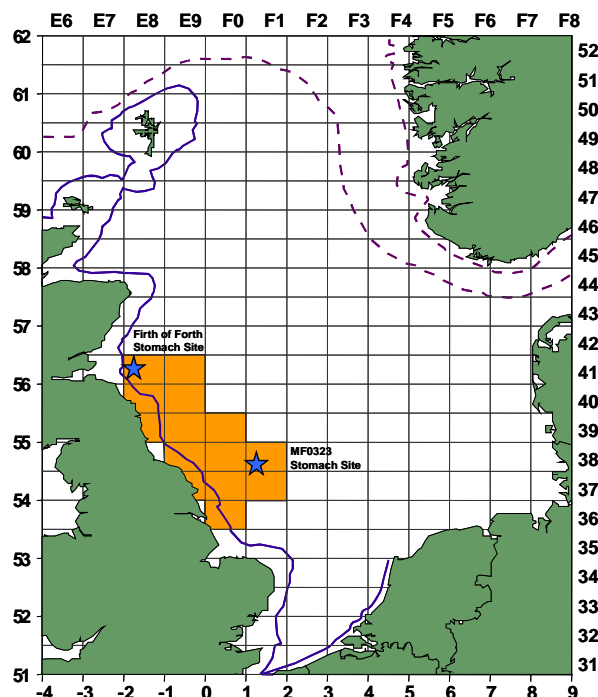


Figure 3. The sampled area marked in ICES rectangles for the August survey. Blue stars indicate the position of current or recent sites where stomach data on whiting have been collected.

Survey design

Fishing was conducted in order to sample whiting representatively from the area of interest (shown in Figure 3).

1. The sampling took the form of tows of 1h duration. Multiple short tows as opposed to fewer long tows are desirable for stomach content evaluation as the statistical power of the data analysis is improved.
2. Two 1h tows were undertaken within the ICES rectangle (shown in Figure 3).
3. The start and end positions of the tow were decided by the skipper, as long as all other requirements detailed in section “Survey area” were met.



Figure 4. A large haul of fish caught during the August cruise.

Processing of catch and stomach sampling

A length distribution was obtained by measuring a representative number of whiting from each haul. Normally this was the lengths of one basket of fish with a raising factor according to the number of baskets, but due to small catches in some hauls, all fish were measured. The catch of whiting was sorted into length categories 15 – 19cm, 20 – 24cm, 25 – 29cm, 30 – 34cm and 35+cm. Stomachs were opened and

non-empty stomachs were placed into freezer bags and frozen for subsequent analysis in the laboratory. This continued until 10 fish from each size category were collected or until no fish remained in the appropriate size category. Any remaining whiting in the sub-samples were examined onboard and stomach contents were marked on a simple tick sheet (Appendix 3). This allowed an initial idea of what was present in the stomachs of whiting as well as allowing a large number of samples to be processed.

Results

Position of hauls

The start positions of each of the hauls are shown in Figure 5. Hauls were predominantly in a straight line for a duration of approximately 1h. The speed of trawling was ~ 3.5 knots.

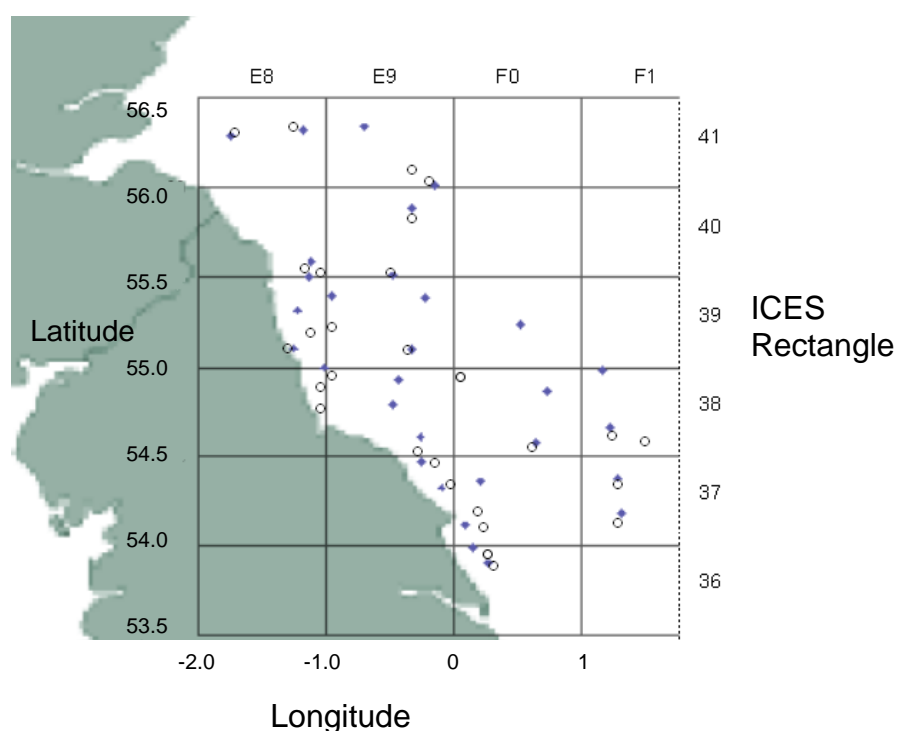


Figure 5. The start positions of the August (blue diamonds) and October hauls (circles).

Abundance of whiting measured as CPUE / catch in one hour

The abundance of whiting in the coastal areas of the North Sea sampled in this survey was very patchy, particularly in the August survey. In hour-long hauls, the amount of whiting caught varied from just 4 fish to >230 stone of fish (1500kg) (Figure 6, data available in Appendix 4). The mean catch per hour long haul was higher in August (32.3 stone, 203kg) than in October (23.6 stone, 150kg), but was considerably more variable (standard deviations of weight in stone 21.0 and 49.0 for August and October, respectively).

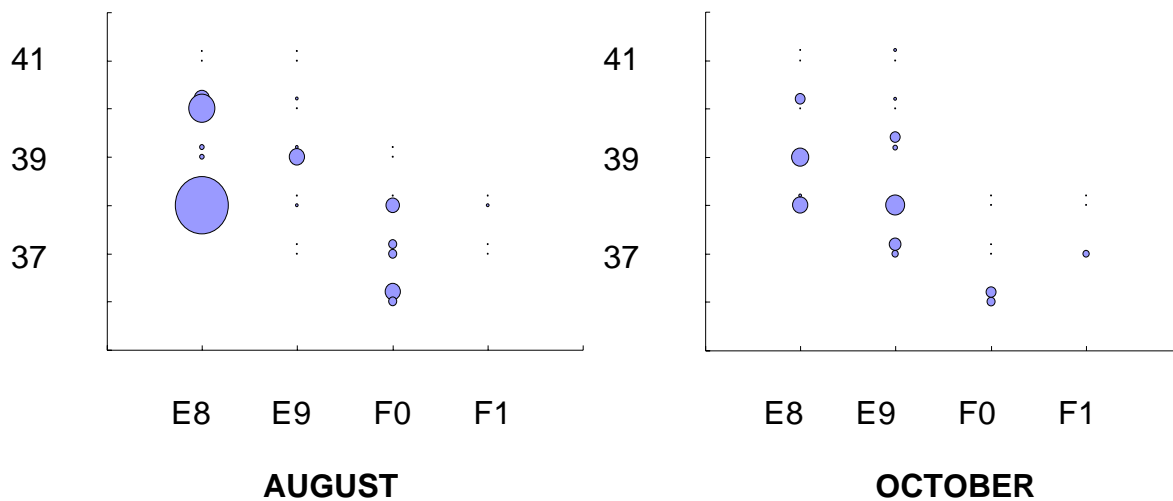


Figure 6. The catch of whiting from the different hauls. Width of the circle represents weight of whiting in haul. For reference, rectangle 38F1 in August survey <1 stone (5kg), rectangle 38E8 in August survey = 238 stone (1500kg). Numerical data are given in Appendix 4.

Whiting length distribution

Length distributions were similar between the August and October cruises, but with differences in the relative abundance of small fish. Small whiting were scarce in August, with few individuals in the 15-20cm category being present in the hauls to allow sampling of their stomach contents (Figure 7). Although this size category was also absent from many of the hauls taken in the October survey, at some haul locations whiting were present in the 15-20 cm category and in some hauls whiting <15cm were caught. Whiting catches were dominated by fish of 21 – 35cm in both cruises (Figure 7).

Initial, onboard analysis of diet

In both August and October cruises most stomachs sampled were either empty or contained small crustaceans (e.g. shrimp, euphausiids, mysids). Only a small number of stomachs (<10% in both surveys) contained any fish (Table 1). Squid formed a significant part of the ‘other’ category, being common prey items in both surveys, but were more prevalent in October.

The stomachs each given haul were either predominantly empty, or contained a large number of crustaceans, although in some hauls from October an approximately equal number of stomachs either contained crustaceans or were empty. This split in stomach contents seemed to reflect the substrate type the fish were caught over, particularly in August. Whiting caught over soft sediment had stomach contents of mainly shrimp or euphausiids, those caught over hard ground were largely empty. A few soft sediment sites also resulted in predominantly empty stomachs (Figure 8). It was noted by the scientist on board and the crew that the fish caught over areas of hard ground with empty stomachs during the August survey were very thin and of poor condition. Furthermore the livers of the fish were frequently black and contained many parasites.

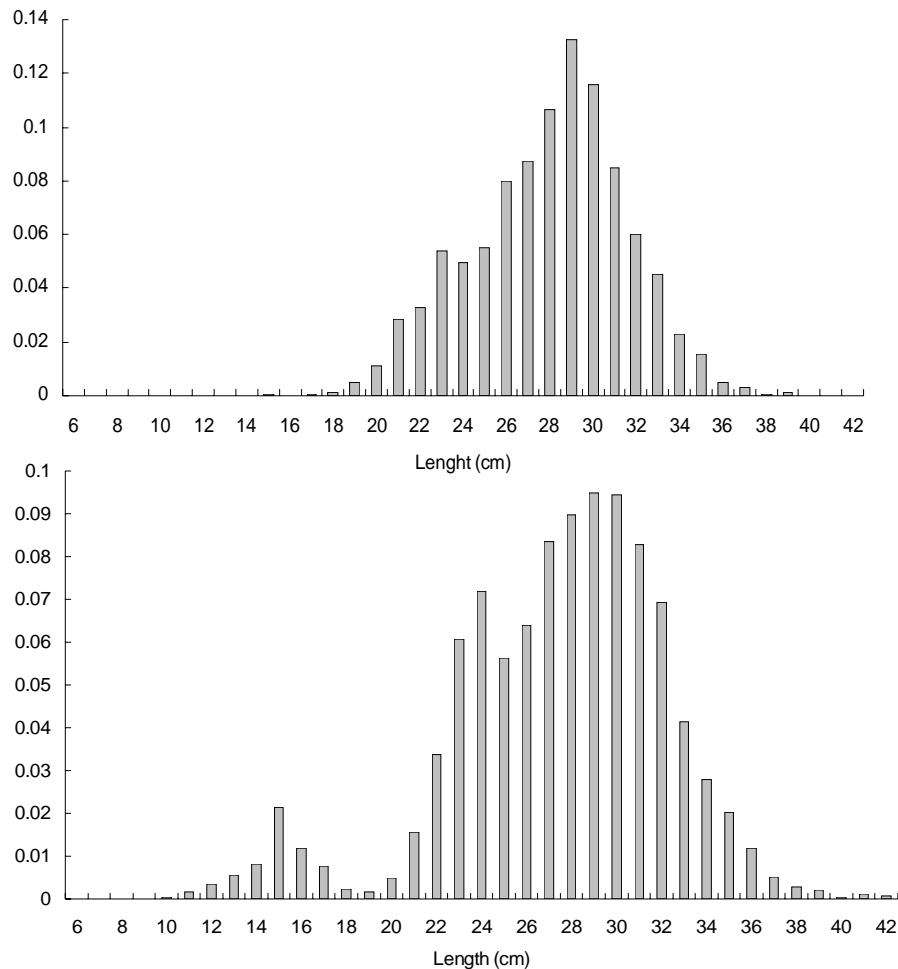


Figure 7. Length distributions of whiting in August (top) and October (bottom) catches. Y-axis indicates the proportion of the total catch at the given size.

Table 1. The diet of whiting from onboard analysis of stomach contents. A total of 634 stomachs was analysed onboard in the August survey and 782 in the October survey. Scientists onboard report that squid form a significant part of the 'other' component of the diet, particularly in the October cruise. Shrimp-like crustaceans (mostly euphausiids and mysids) were the main 'crustacean' component. *5% of stomachs in both surveys were thought to have been regurgitated, these figures are included in the empty category.

Stomach contents	% of stomachs containing specified food type	
	August	October
Empty*	61	50
Fish	3	7
Crustacean	31	33
Worm	0	2
Other	5	8

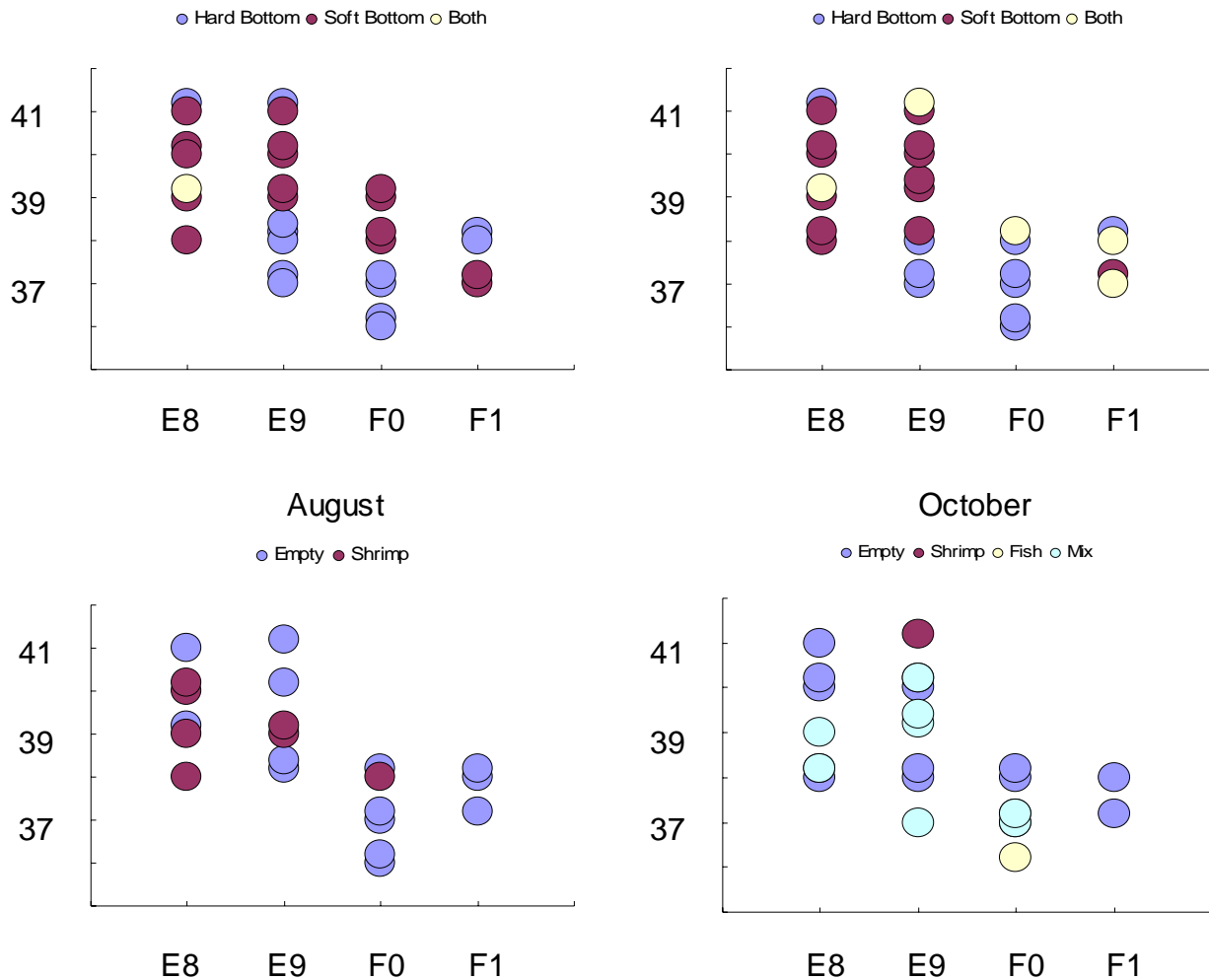


Figure 8. An indication of the number of whiting feeding on shrimp-like crustaceans or not feeding at all (empty stomachs) based on onboard analysis of stomach contents. In the August survey a strong association between substratum type and stomach contents was found, shrimp being found in stomachs of whiting caught over soft ground and empty stomachs over hard ground. The pattern is less evident in the October survey. Note that not every sample site has stomach contents data; if insufficient fish were caught, all fish were kept for laboratory analysis.

Detailed diet composition

Unlike the onboard analysis, the detailed stomach analysis showed seasonal differences in the diet of whiting (Figure 9). This difference between the data sets largely represents differences in the processing of samples, since the detailed analysis was performed by weight of prey and the onboard analysis simply by presence or absence.

In August fish constituted <50% of the diet of whiting by weight, and considerably less by number of prey items consumed (284 out of 1273 prey items or 22%). Crustaceans were the main component of the diet, with euphausiids dominating the diet of fish caught over soft substrata and crabs over hard substrata. Pipefish formed a large part of the diet of whiting over hard substrata, which has coincided with large increases in their availability over recent years (NERC, 2006; Kirby *et al.*, 2006).

During the October cruise whiting fed more on fish, although crustaceans still formed a significant part of the diet (18% by weight). Gadoids made up 11% of the diet by weight of prey. Gadoids were significantly heavier than small crustaceans. The 11% by weight was made up of a total of 34 gadoids, out of a total of 1297 prey items in the October survey. Hagfish, which like pipefish are not considered a common prey item for whiting, were also found in large quantities in stomachs of whiting over soft sediment.

No cod were found in the whiting stomachs in either survey, all gadoids being identified to species level using otoliths where these were present.

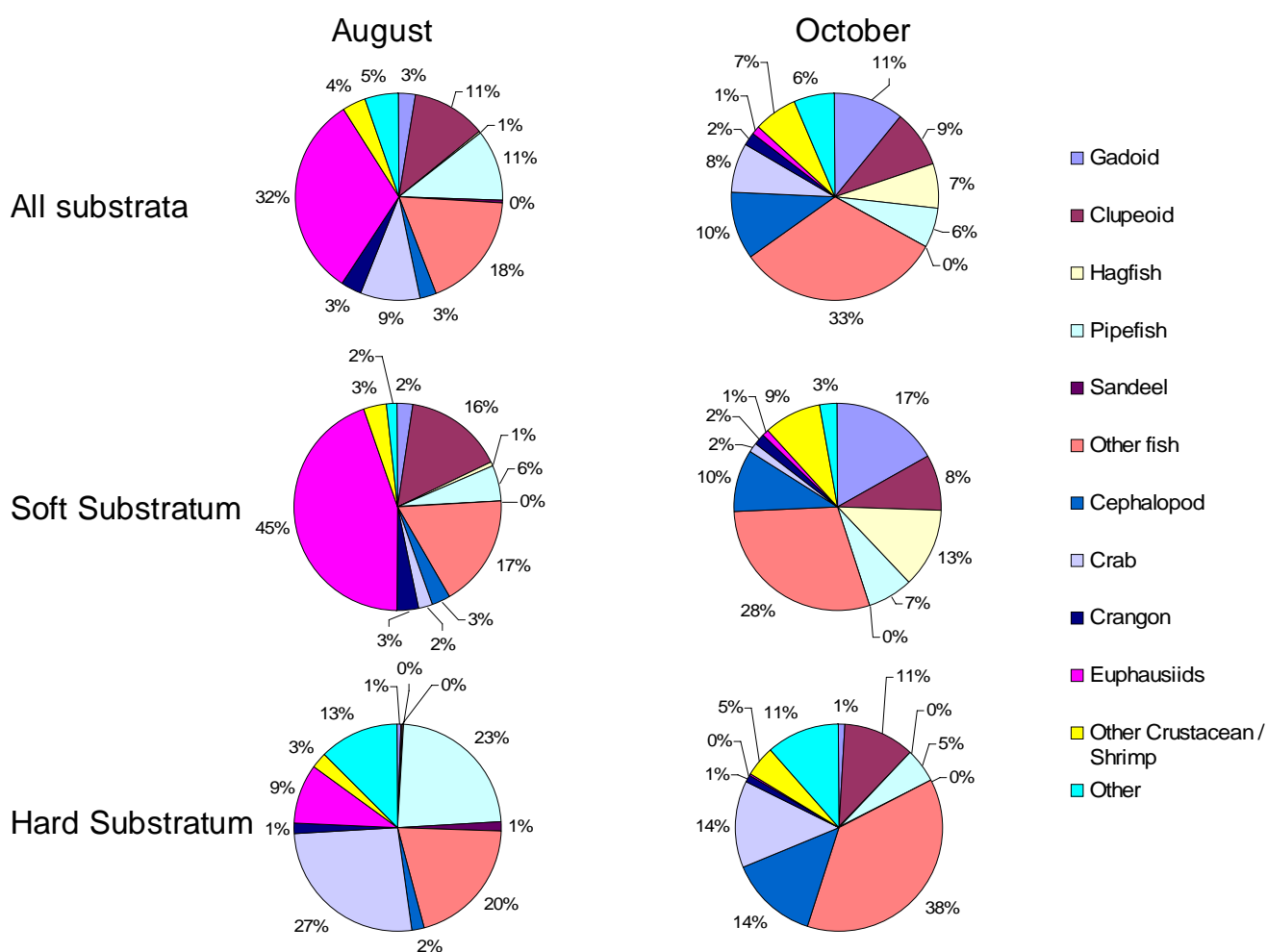


Figure 9. The percentage of stomach contents in different prey categories by weight from the two cruises. Data are also broken down by substratum type (mixed bottom types within hauls are excluded from these analyses).

Comparison with Year of the Stomach data

The diet of whiting from the year of the stomach data (Quarter 3 in 1981 and Quarters 3 and 4 in 1991) were analysed for the ICES rectangles sampled in this study (Daan, 1989; Hislop *et al.*, 1997). A considerable difference in the diet of whiting, especially with regard to fish prey, can be observed (Figure 10). The dominant fish in the diet in 1981 and 1991 (herring, sprat and sandeel) were found in the diets of whiting in the

current survey, but in far lower numbers. Norway pout were not found in any whiting stomachs in the current survey. This may largely be an effect of the number of prey available. Sandeels, in particular, are currently at low levels in the North Sea (STECF, 2006). The present October survey was conducted at the start of Q4, and Norway pout should be more common in these more southerly areas of their distribution later in the year. A large percentage of the fish component of the whiting diet in the current survey consisted of pipefish, which have become increasingly abundant in recent years.

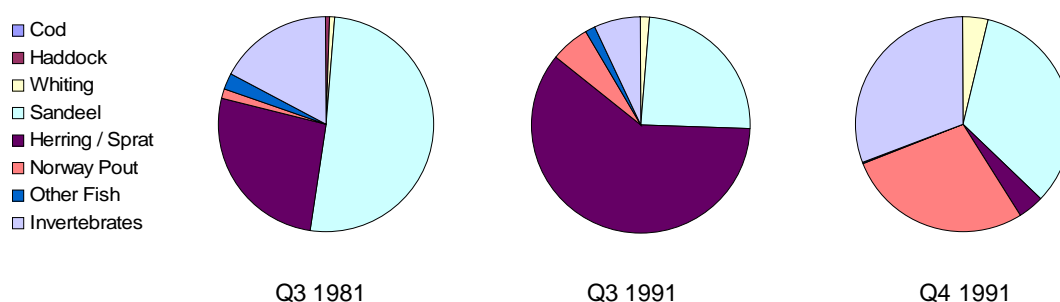


Figure 10. Diet composition of whiting in ICES 'year of the stomach' surveys for the ICES rectangles investigated in this study.

Comparison with recent data from the Dogger Bank and the Firth of Forth

Catches of whiting on the Dogger Bank and in the Firth of Forth were low on both cruises under this FSP survey (Figure 6), and stomachs of whiting were largely empty in these rectangles (Figure 8). Although so few data are available for direct comparisons of stomach analysis in these rectangles between the current surveys and those conducted over the past few years aboard scientific research vessels, comparisons can be made between the current survey as a whole and these spatially smaller-scale, but more intensive, stomach surveys.

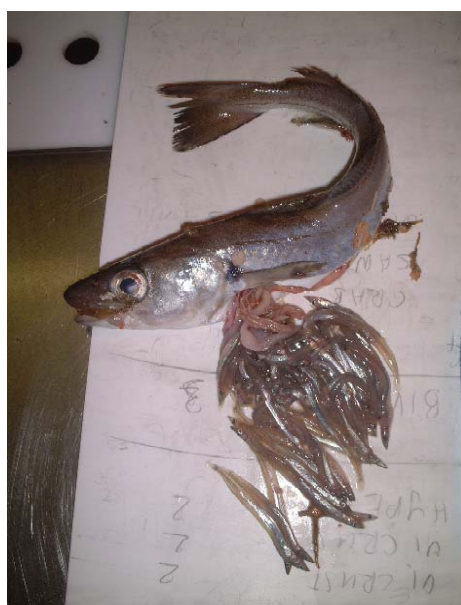


Figure 11. Sandeel in the opened stomach of a whiting from the Dogger Bank (ICES rectangle 38F1).

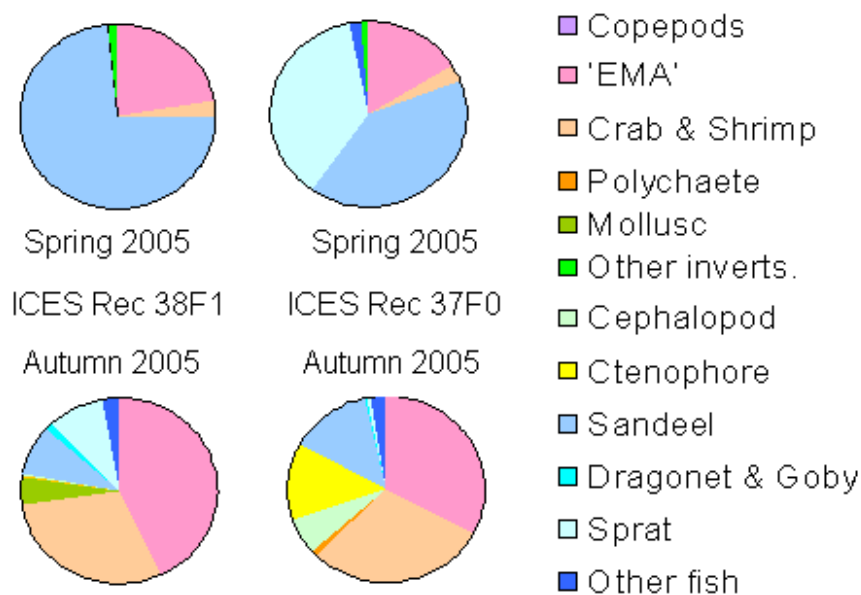


Figure 12. Diet of whiting from two surveys on the Dogger Bank in 2005. Percentage is of number of prey items in stomach. 'EMA' refers collectively to Euphausiids, Mysids and Amphipods. Figure adapted from Pinnegar et al. (2006).

At survey sites on and near the Dogger Bank (ICES rectangles 38F1 and 37F0), whiting consumed large quantities of fish, particularly sandeel, in spring (May, 2005) (Figure 12). In the autumn cruise, which took place in October 2005 and is more comparable with the current survey, large numbers of crustaceans were consumed, particularly pelagic crustaceans such as mysids, amphipods and euphausiids. Fish formed a small part of the diet (15 - 25%) which is broadly comparable with the onboard analysis in the current survey, or the detailed analysis in the current survey if the number of prey items rather than prey weight is considered (see above). These surveys on the Dogger Bank also highlight 2006 as a poor year for whiting abundance in this region compared with 2004 and 2005.

Data from the Firth of Forth was collected annually between late May and early July (Greenstreet *et al.*, 2005). Around 90% of the diet of whiting in the Firth of Forth between 1997 and 2003 consisted of fish, the vast majority of which was sandeel (70 – 80% of the diet of whiting). These results differ significantly from the current survey, but coincide with the high abundances of sandeel that occur during this season. For example, the diet of whiting in spring in ICES rectangle 38F1 also shows a high proportion of sandeel in the diet of whiting (Figure 12). Sandeels bury themselves in the sediment during autumn and winter and are therefore much less available to predators such as whiting which target them in the water column.

Discussion

This FSP survey provided details on the distribution of whiting and their diet off the northeast coast of England and the southeast coast of Scotland. The distribution of whiting was very patchy in this area, with some large catches, and some very poor catches.

The diet of fish caught during the August cruise was determined largely by the sediment type over which the fish were caught, small crustaceans dominating the diet of fish caught over soft sediment. Fish caught on hard substrata appeared to eat very little, and many of these fish were very thin and of poor quality. The diet of whiting caught during the October cruise did show some association with sediment type over which they were caught, but not as strongly as in the August cruise.

Very little predation on 'traditional' prey species such as clupeoids, sandeels and Norway pout occurred in contrast to surveys in this area in 1981 and 1991. No cod were found in the stomachs of whiting and just 45 gadoids were found in the stomachs of all the whiting sampled.

The high proportion of empty stomachs of whiting over hard substrata, particularly during the August survey, may indicate a scarcity of suitable food. Whiting are known to be opportunistic predators (Daan *et al.*, 1990) and are likely to consume a wide variety of items that they come across. In this study, pipefish formed a large component of the fish consumed (11% in August and 7% in October, and 23% of the diet over hard substrata in August) suggesting a lack of availability of other fish on which to feed. A lack of food may indicate potentially serious problems in the hard-bottomed marine communities in the North Sea. Further work in this area should be prioritised as it has implications for both cod recovery, as cod largely consume a similar range of prey to whiting, and the entire North Sea ecosystem.

No cod were consumed by whiting during this survey, but there was very little predation on cod by whiting in the ICES 'year of the stomach' surveys (~2% of the diet over the entire North Sea). In the area covered by the current survey only 0.1% of the diet was cod in 1981 and no cod were found in whiting stomachs in this area in 1991. The lack of predation by whiting on cod in this FSP survey may have been, at least in part, due to the scarcity of suitable prey. Cod of suitable size for whiting to eat were not found in large numbers in any of the catches, so were unlikely to make up a large proportion of the diet. This result has also been confirmed by the FSP north east cod survey for 2006, which shows less juvenile cod (<20cm) present than in 2005 (Armstrong *et al.*, 2007). Whiting of potential prey size, however, were found in the catches, particularly during the October trip, and were found in the stomachs of the whiting caught during these surveys.

The consumption of fish by predatory fish is an important component of marine food webs (Daan *et al.*, 1990), and needs to be accounted for when considering fish stocks, particularly recovering fish stocks, where ecological interactions may prevent stocks from recovering. Whiting are at an historically low level in the North Sea (ICES, 2006), but a large sub-population has been thought to exist off the northeast coast of

England (Armstrong et al., 2006). This survey suggests that the distribution of whiting off the northeast coast of England is, in fact, highly patchy, and in conjunction with further Northeast Cod FSP surveys will help understand distribution of whiting in the area. Given the apparent patchiness of the distribution, and the generally low levels of whiting throughout the North Sea, it is unlikely that the current population levels of whiting will have a big effect on cod recovery unless spatial overlap between areas of high juvenile cod abundance and high whiting abundance occur.

Acknowledgements

The authors of this report gratefully acknowledge the help and dedication of the skipper and crew of the Nimrod, without whose cooperation this project would not have been possible. John Dann is thanked for his input and advice in the project and management of seagoing staff time. Ewen Bell, Mike Armstrong, Dave Righton and Andy Payne are thanked for advice in setting up the project and devising a sampling programme and workable methodology. Lauren Clancy, Bill Mulligan and Sarah Pitcher are thanked for their time in processing and inputting data.

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Appendix 1. Detailed operations plan

THE CENTRE FOR ENVIRONMENT, FISHERIES AND AQUACULTURE SCIENCE

LOWESTOFT LABORATORY, SUFFOLK, NR33 0HT, ENGLAND

FISHERIES SCIENCE PARTNERSHIP 2006 PROGRAMME 13: North Sea Whiting

Detailed Operational Plan

The Detailed Operation Plan conforms with the details in the Tender and Contract.

Aims

1. The survey aims to address specific concerns on the predation of juvenile cod by whiting. The data collected in the survey will indicate if there are significant shifts in the diet of whiting, both in time, since the last North Sea wide stomach data was collected, and in space, by sampling in coastal areas, as well as in non-coastal areas where other recent data is available.

Vessel

The vessel will be Nimrod BH 227, Skipper: David Handyside

Cefas Observer

Cefas observer on the 21st August trip will be Randolph Velterop. The observer on the October trip is yet to be confirmed.

Duration

The vessel will fish in the designated area for a maximum of eight days in August and nine days in October.

Departure date for first trip: 21st August 2006.

Survey Area

Fishing will be undertaken within British Fishery Limits in the North Sea between longitudes 2°W and 2° E, and bounded in the north by approx. 56° N and in the south by 52° N in the ICES rectangles 36F0, 37E9, 37F0, 37F1, 38E9, 38F0, 38F1, 39E8, 39E9, 39F0, 40E8, 40E9, 41E8 and 41E9 (see attached Figure 1). Fishing will be conducted in a way, which samples across the entire area specified, within the British Fishery Limits and to the agreed Operations Plan.

Fishing Gear

The fishing gear must be an otter trawl (such as, but not restricted to, a Whitby jet trawl) fitted with 80mm mesh cod-end and rockhopper gear. The exact specification of the gear is left to the discretion of the skipper, but must not differ from that specified in the tender application. The gear should be identical for both cruises and the skipper must note the details of the gear (see below).

If required by the observer a shrimp-mesh liner must be available to be fitted inside the cod-end.

Deep freeze facilities of greater than or equal to 200 litres must be available on board the boat.

Survey design

Fishing will be conducted in a way that samples whiting representatively from the area of interest (shown in Figure 1).

4. The sampling will take the form of 1 hour duration tows.
5. Two, one hour long tows will be undertaken which both start and end in each of the ICES rectangles mentioned above and shown in Figure 1.
6. The start and end positions of the tow are at the discretion of the skipper, as long as all other requirements as detailed in section “Survey Area” are met. Time between tows for the required sampling work must also be allowed.

Working pattern

- Tow duration: Approximately 1 hour.
- The survey will take place during day or night as required.
- The total working time for the observer on deck will be 12 – 14 hours per day, and the observer must have a sufficient period of sleep (minimum 6 hours per day).
- All tows will form part of the survey and must be sampled by the observer as per the sampling requirements. No commercial fishing will take place outside of the survey.

Instructions for observers

- Carry out a length measure on representative samples of the catches of whiting. Ensure that the raising factors for the length frequencies are recorded and the method is clearly described.
- Collect stomachs of 10 whiting from each of the size categories below, replace any empty stomach samples with full stomachs.

15 – 19 cm
20 – 24 cm
25 – 29 cm
30 – 34 cm
35 + cm

- For each stomach collected, or each empty stomach the station number and length of the fish should be recorded. Station number and fish ID number should be recorded on the bags of stomach contents.
- Additional stomachs from a broad size range of whiting should be opened on deck. Contents of the stomachs as well as length of fish should be recorded on the supplied tick charts. Stomach contents which include cod should be retained, bagged and labelled.
- John Dann to be contacted daily if possible for progress update and to resolve any operational or sampling difficulties.
- A written cruise report must be provided immediately after the survey. This should be read and agreed by the skipper (report should say “seen in draft by skipper”).

Instructions for skipper

- Record gear details and parameters at each station.
- Record times and positions of tows, including position at any significant change in towing direction. Provide these details to the observer as requested.
- Record details of tide, weather, speed over ground.
- The stomach sampling involves a lot of work on the deck, and a dedicated crew member is required to assist the accompanying Cefas scientist.

Contacts and procedures.

John Dann should be informed when you sail and dock, by phone (work: 01502 524544, mobile: 07770 742247)

John Dann or Richard Stafford to be contacted by phone at intervals to record progress and problems encountered. (RS: work 01502 524374)

Nimrod: - Mobile No for boat 07740 604843

Randolph Velterop (observer) - Work 01392 264606

Signed

Richard Stafford (Cefas)

10/8/2006 (Date)

David Handyside (owner/skipper)

10/8/2006(Date)

Fig. 1. The shaded rectangles are the required sites in which 2 x one hour long hauls must be made in both the August and October surveys. n.b. Figure 1 of detailed operations plan removed. Identical to Figure 2 of this report.

Appendix 2. Cruise narratives and trip debriefing of scientists on board

MF017

FSP NORTH SEA WHITING STOMACH SURVEY.

Randolph Velterop

Trip code: FSP NS WHG *Gear:* OTTER TRAWL *Observer:* RANDOLPH VELTEROP

Date disembarked: 21/8/06 *Days aboard:* 6

Fishing grounds worked: 36F0, 37E9, 37F0, 37F1, 38E9, 38F0, 38F1, 39E8, 39E9, 39F0, 40E8, 40E9, 41E8, 41E9, (38E8)

Fishing success: estimated 968 stone (6147kg) of whiting caught of which 666 stone (4229kg) was retained.

Points of biological interest:

Prevalence of liver parasites / disease. Maybe look into for October survey (contact Steve Feist Weymouth). Could be linked to poor condition and lack of food?

Any full whiting generally found in deeper water over soft sediments where stomach contents usually contained shrimp.

Points of fishery interest:

Very little whiting seen offshore majority inshore with highest catch (total 238 stone, 1511kg) coming from stat rectangle 38E8.

Very little fish in shallower water especially Dogger Bank

Points of safety interest:

None

Other comments:

Views from skipper, crew or owner:

Whiting and haddock seem to be starving, very poor condition

Skipper generally only fishes area 38E8 for whiting as there has been a prevalence of them for the past 5 years. This rectangle had been left off the survey but after discussion with the skipper we conducted 1 tow in the area in order to demonstrate the quantities of whiting present and put forward a case for including tows in this area in the October survey.

The Nimrod sailed from Amble at 03:00 on the 21st August 2006 and steamed to a fishing area position in ICES rectangle 39E8. Fishing commenced at 05:39 in an easterly and then a southerly direction with the completion of 6 tows that day in 39E8, 39E9 and 38E9. Tows 5 and 6 in the latter rectangle produced very few stomach

samples so it was decided to conduct a 3rd tow in the same rectangle the following morning resulting in 6 stone of whiting and again little in the way of samples.

Working southward on Tuesday 22nd August a further 5 tows were completed without a further 5 tows were completed without complications in 37E9, 37F0, and 36F0. The latter 2 tows in 36F0 were conducted after contact with various local potting boats due to the high density of static gear off Flanborough Head. Hauls 11 (36F0) and 12 (37F0) saw a good run of 30 cm + fish. A total of 42 & 43 full stomachs were sampled with a lack of samples of smaller > 20 cm fish.

Haul 14 was conducted on 23rd August over softer ground and produced a good sample of full, small (> 20 cm) whiting. As predicted the two tows conducted on the Dogger Bank produced a small run of fish with a maximum of ¾ stone of whiting.

Working in a northerly direction 6 hauls were successfully completed on Thursday 24th August in Rectangles 38F1, 39F0 and 40E9. A further 5 hauls were carried out the following day in rectangles 40E9, 41E9 & 41E8. These included the Firth of Forth stomach site which produced very little in the way of samples (2 stomachs samples) and only 6 whiting.

Saturday 26th August saw the completion of 2 successful hauls in rectangles 40E8, the deeper water produced good hauls of whiting and excellent stomach sampled bar smaller (< 20 cm) whiting. Nimrod then steamed 4 hours south to undertake a final haul.

During the survey period 21st-26th August all tows were completed as planned with at least 2 tows conducted in every stated ICES rectangle. A total of 36 tows were successfully undertaken during this period.

I would like to acknowledge the efforts of Skipper David Handyside, and crew Steve Handyside, Jason Harris and Iean Clow, without who's hard work the survey would not have been possible.

CRUISE NARRATIVE.
MF017
FSP NORTH SEA WHITING STOMACH SURVEY.
Oliver Wade.

The MFV Nimrod sailed from Amble at 4:00 hours on the 9th October in a blustery force 5 SE. The forecast was giving poor weather from Wednesday onwards so in conjunction with the skipper it was decided to steam straight east doing a couple of tows along the way and get the furthest offshore rectangles out of the way before the weather turned for the worst. We used a shrimp liner in the net from the start to try to increase the number of small fish since this had been adopted in the previous survey

On Tuesday we found ourselves out in the eastern most rectangles and oddly the shallowest water we would be fishing in, here was the only place during the whole trip where we found any whiting of the 15-19cm length class in the 20 fathom depths. By Wednesday we were still fishing and the weather had taken a turn for the better rather than the worse and we were managing about 5 tows a day.

This fine weather continued into Thursday and the survey continued to go as planned and we landed into Blyth at 10 o'clock that night having completed 18 stations. By this stage several trends were becoming apparent which were confirmed by observations through the remaining 10 stations.

Firstly the complete absence of whiting in the 15-19 cm length class, even when on some hauls (haul17) we caught a good number of whiting smaller than this, and larger too, but still none of the required 15-19cm size. Secondly we were having to go through a disproportionately large number of fish to find enough with full stomachs to fulfil the requirements of the cruise, however many of those fish whose stomachs were empty had very elongated and stretched stomachs as if they had recently been full and possibly regurgitated their food? However this is a subject of conjecture since very little evidence of this was found. Finally a noticeable absence of Codling that according to crew and skipper have not been present all year, this was both in the catch and also in the Whittings' stomachs of which no cod were seen at all. The majority of the stomachs that were opened up contained either shrimp or squid, any that contained fish were predominantly sprat/herring and pipefish.

The Nimrod sailed again at 6:00 on 13th October and after a couple of tows close to shore we had a long steam to do the northern most rectangles. These grounds have never been ones where people go to catch whiting and as such this was reflected in the catch compositions. The majority of the tows were completed at night since this was when the skipper felt we had the best chance of catching any however the main component of the catches seemed to be small haddock. On the 14th October we moved into 41E9 and onto muddy soft ground where there were plenty of shrimps and this seems to have made up the majority of the Whittings' diet in this area.

The Nimrod landed into Amble on the 15th October at 14:30 with all 28 stations having been completed.

Appendix 3. On board stomach sampling data collection tick sheet

Fish ID	15-19	20-24	25-29	30-34	35+	Empty	Regurg	Cod	Sandeel	Sprat/Herring	Other Gadoid	Other Fish	Shrimp / prawn	Other Crust	Worm	Other
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																
11																
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24																
25																

Date:

Station Number:

Sheet number for this station:

Appendix 4. Tabulated catch data for each haul

Table A4.1 August Cruise

Station	Rectangle	Shot Latitude	Shot Longitude(E)	Substratum type	Total catch (Stone)	Total catch (kg)
1	39E8	55.10	-1.26	SOFT GROUND	28	178
2	39E8	55.31	-1.23	HARD & SOFT GROUND	25	159
3	39E9	55.40	-0.96	SOFT GROUND	72	457
4	39E9	55.10	-0.33	SOFT GROUND	19	121
5	38E9	54.93	-0.43	HARD GROUND	2	13
6	38E9	54.79	-0.49	HARD GROUND	18	114
7	38E9	54.61	-0.26	HARD GROUND	6	38
8	37E9	54.47	-0.26	HARD GROUND	1	6
9	37E9	54.33	-0.10	HARD GROUND	3	19
10	37F0	54.11	0.09	HARD GROUND	43	273
11	36F0	53.99	0.16	HARD GROUND	71	451
12	36F0	53.90	0.27	HARD GROUND	46	292
13	37F0	54.36	0.21	HARD GROUND	42	267
14	38F0	54.58	0.65	SOFT GROUND	67	425
15	38F0	54.66	1.22	HARD GROUND	2	13
16	37F1	54.38	1.29	SOFT GROUND	1	6
17	37F1	54.19	1.32	SOFT GROUND	5	32
18	38F1	54.98	1.17	HARD GROUND	19	121
19	38F0	54.86	0.72	SOFT GROUND	4	25
20	39F0	55.23	0.52	SOFT GROUND	6	38
21	39F0	55.38	-0.22	SOFT GROUND	5	32
22	40E9	55.51	-0.47	SOFT GROUND	10	64
23	40E9	55.89	-0.33	SOFT GROUND	17	108
24	41E9	56.02	-0.15	SOFT GROUND	7	44
25	41E9	56.34	-0.71	HARD GROUND	8	51
26	41E8	56.33	-1.19	SOFT GROUND	7	44
27	41E8	56.29	-1.75	HARD GROUND	1	6
28	40E8	55.50	-1.14	SOFT GROUND	73	464
29	40E8	55.59	-1.12	SOFT GROUND	124	787
30	38E8	54.99	-1.02	SOFT GROUND	238	1511

Table A4.2 October Cruise

Station	Rectangle	Shot Latitude	Shot Longitude(E)	Substratum type	Total catch (Stone)	Total catch (kg)
1	39E8	55.18	-1.10	SOFT GROUND	14	89
2	39E9	55.22	-0.89	SOFT GROUND	26	165
3	39E9	55.10	-0.34	SOFT GROUND	40	254
4	38F0	54.95	0.05	HARD GROUND	9	57
5	38F0	54.57	0.65	HARD & SOFT GROUND	11	70
6	38F1	54.57	1.65	HARD & SOFT GROUND	9	57
7	38F1	54.60	1.26	HARD GROUND	1	6
8	37F1	54.37	1.28	HARD & SOFT GROUND	27	171
9	37F1	54.18	1.32	HARD & SOFT GROUND	5	32
10	37F0	54.13	0.32	HARD GROUND	8	51
11	36F0	53.97	0.27	HARD GROUND	35	222
12	36F0	53.90	0.28	HARD GROUND	46	292
13	37F0	54.22	0.27	HARD GROUND	9	57
14	37E9	54.36	-0.05	HARD GROUND	32	203
15	37E9	54.48	-0.12	HARD GROUND	52	330
16	38E9	54.54	-0.32	HARD GROUND	4	25
17	38E8	54.75	-1.08	SOFT GROUND	60	381
18	38E8	54.91	-1.07	SOFT GROUND	19	121
19	39E8	55.12	-1.37	HARD & SOFT GROUND	67	425
20	38E9	54.95	-0.97	SOFT GROUND	76	483
21	40E9	55.50	-0.49	SOFT GROUND	6	38
22	40E9	55.87	-0.33	SOFT GROUND	19	121
23	41E9	56.02	-0.16	SOFT GROUND	11	70
24	41E9	56.11	-0.38	HARD & SOFT GROUND	17	108
25	41E8	56.30	-1.07	SOFT GROUND	5	32
26	41E8	56.29	-1.75	HARD GROUND	1	6
27	40E8	55.51	-1.03	SOFT GROUND	11	70
28	40E8	55.57	-1.12	SOFT GROUND	41	260

Appendix 5. Stomach data of laboratory analysed fish

The stomach data collected as part of this survey will be made publicly available in electronic format. Data on the location of the haul, bottom conditions, length of fish and stomach contents (including empty stomachs) will be available by mid 2007 at: <http://www.wdc-mare.org/data/>. Requests for data prior to this should be made to richard.stafford@cefas.co.uk