Cefas

Cefas contract report C2848

Radiological Habits Survey: Sellafield Review, 2012

2013

Environment Report RL 04a/13

Environment Agency

Food Standards Agency
food.gov.uk

Office for Nuclear Regulation
An agency of HSE

This page has been intentionally left blank

Environment Report RL 04a/13

Final report

Radiological Habits Survey: Sellafield Review, 2012

Aquatic pathways review

G.P. Papworth, F.J. Clyne, C.J. Garrod, V.E. Ly and A. Dewar

Peer reviewed by G.J. Hunt
Approved for publication by W.C. Camplin

2013

The work described in this report was carried out under contract to the Environment Agency, the Food Standards Agency and the Health and Safety Executive.
Cefas contract C2848
FSA Project PAU 198 / Lot 7 / ERI006

This report should be cited as: Papworth, G.P., Clyne, F.J., Garrod, C.J., Ly, V.E., and Dewar, A., 2013. Radiological Habits Survey: Sellafield Review, 2012. RL 04a/13. Cefas, Lowestoft

A copy can be obtained by downloading from the Cefas website: www.cefas.defra.gov.uk

CONTENTS

TABLES

ANNEXES

1. INTRODUCTION

The public may be exposed to radiation as a result of the operations at the Sellafield nuclear licensed site in Cumbria through the permitted discharges of liquid radioactive wastes into the Irish Sea. This report provides information on activities carried out locally by members of the public, which may influence their radiation exposure. The study has been funded by the Environment Agency, the Food Standards Agency and the Office for Nuclear Regulation in order to support their respective roles in protecting the public from the effects of radiation.

Full habits surveys (encompassing aquatic, terrestrial and direct radiation pathways) are generally undertaken in the vicinity of Sellafield every 5 years, the last of which was conducted by the Centre for Environment, Fisheries & Aquaculture Science (Cefas) in 2008 (Clyne *et al.*, 2009). Annual reviews, which specifically investigate the consumption of crustaceans and molluscs, and occupancy over intertidal substrates by members of the Sellafield Fishing Community, are usually conducted in the vicinity of Sellafield in years when a full habits survey is not undertaken. The fieldwork period for full surveys is longer than the fieldwork period for annual reviews so a greater number of people are interviewed during full surveys and larger data sets are obtained.

In 2012, a full habits survey was conducted in the vicinity of the Low Level Waste Repository (LLWR), which is located approximately 5 km to the south-east of the Sellafield site. Due to the close proximity of these sites, the aquatic survey areas are the same, and therefore, the data obtained for aquatic pathways during the 2012 LLWR survey have been used in this 2012 Sellafield review report. Data for the following aquatic pathways were obtained: the consumption of fish, crustaceans, molluscs, wildfowl and salt marsh grazed sheep meat; intertidal occupancy; handling of fishing gear and sediment.

Consumption, occupancy and handling rates for adults are used in radiological dose assessments for Sellafield, as reported in the Radioactivity in Food and the Environment (RIFE) series (for example, EA, FSA, NIEA and SEPA, 2012). When a full habits survey is conducted, the mean rates for the high-rate groups for aquatic foods, intertidal occupancy and handling obtained during the survey are used in aquatic dose assessments. During years when a review of only shellfish and intertidal occupancy is conducted, the mean rates for the high-rate groups for the consumption of crustaceans, molluscs, and for intertidal occupancy obtained during the survey and the mean rates for the high-rate groups for the consumption of fish and for handling from the previous full habits survey are used in aquatic dose assessments. The use of habits data in the total dose assessment of additive exposure for Sellafield is explained in Section 7.3.

In addition to the habits surveys undertaken in the vicinity of Sellafield, several of the higher rate consumers of shellfish keep a diary of their seafood consumption and intertidal occupancy for a two

week period every three months. These data can be used to check the validity of the interview data if extreme consumption rates are recorded. It was not necessary to use the diaries to check the validity of the interview data used in this report.

2. SURVEY AREA

The aquatic survey area, shown in Figure 1, extended from Parton to Tarn Bay. This included all intertidal areas and extended up to 11 km offshore.

Figure 1. The aquatic survey area

3. CONDUCT OF THE SURVEY

The data for this Sellafield review was obtained during the LLWR habits survey fieldwork, which was carried out from 14th to 24th August 2012, by a team of four people, according to techniques described by Leonard *et al.* (1982). During the fieldwork, individuals were interviewed and asked to estimate consumption rates, occupancy rates over intertidal areas, and handling rates of fishing gear and sediment relevant to the aquatic survey area, for themselves and members of their families. Information was obtained about the origins of the seafood being consumed and locations of intertidal occupancy and handling of fishing gear and sediment.

Data for aquatic pathways were obtained for 220 adults, 29 children and 13 infants.

4. METHODS OF DATA ANALYSIS

4.1 Data recording

Consumption, occupancy and handling data collected during interviews were recorded in logbooks. These data were examined and any notably high rates were double-checked, by means of a follow-up phone call or against the diary data provided by some interviewees. The raw data were entered into a purpose-built database where each individual for whom information was obtained was given a unique identifier (the observation number) to assist in maintaining data quality. The observation numbers used in this report are the same as those used in the 2012 LLWR habits survey report.

The consumption and occupancy data in the text of this report are rounded to two significant figures, except for values less than 1.0, which are rounded to one decimal place. This method of presentation reflects the authors' judgement on the accuracy of the methods used. In the tables and annexes, the consumption rate data are usually presented to one decimal place. Occasionally, this rounding process causes the computed values (row totals, mean rates and 97.5th percentiles), which are based on un-rounded data, to appear slightly erroneous. External exposure data are quoted as integer number of hours per year.

Data were structured into age groups because different dose coefficients (i.e. the factors which convert intakes of radioactivity into dose) can apply to different ages. The International Commission on Radiological Protection (ICRP) revised its recommendations for the age groupings to be used in radiological assessments and these recommendations were adopted in the 2010 habits survey reports. Consequently, the age ranges used in the habits survey reports prior to 2010 differ from those used currently.

The age ranges used in this report and the names used for the age groups, based on the recommendations in ICRP 101 (ICRP, 2007), are listed below, together with those used in reports prior to 2010, for comparison.

Age ranges used from 2010 onwards	
Name of age group[a]	**Age range in group**
Infant	0 to 5-year-old
Child	6-year-old to 15-year-old
Adult	16-year-old and over

Age ranges used in reports prior to 2010	
Name of age group	**Age range in group**
3-month-old	Under 1-year-old
1-year-old	1-year-old
5-year-old	2-year-old to 6-year-old
10-year-old	7-year-old to 11-year-old
15-year-old	12-year-old to 16-year-old
Adult	17-year-old and over

Notes

[a]In the 2010 reports only, the infant age group was called the 1-year-old age group and the child age group was called the 10-year-old age group.

Since there are fewer age groups for children in the current regime, there should, in general, be more observations in each group, resulting in greater robustness in the data. However, data for children since 2010 will not be directly comparable with data for children prior to 2010, since the age ranges in the age groups will be different.

4.2 Data analysis

The consumption, occupancy and handling rates obtained during the fieldwork are provided in Annex 1 for adults and in Annex 2 for children and infants. These can be used in radiological assessments of the effects of the discharges from the Sellafield site.

The consumption, occupancy and handling data have been analysed in three ways. Firstly, the 'cut-off' method described by Hunt *et al.* (1982) was used. With the 'cut-off' method, the appropriate high rate was calculated by taking the arithmetic mean of the values between the maximum observed rate and one third of the maximum observed rate. In this report, the term 'high-rate group' is used to represent the individuals derived by the 'cut-off' method. The mean of the high-rate group was calculated for each food group and occupancy over each intertidal substrate identified in the survey. Secondly, the 97.5th percentile rate was calculated for each group by using the *Microsoft Excel* mathematical function for calculating percentiles. The use of percentiles accords with precedents used in risk assessments of the safety of food consumption. It should be noted that the interviewees in this study are often selected and therefore the calculated percentiles are not based on random data. Thirdly, profiles have been produced that give a complete view of the habits of the individual that might lead to exposure to all the discharges and radiation from the site. The profiles are based on values calculated by the 'cut-off' method. The profiled data can be used to assess total dose, integrated across all pathways of exposure.

5. INTERNAL EXPOSURE

Consumption data for aquatic foods are presented in Tables 1 to 5 for adults and in Tables 6 to 9 for children and infants. The tables include the mean consumption rates for the high-rate groups and the observed 97.5th percentile rates calculated as described in Section 4.2.

5.1 Food consumption data

The people consuming the greatest quantities of foods from the aquatic survey area were commercial and hobby fishermen, anglers, shellfish collectors, bait diggers, wildfowlers and the families of these groups of people. It should be noted that not all of the consumers were catching fish or collecting shellfish. Table A presents a summary of the consumption rates of foods from the aquatic survey area for the adult, child and infant age groups. The table includes the mean consumption rates for the high-rate groups and the observed 97.5th percentile rates. No individuals in the infant age group were identified consuming crustaceans, molluscs or wildfowl and no individuals in the child and infant age groups were identified consuming salt marsh grazed sheep meat.

Table A. Summary of consumption rates of foods from the aquatic survey area

Food group	Number of observations	Number of individuals in the high-rate group	Observed maximum for the high-rate group (kg y^{-1})	Observed minimum for the high-rate group (kg y^{-1})	Observed mean for the high-rate group (kg y^{-1})	Observed 97.5th percentile (kg y^{-1})
Adults						
Fish	94	20	64.5	23.6	36.8	57.8
Crustaceans	62	16	53.0	17.7	29.3	48.2
Molluscs	27	4	12.8	4.4	9.1	12.2
Wildfowl	14	2	16.8	11.5	14.2	15.1
Salt marsh grazed sheep meat	6	6	1.9	1.9	1.9	1.9
Child age group (6 - 15 years old)						
Fish	8	4	8.2	5.2	6.1	7.8
Crustaceans	2	1	10.0	10.0	10.0	9.8
Molluscs	2	2	0.1	0.1	0.1	0.1
Wildfowl	1	1	2.8	2.8	2.8	NA
Infant age group (0 - 5 years old)						
Fish	4	3	3.6	2.6	3.3	3.6

Notes
NA – Not applicable

The predominant species of fish consumed by people in the adult high-rate group were cod, thornback ray, mackerel, plaice, pollack and whiting, with smaller quantities of bass, Dover sole, grey mullet, haddock, herring, red gurnard, sea trout, squid (although squid are molluscs, they are in the fish group as radiologically they are more akin to fish) and turbot. The species of fish consumed by individuals in the child high-rate group were cod, haddock, mackerel and whiting. The species of fish

consumed by the individuals in the infant high-rate group were cod, bass, dab, flounder, mackerel, plaice and whiting. All of these fish species were caught at various locations throughout the survey area.

The predominant species of crustaceans consumed by people in the adult high-rate group were *Nephrops,* brown crab, common lobster, with smaller quantities of common prawn and brown shrimp. The species of crustaceans consumed by individuals in the child high-rate group were brown crab, common lobster and common prawn. All of these crustacean species were caught at various locations throughout the survey area.

The predominant species of molluscs consumed by people in the adult high-rate group were winkles, mussels, cockles, with smaller quantities of limpets. The only species of molluscs consumed by individuals in the child age group was razor shells. The winkles were collected from Parton to Drigg; the mussels were collected at Parton and from Nethertown to Ravenglass; the limpets were collected at Coulderton; the cockles were collected at Ravenglass; the razor shells were collected at Nethertown, Braystones and Sellafield.

The species of wildfowl consumed by people in the adult high-rate group were greylag goose, goose (unspecified species), Canada goose and mallard with smaller quantities of teal and wigeon. The species of wildfowl consumed by the individual in the child high-rate group were Canada goose, greylag goose and mallard. The wildfowl were shot on salt marshes in the Ravenglass Estuary including Carleton Marsh and Newbiggin Marsh.

Livestock were grazed on salt marshes near Saltcoats. Adults' consumption of lamb meat from animals grazed on these marshes was identified.

5.2 Species composition of the fish and shellfish high-rate groups for adults and comparison with 2011 and 2008 data

The species composition of the fish, crustacean and mollusc high-rate groups for adults from the 2012 Sellafield review data are provided for use in dose assessments for RIFE-18. The percentage composition for the predominant fish and shellfish species are as follows:

- Fish: 25% cod and 75% other fish (mean consumption rate for the adult high-rate group, 37 kg y^{-1})
- Crustaceans: 50% *Nephrops* (including 10% mix of common prawn and brown shrimps), 30% brown crab and 20% common lobster (mean consumption rate for the adult high-rate group, 29 kg y^{-1})
- Molluscs: 60% winkles and 40% other molluscs (mean consumption rate for the adult high-rate group, 9.1 kg y^{-1})

These data can be compared with the percentage composition for the predominant fish species consumed by the adult high-rate group from the 2008 Sellafield full habits survey, which has been retained for use in dose assessments since RIFE-14 (EA, FSA, NIEA and SEPA, 2009), and the predominant crustacean and mollusc species consumed by the adult high-rate groups from the 2011 Sellafield review, which were used in dose assessments for RIFE-17 (EA, FSA, NIEA and SEPA, 2012). The percentage compositions were:

- Fish: 25% cod and 75% other fish (mean consumption rate for the adult high-rate group, 40 kg y^{-1})
- Crustaceans: 40% brown crab, 30% common lobster, 30% *Nephrops* (including common prawn) (mean consumption rate for the adult high-rate group, 27 kg y^{-1})
- Molluscs: 60% winkles and 40% other molluscs (mean consumption rate for the adult high-rate group, 12 kg y^{-1})

In the 2012 Sellafield review, the mean consumption rate for the adult high-rate group for fish decreased by 3.0 kg y^{-1} compared with the last full habits survey in 2008. In the 2012 Sellafield review, the mean consumption rate for the adult high-rate group for crustaceans increased by 2.0 kg y^{-1} and the mean consumption rate for the adult high-rate group for molluscs decreased by 2.9 kg y^{-1}, compared with the 2011 Sellafield review.

The main species of fish consumed in 2008 and the main species of crustaceans and molluscs consumed in 2011 were the same as in 2012. The percentage breakdown of species consumed remained the same for fish and molluscs. The percentage breakdown for crustaceans changed slightly; brown crab and common lobster both decreased by 10% and *Nephrops* increased by 20% compared with 2011.

5.3 Consumption trends

The consumption rates for the adult high-rate groups for crustaceans and molluscs over the previous ten years (2003 - 2012) are shown in Figures 2 and 3. The mean rate for the high-rate group is presented as the 'total', and the species consumption rates are the adult means for the high-rate groups distributed according to the percentage breakdowns as described in Section 5.2. The raw data are presented in Annex 3a.

For crustaceans, the increase in the percentage of *Nephrops* was attributed to several high-rate consumers who had not previously been identified in habits surveys. These included *Nephrops* trawler fishermen who consumed their own catch and a hobby fisherman who caught and consumed large quantities of crustaceans. In recent years there has been an increase in the fishing effort directed at *Nephrops* by the Whitehaven fleet which has led to an increase in the time spent fishing in the survey area. Previously, many boats fished for *Nephrops* for 6 months of the year, whereas many boats now target *Nephrops* for most of the year. More fishing boats were in port at the time of the

2012 survey than during previous surveys and interviews were conducted with fishermen who had not previously been identified.

The downward trend in the consumption of molluscs continued in 2012. This decrease is a result of several people who have stopped consuming molluscs for various reasons, such as due to old age or ill health, but who had historically consumed large quantities of molluscs.

Figure 2. Consumption rates for the adult high-rate group for crustaceans, 2003 – 2012 (kg y^{-1})

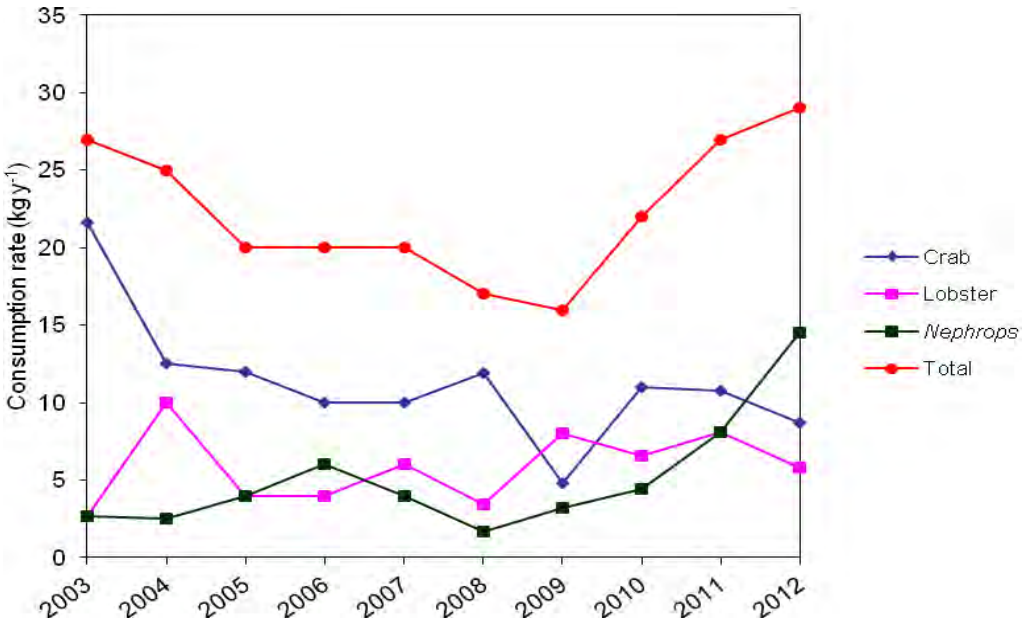
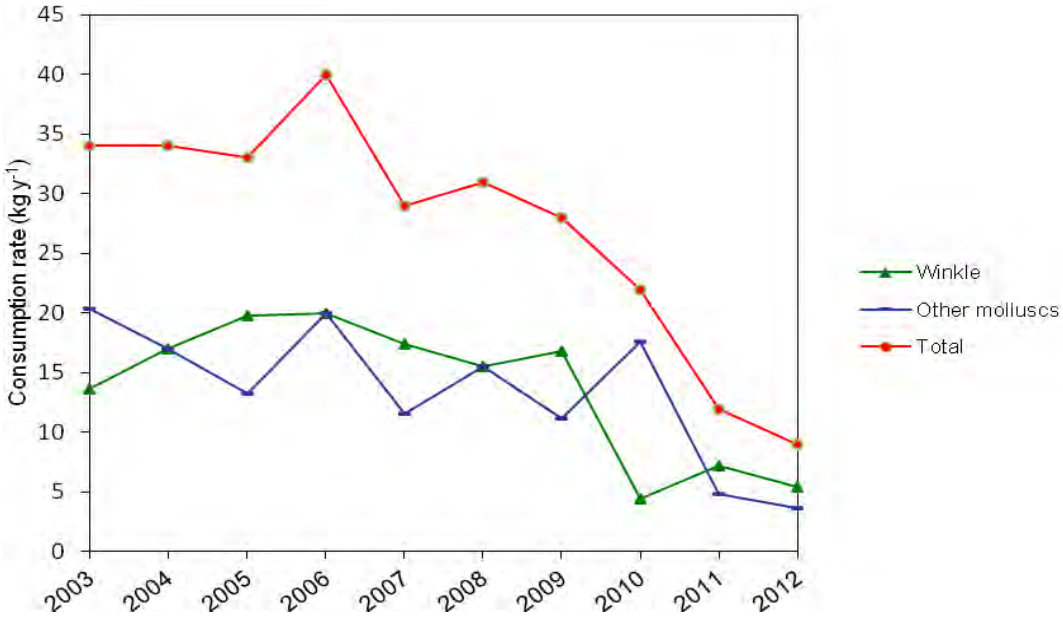


Figure 3. Consumption rates for the adult high-rate group for molluscs, 2003 – 2012 (kg y^{-1})



6. EXTERNAL EXPOSURE

6.1 Intertidal occupancy

Intertidal occupancy rates for adults are presented in Table 10 and intertidal occupancy rates for children and infants are presented in Table 11. It should be noted that there are often more than one substrate at one named location and that substrates at a given location are liable to change over time. Activities were assigned to the predominant substrate over which they were taking place.

Adults' intertidal occupancy rates

Table B presents a summary of the adults' intertidal occupancy rates in the aquatic survey area. The table includes the mean occupancy rates for the high-rate groups and the observed 97.5th percentile rates.

Table B. Summary of adults' intertidal occupancy rates

Intertidal substrate	Number of observations	Number of people in the high-rate group	Maximum of the high-rate group (h y^{-1})	Mean of the high-rate group (h y^{-1})	97.5th percentile (h y^{-1})
Mud	5	5	96	70	93
Mud and sand	16	8	234	156	224
Mud, sand and stones	7	1	1095	1095	980
Rock	13	7	400	228	358
Salt marsh	7	2	312	312	312
Sand	109	23	1026	553	805
Sand and stones	31	6	1398	795	1045

The following activities were undertaken by people in the adult high-rate groups for occupancy over intertidal substrates:

- For mud: wildfowling at Newbiggin Marsh, Carleton Marsh and on the banks of the River Irt.
- For mud and sand: bait digging at Whitehaven outer harbour, Eskmeals and Ravenglass; collecting cockles and mussels at Ravenglass.
- For mud, sand and stones: walking and boat maintenance at Ravenglass.
- For rock: angling at Parton, Saltom Bay, St Bees Head and Whitehaven; collecting crabs at Barrow Mouth.
- For salt marsh: tending livestock at Saltcoats.
- For sand: bait digging at St Bees, Nethertown, Drigg, Braystones and Eskmeals; walking at Braystones and Eskmeals; angling at Braystones, Drigg and St Bees; setting nets at

Braystones and Sellafield; setting pots on the shore at Drigg; dog walking from Braystones to Drigg and at Eskmeals; playing at Seascale.

- For sand and stones: dog walking and collecting mussels at Parton; collecting winkles from Parton to Drigg; angling at Seascale and from Parton to Drigg; collecting peeler crabs at Nethertown.

The adults' intertidal occupancy rates from the 2012 Sellafield review can be compared with those from the 2011 Sellafield review, which are presented in Table C.

Table C. Summary of adults' intertidal occupancy rates from the 2011 Sellafield review

Intertidal substrate	Number of observations	Number of people in the high-rate group	Maximum of the high-rate group (h y^{-1})	Mean of the high-rate group (h y^{-1})	97.5th percentile (h y^{-1})
Mud	9	9	117	80	116
Mud and sand	5	3	520	307	488
Mud, sand and stones	6	3	1095	744	1046
Rock	1	1	9	9	Not applicable
Salt marsh	3	3	60	57	60
Sand	19	12	912	633	895
Sand and stones	15	2	927	859	879

In 2012, compared with 2011, there were increases in the following mean intertidal occupancy rates for the high-rate groups:

- From 740 h y^{-1} to 1100 h y^{-1} for mud, sand and stones
- From 9 h y^{-1} to 230 h y^{-1} for rock
- From 57 h y^{-1} to 310 h y^{-1} for salt marsh

In 2012, compared with 2011, there were decreases in the following mean intertidal occupancy rates for the high-rate groups:

- From 80 h y^{-1} to 70 h y^{-1} for mud
- From 310 h y^{-1} to 160 h y^{-1} for mud and sand
- From 630 h y^{-1} to 550 h y^{-1} for sand
- From 860 h y^{-1} to 800 h y^{-1} for sand and stones

Since the fieldwork period was longer for the 2012 survey compared with the 2011 survey, a larger data set was obtained and this has driven some of the changes in the mean occupancy rates for the high rate groups over intertidal substrates. The increase in the mean intertidal occupancy rate for the high-rate group for salt marsh was attributed to two people with high occupancy rates for tending

livestock, who were not identified in the 2011 survey. The increase in the mean occupancy rates for the high-rate group for rock was attributed to several anglers and two people who were collecting crabs for a large amount of time, whereas in the 2011 survey, only one activity was identified taking place on rock, which was hooking for lobster. The decrease in the mean occupancy rate for the high-rate group for mud and sand was due to a reduction in the number of hours that a nature warden spent walking on the shore.

Children's and infants' intertidal occupancy rates

Table D presents a summary of the children's and infants' intertidal occupancy rates in the aquatic survey area. The table includes the mean occupancy rates for the high-rate groups and the observed 97.5th percentile rates.

Table D. Summary of children's and infants' intertidal occupancy rates

Intertidal substrate	Number of observations	Number of individuals in the high-rate group	Maximum of the high-rate group (h y^{-1})	Mean of the high-rate group (h y^{-1})	97.5th percentile (h y^{-1})
Child age group (6 – 15 years old)					
Sand	22	9	240	149	240
Sand and stones	7	5	546	480	546
Infant age group (0 – 5 years old)					
Sand	12	3	250	207	250

The following activities were undertaken by individuals in the child high-rate groups for occupancy over intertidal substrates:

- For sand: playing at Braystones and Seascale; dog walking at St Bees, Seascale and Drigg.
- For sand and stones: angling from St Bees to Drigg; collecting winkles from Parton to Drigg; playing at Parton.

The three individuals in the infant high-rate group were playing on sand at Seascale.

6.2 Handling of fishing gear and sediment

Handling fishing gear that has become entrained with fine sediment particles, or handling sediment while undertaking activities such as bait digging or mollusc collecting, can potentially give rise to skin exposure from beta radiation. Doses to the skin need consideration as part of the dose limitation system (ICRP, 1991).

Fishing gear can also be a source of gamma exposure due to occupancy in the vicinity of the gear. However, this pathway is minor compared with the exposure received during occupancy over intertidal areas and it has therefore been omitted from the report. Handling of angling equipment was

not considered to be a significant pathway. Therefore, as in previous surveys, data for this pathway were not collected.

Handling rates of fishing gear and sediment for adults are presented in Table 12 and handling rates of sediment for children are presented in Table 13.

Adults' handling rates of fishing gear and sediment

Table E presents a summary of the handling rates of fishing gear and sediment for adults. The table includes the mean handling rates for the high-rate groups and the observed 97.5th percentile rates.

Table E. Summary of adults' handling rates of fishing gear and sediment

Handling activity	Number of observations	Number of people in the high-rate group	Maximum of the high-rate group (h y^{-1})	Mean of the high-rate group (h y^{-1})	97.5th percentile (h y^{-1})
Handling fishing gear	35	5	1524	1191	1524
Handling sediment	35	5	856	706	844

The activities undertaken by people in the adult high-rate groups for handling included:

- For handling fishing gear: handling pots from Parton to Nethertown and from Sellafield to Tarn Bay; handling nets from Parton to Braystones.
- For handling sediment: collecting winkles from Parton to Drigg; bait digging from Whitehaven outer harbour to Eskmeals; collecting limpets at Coulderton; collecting crabs at Barrow Mouth.

The handling rates of fishing gear and sediment for adults from the 2012 Sellafield review can be compared with those from the 2008 full Sellafield survey, which are presented in Table F.

Table F. Summary of adults' handling rates of fishing gear and sediment from the 2008 Sellafield full survey

Intertidal substrate	Number of observations	Number of people in the high-rate group	Maximum of the high-rate group (h y^{-1})	Mean of the high-rate group (h y^{-1})	97.5th percentile (h y^{-1})
Handling fishing gear	20	11	1200	975	1200
Handling sediment	35	2	972	957	947

In 2012, compared with 2008, the mean rate for the high-rate group increased for handling fishing gear and decreased for handling sediment.

Children's handling rates of sediment

Table G presents a summary of the handling rates of sediment for children. The table includes the mean handling rate for the high-rate group.

Table G. Summary of children's handling rates of sediment

Handling activity	Number of observations	Number of people in the high-rate group	Maximum of the high-rate group (h y^{-1})	Mean of the high-rate group (h y^{-1})	97.5th percentile (h y^{-1})
Handling sediment	1	1	80	80	Not applicable

The child in the high-rate group for handling sediment was identified collecting winkles from Parton to Drigg. No children were identified handling fishing gear and no infants were identified handling fishing gear or sediment.

7. USE OF HABITS DATA FOR DOSE ASSESSMENTS

7.1 Aquatic combinations for adults in the Sellafield Fishing Community

Table 14 presents the consumption rates, occupancy rates and handling rates for people who appear in at least one of the high-rate groups for fish, crustaceans, molluscs, intertidal substrates or handling fishing gear or sediment. The table shows that several individuals are members of multiple high-rate groups. For example, observation number 138 is in the high-rate group for fish, crustaceans, molluscs, occupancy over sand and handling fishing gear. This supports the continuation of assessing the dose to the representative person based on a combination of internal and external pathways. Therefore, the Radioactivity in Food and the Environment (RIFE) Sellafield Fishing Community aquatic assessments for 2012 will be based on combinations of consumption and intertidal occupancy pathways identified from Table 14.

7.2 Sellafield 5-year averages

Annex 3a shows the consumption and occupancy rates for the Sellafield Fishing Community, which are presented in the RIFE reports. The consumption rates of crustaceans and molluscs, and intertidal occupancy rates are updated annually using the Sellafield review data or full survey data, as applicable. The fish consumption rates are updated when a full survey is conducted at Sellafield or LLWR. Annex 3b presents the 5-year averages of the data in Annex 3a. The 5-year average (2008 - 2012) of the high-rate group data (for fish, crustaceans, molluscs and intertidal occupancy) will be used in RIFE-18 assessments in order to provide a longer term trend of dose to members of the Sellafield Fishing Community group. The intertidal occupancy substrate termed ‘mud and sand’ in Annex 3a and Annex 3b combines occupancy rates for the following substrates: mud; mud and sand; mud, sand and stones; sand; and sand and stones. This is because people who were spending time on intertidal areas in the aquatic survey area were undertaking many different activities over a wide range of substrates.

7.3 Profiled habits data

The UK environment agencies and the Food Standards Agency have considered ways of using habits data to calculate total dose retrospectively. The adopted approach is to use the adult consumption and occupancy data collected in each habits survey to create a matrix with a series of habits profiles for each nuclear licensed site. The National Dose Assessment Working Group (NDAWG) has considered this approach to assessing retrospective total doses (Camplin *et al.*, 2005) and has agreed that using habits profiles is an appropriate approach. Retrospective total doses around Sellafield are made using these profiles and reported in the RIFE reports (e.g. EA, FSA, NIEA and SEPA, 2012).

The matrix for the 2012 Sellafield adults' profiled habits data is presented in Annex 4. It is based on data from the 2008 Sellafield full habits survey (aquatic, terrestrial and direct radiation pathways), which had been updated with data from the 2009, 2010 and 2011 Sellafield annual shellfish and intertidal occupancy reviews, and with data from the 2012 LLWR habits survey that are applicable to the Sellafield area.

In the 2009, 2010 and 2011 Sellafield reviews, the profiles were only updated with the data for the people who were interviewed during the Sellafield reviews; that is, for intertidal occupancy, and consumption of crustaceans, molluscs and fish. All other observations and pathways from the original 2008 profiled habits matrix were retained unless it was known that an individual had stopped their activity, in which case, their data were deleted. If data were collected for new interviewees, these were added as new observations.

The method for updating the profile in 2012 was different to that used for previous Sellafield reviews since the new data were obtained indirectly from the 2012 LLWR full habits survey. All observations with only aquatic data were deleted from the 2011 Sellafield profile and replaced with all observations with only aquatic data from the 2012 LLWR survey. Those people interviewed in the LLWR terrestrial and direct radiation survey areas that had aquatic data were added as new observations in the Sellafield profile but only their aquatic data were included. Additionally, due to the close proximity of the Sellafield and LLWR sites (approximately 5 km between the site centres), the terrestrial survey areas overlap, so pathways applicable to Sellafield for people who lived in this area and who were interviewed in 2012 were updated or added to the profile. The 2008 Sellafield direct radiation occupancy rates for the people in the overlap area were unchanged. All other observations and pathways from the 2011 profile were retained.

The profiled data shown in Annex 4 are not comparable with the raw data presented in Annex 1 because the 2012 profile has been created using data from 2008 to 2012.

8. SUMMARY AND RECOMMENDATIONS

The 2012 Sellafield review provides data for the consumption of fish, shellfish, intertidal occupancy and handling rates of fishing gear and sediment relating to liquid discharges from the Sellafield nuclear site. Data were collected for 220 adults, 29 children and 13 infants.

The mean rates for the adult high-rate groups from the 2012 Sellafield review that are provided for use in RIFE-18 dose assessments are as follows:

- Fish 37 kg y^{-1}
- Crustaceans 29 kg y^{-1}
- Molluscs 9.1 kg y^{-1}
- Wildfowl 14 kg y^{-1}
- Salt marsh grazed sheep meat 1.9 kg y^{-1}
- Occupancy over mud 70 h y^{-1}
- Occupancy over mud and sand 160 h y^{-1}
- Occupancy over mud, sand and stones 1100 h y^{-1}
- Occupancy over rock 230 h y^{-1}
- Occupancy over salt marsh 310 h y^{-1}
- Occupancy over sand 550 h y^{-1}
- Occupancy over sand and stones 800 h y^{-1}
- Handling fishing gear 1200 h y^{-1}
- Handling sediment 710 h y^{-1}

In the 2012 Sellafield review compared with the 2008 Sellafield full habits survey, the mean rate for the high-rate group for fish decreased by 3.0 kg y^{-1}. In the 2012 Sellafield review compared with the 2011 Sellafield review, the mean rates for the high-rate groups increased by 2.0 kg y^{-1} for crustaceans and decreased by 3.0 kg y^{-1} for molluscs.

In 2012, in comparison with the 2011 Sellafield review, the mean rates for the high-rate groups for occupancy over intertidal substrates increased by 350 h y^{-1} for mud, sand and stones, by 220 h y^{-1} for rock, and by 260 h y^{-1} for salt marsh, and decreased by 10 h y^{-1} for mud, by 150 h y^{-1} for mud and sand, by 80 h y^{-1} for sand, and by 64 h y^{-1} for sand and stones.

The handling rates for fishing gear increased from 980 h y^{-1} to 1200 h y^{-1} in 2012 compared with the 2008 Sellafield full habits survey, whereas, the handling rates for sediment decreased from 960 h y^{-1} to 710 h y^{-1}.

The Sellafield Fishing Community 5-year average consumption and intertidal occupancy rates (see Annex 3b) that are provided for use in RIFE-18 dose assessments are as follows:

- Cod 9.9 kg y^{-1}
- Other fish 30 kg y^{-1}
- Crabs 9.4 kg y^{-1}
- Lobsters 6.4 kg y^{-1}
- *Nephrops* (including common prawns and brown shrimps) 6.4 kg y^{-1}
- Winkles 9.9 kg y^{-1}
- Other molluscs 11 kg y^{-1}
- Occupancy over an intertidal substrate termed ‘mud and sand’ (mud; mud and sand; mud, sand and stones; sand; and sand and stones combined) 890 h y^{-1}

9. REFERENCES

Camplin, W.C., Grzechnik, M.P. and Smedley, C.A., 2005. Methods for assessment of total dose in the Radioactivity in Food and the Environment report. Presented to the National Dose Assessments Working Group (NDAWG). Paper NDAWG/3/2005, 27th April 2005.

Clyne, F.J., Tipple, J.R., Garrod, C.J. and Jeffs, T.M., 2009. Radiological Habits Survey: Sellafield, 2008. RL 02/09. Cefas, Lowestoft.

EA, FSA, NIEA and SEPA, 2009. Radioactivity in Food and the Environment, 2008. EA, FSA, NIEA and SEPA, Warrington, London, Belfast and Stirling. RIFE (14).

EA, FSA, NIEA and SEPA, 2012. Radioactivity in Food and the Environment, 2011. EA, FSA, NIEA and SEPA, Warrington, London, Belfast and Stirling. RIFE (17).

Hunt, G.J., Hewett, C.J. and Shepherd, J.G., 1982. The identification of critical groups and its application to fish and shellfish consumers in the coastal area of the north-east Irish Sea. Health Physics, Vol. 43, No 6, pp. 875-889.

ICRP, 1991. 1990 Recommendations of the International Commission on Radiological Protection. Annal. ICRP 21 (1-3). Pergamon Press, Oxford, (ICRP Publ. 60)

ICRP, 2007. The 2007 Recommendations of the International Commission on Radiological Protection. Annal. ICRP 37 (2-4). Elsevier Science, Oxford, (ICRP Publ. 103).

Leonard, D.R.P., Hunt, G.J. and Jones, P.G.W., 1982. Investigation of individual radiation exposures from discharges to the aquatic environment: techniques used in habits surveys. Proc. 3rd Int. Symp. Soc. Radiol. Prot., Inverness, 6 to 11 June 1982. Vol 2, 512-517. Society for Radiological Protection.

Table 1. Adults' consumption rates of fish from the aquatic survey area (kg y^{-1})

Observation number	Bass	Brill	Cod	Dab	Dover sole	Flounder	Grey mullet	Haddock	Herring	Mackerel	Mixed fish	Plaice	Pollack	Red gurnard	Saithe	Salmon	Sea trout	Squid	Thornback ray	Turbot	Whiting	Total
235	**3.2**	**-**	**6.8**	**-**	**3.2**	**-**	**5.5**	**6.8**	**3.2**	**3.2**	**-**	**6.8**	**6.8**	**-**	**-**	**-**	**-**	**5.9**	**6.8**	**3.2**	**3.2**	**64.5**
48	**-**	**-**	**22.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**15.0**	**-**	**-**	**-**	**-**	**-**	**-**	**22.5**	**-**	**-**	**59.9**
134	**-**	**-**	**14.7**	**-**	**-**	**-**	**-**	**-**	**4.7**	**-**	**-**	**17.7**	**-**	**-**	**-**	**-**	**-**	**-**	**20.6**	**-**	**-**	**57.8**
133	**-**	**-**	**14.7**	**-**	**-**	**-**	**-**	**-**	**4.7**	**-**	**-**	**17.7**	**-**	**-**	**-**	**-**	**-**	**-**	**20.6**	**-**	**-**	**57.8**
234	**-**	**-**	**20.4**	**-**	**-**	**-**	**5.5**	**20.4**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.3**	**-**	**-**	**-**	**46.7**
339	**-**	**-**	**16.5**	**-**	**-**	**-**	**-**	**-**	**-**	**25.0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**41.5**
187	**5.0**	**-**	**10.0**	**-**	**-**	**-**	**5.0**	**-**	**-**	**2.0**	**-**	**-**	**2.0**	**2.0**	**-**	**-**	**-**	**-**	**10.0**	**5.0**	**-**	**41.0**
138	**16.3**	**-**	**10.9**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**10.9**	**-**	**-**	**38.1**
164	**3.2**	**-**	**15.9**	**-**	**-**	**-**	**-**	**-**	**-**	**6.9**	**-**	**6.0**	**2.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**34.5**
232	**11.3**	**-**	**13.6**	**-**	**-**	**-**	**-**	**-**	**-**	**6.8**	**-**	**-**	**-**	**-**	**-**	**-**	**2.3**	**-**	**-**	**-**	**-**	**34.0**
240	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**27.2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**27.2**
98	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.8**	**-**	**-**	**12.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**12.5**	**26.8**
99	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.8**	**-**	**-**	**12.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**12.5**	**26.8**
100	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.8**	**-**	**-**	**12.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**12.5**	**26.8**
101	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.8**	**-**	**-**	**12.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**12.5**	**26.8**
102	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.8**	**-**	**-**	**12.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**12.5**	**26.8**
103	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.8**	**-**	**-**	**12.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**12.5**	**26.8**
125	**-**	**-**	**14.5**	**-**	**-**	**-**	**-**	**-**	**-**	**1.1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**8.2**	**-**	**-**	**23.8**
126	**-**	**-**	**14.5**	**-**	**-**	**-**	**-**	**-**	**-**	**1.1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**8.2**	**-**	**-**	**23.8**
139	**-**	**-**	**10.9**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.8**	**-**	**-**	**-**	**-**	**-**	**-**	**10.9**	**-**	**-**	**23.6**
188	2.5	-	5.0	-	-	-	2.5	-	-	1.0	-	-	1.0	1.0	-	-	-	-	5.0	2.5	-	20.5
153	6.7	-	10.8	-	-	-	-	-	-	-	-	1.5	-	-	-	-	-	-	-	-	-	19.0
154	6.7	-	10.8	-	-	-	-	-	-	-	-	1.5	-	-	-	-	-	-	-	-	-	19.0
162	6.8	-	10.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17.7
163	6.8	-	10.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17.7
205	-	-	7.3	-	3.2	-	-	-	-	-	-	7.3	-	-	-	-	-	-	-	-	-	17.7
204	-	0.9	3.6	0.9	-	-	-	-	-	3.6	-	1.8	2.7	-	-	-	-	-	3.6	-	-	17.2

Table 1. Adults' consumption rates of fish from the aquatic survey area (kg y^{-1})

Observation number	Bass	Brill	Cod	Dab	Dover sole	Flounder	Grey mullet	Haddock	Herring	Mackerel	Mixed fish	Plaice	Pollack	Red gurnard	Saithe	Salmon	Sea trout	Squid	Thornback ray	Turbot	Whiting	Total
203	-	0.9	3.6	0.9	-	-	-	-	-	3.6	-	1.8	2.7	-	-	-	-	-	3.6	-	-	17.2
206	-	-	15.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15.0
242	6.4	-	6.4	-	-	0.9	-	-	-	-	-	0.9	-	-	-	-	-	-	-	-	-	14.5
54	-	-	-	-	-	-	-	-	-	-	-	14.2	-	-	-	-	-	-	-	-	-	14.2
55	-	-	-	-	-	-	-	-	-	-	-	14.2	-	-	-	-	-	-	-	-	-	14.2
56	-	-	-	-	-	-	-	-	-	-	-	14.2	-	-	-	-	-	-	-	-	-	14.2
129	4.3	-	6.0	-	-	-	-	-	-	2.8	-	-	-	-	-	-	-	-	0.7	-	-	13.7
130	4.3	-	6.0	-	-	-	-	-	-	2.8	-	-	-	-	-	-	-	-	0.7	-	-	13.7
209	-	-	4.1	-	-	-	-	-	-	-	-	9.1	-	-	-	-	-	-	-	-	-	13.2
210	-	-	4.1	-	-	-	-	-	-	-	-	9.1	-	-	-	-	-	-	-	-	-	13.2
211	-	-	4.1	-	-	-	-	-	-	-	-	9.1	-	-	-	-	-	-	-	-	-	13.2
131	4.3	-	6.0	-	-	-	-	-	-	2.8	-	-	-	-	-	-	-	-	-	-	-	13.0
132	4.3	-	6.0	-	-	-	-	-	-	2.8	-	-	-	-	-	-	-	-	-	-	-	13.0
45	-	1.4	4.1	-	2.3	-	-	-	-	-	-	4.1	-	-	-	-	-	-	-	-	-	11.8
44	-	1.4	4.1	-	2.3	-	-	-	-	-	-	4.1	-	-	-	-	-	-	-	-	-	11.8
46	-	1.4	4.1	-	2.3	-	-	-	-	-	-	4.1	-	-	-	-	-	-	-	-	-	11.8
94	-	2.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.3	2.6	-	10.5
95	-	2.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.3	2.6	-	10.5
268	2.8	-	3.9	-	-	-	-	-	-	3.6	-	-	-	-	-	-	-	-	-	-	-	10.3
282	7.7	-	1.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.3
184	-	-	3.6	1.8	-	-	-	-	-	-	-	3.6	-	-	-	-	-	-	-	-	-	9.1
185	-	-	3.6	1.8	-	-	-	-	-	-	-	3.6	-	-	-	-	-	-	-	-	-	9.1
186	-	-	3.6	1.8	-	-	-	-	-	-	-	3.6	-	-	-	-	-	-	-	-	-	9.1
202	-	-	-	-	-	-	-	-	-	2.7	-	5.4	-	-	-	-	-	-	-	-	-	8.2
231	3.6	-	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.2
236	-	-	4.1	-	-	-	-	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	8.2
259	1.7	-	2.3	-	-	-	-	-	-	2.2	-	1.6	-	-	-	-	-	-	-	-	-	7.7

Table 1. Adults' consumption rates of fish from the aquatic survey area (kg y^{-1})

Observation number	Bass	Brill	Cod	Dab	Dover sole	Flounder	Grey mullet	Haddock	Herring	Mackerel	Mixed fish	Plaice	Pollack	Red gurnard	Saithe	Salmon	Sea trout	Squid	Thornback ray	Turbot	Whiting	Total
260	1.7	-	2.3	-	-	-	-	-	-	2.2	-	1.6	-	-	-	-	-	-	-	-	-	7.7
261	1.7	-	2.3	-	-	-	-	-	-	2.2	-	1.6	-	-	-	-	-	-	-	-	-	7.7
262	1.7	-	2.3	-	-	-	-	-	-	2.2	-	1.6	-	-	-	-	-	-	-	-	-	7.7
263	1.7	-	2.3	-	-	-	-	-	-	2.2	-	1.6	-	-	-	-	-	-	-	-	-	7.7
207	-	-	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.5
208	-	-	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.5
155	2.3	-	2.3	0.9	-	0.5	-	-	-	-	-	1.4	-	-	-	-	-	-	-	-	-	7.3
183	0.9	-	0.9	-	-	-	-	-	-	0.9	-	0.9	0.9	-	-	1.4	1.4	-	-	-	-	7.3
156	2.3	-	2.3	0.9	-	0.5	-	-	-	-	-	1.4	-	-	-	-	-	-	-	-	-	7.3
182	0.9	-	0.9	-	-	-	-	-	-	0.9	-	0.9	0.9	-	-	1.4	1.4	-	-	-	-	7.3
253	-	-	1.3	-	-	-	-	0.8	-	-	-	0.9	-	-	-	2.3	1.9	-	-	-	-	7.2
254	-	-	1.3	-	-	-	-	0.8	-	-	-	0.9	-	-	-	2.3	1.9	-	-	-	-	7.2
266	1.9	-	2.6	-	-	-	-	-	-	2.4	-	-	-	-	-	-	-	-	-	-	-	6.9
169	1.8	-	1.8	-	-	-	-	-	-	1.8	-	1.4	-	-	-	-	-	-	-	-	-	6.8
170	1.8	-	1.8	-	-	-	-	-	-	1.8	-	1.4	-	-	-	-	-	-	-	-	-	6.8
63	-	-	3.0	-	-	-	-	-	-	3.5	-	-	-	-	-	-	-	-	-	-	-	6.5
64	-	-	3.0	-	-	-	-	-	-	3.5	-	-	-	-	-	-	-	-	-	-	-	6.5
312	-	-	5.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.9
313	-	-	5.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.9
314	-	-	5.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.9
159	1.8	-	1.8	-	-	-	-	-	-	-	-	0.2	0.9	-	0.9	-	-	-	-	-	-	5.7
160	1.8	-	1.8	-	-	-	-	-	-	-	-	0.2	0.9	-	0.9	-	-	-	-	-	-	5.7
161	1.8	-	1.8	-	-	-	-	-	-	-	-	0.2	0.9	-	0.9	-	-	-	-	-	-	5.7
65	-	-	1.3	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	1.7	5.2
66	-	-	1.3	-	-	-	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	1.7	5.2
243	1.6	-	1.6	-	-	0.2	-	-	-	-	-	0.2	-	-	-	-	-	-	-	-	-	3.6
96	-	-	-	-	-	-	-	-	-	3.5	-	-	-	-	-	-	-	-	-	-	-	3.5

Table 1. Adults' consumption rates of fish from the aquatic survey area (kg y^{-1})

Observation number	Bass	Brill	Cod	Dab	Dover sole	Flounder	Grey mullet	Haddock	Herring	Mackerel	Mixed fish	Plaice	Pollack	Red gurnard	Saithe	Salmon	Sea trout	Squid	Thornback ray	Turbot	Whiting	Total
97	-	-	-	-	-	-	-	-	-	3.5	-	-	-	-	-	-	-	-	-	-	-	3.5
285	-	-	1.7	-	-	-	-	-	-	-	-	-	1.7	-	-	-	-	-	-	-	-	3.4
286	-	-	1.7	-	-	-	-	-	-	-	-	-	1.7	-	-	-	-	-	-	-	-	3.4
61	-	-	1.0	-	-	-	-	-	-	1.0	-	-	1.0	-	-	-	-	-	-	-	-	3.0
62	-	-	1.0	-	-	-	-	-	-	1.0	-	-	1.0	-	-	-	-	-	-	-	-	3.0
229	-	-	1.4	-	-	-	-	-	-	-	-	0.6	-	-	-	-	-	-	-	-	-	2.0
230	-	-	1.4	-	-	-	-	-	-	-	-	0.6	-	-	-	-	-	-	-	-	-	2.0
89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.5	-	-	1.5
90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.5	-	-	1.5
91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.5	-	-	1.5
127	-	-	-	-	-	-	-	-	-	1.1	-	-	-	-	-	-	-	-	-	-	-	1.1
214	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.5	-	-	-	-	-	0.5
215	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.5	-	-	-	-	-	0.5

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of fish based on the 20 high-rate adult consumers is 36.8 kg y^{-1}

The observed 97.5th percentile rate based on 94 observations is 57.8 kg y^{-1}

Table 2. Adults' consumption rates of crustaceans from the aquatic survey area (kg y^{-1})

Observation number	Brown crab	Brown shrimp	Common lobster	Common prawn	*Nephrops*	Total
138	**17.2**	**14.3**	**1.7**	**19.7**	**-**	**53.0**
235	**15.4**	**-**	**7.3**	**-**	**25.9**	**48.6**
71	**25.0**	**-**	**-**	**-**	**22.9**	**47.9**
72	**25.0**	**-**	**-**	**-**	**22.9**	**47.9**
209	**14.3**	**-**	**14.6**	**-**	**0.4**	**29.4**
211	**14.3**	**-**	**14.6**	**-**	**0.4**	**29.4**
210	**14.3**	**-**	**14.6**	**-**	**0.4**	**29.4**
135	**11.8**	**-**	**11.8**	**-**	**-**	**23.6**
54	**-**	**-**	**-**	**-**	**21.3**	**21.3**
55	**-**	**-**	**-**	**-**	**21.3**	**21.3**
56	**-**	**-**	**-**	**-**	**21.3**	**21.3**
164	**8.8**	**-**	**11.2**	**-**	**-**	**20.0**
44	**-**	**-**	**-**	**-**	**19.5**	**19.5**
45	**-**	**-**	**-**	**-**	**19.5**	**19.5**
46	**-**	**-**	**-**	**-**	**19.5**	**19.5**
205	**7.8**	**-**	**9.9**	**-**	**-**	**17.7**
49	-	-	-	-	15.0	15.0
234	1.0	-	0.6	-	11.6	13.2
339	4.8	-	3.8	3.7	-	12.3
312	3.6	-	5.6	0.9	-	10.0
314	3.6	-	5.6	0.9	-	10.0
313	3.6	-	5.6	0.9	-	10.0
133	3.6	-	5.6	-	-	9.2
134	3.6	-	5.6	-	-	9.2
202	6.6	-	-	-	-	6.6
184	-	-	-	-	5.9	5.9
185	-	-	-	-	5.9	5.9
186	-	-	-	-	5.9	5.9
240	-	-	-	-	5.9	5.9
259	3.0	-	2.2	-	-	5.2
260	3.0	-	2.2	-	-	5.2
129	3.3	-	1.7	-	-	5.0
130	3.3	-	1.7	-	-	5.0
131	3.3	-	1.7	-	-	5.0
132	3.3	-	1.7	-	-	5.0
169	2.0	-	2.0	-	-	4.1
170	2.0	-	2.0	-	-	4.1
203	1.4	-	2.2	-	-	3.5
204	1.4	-	2.2	-	-	3.5
153	3.3	-	-	-	-	3.3
154	3.3	-	-	-	-	3.3
187	1.0	-	2.0	-	-	3.0
253	0.7	-	0.9	1.2	-	2.8
254	0.7	-	0.9	1.2	-	2.8
236	0.2	-	-	-	2.3	2.5
188	1.0	-	1.0	-	-	2.0

Table 2. Adults' consumption rates of crustaceans from the aquatic survey area (kg y^{-1})

Observation number	Brown crab	Brown shrimp	Common lobster	Common prawn	*Nephrops*	Total
125	-	-	0.3	1.6	-	1.9
126	-	-	0.3	1.6	-	1.9
140	-	-	1.7	-	-	1.7
51	-	-	-	-	1.7	1.7
92	-	-	-	-	1.5	1.5
48	-	-	-	-	1.2	1.2
159	0.9	-	0.2	-	-	1.1
160	0.9	-	0.2	-	-	1.1
161	0.9	-	0.2	-	-	1.1
261	0.5	-	0.4	-	-	0.9
262	0.5	-	0.4	-	-	0.9
263	0.5	-	0.4	-	-	0.9
229	0.5	-	-	-	-	0.5
230	0.5	-	-	-	-	0.5
231	0.3	-	0.2	-	-	0.5
232	0.3	-	0.2	-	-	0.5

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of crustaceans based on the 16 high-rate adult consumers is 29.3 kg y^{-1}

The observed 97.5th percentile rate based on 62 observations is 48.2 kg y^{-1}

Table 3. Adults' consumption rates of molluscs from the aquatic survey area (kg y^{-1})

Observation number	Cockle	Limpet	Mussel	Razor shell	Winkle	Total
317	**-**	**1.0**	**-**	**-**	**11.8**	**12.8**
235	**5.9**	**-**	**5.9**	**-**	**-**	**11.8**
138	**-**	**-**	**1.2**	**-**	**6.0**	**7.2**
202	**-**	**-**	**-**	**-**	**4.4**	**4.4**
187	-	-	1.0	3.0	-	4.0
164	-	-	1.4	-	1.4	2.7
162	0.5	-	0.5	-	1.4	2.3
163	0.5	-	0.5	-	1.4	2.3
129	-	-	-	-	2.0	2.0
318	-	-	-	-	1.3	1.3
319	-	-	-	-	1.3	1.3
139	-	-	1.2	-	-	1.2
188	-	-	-	1.0	-	1.0
209	0.3	-	-	-	0.5	0.8
234	0.3	-	0.3	-	-	0.7
121	-	-	0.2	-	0.3	0.5
153	-	-	0.5	-	-	0.5
154	-	-	0.5	-	-	0.5
159	-	-	0.2	-	0.2	0.5
160	-	-	0.2	-	0.2	0.5
161	-	-	0.2	-	0.2	0.5
231	0.5	-	-	-	-	0.5
232	0.5	-	-	-	-	0.5
316	-	-	-	-	0.4	0.4
210	0.3	-	-	-	-	0.3
182	-	-	-	0.2	-	0.2
183	-	-	-	0.2	-	0.2

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of molluscs based on the 4 high-rate adult consumers is 9.1 kg y^{-1}

The observed 97.5th percentile rate based on 27 observations is 12.2 kg y^{-1}

Table 4. Adults' consumption rates of wildfowl from the aquatic survey area (kg y^{-1})

Observation number	Canada goose	Goose (unspecified species)	Greylag goose	Mallard	Snipe	Teal	Wigeon	Total
340	**5.6**	**-**	**8.8**	**1.1**	**-**	**0.4**	**0.9**	**16.8**
203	**-**	**8.8**	**-**	**2.7**	**-**	**-**	**-**	**11.5**
312	0.9	-	1.4	0.6	-	-	-	2.8
313	0.9	-	1.4	0.6	-	-	-	2.8
314	0.9	-	1.4	0.6	-	-	-	2.8
339	-	-	-	2.0	0.1	-	-	2.1
115	-	-	-	1.4	-	-	-	1.4
116	-	-	-	1.4	-	-	-	1.4
390	-	-	-	0.3	-	-	-	0.3
391	-	-	-	0.3	-	-	-	0.3
392	-	-	-	0.3	-	-	-	0.3
393	-	-	-	0.3	-	-	-	0.3
394	-	-	-	0.3	-	-	-	0.3
395	-	-	-	0.3	-	-	-	0.3

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of wildfowl based on the 2 high-rate adult consumers is 14.2 kg y^{-1}

The observed 97.5th percentile rate based on 14 observations is 15.1 kg y^{-1}

Table 5. Adults' consumption rates of salt marsh grazed sheep meat from the aquatic survey area (kg y^{-1})

Observation number	Salt marsh grazed lamb
253	**1.9**
254	**1.9**
255	**1.9**
256	**1.9**
257	**1.9**
258	**1.9**

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of salt marsh grazed sheep meat based on the 6 high-rate adult consumers is 1.9 kg y^{-1}

The observed 97.5th percentile rate based on 6 observations is 1.9 kg y^{-1}

Table 6. Children's and infants' consumption rates of fish from the aquatic survey area (kg y^{-1})

Child age group (6 - 15 years old)

Observation number	Age	Bass	Cod	Dab	Flounder	Grey mullet	Haddock	Mackerel	Plaice	Whiting	Total
238	**13**	**-**	**4.1**	**-**	**-**	**-**	**4.1**	**-**	**-**	**-**	**8.2**
315	**15**	**-**	**5.9**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**5.9**
68	**8**	**-**	**1.3**	**-**	**-**	**-**	**-**	**2.2**	**-**	**1.7**	**5.2**
69	**10**	**-**	**1.3**	**-**	**-**	**-**	**-**	**2.2**	**-**	**1.7**	**5.2**
189	11	-	1.0	-	-	1.0	-	-	-	-	2.0
190	10	-	1.0	-	-	1.0	-	-	-	-	2.0
191	9	-	1.0	-	-	1.0	-	-	-	-	2.0
192	9	-	1.0	-	-	1.0	-	-	-	-	2.0

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of fish for the child age group based upon the 4 high-rate consumers is 6.1 kg y^{-1}

The observed 97.5th percentile rate based on 8 observations is 7.8 kg y^{-1}

Infant age group (0 - 5 years old)

Observation number	Age	Bass	Cod	Dab	Flounder	Grey mullet	Haddock	Mackerel	Plaice	Whiting	Total
157	**5**	**1.1**	**1.1**	**0.5**	**0.2**	**-**	**-**	**-**	**0.7**	**-**	**3.6**
158	**3**	**1.1**	**1.1**	**0.5**	**0.2**	**-**	**-**	**-**	**0.7**	**-**	**3.6**
67	**5**	**-**	**0.7**	**-**	**-**	**-**	**-**	**1.1**	**-**	**0.9**	**2.6**
193	4	-	0.5	-	-	0.5	-	-	-	-	1.0

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of fish for the infant age group based upon the 3 high-rate consumers is 3.3 kg y^{-1}

The observed 97.5th percentile rate based on 4 observations is 3.6 kg y^{-1}

Table 7. Children's consumption rates of crustaceans from the aquatic survey area (kg y^{-1})

Child age group (6 - 15 years old)

Observation number	Age	Brown crab	Common lobster	Common prawn	*Nephrops*	Total
315	**15**	**3.6**	**5.6**	**0.9**	**-**	**10.0**
238	13	0.2	-	-	2.3	2.5

Notes

The emboldened observation is the high-rate consumer

The mean consumption rate of crustaceans for the child age group based upon the only high-rate consumer is 10.0 kg y^{-1}

The observed 97.5th percentile rate based on 2 observations is 9.8 kg y^{-1}

Table 8. Children's consumption rates of molluscs from the aquatic survey area (kg y^{-1})

Child age group (6 - 15 years old)

Observation number	Age	Razor shell
190	**10**	**0.1**
191	**9**	**0.1**

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of molluscs for the child age group based upon the 2 high-rate consumers is 0.1 kg y^{-1}

The observed 97.5th percentile rate based on 2 observations is 0.1 kg y^{-1}

Table 9. Children's consumption rates of wildfowl from the aquatic survey area (kg y^{-1})

Child age group (6 - 15 years old)

Observation number	Age	Canada goose	Greylag goose	Mallard	Total
315	**15**	**0.9**	**1.4**	**0.6**	**2.8**

Notes

The emboldened observation is the high-rate consumer

The mean consumption rate of wildfowl for the child age group based upon the only high-rate consumer is 2.8 kg y^{-1}

The observed 97.5th percentile rate is not applicable for 1 observation

Table 10. Adults' intertidal occupancy rates in the aquatic survey area (h y^{-1})

Observation number	Location	Activity	Mud	Mud and sand	Mud, sand and stones	Rock	Salt marsh	Sand	Sand and stones
340	**Newbiggin Marsh and Carleton Marsh**	**Wildfowling**	**96**	-	-	-	-	-	-
	Newbiggin Marsh and Carleton Marsh	Dog walking	**-**	-	-	-	78	-	-
401	**River Irt**	**Wildfowling**	**63**	-	-	-	-	-	-
402	**River Irt**	**Wildfowling**	**63**	-	-	-	-	-	-
403	**River Irt**	**Wildfowling**	**63**	-	-	-	-	-	-
404	**River Irt**	**Wildfowling**	**63**	-	-	-	-	-	-
316	**Whitehaven Outer Harbour**	**Bait digging**	-	**234**	-	-	-	-	-
	Braystones and Eskmeals	**Bait digging and walking**	-	**-**	-	-	-	**843**	-
	Braystones	**Angling**	-	**-**	-	-	-		-
	Nethertown	Collecting winkles	-	**-**	-	-	-	**-**	154
	Coulderton	Collecting limpets	-	**-**	-	-	-	**-**	
164	**Whitehaven Outer Harbour and Eskmeals**	**Bait digging**	-	**208**	-	-	-	-	-
	Parton and St Bees Head	Angling	-	**-**	-	100	-	-	-
	Parton to Drigg	**Angling**	-	**-**	-	-	-	-	**1398**
	Parton	**Dog walking, collecting mussels and collecting winkles**	-	**-**	-	-	-	-	
171	**Whitehaven Outer Harbour**	**Bait digging**	-	**200**	-	-	-	-	-
	Parton and St Bees Head	Angling	-	**-**	-	40	-	-	-
	Parton to Tarn Bay	Angling	-	**-**	-	-	-	-	220
162	**Whitehaven Outer Harbour**	**Bait digging**	-	**164**	-	-	-	-	-
	Ravenglass	**Collecting mussels and cockles**	-		-	-	-	-	-
	St Bees Head	**Angling**	-	**-**	-	**214**	-	-	-
	Parton to Drigg	Angling	-	**-**	-	**-**	-	-	419
	Barrow Mouth	Collecting winkles	-	**-**	-	**-**	-	-	
266	**Whitehaven Outer Harbour**	**Bait digging**	-	**156**	-	**-**	-	-	-
	Whitehaven	Angling	-	**-**	-	48	-	-	-
	Drigg and St Bees	Angling	-	**-**	-	-	-	156	-
267	**Whitehaven Outer Harbour**	**Bait digging**	-	**104**	-	**-**	-	-	-
	Parton and Whitehaven	**Angling**	-	**-**	-	**156**	-	-	-
	Drigg and St Bees	Angling	-	**-**	-	**-**	-	312	-
268	**Whitehaven Outer Harbour**	**Bait digging**	-	**104**	-	**-**	-	-	-
	Parton and Whitehaven	**Angling**	-	**-**	-	**156**	-	-	-
	Drigg and St Bees	Angling	-	**-**	-	**-**	-	312	-

Table 10. Adults' intertidal occupancy rates in the aquatic survey area (h y^{-1})

Observation number	Location	Activity	Mud	Mud and sand	Mud, sand and stones	Rock	Salt marsh	Sand	Sand and stones
242	**Ravenglass**	**Bait digging**	-	**80**	-	-	-	-	-
	Ravenglass	Collecting mussels	-	**-**	20	-	-	-	**-**
	Drigg	Bait digging	-	**-**	-	-	-	100	**-**
	St Bees to Drigg	**Angling**	-	**-**	-	-	-	-	**476**
	Nethertown	**Collecting peeler crabs**	-	**-**	-	-	-	-	
259	Whitehaven Outer Harbour	Bait digging	-	65	-	-	-	-	-
	Barrow Mouth	**Collecting crabs**	-	-	-	**260**	-	**-**	-
	Drigg and St Bees	**Angling**	-	-	-	**-**	-	**611**	-
	St Bees, Nethertown and Drigg	**Bait digging**	-	-	-	**-**	-		-
264	Whitehaven Outer Harbour	Bait digging	-	65	-	**-**	-	-	-
	Barrow Mouth	**Collecting crabs**	-	-	-	**260**	-	**-**	-
	Drigg and St Bees	**Angling**	-	-	-	**-**	-	**611**	-
	St Bees, Nethertown and Drigg	**Bait digging**	-	-	-	**-**	-		-
265	Whitehaven Outer Harbour	Bait digging	-	65	-	-	-	-	-
	Drigg and St Bees	**Angling**	-	-	-	**-**	-	**611**	-
	St Bees, Nethertown and Drigg	**Bait digging**	-	-	-	**-**	-		-
169	Whitehaven Outer Harbour	Bait digging	-	60	-	**-**	-	-	-
	Parton and St Bees Head	Angling	-	-	-	30	-	-	-
	Parton to Tarn Bay	Angling	-	-	-	-	-	-	120
234	Whitehaven Outer Harbour to Ravenglass	Bait digging	-	51	-	-	-	-	-
	Braystones and Sellafield	**Setting nets**	-	-	-	-	-	**360**	-
	Parton to Drigg	**Collecting winkles**	-	-	-	-	-	**-**	**927**
	St Bees to Drigg	**Angling**	-	-	-	-	-	**-**	
153	Whitehaven Outer Harbour	Bait digging	-	38	-	-	-	**-**	-
	Parton and St Bees Head	**Angling**	-	-	-	**150**	-	**-**	-
	Parton to Drigg	**Angling**	-	-	-	**-**	-	**-**	**600**
138	Ravenglass	Collecting mussels	-	12	-	-	-	**-**	-
	Braystones	**Setting nets and bait digging**	-	-	-	-	-	**1026**	-
	Drigg	**Setting pots on the shore**	-	-	-	-	-		-
	Parton, Nethertown, Braystones and Coulderton	Angling	-	-	-	-	-	**-**	231
	Nethertown	Collecting winkles	-	-	-	-	-	**-**	
209	Ravenglass	Collecting cockles	-	4	-	-	-	-	-
	Whitehaven South Beach	Collecting winkles	-	-	-	-	-	-	2

Table 10. Adults' intertidal occupancy rates in the aquatic survey area (h y^{-1})

Observation number	Location	Activity	Mud	Mud and sand	Mud, sand and stones	Rock	Salt marsh	Sand	Sand and stones
205	**Ravenglass**	**Walking and boat maintenance**	-	-	**1095**	-	-	-	-
312	Ravenglass	Boat maintenance	-	-	330	-	-	-	-
	Ravenglass Estuary	Wildfowling	-	-	-	-	42	-	-
314	Ravenglass	Boat maintenance	-	-	330	-	-	-	-
	Ravenglass Estuary	Wildfowling	-	-	-	-	42	-	-
151	Lower reaches of River Ehen	Angling	-	-	135	-	-	-	-
	Braystones	Walking	-	-	-	-	-	90	-
155	Ravenglass	Collecting crabs	-	-	38	-	-	-	-
	Seascale	Dog walking	-	-	-	-	-	300	-
	Drigg	Bait digging	-	-	-	-	-		-
	Seascale	**Angling**	-	-	-	-	-	-	**580**
182	River Ehen	Angling	-	-	16	-	-	-	-
	Nethertown	Collecting razor shells	-	-	-	-	-	2	-
	Parton to Tarn Bay	Riding a quad bike	-	-	-	-	-	-	416
	Saltom Bay, Nethertown and Ravenglass	Angling	-	-	-	-	-	-	
98	**Parton and Saltom Bay**	**Angling**	-	-	-	**400**	-	-	-
	Whitehaven Outer Harbour	Bait digging	-	-	-	-	-	46	-
202	Kokoarrah Scar	Hooking for crabs	-	-	-	12	-	-	-
	Drigg	Collecting winkles	-	-	-	-	-	-	140
	Nethertown	Beachcombing	-	-	-	-	-	-	
159	Kokoarrah Scar	Hooking for crabs	-	-	-	6	-	-	-
	Seascale	Dog walking	-	-	-	-	-	277	-
	Drigg	Bait digging	-	-	-	-	-		-
	Seascale	Angling	-	-	-	-	-	-	162
	Drigg	Collecting winkles and mussels	-	-	-	-	-	-	
253	**Saltcoats**	**Tending livestock**	-	-	-	-	**312**	-	-
255	**Saltcoats**	**Tending livestock**	-	-	-	-	**312**	-	-
382	Eskmeals Nature Reserve	Walking	-	-	-	-	52	156	-
339	Ravenglass Estuary	Walking	-	-	-	-	4	-	-
241	**Braystones**	**Setting nets**	-	-	-	-	-	**875**	-
197	**Seascale to Drigg**	**Dog walking**	-	-	-	-	-	**788**	-
196	**Seascale to Drigg**	**Dog walking**	-	-	-	-	-	**730**	-
229	**Drigg**	**Dog walking**	-	-	-	-	-	**639**	-

Table 10. Adults' intertidal occupancy rates in the aquatic survey area (h y^{-1})

Observation number	Location	Activity	Mud	Mud and sand	Mud, sand and stones	Rock	Salt marsh	Sand	Sand and stones
324	**Drigg**	**Dog walking**	-	-	-	-	-	**548**	-
179	**Seascale**	**Dog walking**	-	-	-	-	-	**548**	-
195	**Seascale to Drigg**	**Dog walking**	-	-	-	-	-	**548**	-
194	**Seascale to Drigg**	**Dog walking**	-	-	-	-	-	**520**	-
283	**Drigg**	**Dog walking**	-	-	-	-	-	**456**	-
180	**Braystones**	**Dog walking**	-	-	-	-	-	**400**	-
	Sellafield	Dog walking	-	-	-	-	-	**-**	330
181	**Braystones**	**Dog walking**	-	-	-	-	-	**400**	-
	Sellafield	Dog walking	-	-	-	-	-	**-**	330
342	**Seascale**	**Playing and dog walking**	-	-	-	-	-	**395**	-
269	**Eskmeals**	**Dog walking**	-	-	-	-	-	**365**	-
347	**Braystones to Sellafield**	**Dog walking**	-	-	-	-	-	**365**	-
313	**Seascale to Drigg**	**Dog walking**	-	-	-	-	-	**365**	-
198	**Seascale to Drigg**	**Dog walking**	-	-	-	-	-	**365**	-
240	**Braystones and Sellafield**	**Setting nets**	-	-	-	-	-	**360**	-
	Parton to Drigg	**Collecting winkles**	-	-	-	-	-	**-**	**791**
129	Whitehaven Outer Harbour	Bait digging	-	-	-	-	-	309	-
	Drigg and Ravenglass	Angling	-	-	-	-	-		-
	St Bees	Collecting winkles	-	-	-	-	-		-
	Parton	Dog walking, setting pots on the shore and angling	-	-	-	-	-	-	451
86	St Bees	Dog walking	-	-	-	-	-	300	-
187	Braystones	Collecting razor shells, bait digging, playing and walking	-	-	-	-	-	260	-
	Braystones	Collecting seaweed and crabs	-	-	-	-	-	-	214
	Nethertown, Braystones and Sellafield	Angling	-	-	-	-	-	-	
	Braystones and Sellafield	Beachcombing	-	-	-	-	-	-	
156	Seascale	Dog walking	-	-	-	-	-	250	-
199	Seascale to Drigg	Dog walking	-	-	-	-	-	243	-
271	Seascale and Drigg	Dog walking	-	-	-	-	-	240	-
272	Seascale and Drigg	Dog walking	-	-	-	-	-	240	-
284	Eskmeals	Dog walking	-	-	-	-	-	228	-
35	St Bees	Dog walking	-	-	-	-	-	225	-

Table 10. Adults' intertidal occupancy rates in the aquatic survey area (h y^{-1})

Observation number	Location	Activity	Mud	Mud and sand	Mud, sand and stones	Rock	Salt marsh	Sand	Sand and stones
235	Braystones	Setting nets and walking	-	-	-	-	-	196	-
	St Bees to Drigg	Angling	-	-	-	-	-	-	68
270	Eskmeals	Dog walking	-	-	-	-	-	188	-
346	Seascale	Dog walking	-	-	-	-	-	183	-
348	Seascale	Dog walking	-	-	-	-	-	183	-
282	Drigg	Angling	-	-	-	-	-	182	-
	Nethertown and Drigg	Bait digging	-	-	-	-	-		-
	Nethertown	Angling	-	-	-	-	-	-	83
293	Drigg	Dog walking	-	-	-	-	-	175	-
294	Drigg	Dog walking	-	-	-	-	-	175	-
200	St Bees to Braystones	Dog walking	-	-	-	-	-	150	46
201	St Bees to Braystones	Dog walking	-	-	-	-	-	150	46
74	Whitehaven Outer Harbour	Dog walking	-	-	-	-	-	150	-
335	Seascale and Drigg	Walking	-	-	-	-	-	150	-
336	Seascale and Drigg	Walking	-	-	-	-	-	150	-
236	Braystones	Playing	-	-	-	-	-	148	-
	St Bees to Drigg	Angling	-	-	-	-	-	-	216
	Parton to Drigg	Collecting winkles	-	-	-	-	-	-	
125	St Bees, Coulderton, Nethertown and Ravenglass	Walking	-	-	-	-	-	134	-
	Parton	Walking	-	-	-	-	-	-	52
36	St Bees	Dog walking	-	-	-	-	-	130	-
37	St Bees	Dog walking	-	-	-	-	-	130	-
233	Drigg	Walking	-	-	-	-	-	122	-
175	Seascale	Playing	-	-	-	-	-	120	-
176	Seascale	Playing	-	-	-	-	-	120	-
42	St Bees	Dog walking	-	-	-	-	-	117	-
73	Whitehaven Outer Harbour	Dog walking	-	-	-	-	-	100	-
232	Drigg	Dog walking	-	-	-	-	-	100	-
152	Braystones	Walking	-	-	-	-	-	90	-
172	Seascale	Dog walking	-	-	-	-	-	90	-
131	Whitehaven Outer Harbour	Bait digging	-	-	-	-	-	88	-
	Parton	Angling	-	-	-	-	-	-	188
275	Drigg	Dog walking	-	-	-	-	-	78	-

Table 10. Adults' intertidal occupancy rates in the aquatic survey area (h y^{-1})

Observation number	Location	Activity	Mud	Mud and sand	Mud, sand and stones	Rock	Salt marsh	Sand	Sand and stones
276	Drigg	Dog walking	-	-	-	-	-	78	-
277	Drigg	Dog walking	-	-	-	-	-	78	-
142	Drigg	Horse riding	-	-	-	-	-	75	-
307	Drigg	Dog walking	-	-	-	-	-	65	-
308	Drigg	Dog walking	-	-	-	-	-	65	-
136	Drigg	Dog walking	-	-	-	-	-	63	-
137	Drigg	Dog walking	-	-	-	-	-	63	-
278	Seascale and Drigg	Playing	-	-	-	-	-	60	-
279	Seascale and Drigg	Playing	-	-	-	-	-	60	-
378	Seascale to Drigg	Walking	-	-	-	-	-	52	-
379	Seascale to Drigg	Walking	-	-	-	-	-	52	-
188	Braystones	Playing and walking	-	-	-	-	-	48	-
285	Seascale and Drigg	Walking	-	-	-	-	-	40	-
286	Seascale and Drigg	Walking	-	-	-	-	-	40	-
216	Drigg	Walking	-	-	-	-	-	36	-
217	Drigg	Walking	-	-	-	-	-	36	-
218	Drigg	Walking	-	-	-	-	-	36	-
221	Drigg	Walking	-	-	-	-	-	36	-
222	Drigg	Walking	-	-	-	-	-	36	-
223	Drigg	Walking	-	-	-	-	-	36	-
81	St Bees	Playing	-	-	-	-	-	35	-
82	St Bees	Playing	-	-	-	-	-	35	-
38	St Bees	Walking	-	-	-	-	-	30	-
39	St Bees	Walking	-	-	-	-	-	30	-
302	Drigg	Walking	-	-	-	-	-	30	-
343	Seascale	Playing	-	-	-	-	-	30	-
83	St Bees	Playing	-	-	-	-	-	30	-
300	Drigg	Walking	-	-	-	-	-	26	-
301	Drigg	Walking	-	-	-	-	-	26	-
375	Seascale and Drigg	Walking	-	-	-	-	-	24	-
376	Seascale to Drigg	Walking	-	-	-	-	-	24	-
75	Whitehaven Outer Harbour	Playing	-	-	-	-	-	16	-
76	Whitehaven Outer Harbour	Playing	-	-	-	-	-	16	-

Table 10. Adults' intertidal occupancy rates in the aquatic survey area (h y^{-1})

Observation number	Location	Activity	Mud	Mud and sand	Mud, sand and stones	Rock	Salt marsh	Sand	Sand and stones
2	Seascale	Playing	-	-	-	-	-	15	-
104	Seascale to Drigg	Horse riding	-	-	-	-	-	12	-
309	Seascale	Playing	-	-	-	-	-	9	-
310	Seascale	Playing	-	-	-	-	-	9	-
328	Drigg	Dog walking	-	-	-	-	-	9	-
329	Drigg	Dog walking	-	-	-	-	-	9	-
214	Drigg	Walking	-	-	-	-	-	4	-
327	Drigg	Walking	-	-	-	-	-	4	-
203	Coulderton	Dog walking	-	-	-	-	-	-	364
88	Whitehaven North Beach	Dog walking	-	-	-	-	-	-	150
87	Whitehaven North Beach	Dog walking	-	-	-	-	-	-	150
61	Parton	Angling	-	-	-	-	-	-	30
121	Drigg	Collecting mussels and winkles	-	-	-	-	-	-	3

Notes

Emboldened observations are the high-rate individuals

The mean intertidal occupancy rate over mud based on 5 high-rate observations is 70 h y^{-1}

The observed 97.5th percentile rate based on 5 observations for mud is 93 h y^{-1}

The mean intertidal occupancy rate over mud and sand based on 8 high-rate observations is 156 h y^{-1}

The observed 97.5th percentile rate based on 16 observations for mud and sand is 224 h y^{-1}

The mean intertidal occupancy rate over mud, sand and stones based on 1 observation is 1095 h y^{-1}

The observed 97.5th percentile rate based on 7 observations for mud, sand and stones is 980 h y^{-1}

The mean intertidal occupancy rate over rock based on 7 high-rate observations is 228 h y^{-1}

The observed 97.5th percentile rate based on 13 observations for rock is 358 h y^{-1}

The mean intertidal occupancy rate over salt marsh based on 2 high-rate observations is 312 h y^{-1}

The observed 97.5th percentile rate based on 7 observations for salt marsh is 312 h y^{-1}

The mean intertidal occupancy rate over sand based on 23 high-rate observations is 553 h y^{-1}

The observed 97.5th percentile rate based on 109 observations for sand is 805 h y^{-1}

The mean intertidal occupancy rate over sand and stones based on 6 high-rate observations is 795 h y^{-1}

The observed 97.5th percentile rate based on 31 observations for sand and stones is 1045 h y^{-1}

Table 11. Children's and infants' intertidal occupancy rates in the aquatic survey area (h y^{-1})

Child age group (6 - 15 years old)

Observation number	Age	Location	Activity	Sand	Sand and stones
273	**10**	**Seascale and Drigg**	**Dog walking**	**240**	-
274	**13**	**Seascale and Drigg**	**Dog walking**	**240**	-
237	**14**	**Braystones**	**Playing**	**148**	-
		St Bees to Drigg	Angling	**-**	136
238	**13**	**Braystones**	**Playing**	**148**	-
		St Bees to Drigg	**Angling**	**-**	**216**
		Parton to Drigg	**Collecting winkles**	**-**	
239	**9**	**Braystones**	**Playing**	**148**	-
		St Bees to Drigg	Angling	**-**	136
177	**6**	**Seascale**	**Playing**	**120**	-
43	**10**	**St Bees**	**Dog walking**	**117**	-
173	**10**	**Seascale**	**Playing**	**90**	-
174	**6**	**Seascale**	**Playing**	**90**	-
144	9	Drigg	Horse riding	75	-
145	11	Drigg	Horse riding	75	-
280	8	Seascale and Drigg	Playing	60	-
219	9	Drigg	Playing	36	-
84	14	St Bees	Playing	30	-
40	9	St Bees	Playing	30	-
41	7	St Bees	Playing	30	-
190	10	Braystones	Playing	24	-
191	9	Braystones	Playing	24	-
189	11	Braystones	Playing	18	-
192	9	Braystones	Playing	18	-
78	11	Whitehaven Outer Harbour	Playing	16	-
77	10	Whitehaven Outer Harbour	Playing	16	-
165	**11**	**Parton**	**Playing**	**-**	**546**
166	**6**	**Parton**	**Playing**	**-**	**546**
167	**12**	**Parton**	**Playing**	**-**	**546**
168	**14**	**Parton**	**Playing**	**-**	**546**

Notes

Emboldened observations are the high-rate individuals

The mean intertidal occupancy rate over sand based on 9 high-rate observations is 149 h y^{-1}

The observed 97.5th percentile rate based on 22 observations for sand is 240 h y^{-1}

The mean intertidal occupancy rate over sand and stones based on 5 high-rate observations is 480 h y^{-1}

The observed 97.5th percentile rate based on 7 observations for sand and stones is 546 h y^{-1}

Table 11. Children's and infants' intertidal occupancy rates in the aquatic survey area (h y^{-1})

Infant age group (0 - 5 years old)

Observation number	Age	Location	Activity	Sand
157	**5**	**Seascale**	**Playing**	**250**
158	**3**	**Seascale**	**Playing**	**250**
178	**4**	**Seascale**	**Playing**	**120**
281	5	Seascale and Drigg	Playing	60
220	0.2	Drigg	Playing	36
85	2	St Bees	Playing	30
344	5	Seascale	Playing	30
345	1	Seascale	Playing	30
193	4	Braystones	Playing	18
3	3	Seascale	Playing	15
4	2	Seascale	Playing	15
5	2	Seascale	Playing	15

Notes

Emboldened observations are the high-rate individuals

The mean intertidal occupancy rate over sand based on 3 high-rate observations is 207 h y^{-1}

The observed 97.5th percentile rate based on 12 observations for sand is 250 h y^{-1}

Table 12. Adults' handling rates of fishing gear and sediment in the aquatic survey area (h y^{-1})

Observation number	Location	Activity	Fishing gear	Sediment
312	**Sellafield to Tarn Bay**	**Handling pots**	**1524**	-
	Ravenglass Estuary	Wildfowling	-	42
314	**Sellafield to Tarn Bay**	**Handling pots**	**1524**	-
	Ravenglass Estuary	Wildfowling	-	42
138	**Parton, Seamill, Nethertown and Braystones**	**Handling nets**	**1290**	-
	Drigg	**Handling pots**		
	Braystones	Bait digging	-	69
	Nethertown	Collecting winkles	-	
	Ravenglass	Collecting mussels	-	
241	**Braystones**	**Handling nets**	**875**	-
209	**Parton to Nethertown**	**Handling pots and nets**	**740**	-
	Ravenglass	Collecting cockles	-	6
	Whitehaven South Beach	Collecting winkles	-	
206	Southern part of the survey area	Handling pots	450	-
139	Nethertown, Parton and Seamill	Handling nets	398	-
234	Braystones and Sellafield	Handling nets	360	-
	Parton to Drigg	**Collecting winkles**	-	**842**
	Whitehaven Outer Harbour to Ravenglass	**Bait digging**	-	
240	Braystones and Sellafield	Handling nets	360	-
	Parton to Drigg	**Collecting winkles**	-	**791**
205	Southern part of the survey area	Handling pots	320	-
44	St Bees to Ravenglass	Handling trawl gear	300	-
47	St Bees to Ravenglass	Handling trawl gear	300	-
70	Parton to Tarn Bay	Handling trawl gear	263	-
71	Parton to Tarn Bay	Handling trawl gear	263	-
48	St Bees to Whitehaven	Handling trawl gear	225	-
50	St Bees to Whitehaven	Handling trawl gear	225	-
53	Parton to Tarn Bay	Handling trawl gear	197	-
54	Parton to Tarn Bay	Handling trawl gear	197	-

Table 12. Adults' handling rates of fishing gear and sediment in the aquatic survey area (h y^{-1})

Observation number	Location	Activity	Fishing gear	Sediment
55	Parton to Tarn Bay	Handling trawl gear	197	-
56	Parton to Tarn Bay	Handling trawl gear	197	-
51	Parton to Tarn Bay	Handling trawl gear	175	-
52	Parton to Tarn Bay	Handling trawl gear	175	-
184	In the survey area	Handling trawl gear	156	-
185	In the survey area	Handling trawl gear	156	-
186	In the survey area	Handling trawl gear	156	-
93	Parton to Tarn Bay	Handling trawl gear	84	-
94	Parton to Tarn Bay	Handling trawl gear	84	-
129	Parton	Handling pots	80	-
	St Bees	Collecting winkles	-	93
	Whitehaven Outer Harbour	Bait digging	-	
164	Off Parton	Handling pots	65	-
	Parton	Collecting mussels and winkles	-	232
	Whitehaven Outer Harbour and Eskmeals	Bait digging	-	
89	Parton to Tarn Bay	Handling trawl gear	53	-
90	Parton to Tarn Bay	Handling trawl gear	53	-
91	Parton to Tarn Bay	Handling trawl gear	53	-
92	Parton to Tarn Bay	Handling trawl gear	53	-
235	Braystones	Handling nets	48	-
203	Coulderton	Handling pots	20	-
316	**Braystones, Eskmeals and Whitehaven Outer Harbour**	**Bait digging**	**-**	**856**
	Nethertown	**Collecting winkles**	**-**	
	Coulderton	**Collecting limpets**	**-**	
259	**Barrow Mouth**	**Collecting crabs**	-	**520**
	St Bees, Nethertown, Drigg and Whitehaven Outer Harbour	**Bait digging**	-	
264	**Barrow Mouth**	**Collecting crabs**	-	**520**
	St Bees, Nethertown, Drigg and Whitehaven Outer Harbour	**Bait digging**	-	

Table 12. Adults' handling rates of fishing gear and sediment in the aquatic survey area (h y^{-1})

Observation number	Location	Activity	Fishing gear	Sediment
242	Drigg and Ravenglass	Bait digging	-	260
	Nethertown	Collecting crabs	-	
	Ravenglass	Collecting mussels	-	
265	St Bees, Nethertown, Drigg and Whitehaven Outer Harbour	Bait digging	-	260
171	Whitehaven Outer Harbour	Bait digging	-	200
162	Whitehaven Outer Harbour	Bait digging	-	173
	Barrow Mouth	Collecting winkles	-	
	Ravenglass	Collecting mussels and cockles	-	
266	Whitehaven Outer Harbour	Bait digging	-	156
187	Braystones	Bait digging and collecting crabs, razor shells and seaweed	-	154
155	Drigg	Bait digging	-	138
	Ravenglass	Collecting crabs	-	
267	Whitehaven Outer Harbour	Bait digging	-	104
268	Whitehaven Outer Harbour	Bait digging	-	104
282	Nethertown and Drigg	Bait digging	-	99
340	Newbiggin Marsh and Carleton Marsh	Wildfowling	-	96
131	Whitehaven Outer Harbour	Bait digging	-	88
236	Parton to Drigg	Collecting winkles	-	80
401	River Irt	Wildfowling	-	63
402	River Irt	Wildfowling	-	63
403	River Irt	Wildfowling	-	63
404	River Irt	Wildfowling	-	63
169	Whitehaven Outer Harbour	Bait digging	-	60
159	Drigg	Bait digging and collecting mussels and winkles	-	58
98	Whitehaven Outer Harbour	Bait digging	-	46
153	Whitehaven Outer Harbour	Bait digging	-	38
202	Drigg	Collecting winkles	-	10

Table 12. Adults' handling rates of fishing gear and sediment in the aquatic survey area (h y^{-1})

Observation number	Location	Activity	Fishing gear	Sediment
121	Drigg	Collecting mussels and winkles	-	3
182	Nethertown	Collecting razor shells	-	2

Notes

Emboldened observations are the high-rate individuals

The mean fishing gear handling rate based on 5 high-rate observations is 1191 h y^{-1}

The observed 97.5th percentile rate based on 35 observations for fishing gear is 1524 h y^{-1}

The mean sediment handling rate based on 5 high-rate observations is 706 h y^{-1}

The observed 97.5th percentile rate based on 35 observations for sediment is 844 h y^{-1}

Table 13. Children's handling rates of sediment in the aquatic survey area (h y^{-1})

Observation number	Age	Location	Activity	Sediment
Child age group (6 - 15 years old)				
238	**13**	**Parton to Drigg**	**Collecting winkles**	**80**

Notes

The emboldened observation is the high-rate individual

The mean sediment handling rate based on the only high-rate observation is 80 h y^{-1}

The observed 97.5th percentile rate is not applicable for 1 observation

Table 14. Aquatic combinations for adults

Observation Number	Consumption rates (kg y^{-1})					Occupancy rates (h y^{-1})							Handling rates (h y^{-1})	
	Fish	Crustaceans	Molluscs	Wildfowl	Salt marsh grazed sheep meat	Mud and sand	Mud, sand and stones	Mud	Rock	Sand	Sand and stones	Salt marsh	Handling fishing gear	Handling sediment
235	**64.51**	**48.59**	**11.79**	-	-	-	-	-	-	196	68	-	48	-
48	**59.88**	1.18	-	-	-	-	-	-	-	-	-	-	225	-
133	**57.77**	9.16	-	-	-	-	-	-	-	-	-	-	-	-
134	**57.77**	9.16	-	-	-	-	-	-	-	-	-	-	-	-
234	**46.71**	13.23	0.68	-	-	51	**-**	**-**	**-**	**360**	**927**	**-**	360	**842**
339	**41.51**	12.26	-	2.09	-	-	-	-	-	-	-	4	-	-
187	**41.00**	3.00	4.00	-	-	-	-	-	-	260	214	-	-	154
138	**38.10**	**52.95**	**7.18**	-	-	12	-	-	-	**1026**	231	-	**1290**	69
164	**34.51**	**20.03**	2.72	-	-	**208**	-	-	100	-	**1398**	-	65	232
232	**34.02**	0.49	0.45	-	-	-	-	-	-	100	-	-	-	-
240	**27.22**	5.90	-	-	-	**-**	**-**	**-**	**-**	**360**	**791**	**-**	360	**791**
98	**26.84**	-	-	-	-	-	-	-	**400**	46	-	-	-	46
99	**26.84**	-	-	-	-	-	-	-	-	-	-	-	-	-
100	**26.84**	-	-	-	-	-	-	-	-	-	-	-	-	-
101	**26.84**	-	-	-	-	-	-	-	-	-	-	-	-	-
102	**26.84**	-	-	-	-	-	-	-	-	-	-	-	-	-
103	**26.84**	-	-	-	-	-	-	-	-	-	-	-	-	-
125	**23.79**	1.87	-	-	-	-	-	-	-	134	52	-	-	-
126	**23.79**	1.87	-	-	-	-	-	-	-	-	-	-	-	-
139	**23.57**	-	1.18	-	-	-	-	-	-	-	-	-	398	-
153	18.99	3.30	0.45	-	-	38	-	-	**150**	-	**600**	-	-	38
205	17.69	**17.71**	-	-	-	-	**1095**	-		-	-	-	320	-
162	17.69	-	2.27	-	-	**164**	-	-	**214**	-	419	-	-	173
203	17.24	3.52	-	**11.50**	-	-	-	-	-	-	364	-	20	-
242	14.52	-	-	-	-	**80**	20	-	-	100	**476**	-	-	260
54	14.18	**21.32**	-	-	-	-	-	-	-	-	-	-	197	-
55	14.18	**21.32**	-	-	-	-	-	-	-	-	-	-	197	-
56	14.18	**21.32**	-	-	-	-	-	-	-	-	-	-	197	-
209	13.15	**29.35**	0.83	-	-	4	-	-	-	-	2	-	**740**	6
210	13.15	**29.35**	0.33	-	-		-	-	-	-	-	-	-	

Table 14. Aquatic combinations for adults

Observation Number	Consumption rates (kg y^{-1})					Occupancy rates (h y^{-1})							Handling rates (h y^{-1})	
	Fish	Crustaceans	Molluscs	Wildfowl	Salt marsh grazed sheep meat	Mud and sand	Mud, sand and stones	Mud	Rock	Sand	Sand and stones	Salt marsh	Handling fishing gear	Handling sediment
211	13.15	**29.35**	-	-	-	-	-	-	-	-	-	-	-	-
44	11.79	**19.50**	-	-	-	-	-	-	-	-	-	-	300	-
45	11.79	**19.50**	-	-	-	-	-	-	-	-	-	-	-	-
46	11.79	**19.50**	-	-	-	-	-	-	-	-	-	-	-	-
268	10.26	-	-	-	-	**104**	-	-	**156**	312	-	-	-	104
202	8.16	6.60	**4.44**	-	-	-	-	-	12	-	140	-	-	10
259	7.71	5.17	-	-	-	65	**-**	**-**	**260**	**611**	**-**	**-**	-	**520**
155	7.26	-	-	-	-		38	-	-	300	**580**	-	-	138
253	7.23	2.79	-	-	-	-	-	-	-	-	-	**312**	-	-
266	6.87	-	-	-	-	**156**	-	-	48	156	-	-	-	156
312	5.94	10.03	-	2.81	-	-	**330**	-	-	-	-	42	**1524**	42
313	5.94	10.03	-	2.81	-	-	-	-	-	**365**	-	-	-	-
314	5.94	10.03	-	2.81	-	-	**330**	-	-	-	-	42	**1524**	42
229	1.96	0.55	-	-	-	-	-	-	-	**639**	-	-	-	-
71	-	**47.89**	-	-	-	-	-	-	-	-	-	-	263	-
72	-	**47.89**	-	-	-	-	-	-	-	-	-	-	-	-
135	-	**23.59**	-	-	-	-	-	-	-	-	-	-	-	-
317	-	-	**12.82**	-	-	-	-	-	-	-	-	-	-	-
316	-	-	0.41	-	-	**234**	**-**	**-**	**-**	**843**	154	**-**	-	**856**
253	-	-	-	-	**1.9**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
151	-	-	-	-	-	-	**135**	-	-	90	-	-	-	-
171	-	-	-	-	-	**200**	-	-	40	-	220	-	-	200
179	-	-	-	-	-	-	-	-	-	**548**	-	-	-	-
180	-	-	-	-	-	-	-	-	-	**400**	330	-	-	-
181	-	-	-	-	-	-	-	-	-	**400**	330	-	-	-
194	-	-	-	-	-	-	-	-	-	**520**	-	-	-	-
195	-	-	-	-	-	-	-	-	-	**548**	-	-	-	-
196	-	-	-	-	-	-	-	-	-	**730**	-	-	-	-
197	-	-	-	-	-	-	-	-	-	**788**	-	-	-	-
198	-	-	-	-	-	-	-	-	-	**365**	-	-	-	-

Table 14. Aquatic combinations for adults

Observation Number	Consumption rates (kg y^{-1})					Occupancy rates (h y^{-1})							Handling rates (h y^{-1})	
	Fish	Crustaceans	Molluscs	Wildfowl	Salt marsh grazed sheep meat	Mud and sand	Mud, sand and stones	Mud	Rock	Sand	Sand and stones	Salt marsh	Handling fishing gear	Handling sediment
241	-	-	-	-	-	-	-	-	-	**875**	-	-	**875**	-
255	-	-	-	-	-	-	-	-	-	-	-	**312**	-	-
264	-	-	-	-	-	65	**-**	**-**	**260**	**611**	**-**	**-**	-	**520**
265	-	-	-	-	-	65	-	-	-	**611**	-	-	-	260
267	-	-	-	-	-	**104**	-	-	**156**	312	-	-	-	104
269	-	-	-	-	-	-	-	-	-	**365**	-	-	-	-
283	-	-	-	-	-	-	-	-	-	**456**	-	-	-	-
324	-	-	-	-	-	-	-	-	-	**548**	-	-	-	-
340	-	-	-	**16.80**	-	-	-	**96**	-	-	-	78	-	96
342	-	-	-	-	-	-	-	-	-	**395**	-	-	-	-
347	-	-	-	-	-	-	-	-	-	**365**	-	-	-	-
401	-	-	-	-	-	-	-	**63**	-	-	-	-	-	63
402	-	-	-	-	-	-	-	**63**	-	-	-	-	-	63
403	-	-	-	-	-	-	-	**63**	-	-	-	-	-	63
404	-	-	-	-	-	-	-	**63**	-	-	-	-	-	63

Notes

Values in high-rate groups are emboldened

Annex 1. Adults' consumption rates (kg y^{-1}), intertidal occupancy rates and handling rates (h y^{-1}) in the aquatic survey area

Observation number[a]	Sex	Age (years)	Fish	Crustaceans	Molluscs	Wildfowl	Salt marsh grazed sheep meat	Intertidal occupancy over mud	Intertidal occupancy over mud and sand	Intertidal occupancy over mud, sand and stones	Intertidal occupancy over rock	Intertidal occupancy over salt marsh	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling fishing gear	Handling sediment
2	F	U	-	-	-	-	-	-	-	-	-	-	15	-	-	-
35	M	U	-	-	-	-	-	-	-	-	-	-	225	-	-	-
36	M	U	-	-	-	-	-	-	-	-	-	-	130	-	-	-
37	F	U	-	-	-	-	-	-	-	-	-	-	130	-	-	-
38	M	U	-	-	-	-	-	-	-	-	-	-	30	-	-	-
39	F	U	-	-	-	-	-	-	-	-	-	-	30	-	-	-
42	F	U	-	-	-	-	-	-	-	-	-	-	117	-	-	-
44	M	U	11.8	**19.5**	-	-	-	-	-	-	-	-	-	-	300	-
45	F	U	11.8	**19.5**	-	-	-	-	-	-	-	-	-	-	-	-
46	M	U	11.8	**19.5**	-	-	-	-	-	-	-	-	-	-	-	-
47	M	U	-	-	-	-	-	-	-	-	-	-	-	-	300	-
48	M	U	**59.9**	1.2	-	-	-	-	-	-	-	-	-	-	225	-
49	F	U	-	15.0	-	-	-	-	-	-	-	-	-	-	-	-
50	M	U	-	-	-	-	-	-	-	-	-	-	-	-	225	-
51	M	U	-	1.7	-	-	-	-	-	-	-	-	-	-	175	-
52	M	U	-	-	-	-	-	-	-	-	-	-	-	-	175	-
53	M	U	-	-	-	-	-	-	-	-	-	-	-	-	197	-
54	M	U	14.2	**21.3**	-	-	-	-	-	-	-	-	-	-	197	-
55	M	U	14.2	**21.3**	-	-	-	-	-	-	-	-	-	-	197	-
56	M	U	14.2	**21.3**	-	-	-	-	-	-	-	-	-	-	197	-
57	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-
58	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-
59	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-
61	M	U	3.0	-	-	-	-	-	-	-	-	-	-	30	-	-
62	F	U	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-
63	M	21	6.5	-	-	-	-	-	-	-	-	-	-	-	-	-

Annex 1. Adults' consumption rates (kg y^{-1}), intertidal occupancy rates and handling rates (h y^{-1}) in the aquatic survey area

Observation number[a]	Sex	Age (years)	Fish	Crustaceans	Molluscs	Wildfowl	Salt marsh grazed sheep meat	Intertidal occupancy over mud	Intertidal occupancy over mud and sand	Intertidal occupancy over mud, sand and stones	Intertidal occupancy over rock	Intertidal occupancy over salt marsh	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling fishing gear	Handling sediment
64	M	21	6.5	-	-	-	-	-	-	-	-	-	-	-	-	-
65	M	U	5.2	-	-	-	-	-	-	-	-	-	-	-	-	-
66	F	U	5.2	-	-	-	-	-	-	-	-	-	-	-	-	-
70	M	U	-	-	-	-	-	-	-	-	-	-	-	-	263	-
71	M	U	-	**47.9**	-	-	-	-	-	-	-	-	-	-	263	-
72	F	U	-	**47.9**	-	-	-	-	-	-	-	-	-	-	-	-
73	M	U	-	-	-	-	-	-	-	-	-	-	100	-	-	-
74	F	U	-	-	-	-	-	-	-	-	-	-	150	-	-	-
75	F	U	-	-	-	-	-	-	-	-	-	-	16	-	-	-
76	F	U	-	-	-	-	-	-	-	-	-	-	16	-	-	-
79	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-
80	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-
81	F	U	-	-	-	-	-	-	-	-	-	-	35	-	-	-
82	M	U	-	-	-	-	-	-	-	-	-	-	35	-	-	-
83	M	16	-	-	-	-	-	-	-	-	-	-	30	-	-	-
86	F	48	-	-	-	-	-	-	-	-	-	-	300	-	-	-
87	M	55	-	-	-	-	-	-	-	-	-	-	-	150	-	-
88	M	U	-	-	-	-	-	-	-	-	-	-	-	150	-	-
89	M	U	1.5	-	-	-	-	-	-	-	-	-	-	-	53	-
90	M	U	1.5	-	-	-	-	-	-	-	-	-	-	-	53	-
91	M	U	1.5	-	-	-	-	-	-	-	-	-	-	-	53	-
92	M	U	-	1.5	-	-	-	-	-	-	-	-	-	-	53	-
93	M	U	-	-	-	-	-	-	-	-	-	-	-	-	84	-
94	M	U	10.5	-	-	-	-	-	-	-	-	-	-	-	84	-
95	F	U	10.5	-	-	-	-	-	-	-	-	-	-	-	-	-
96	M	U	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-
97	F	U	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-

Annex 1. Adults' consumption rates (kg y^{-1}), intertidal occupancy rates and handling rates (h y^{-1}) in the aquatic survey area

Observation number[a]	Sex	Age (years)	Fish	Crustaceans	Molluscs	Wildfowl	Salt marsh grazed sheep meat	Intertidal occupancy over mud	Intertidal occupancy over mud and sand	Intertidal occupancy over mud, sand and stones	Intertidal occupancy over rock	Intertidal occupancy over salt marsh	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling fishing gear	Handling sediment
98	M	28	**26.8**	-	-	-	-	-	-	-	**400**	-	46	-	-	46
99	F	28	**26.8**	-	-	-	-	-	-	-	-	-	-	-	-	-
100	M	55	**26.8**	-	-	-	-	-	-	-	-	-	-	-	-	-
101	F	56	**26.8**	-	-	-	-	-	-	-	-	-	-	-	-	-
102	M	61	**26.8**	-	-	-	-	-	-	-	-	-	-	-	-	-
103	F	63	**26.8**	-	-	-	-	-	-	-	-	-	-	-	-	-
104	F	U	-	-	-	-	-	-	-	-	-	-	12	-	-	-
115	M	U	-	-	-	1.4	-	-	-	-	-	-	-	-	-	-
116	M	U	-	-	-	1.4	-	-	-	-	-	-	-	-	-	-
121	F	U	-	-	0.5	-	-	-	-	-	-	-	-	3	-	3
125	M	71	**23.8**	1.9	-	-	-	-	-	-	-	-	134	52	-	-
126	F	68	**23.8**	1.9	-	-	-	-	-	-	-	-	-	-	-	-
127	F	U	1.1	-	-	-	-	-	-	-	-	-	-	-	-	-
129	M	76	13.7	5.0	2.0	-	-	-	-	-	-	-	309	451	80	93
130	F	74	13.7	5.0	-	-	-	-	-	-	-	-	-	-	-	-
131	M	54	13.0	5.0	-	-	-	-	-	-	-	-	88	188	-	88
132	F	52	13.0	5.0	-	-	-	-	-	-	-	-	-	-	-	-
133	M	73	**57.8**	9.2	-	-	-	-	-	-	-	-	-	-	-	-
134	F	74	**57.8**	9.2	-	-	-	-	-	-	-	-	-	-	-	-
135	F	43	-	**23.6**	-	-	-	-	-	-	-	-	-	-	-	-
136	F	56	-	-	-	-	-	-	-	-	-	-	63	-	-	-
137	M	60	-	-	-	-	-	-	-	-	-	-	63	-	-	-
138	M	U	**38.1**	**53.0**	**7.2**	-	-	-	12	-	-	-	**1026**	231	**1290**	69
139	M	U	**23.6**	-	1.2	-	-	-	-	-	-	-	-	-	398	-
140	F	U	-	1.7	-	-	-	-	-	-	-	-	-	-	-	-
142	F	U	-	-	-	-	-	-	-	-	-	-	75	-	-	-
151	M	67	-	-	-	-	-	-	-	135	-	-	90	-	-	-

Annex 1. Adults' consumption rates (kg y^{-1}), intertidal occupancy rates and handling rates (h y^{-1}) in the aquatic survey area

Observation number[a]	Sex	Age (years)	Fish	Crustaceans	Molluscs	Wildfowl	Salt marsh grazed sheep meat	Intertidal occupancy over mud	Intertidal occupancy over mud and sand	Intertidal occupancy over mud, sand and stones	Intertidal occupancy over rock	Intertidal occupancy over salt marsh	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling fishing gear	Handling sediment
152	F	54	-	-	-	-	-	-	-	-	-	-	90	-	-	-
153	M	61	19.0	3.3	0.5	-	-	-	38	-	**150**	-	-	**600**	-	38
154	F	62	19.0	3.3	0.5	-	-	-	-	-	-	-	-	-	-	-
155	M	34	7.3	-	-	-	-	-	-	38	-	-	300	**580**	-	138
156	F	36	7.3	-	-	-	-	-	-	-	-	-	250	-	-	-
159	M	50	5.7	1.1	0.5	-	-	-	-	-	6	-	277	162	-	58
160	F	48	5.7	1.1	0.5	-	-	-	-	-	-	-	-	-	-	-
161	M	19	5.7	1.1	0.5	-	-	-	-	-	-	-	-	-	-	-
162	M	62	17.7	-	2.3	-	-	-	**164**	-	**214**	-	-	419	-	173
163	F	59	17.7	-	2.3	-	-	-	-	-	-	-	-	-	-	-
164	M	67	**34.5**	**20.0**	2.7	-	-	-	**208**	-	100	-	-	**1398**	65	232
169	M	45	6.8	4.1	-	-	-	-	60	-	30	-	-	120	-	60
170	F	44	6.8	4.1	-	-	-	-	-	-	-	-	-	-	-	-
171	M	21	-	-	-	-	-	-	**200**	-	40	-	-	220	-	200
172	M	32	-	-	-	-	-	-	-	-	-	-	90	-	-	-
175	M	30	-	-	-	-	-	-	-	-	-	-	120	-	-	-
176	F	29	-	-	-	-	-	-	-	-	-	-	120	-	-	-
179	F	67	-	-	-	-	-	-	-	-	-	-	**548**	-	-	-
180	F	49	-	-	-	-	-	-	-	-	-	-	**400**	330	-	-
181	F	27	-	-	-	-	-	-	-	-	-	-	**400**	330	-	-
182	M	32	7.3	-	0.2	-	-	-	-	16	-	-	2	416	-	2
183	F	36	7.3	-	0.2	-	-	-	-	-	-	-	-	-	-	-
184	M	U	9.1	5.9	-	-	-	-	-	-	-	-	-	-	156	-
185	M	U	9.1	5.9	-	-	-	-	-	-	-	-	-	-	156	-
186	M	U	9.1	5.9	-	-	-	-	-	-	-	-	-	-	156	-
187	M	58	**41.0**	3.0	4.0	-	-	-	-	-	-	-	260	214	-	154
188	F	57	20.5	2.0	1.0	-	-	-	-	-	-	-	48	-	-	-

Annex 1. Adults' consumption rates (kg y^{-1}), intertidal occupancy rates and handling rates (h y^{-1}) in the aquatic survey area

Observation number[a]	Sex	Age (years)	Fish	Crustaceans	Molluscs	Wildfowl	Salt marsh grazed sheep meat	Intertidal occupancy over mud	Intertidal occupancy over mud and sand	Intertidal occupancy over mud, sand and stones	Intertidal occupancy over rock	Intertidal occupancy over salt marsh	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling fishing gear	Handling sediment
194	F	35	-	-	-	-	-	-	-	-	-	-	**520**	-	-	-
195	M	45	-	-	-	-	-	-	-	-	-	-	**548**	-	-	-
196	F	44	-	-	-	-	-	-	-	-	-	-	**730**	-	-	-
197	M	63	-	-	-	-	-	-	-	-	-	-	**788**	-	-	-
198	F	41	-	-	-	-	-	-	-	-	-	-	**365**	-	-	-
199	M	36	-	-	-	-	-	-	-	-	-	-	243	-	-	-
200	M	24	-	-	-	-	-	-	-	-	-	-	150	46	-	-
201	F	33	-	-	-	-	-	-	-	-	-	-	150	46	-	-
202	M	77	8.2	6.6	**4.4**	-	-	-	-	-	12	-	-	140	-	10
203	M	65	17.2	3.5	-	**11.5**	-	-	-	-	-	-	-	364	20	-
204	F	52	17.2	3.5	-	-	-	-	-	-	-	-	-	-	-	-
205	M	81	17.7	**17.7**	-	-	-	-	-	**1095**	-	-	-	-	320	-
206	M	U	15.0	-	-	-	-	-	-	-	-	-	-	-	450	-
207	F	U	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-
208	F	U	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-
209	M	48	13.2	**29.4**	0.8	-	-	-	4	-	-	-	-	2	**740**	6
210	F	48	13.2	**29.4**	0.3	-	-	-	-	-	-	-	-	-	-	-
211	F	18	13.2	**29.4**	-	-	-	-	-	-	-	-	-	-	-	-
214	F	65	0.5	-	-	-	-	-	-	-	-	-	4	-	-	-
215	M	81	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-
216	F	30	-	-	-	-	-	-	-	-	-	-	36	-	-	-
217	M	24	-	-	-	-	-	-	-	-	-	-	36	-	-	-
218	F	36	-	-	-	-	-	-	-	-	-	-	36	-	-	-
221	M	64	-	-	-	-	-	-	-	-	-	-	36	-	-	-
222	F	60	-	-	-	-	-	-	-	-	-	-	36	-	-	-
223	M	54	-	-	-	-	-	-	-	-	-	-	36	-	-	-
229	M	77	2.0	0.5	-	-	-	-	-	-	-	-	**639**	-	-	-

Annex 1. Adults' consumption rates (kg y^{-1}), intertidal occupancy rates and handling rates (h y^{-1}) in the aquatic survey area

Observation number[a]	Sex	Age (years)	Fish	Crustaceans	Molluscs	Wildfowl	Salt marsh grazed sheep meat	Intertidal occupancy over mud	Intertidal occupancy over mud and sand	Intertidal occupancy over mud, sand and stones	Intertidal occupancy over rock	Intertidal occupancy over salt marsh	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling fishing gear	Handling sediment
230	F	77	2.0	0.5	-	-	-	-	-	-	-	-	-	-	-	-
231	M	74	8.2	0.5	0.5	-	-	-	-	-	-	-	-	-	-	-
232	F	72	**34.0**	0.5	0.5	-	-	-	-	-	-	-	100	-	-	-
233	F	76	-	-	-	-	-	-	-	-	-	-	122	-	-	-
234	M	65	**46.7**	13.2	0.7	-	-	-	51	-	-	-	**360**	**927**	360	**842**
235	F	61	**64.5**	**48.6**	**11.8**	-	-	-	-	-	-	-	196	68	48	-
236	M	16	8.2	2.5	-	-	-	-	-	-	-	-	148	216	-	80
240	M	29	**27.2**	5.9	-	-	-	-	-	-	-	-	**360**	**791**	360	**791**
241	M	53	-	-	-	-	-	-	-	-	-	-	**875**	-	**875**	-
242	M	U	14.5	-	-	-	-	-	**80**	20	-	-	100	**476**	-	260
243	F	U	3.6	-	-	-	-	-	-	-	-	-	-	-	-	-
253	M	54	7.2	2.8	-	-	**1.9**	-	-	-	-	**312**	-	-	-	-
254	F	51	7.2	2.8	-	-	**1.9**	-	-	-	-	-	-	-	-	-
255	M	31	-	-	-	-	**1.9**	-	-	-	-	**312**	-	-	-	-
256	F	U	-	-	-	-	**1.9**	-	-	-	-	-	-	-	-	-
257	F	23	-	-	-	-	**1.9**	-	-	-	-	-	-	-	-	-
258	F	21	-	-	-	-	**1.9**	-	-	-	-	-	-	-	-	-
259	M	45	7.7	5.2	-	-	-	-	65	-	**260**	-	**611**	-	-	**520**
260	F	47	7.7	5.2	-	-	-	-	-	-	-	-	-	-	-	-
261	F	26	7.7	0.9	-	-	-	-	-	-	-	-	-	-	-	-
262	F	22	7.7	0.9	-	-	-	-	-	-	-	-	-	-	-	-
263	M	28	7.7	0.9	-	-	-	-	-	-	-	-	-	-	-	-
264	M	42	-	-	-	-	-	-	65	-	**260**	-	**611**	-	-	**520**
265	M	69	-	-	-	-	-	-	65	-	-	-	**611**	-	-	260
266	M	66	6.9	-	-	-	-	-	**156**	-	48	-	156	-	-	156
267	M	68	-	-	-	-	-	-	**104**	-	**156**	-	312	-	-	104
268	M	49	10.3	-	-	-	-	-	**104**	-	**156**	-	312	-	-	104

Annex 1. Adults' consumption rates (kg y^{-1}), intertidal occupancy rates and handling rates (h y^{-1}) in the aquatic survey area

Observation number[a]	Sex	Age (years)	Fish	Crustaceans	Molluscs	Wildfowl	Salt marsh grazed sheep meat	Intertidal occupancy over mud	Intertidal occupancy over mud and sand	Intertidal occupancy over mud, sand and stones	Intertidal occupancy over rock	Intertidal occupancy over salt marsh	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling fishing gear	Handling sediment
269	M	66	-	-	-	-	-	-	-	-	-	-	**365**	-	-	-
270	F	49	-	-	-	-	-	-	-	-	-	-	188	-	-	-
271	M	45	-	-	-	-	-	-	-	-	-	-	240	-	-	-
272	F	42	-	-	-	-	-	-	-	-	-	-	240	-	-	-
275	F	25	-	-	-	-	-	-	-	-	-	-	78	-	-	-
276	F	26	-	-	-	-	-	-	-	-	-	-	78	-	-	-
277	F	23	-	-	-	-	-	-	-	-	-	-	78	-	-	-
278	M	47	-	-	-	-	-	-	-	-	-	-	60	-	-	-
279	F	43	-	-	-	-	-	-	-	-	-	-	60	-	-	-
282	M	52	9.3	-	-	-	-	-	-	-	-	-	182	83	-	99
283	M	61	-	-	-	-	-	-	-	-	-	-	**456**	-	-	-
284	F	32	-	-	-	-	-	-	-	-	-	-	228	-	-	-
285	F	74	3.4	-	-	-	-	-	-	-	-	-	40	-	-	-
286	M	75	3.4	-	-	-	-	-	-	-	-	-	40	-	-	-
293	F	U	-	-	-	-	-	-	-	-	-	-	175	-	-	-
294	M	U	-	-	-	-	-	-	-	-	-	-	175	-	-	-
300	F	68	-	-	-	-	-	-	-	-	-	-	26	-	-	-
301	M	72	-	-	-	-	-	-	-	-	-	-	26	-	-	-
302	M	50	-	-	-	-	-	-	-	-	-	-	30	-	-	-
307	F	53	-	-	-	-	-	-	-	-	-	-	65	-	-	-
308	M	58	-	-	-	-	-	-	-	-	-	-	65	-	-	-
309	M	77	-	-	-	-	-	-	-	-	-	-	9	-	-	-
310	F	76	-	-	-	-	-	-	-	-	-	-	9	-	-	-
312	M	53	5.9	10.0	-	2.8	-	-	-	330	-	42	-	-	**1524**	42
313	F	50	5.9	10.0	-	2.8	-	-	-	-	-	-	**365**	-	-	-
314	M	17	5.9	10.0	-	2.8	-	-	-	330	-	42	-	-	**1524**	42
316	M	U	-	-	0.4	-	-	-	**234**	-	-	-	**843**	154	-	**856**

Annex 1. Adults' consumption rates (kg y^{-1}), intertidal occupancy rates and handling rates (h y^{-1}) in the aquatic survey area

Observation number[a]	Sex	Age (years)	Fish	Crustaceans	Molluscs	Wildfowl	Salt marsh grazed sheep meat	Intertidal occupancy over mud	Intertidal occupancy over mud and sand	Intertidal occupancy over mud, sand and stones	Intertidal occupancy over rock	Intertidal occupancy over salt marsh	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling fishing gear	Handling sediment
317	F	U	-	-	**12.8**	-	-	-	-	-	-	-	-	-	-	-
318	F	U	-	-	1.3	-	-	-	-	-	-	-	-	-	-	-
319	M	U	-	-	1.3	-	-	-	-	-	-	-	-	-	-	-
324	F	U	-	-	-	-	-	-	-	-	-	-	**548**	-	-	-
327	F	U	-	-	-	-	-	-	-	-	-	-	4	-	-	-
328	M	70	-	-	-	-	-	-	-	-	-	-	9	-	-	-
329	F	74	-	-	-	-	-	-	-	-	-	-	9	-	-	-
335	M	U	-	-	-	-	-	-	-	-	-	-	150	-	-	-
336	F	U	-	-	-	-	-	-	-	-	-	-	150	-	-	-
339	M	U	**41.5**	12.3	-	2.1	-	-	-	-	-	4	-	-	-	-
340	M	69	-	-	-	**16.8**	-	**96**	-	-	-	78	-	-	-	96
342	M	30	-	-	-	-	-	-	-	-	-	-	**395**	-	-	-
343	F	32	-	-	-	-	-	-	-	-	-	-	30	-	-	-
346	F	24	-	-	-	-	-	-	-	-	-	-	183	-	-	-
347	M	51	-	-	-	-	-	-	-	-	-	-	**365**	-	-	-
348	M	67	-	-	-	-	-	-	-	-	-	-	183	-	-	-
375	F	U	-	-	-	-	-	-	-	-	-	-	24	-	-	-
376	M	U	-	-	-	-	-	-	-	-	-	-	24	-	-	-
378	F	66	-	-	-	-	-	-	-	-	-	-	52	-	-	-
379	M	U	-	-	-	-	-	-	-	-	-	-	52	-	-	-
382	M	77	-	-	-	-	-	-	-	-	-	52	156	-	-	-
390	M	U	-	-	-	0.3	-	-	-	-	-	-	-	-	-	-
391	F	U	-	-	-	0.3	-	-	-	-	-	-	-	-	-	-
392	M	U	-	-	-	0.3	-	-	-	-	-	-	-	-	-	-
393	F	U	-	-	-	0.3	-	-	-	-	-	-	-	-	-	-
394	M	U	-	-	-	0.3	-	-	-	-	-	-	-	-	-	-
395	F	U	-	-	-	0.3	-	-	-	-	-	-	-	-	-	-

Annex 1. Adults' consumption rates (kg y^{-1}), intertidal occupancy rates and handling rates (h y^{-1}) in the aquatic survey area

Observation number[a]	Sex	Age (years)	Fish	Crustaceans	Molluscs	Wildfowl	Salt marsh grazed sheep meat	Intertidal occupancy over mud	Intertidal occupancy over mud and sand	Intertidal occupancy over mud, sand and stones	Intertidal occupancy over rock	Intertidal occupancy over salt marsh	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling fishing gear	Handling sediment
401	M	U	-	-	-	-	-	**63**	-	-	-	-	-	-	-	63
402	M	U	-	-	-	-	-	**63**	-	-	-	-	-	-	-	63
403	M	U	-	-	-	-	-	**63**	-	-	-	-	-	-	-	63
404	M	U	-	-	-	-	-	**63**	-	-	-	-	-	-	-	63

Notes

Emboldened observations are the high-rate individuals

U - Unknown

[a]Observation numbers are taken directly from the 2012 Low Level Waste Repository (LLWR) habits survey report.

Annex 2. Children's and infants' consumption rates (kg y^{-1}), intertidal occupancy rates and handling rates (h y^{-1}) in the aquatic survey area

Observation number[a]	Sex	Age (years)	Fish	Crustaceans	Molluscs	Wildfowl	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling sediment
Child age group (6 - 15 years old)									
40	F	9	-	-	-	-	30	-	-
41	F	7	-	-	-	-	30	-	-
43	F	10	-	-	-	-	**117**	-	-
68	M	8	**5.2**	-	-	-	-	-	-
69	F	10	**5.2**	-	-	-	-	-	-
77	M	10	-	-	-	-	16	-	-
78	M	11	-	-	-	-	16	-	-
84	M	14	-	-	-	-	30	-	-
144	F	9	-	-	-	-	75	-	-
145	F	11	-	-	-	-	75	-	-
165	M	11	-	-	-	-	-	**546**	-
166	F	6	-	-	-	-	-	**546**	-
167	F	12	-	-	-	-	-	**546**	-
168	F	14	-	-	-	-	-	**546**	-
173	M	10	-	-	-	-	**90**	-	-
174	M	6	-	-	-	-	**90**	-	-
177	F	6	-	-	-	-	**120**	-	-
189	F	11	2.0	-	-	-	18	-	-
190	F	10	2.0	-	**0.1**	-	24	-	-
191	F	9	2.0	-	**0.1**	-	24	-	-
192	M	9	2.0	-	-	-	18	-	-
219	M	9	-	-	-	-	36	-	-
237	M	14	-	-	-	-	**148**	136	-
238	M	13	**8.2**	2.5	-	-	**148**	**216**	**80**
239	F	9	-	-	-	-	**148**	136	-
273	M	10	-	-	-	-	**240**	-	-
274	F	13	-	-	-	-	**240**	**-**	-
280	M	8	-	-	-	-	60	-	-
315	M	15	**5.9**	**10.0**	-	**2.8**	-	**-**	**-**
Infant age group (0 - 5 years old)									
3	M	3	-	-	-	-	15	-	-
4	M	2	-	-	-	-	15	-	-
5	M	2	-	-	-	-	15	-	-
67	F	5	**2.6**	-	-	-	-	-	-
85	F	2	-	-	-	-	30	-	-
157	F	5	**3.6**	-	-	-	**250**	-	-
158	F	3	**3.6**	-	-	-	**250**	-	-
178	F	4	-	-	-	-	**120**	-	-
193	F	4	1.0	-	-	-	18	-	-
220	M	0.2	-	-	-	-	36	-	-

Annex 2. Children's and infants' consumption rates (kg y^{-1}), intertidal occupancy rates and handling rates (h y^{-1}) in the aquatic survey area

Observation number[a]	Sex	Age (years)	Fish	Crustaceans	Molluscs	Wildfowl	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling sediment
281	F	5	-	-	-	-	60	-	-
344	M	5	-	-	-	-	30	-	-
345	F	1	-	-	-	-	30	-	-

Notes

U - Unknown

Emboldened observations are the high-rate individuals

[a]Observation numbers are taken directly from the 2012 Low Level Waste Repository (LLWR) habits survey report.

Annex 3a. Sellafield Fishing Community consumption and intertidal occupancy data reported in AEMR and RIFE (kg y^{-1} and h y^{-1})

Year (report)	FISH					CRUSTACEANS					MOLLUSCS				INTERTIDAL OCCUPANCY		Source of habits data	
	Species Composition	Total	Cod	Plaice	Other fish	Species Composition	Total	Crab	Lobster	*Nephrops*	Species Composition	Total	Winkles	Other molluscs	Substrate	h y^{-1}	Consumption	Occupancy
1994 (AEMR 45)	Plaice and Cod (50%:50%)	26.0	13.0	13.0	0.0	Crabs and Lobsters (65%:35%)	12.0	7.8	4.2	0.0	Winkles and other molluscs (85%:15%)	9.7	8.2	1.5	-	0	1993/94 Survey	-
1995 (RIFE 1)	Plaice and Cod (50%:50%)	26.0	13.0	13.0	0.0	Crabs and Lobsters (75%:25%)	8.6	6.5	2.2	0.0	Winkles and other molluscs (50%:50%)	12.0	6.0	6.0	-	0	1995 Review (crust and moll) and 1993/4 survey (fish)	-
1996 (RIFE 2)	Plaice and Cod (50%:50%)	25.0	12.5	12.5	0.0	Crabs and Lobsters (60%:40%)	12.0	7.2	4.8	0.0	Winkles and other molluscs (60%:40%)	12.0	7.2	4.8	-	0	1995 Review (crust and moll) and 1996 logging data (fish)	-
1997 (RIFE 3)	Plaice and Cod (25%:75%)	37.0	27.8	9.3	0.0	Crabs, Lobsters and *Nephrops* (50%:40%:10%)	17.0	8.5	6.8	1.7	Winkles and other molluscs (40%:60%)	4.2	1.7	2.5	-	0	1997 Review	-
1998 (RIFE 4)	Plaice and Cod (50%:50%)	45.0	22.5	22.5	0.0	Crabs and Lobsters (85%:15%)	28.0	23.8	4.2	0.0	Winkles and other molluscs (30%:70%)	15.0	4.5	10.5	Sand and mollusc beds	1100	1998 Survey	1998 Survey
1999 (RIFE 5)	Plaice and Cod (50%:50%)	43.0	21.5	21.5	0.0	Crabs and Lobsters (80%:20%)	24.0	19.2	4.8	0.0	Winkles and other molluscs (50%:50%)	25.0	12.5	12.5	Sand and mollusc beds	1000	1999 Review	1999 Review
2000 (RIFE 6)	Cod and other fish (40%:60%)	31.0	12.4	0.0	18.6	Crabs, Lobsters and *Nephrops* (40%:40%:20%)	20.0	8.0	8.0	4.0	Winkles and other molluscs (50%:50%)	17.0	8.5	8.5	Sand and mollusc beds	1000	2000 Review	2000 Review
2001 (RIFE 7)	Cod and other fish (40%:60%)	31.0	12.4	0.0	18.6	Crabs, Lobsters and *Nephrops* (40%:40%:20%)	20.0	8.0	8.0	4.0	Winkles and other molluscs (50%:50%)	17.0	8.5	8.5	Sand and mollusc beds	900	2000 Review	2000 Review
2002 (RIFE 8)	Cod and other fish (40%:60%)	51.0	20.4	0.0	30.6	Crabs, Lobsters and *Nephrops* (50%:30%:20%)	16.0	8.0	4.8	3.2	Winkles and mussels (60%:40%)	29.0	17.4	11.6	Mud and sand	1200	2002 Review	2002 Review
2003 (RIFE 9)	Cod and other fish (60%:40%)	41.0	24.6	0.0	16.4	Crabs, Lobsters and *Nephrops* (80%:10%:10%)	27.0	21.6	2.7	2.7	Winkles and other molluscs (40%:60%)	34.0	13.6	20.4	Mud and sand	870	2003 Survey	2003 Survey
2004 (RIFE 10)	Cod and other fish (60%:40%)	41.0	24.6	0.0	16.4	Crabs, Lobsters and *Nephrops* (50%:40%:10%)	25.0	12.5	10.0	2.5	Winkles and other molluscs (50%:50%)	34.0	17.0	17.0	Mud and sand	1000	2004 Review (crust and moll) and 2003 Survey (fish)	2004 Review
2005 (RIFE 11)	Cod and other fish (60%:40%)	41.0	24.6	0.0	16.4	Crabs, Lobsters and *Nephrops* (60%:20%:20%)	20.0	12.0	4.0	4.0	Winkles and other molluscs (60%:40%)	33.0	19.8	13.2	Mud and sand	790	2005 Review (crust and moll) and 2003 Survey (fish)	2005 Review
2006 (RIFE 12)	Cod and other fish (60%:40%)	41.0	24.6	0.0	16.4	Crabs, Lobsters and *Nephrops* (50%:20%:30%)	20.0	10.0	4.0	6.0	Winkles and other molluscs (50%:50%)	40.0	20.0	20.0	Mud and sand	580	2006 Review (crust and moll) and 2003 Survey (fish)	2006 Review
2007 (RIFE 13)	Cod and other fish (60%:40%)	41.0	24.6	0.0	16.4	Crabs, Lobsters and *Nephrops* (50%:30%:20%)	20.4	10.2	6.1	4.1	Winkles and other molluscs (60%:40%)	28.9	17.3	11.6	Mud and sand	830	2007 Review (crust and moll) and 2003 Survey (fish)	2007 Review
2008 (RIFE 14)	Cod and other fish (25%:75%)	40.0	10.0	0.0	30.0	Crabs, Lobsters and *Nephrops* (70%:20%:10%)	16.8	11.8	3.4	1.7	Winkles and other molluscs (50%:50%)	31.4	15.7	15.7	Mud and sand	930	2008 Survey	2008 Survey
2009 (RIFE 15)	Cod and other fish (25%:75%)	40.0	10.0	0.0	30.0	Crabs, Lobsters and *Nephrops* (30%:50%:20%)	16.0	4.8	8	3.2	Winkles and other molluscs (60%:40%)	28.0	16.8	11.2	Mud and sand	960	2009 Review (crust & moll) 2008 Survey (fish)	2009 Review
2010 (RIFE 16)	Cod and other fish (25%:75%)	40.0	10.0	0.0	30.0	Crabs, Lobsters and *Nephrops* (50%:30%:20%)	22.0	11.0	6.6	4.4	Winkles and other molluscs (20%:80%)	22.0	4.4	17.6	Mud and sand	870	2010 Review (crust & moll) 2008 Survey (fish)	2010 Review
2011 (RIFE 17)	Cod and other fish (25%:75%)	40.0	10.0	0.0	30.0	Crabs, Lobsters and *Nephrops* (40%:30%:30%)	27.0	10.8	8.1	8.1	Winkles and other molluscs (60%:40%)	12.0	7.2	4.8	Mud and sand	840	2011 Review (crust & moll) 2008 Survey (fish)	2011 Review
2012 (RIFE 18)	Cod and other fish (25%:75%)	37.0	9.3	0.0	27.8	Crabs, Lobsters and *Nephrops* (30%:20%:50%)	29.0	8.7	5.8	14.5	Winkles and other molluscs (60%:40%)	9.1	5.5	3.6	Mud and sand	850	2012 LLWR Habits Survey	2012 LLWR Habits Survey

Annex 3b. Sellafield Fishing Community 5-year average consumption and intertidal occupancy rates (kg y^{-1} and h y^{-1})

5-year period	FISH				CRUSTACEANS				MOLLUSCS			EXTERNAL
	Total fish	Cod	Plaice	Other fish	Total crustaceans	Crab	Lobster	*Nephrops*	Total molluscs	Winkles	Other molluscs	Intertidal occupancy
1994-98	31.8	17.8	14.1	0.0	15.5	10.8	4.4	0.3	10.6	5.5	5.1	1100
1995-99	35.2	19.5	15.8	0.0	17.9	13.0	4.6	0.3	13.6	6.4	7.3	1050
1996-00	36.2	19.3	13.2	3.7	20.2	13.3	5.7	1.1	14.6	6.9	7.8	1033
1997-01	37.4	19.3	10.7	7.4	21.8	13.5	6.4	1.9	15.6	7.1	8.5	1000
1998-02	40.2	17.8	8.8	13.6	21.6	13.4	6.0	2.2	20.6	10.3	10.3	1040
1999-03	39.4	18.3	4.3	16.8	21.4	13.0	5.7	2.8	24.4	12.1	12.3	994
2000-04	39.0	18.9	0.0	20.1	21.6	11.6	6.7	3.3	26.2	13.0	13.2	994
2001-05	41.0	21.3	0.0	19.7	21.6	12.4	5.9	3.3	29.4	15.3	14.1	952
2002-06	43.0	23.8	0.0	19.2	21.6	12.8	5.1	3.7	34.0	17.6	16.4	888
2003-07	41.0	24.6	0.0	16.4	22.5	13.3	5.4	3.9	34.0	17.5	16.4	814
2004-08	40.8	21.7	0.0	19.1	20.4	11.3	5.5	3.7	33.5	18.0	15.5	826
2005-09	40.6	18.8	0.0	21.8	18.6	9.8	5.1	3.8	32.3	17.9	14.3	818
2006-10	40.4	15.8	0.0	24.6	19.0	9.6	5.6	3.9	30.1	14.8	15.2	834
2007-11	40.2	12.9	0.0	27.3	20.4	9.7	6.4	4.3	24.5	12.3	12.2	886
2008-12	39.4	9.9	0.0	29.6	22.2	9.4	6.4	6.4	20.5	9.9	10.6	890

Annex 4. Summary of adults' profiled consumption data (kg y^{-1} or l y^{-1}) and occupancy data (h y^{-1}) in the Sellafield area

		Pathway Name																												
Profile Name	**Number of individuals**	**Crustacea**	**Direct[a]**	**Eggs**	**Fish - Fresh**	**Fish - Sea**	**Fruit - Domestic**	**Fruit and nuts - Wild**	**Gamma ext - salt marsh**	**Gamma ext - sediments[b]**	**Honey**	**Meat - Cow**	**Meat - Game[c]**	**Meat - Pig**	**Meat - Poultry**	**Meat - Salt marsh grazed sheep**	**Meat - Sheep**	**Meat - Wildfowl**	**Milk**	**Mollusc**	**Mushrooms**	**Occupancy IN water**	**Occupancy ON water**	**Plume (IN; 0-0.25km)[d]**	**Plume (MID; >0.25-0.5km)[d]**	**Plume (OUT; >0.5-1km)[d]**	**Vegetables - Green**	**Vegetables - Other Domestic**	**Vegetables - Potatoes**	**Vegetables - Root**
		kg	-	kg	kg	kg	kg	kg	h	h	kg	kg	kg	kg	kg	kg	kg	kg	l	kg	kg	h	h	h	h	h	kg	kg	kg	kg
Crustacean consumers	**16**	29.3	-	-	-	17.0	-	-	-	270	-	-	-	-	-	-	-	-	-	1.4	-	-	660	-	-	-	-	-	-	-
Occupants for direct radiation	**54**	0.06	1.00	5.4	0.04	1.6	1.2	0.64	-	58	-	5.9	0.06	-	0.16	0.80	1.9	0.09	5.5	0.07	0.06	-	<1	1200	1270	1970	-	1.7	10.6	0.77
Egg consumers	**23**	-	0.57	22.1	-	1.4	2.3	0.68	-	1	0.02	8.2	-	-	0.02	0.20	3.3	-	52.7	-	0.10	-	<1	1570	850	990	0.23	2.1	38.1	0.59
Freshwater fish consumers	**1**	-	1.00	-	2.3	16.8	-	-	-	680	-	-	-	-	-	-	-	-	-	-	-	-	-	290	-	-	-	-	-	-
Sea fish consumers	**20**	9.0	0.05	-	-	36.8	0.05	0.38	<1	320	-	-	-	-	-	0.35	-	0.10	-	1.4	0.08	-	150	-	3	-	-	0.28	0.50	0.63
Domestic fruit consumers	**6**	-	-	5.2	-	-	44.5	0.82	-	9	2.8	23.7	-	-	1.1	13.2	1.9	-	86.4	0.09	0.57	-	-	-	-	-	0.68	23.5	46.8	17.8
Wild fruit and nut consumers	**6**	0.83	0.83	5.5	-	10.3	0.33	5.6	-	95	-	5.2	-	-	-	3.0	5.7	-	19.7	0.83	0.54	-	-	-	5150	-	-	3.2	3.3	4.2
Occupants for exposure - salt marsh	**2**	1.4	-	-	-	3.6	-	-	310	-	-	-	-	-	-	1.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Occupants for exposure - sediments	**24**	5.2	0.04	-	0.09	11.0	-	-	-	840	-	-	-	-	-	-	-	-	-	0.65	-	-	61	12	-	-	-	-	-	-
Honey consumers	**3**	-	-	-	-	-	18.9	-	-	16	8.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.8	17.3	-
Cattle meat consumers	**26**	-	0.27	4.5	-	0.30	4.2	0.49	-	4	-	37.0	-	5.8	0.64	-	5.0	0.10	64.0	0.02	0.20	2	-	1400	-	-	0.86	-	44.4	1.7
Game meat consumers	**3**	-	-	-	0.19	6.5	0.76	2.1	-	-	-	-	14.7	-	3.9	-	-	4.2	-	-	0.18	-	-	-	-	-	-	-	-	-	-
Pig meat consumers	**6**	-	-	-	-	-	-	-	-	-	-	31.5	-	25.3	0.57	-	5.7	0.45	-	-	-	-	-	-	-	-	3.1	-	3.0	5.0
Poultry meat consumers	**5**	-	-	1.8	0.42	1.8	-	0.60	-	8	-	-	0.90	-	9.0	-	-	-	-	-	0.12	-	-	-	-	-	-	-	-	-
Salt marsh grazed sheep meat consumers	**10**	-	0.10	2.4	-	0.65	13.7	0.09	-	-	-	-	-	-	0.39	20.3	-	-	127.8	-	0.34	-	-	-	-	750	-	14.6	69.9	20.9
Sheep meat consumers	**12**	0.07	0.33	5.5	-	0.49	-	1.1	-	2	-	11.6	-	-	0.23	-	15.6	-	29.6	-	0.38	-	-	-	1630	-	-	-	-	-
Wildfowl consumers	**2**	1.8	-	-	-	8.6	-	-	39	230	-	-	-	-	-	-	-	14.2	-	-	-	-	40	-	-	-	-	-	-	-
Milk consumers	**37**	-	-	5.1	-	0.18	3.5	0.57	<1	3	0.04	8.2	-	-	0.43	2.8	1.7	0.07	205.3	0.01	0.18	2	-	-	-	-	1.6	0.74	41.6	3.5
Mollusc consumers	**4**	27.0	-	-	-	27.7	-	-	-	420	-	-	-	-	-	-	-	-	-	9.1	-	-	71	-	-	-	-	-	-	-
Mushroom consumers	**11**	0.46	0.09	8.8	-	7.7	13.6	2.3	-	49	-	4.7	-	-	0.33	8.5	4.7	-	60.5	0.45	1.6	-	-	-	5	-	-	11.7	21.5	10.8
Occupancy IN water	**3**	-	-	0.79	-	-	0.06	0.05	-	23	-	9.3	-	-	-	-	-	-	48.7	-	0.05	32	-	-	-	-	-	-	-	-
Occupancy ON water	**18**	11.2	-	-	-	9.2	-	-	5	37	-	-	-	-	-	-	-	0.31	-	0.05	-	-	1560	-	-	-	-	-	-	-
Occupants for plume pathways (inner area)	**9**	-	1.00	12.5	-	0.87	3.6	0.44	-	2	-	22.9	-	-	-	-	0.66	-	19.7	-	-	-	-	6780	-	-	-	-	29.2	-
Occupants for plume pathways (mid area)	**8**	-	1.00	4.1	-	-	0.56	2.3	-	45	-	3.9	-	-	0.06	0.50	5.7	-	14.8	-	0.03	-	-	-	7490	-	-	1.0	-	-
Occupants for plume pathways (outer area)	**15**	-	1.00	6.2	-	1.0	2.0	0.29	-	64	-	-	0.21	-	0.53	2.2	0.75	-	-	-	0.09	-	2	-	-	6640	-	5.3	2.3	1.9
Green vegetable consumers	**6**	-	-	2.3	-	-	4.9	0.53	-	2	0.15	10.5	-	8.4	1.0	-	1.9	0.45	121.7	-	-	-	-	-	-	-	12.2	4.5	3.0	7.4
Other domestic vegetable consumers	**6**	-	0.33	7.0	-	-	24.7	0.15	-	1	-	-	-	-	-	16.6	-	-	-	-	0.72	-	-	-	-	2610	-	37.6	57.1	21.0
Potato consumers	**32**	-	0.13	5.1	-	0.20	4.8	0.15	-	<1	-	7.1	-	-	0.12	5.9	0.65	0.08	110.2	-	0.15	-	-	500	-	-	0.17	5.7	101.4	7.2
Root vegetable consumers	**2**	-	-	8.9	-	-	62.6	0.45	-	-	-	-	-	-	-	39.6	-	-	-	-	1.7	-	-	-	-	-	-	58.9	82.8	46.7

Notes

The profile comprises the 2008 Sellafield full habits survey data, updated with the 2009, 2010 and 2011 Sellafield review data and the 2012 LLWR data that are applicable to the Sellafield survey areas.

[a]Expressed as the proportion of the profile members who are exposed to direct radiation.

[b]Gamma ext - sediment includes occupancy over mud; mud and sand; mud, sand and stones; sand; and sand and stones.

[c]Game meat includes venison and rabbits/hares.

[d]Plume times are the sums of individuals' indoor and outdoor times.

The means of the high-rate groups are determined by the 'cut-off' method and are highlighted on the diagonal.

This page has been intentionally left blank

This page has been intentionally left blank

About us

Cefas is a multi-disciplinary scientific research and consultancy centre providing a comprehensive range of services in fisheries management, environmental monitoring and assessment, and aquaculture to a large number of clients worldwide.

We have more than 500 staff based in 2 laboratories, our own ocean-going research vessel, and over 100 years of fisheries experience.

We have a long and successful track record in delivering high-quality services to clients in a confidential and impartial manner.
(www.cefas.defra.gov.uk)

Cefas Technology Limited (CTL) is a wholly owned subsidiary of Cefas specialising in the application of Cefas technology to specific customer needs in a cost-effective and focussed manner.

CTL systems and services are developed by teams that are experienced in fisheries, environmental management and aquaculture, and in working closely with clients to ensure that their needs are fully met.
(www.cefastechnology.co.uk)

Customer focus

With our unique facilities and our breadth of expertise in environmental and fisheries management, we can rapidly put together a multi-disciplinary team of experienced specialists, fully supported by our comprehensive in-house resources.

Our existing customers are drawn from a broad spectrum with wide ranging interests. Clients include:

- international and UK government departments
- the European Commission
- the World Bank
- Food and Agriculture Organisation of the United Nations (FAO)
- oil, water, chemical, pharmaceutical, agro-chemical, aggregate and marine industries
- non-governmental and environmental organisations
- regulators and enforcement agencies
- local authorities and other public bodies

We also work successfully in partnership with other organisations, operate in international consortia and have several joint ventures commercialising our intellectual property.

Head office
Centre for Environment,
Fisheries & Aquaculture Science
Pakefield Road, Lowestoft,
Suffolk NR33 0HT UK

Tel +44 (0) 1502 56 2244
Fax +44 (0) 1502 51 3865
Web www.cefas.defra.gov.uk

printed on paper made from
a minimum 75% de-inked
post-consumer waste