

Cefas contract report C6028

Radiological Habits Survey: Sellafield Review, 2014

2015

Environment Report RL 03/15



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Nuclear Regulation**

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Radiological Habits Survey: Sellafield Review, 2014

Submitted to:	Food Standards Agency, Environment Agency and Office for Nuclear Regulation
Date submitted:	19/3/15
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Approved by & date:	Bill Camplin, 18/3/15
Version:	Final

Version Control History			
Author	Date	Comment	Version
Chris Garrod	30/1/15	Sent to FSA and EA for comments.	Draft 1
Chris Garrod	12/2/15	Sent to ONR for comments.	Draft 1
Chris Garrod	18/2/15	Sent to John Hunt for comments.	Draft 1
Chris Garrod	18/3/15	All amendments completed.	Final

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Shellfish consumption and intertidal occupancy review

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2015

This report should be cited as: Garrod, C.J.,
Clyne, F.J. and Papworth, G.P., 2015.
Radiological Habits Survey: Sellafield Review,
2014. RL 03/15. Cefas, Lowestoft

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1. INTRODUCTION

This report describes a review of the public's shellfish consumption and intertidal occupancy relating to liquid radioactive waste discharges from the Sellafield Ltd nuclear site in Cumbria. It is also relevant to liquid discharges from the Low Level Waste Repository (LLWR) site near Drigg and the potential new Moorside nuclear power station, due to the proximity of the sites. The information and data in this report are used in radiological dose assessments as reported in the Radioactivity in Food and the Environment (RIFE) series. The study was funded by the Environment Agency (EA) and the Food Standards Agency (FSA), to support their roles in protecting the public from the effects of radiation.

Radiological protection of the public is based on the concept of a 'representative person'. This notional individual is defined as being representative of the more highly exposed members of the population. It follows that, if the dose to the representative person is acceptable when compared to dose limits and optimisation, other members of the public will receive acceptable doses, and overall protection to the public is provided from the effects of radiation. This Sellafield Review specifically investigated the consumption of crustaceans and molluscs, and occupancy over intertidal substrates, by members of the Sellafield Fishing Community, since historically these pathways have been the major contributors to the dose of the representative person. Reviews are conducted annually, except in years when full surveys are undertaken, because consumption and occupancy rates have been known to vary from year to year, with some people ceasing shellfish consumption, shellfish collection or intertidal activities, and new individuals being identified. The last full habits survey (encompassing aquatic, terrestrial and direct radiation pathways) in the vicinity of Sellafield was conducted by the Centre for Environment, Fisheries & Aquaculture Science (Cefas) in 2013 (Clyne *et al.*, 2014).

The consumption of fish is not specifically investigated for Sellafield Reviews because fish are of generally lower radiological significance around Sellafield than shellfish and intertidal occupancy. However, those people interviewed in relation to shellfish consumption and intertidal occupancy were also asked about their fish consumption and these data have been used to update the total dose assessment of additive exposure (see Section 7.3). For the 2014 Sellafield aquatic dose assessments, the mean consumption rate for the high-rate group for fish will be retained from the 2013 full Sellafield habits survey. Handling rates of sediment and fishing gear are not obtained for Sellafield Reviews, therefore, for assessments purposes, the mean handling rates for the high-rate groups for fishing gear and sediment will be retained from the 2013 full Sellafield habits survey.

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 rates are recorded. This year it was not necessary to use the diaries to check the validity of the interview data used in this report because no extreme consumption or occupancy rates were recorded.

2. SURVEY AREA

The 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

Prior to the fieldwork, individuals identified as having high rates of crustacean consumption, mollusc consumption and/or intertidal occupancy in previous Sellafeld habits surveys were contacted and where possible interview times were arranged.

The fieldwork was carried out from 9th to 12th September 2014, by a team of three people. During the fieldwork, individuals were interviewed and asked to estimate crustacean and mollusc consumption rates, and occupancy rates over intertidal areas, for themselves and members of their families. Interviewees were also asked to provide consumption rates for fish in order to determine combinations of pathways and validate the total dose assessment. Information was obtained about the origins of the seafood being consumed and locations of intertidal occupancy. Investigations were also carried out in order to identify and interview any previously unknown individuals who might have high rates of shellfish consumption or intertidal occupancy. This included visiting the beaches in the survey area.

Observations for 48 adults and 7 children were recorded for the 2014 Sellafeld Review.

4. METHODS OF DATA ANALYSIS

4.1 Data recording

Consumption and occupancy data collected during interviews were recorded in logbooks. 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 consumption and occupancy data in the text of this report are rounded to two significant figures. 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 shown in Table A below, together with those used in reports prior to 2010, for comparison.

Table A. Names of age groups and range of ages within each age group.			
Age ranges used from 2010 onwards		Age ranges used prior to 2010	
Name of age group^a	Age range in group	Name of age group	Age range in group
Infant	0 to 5-year-old	3-month-old	Under 1-year-old
		1-year-old	1-year-old
		5-year-old	2-year-old to 6-year-old
Child	6-year-old to 15-year-old	10-year-old	7-year-old to 11-year-old
		15-year-old	12-year-old to 16-year-old
Adult	16-year-old and over	Adult	17-year-old and over

^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 results of the Sellafeld Review are the individuals' consumption and occupancy rates provided in Annex 1 for adults and in Annex 2 for children. These can be used to update estimates of the dose to the representative person and in other radiological assessments of the effects of the discharges from the Sellafeld site.

The consumption and occupancy 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 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. The profiled habits matrix in this report contains data from the 2013 Sellafeld full habits survey which has been updated with the 2014 Sellafeld Review data.

5. INTERNAL EXPOSURE

Consumption data for aquatic foods are presented in Tables 1 and 2 for adults and in Table 3 for children. 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 Crustaceans and molluscs

The people consuming the greatest quantities of crustaceans and molluscs from the aquatic survey area were commercial and hobby fishermen, shellfish collectors, bait diggers, and the families of these groups of people. It should be noted that not all of the people who were consuming shellfish were also collecting shellfish. Table B presents a summary of the consumption rates of crustaceans and molluscs for adults, and crustaceans for the child age group. The table includes the mean consumption rates for the high-rate groups and the observed 97.5th percentile rates. No individuals in the child age group were identified consuming molluscs, and no individuals in the infant age group were identified consuming crustaceans or molluscs.

Table B. 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 97.5 th percentile (kg y ⁻¹)
Adults						
Crustaceans	27	7	53.4	24.5	36.0	44.5
Molluscs	10	3	17.8	6.1	11.0	15.9
Child age group (6 - 15 years old)						
Crustaceans	2	2	7.0	7.0	7.0	7.0

The species of crustaceans consumed by people in the adult high-rate group were brown crab, brown shrimp, common lobster and *Nephrops*. The only species of crustaceans consumed by individuals in the child high-rate group was *Nephrops*. The brown crab, common lobster and *Nephrops* were caught off-shore throughout the survey area. Brown crabs were also caught in pots that were set from the shore at Coulderton and Drigg. Brown shrimps were caught at Seamill and Whitehaven North Beach by wading out into shallow water and pushing a net.

The species of molluscs consumed by people in the adult high-rate group were limpets, mussels, razor shells and winkles. Limpets were collected from Coulderton; mussels were collected from Whitey Rock (Whitehaven North Beach); winkles were collected from Nethertown and Whitey Rock; and razor shells were collected at Whitehaven North Beach.

5.2 Composition of the crustacean and molluscan food groups for use in dose assessments, and comparison with 2013 data

In previous Sellafeld Review reports the adult high-rate crustacean food group has been presented as three species; crabs, lobsters and *Nephrops*. Any small quantities of brown shrimps and/or common prawns were included with the *Nephrops* for dose assessment purposes. However, in 2014, brown shrimps represented a significant contribution to the consumption rates so, although the *Nephrops* and brown shrimps are still grouped together, they are now included as 'other crustaceans'. The mollusc food group is presented in two parts, as before; winkles and all other molluscs combined.

The percentage composition for the predominant shellfish species consumed by the adult high-rate groups from the 2014 Sellafeld Review, rounded to the nearest 5% for use in dose assessments, are as follows:

- Crustaceans - 35% common lobster, 25% brown crab, 40% other crustaceans (including *Nephrops* and brown shrimp) (mean consumption rate for the adult high-rate group, 36 kg y⁻¹)
- Molluscs - 65% winkles and 35% other molluscs (including limpets, mussels and razor shells) (mean consumption rate for the adult high-rate group, 11 kg y⁻¹)

By comparison, the percentage composition for the predominant shellfish species consumed by the adult high-rate groups from the 2013 Sellafeld full survey, and used in RIFE-19 (EA, FSA, NRW, NIEA and SEPA, 2014) for dose assessments, were:

- Crustaceans - 75% *Nephrops* (including brown shrimp and common prawn), 20% brown crab, 5% common lobster, (mean consumption rate for the adult high-rate group, 25 kg y⁻¹)
- Molluscs - 85% winkles and 15% other molluscs (limpets) (mean consumption rate for the adult high-rate group, 15 kg y⁻¹)

In 2014, the mean consumption rate for the adult high-rate group for crustaceans increased by 11 kg y⁻¹ compared to 2013. This was due to general increases in the consumption rates of the members of the high-rate group. There was a decrease of 4 kg y⁻¹ in the mean consumption rate for the adult high-rate group for molluscs in 2014. This was due to an increase in the number of people included in the high-rate group in 2014, which reduced the overall mean rate compared to the single observation in the high-rate group in 2013.

The main species of crustaceans and molluscs within the high-rate groups were the same in 2013 and 2014, with the exception of no common prawns in 2014 and the addition of mussels and razor shells in 2014. The percentage breakdown of species changed for crustaceans and molluscs in 2014 compared with 2013: for crustaceans, there was a significant decrease in *Nephrops*/other crustaceans and a significant increase in common lobster; for molluscs, there was a decrease in winkles and a significant increase in other molluscs. The differences in species composition from year to year were mainly due

to periodic changes in the availability of the species and variations in the preferences of known regular shellfish consumers.

5.3 Consumption trends

The consumption rates for the adult high-rate groups for crustaceans and molluscs over the previous ten years (2005 - 2014) are shown in Figures 2 and 3, respectively. These figures were plotted using 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. 'Other crustaceans' includes *Nephrops* and brown shrimps.

The increase in crustacean consumption was primarily driven by higher rates of lobster consumption due to changes in species preference by the consumers. The low consumption of molluscs in relation to historic levels is a result of the continuing decline in the number of people consuming molluscs owing to old age or ill health.

Figure 2. Consumption rates for the adult high-rate group for crustaceans, 2005 – 2014 (kg y^{-1})

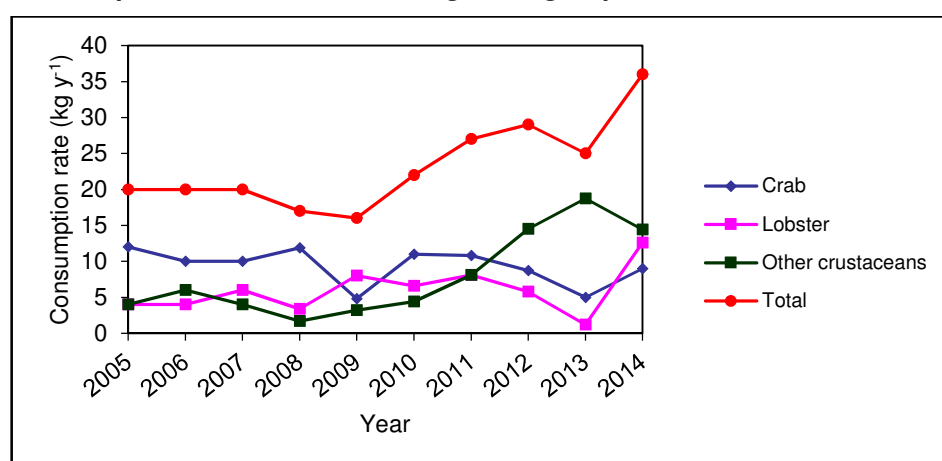
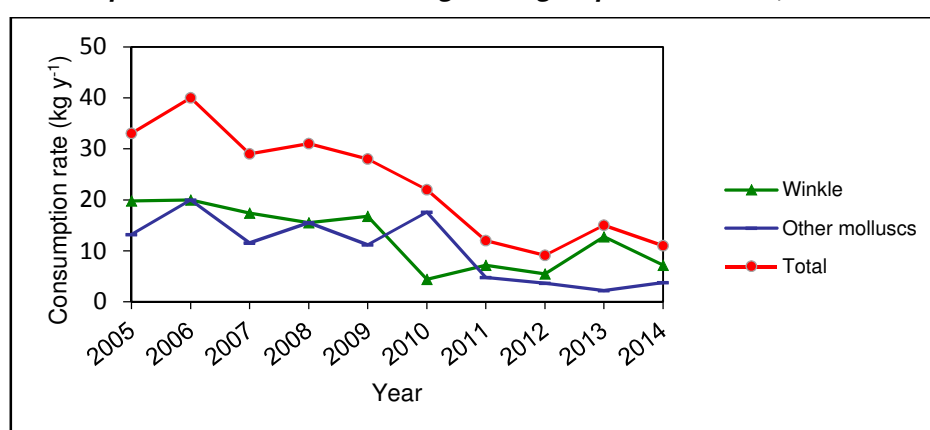


Figure 3. Consumption rates for the adult high-rate group for molluscs, 2005 – 2014 (kg y^{-1})



6. EXTERNAL EXPOSURE

Intertidal occupancy rates for adults are presented in Table 4 and intertidal occupancy rates for children are presented in Table 5. 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.

6.1 Intertidal occupancy

Adults' intertidal occupancy rates

Table C 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 C. 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	4	4	75	63	75
Mud and sand	3	3	176	176	176
Mud, sand and stones	2	1	365	365	358
Rock	2	2	105	70	103
Salt marsh	8	4	320	248	320
Sand	20	10	1104	808	1102
Sand and stones	15	5	820	559	778

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

- For mud: wildfowling on the River Irt, Carleton Marsh and Newbiggin Marsh.
- For mud and sand: dog walking at Saltcoats; bait digging at Whitehaven Outer Harbour.
- For mud, sand and stones: boat maintenance and walking at Ravenglass.
- For rock: hooking crabs and lobsters at Drigg; collecting mussels and winkles at Whitey Rock (Whitehaven North Beach).
- For salt marsh: dog walking at Saltcoats; tending livestock along the River Irt shore.
- For sand: bait digging and walking at Braystones, Drigg and Eskmeals; collecting razor shells at Whitehaven North Beach; attending set nets at Braystones and Drigg; collecting cockles at Ravenglass for a small amount of time; dog walking from Seascale to Sellafield or Drigg.

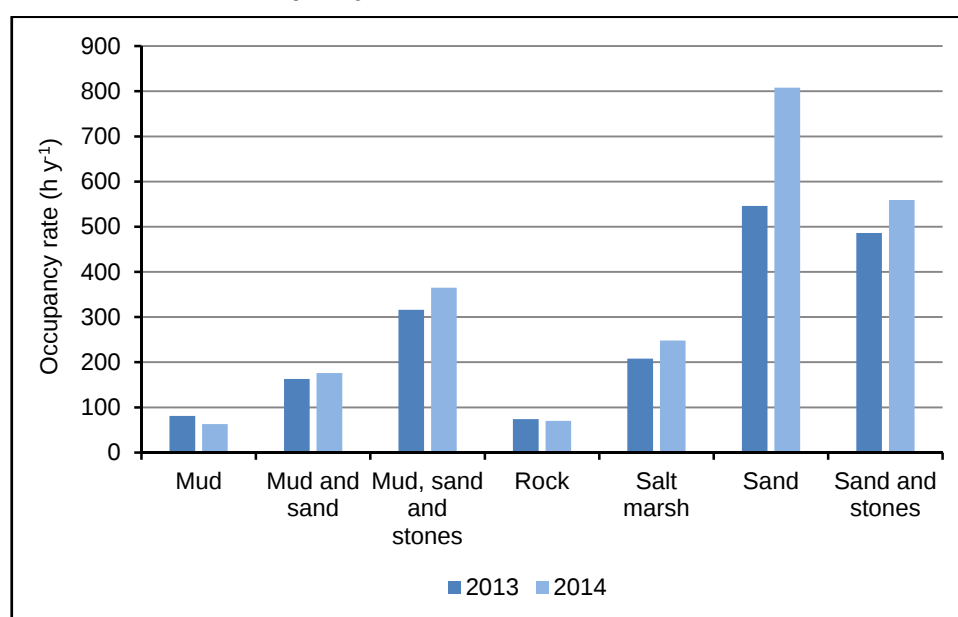
- For sand and stones: angling at Coulderton, Nethertown and Braystones; attending crab pots at Coulderton and Drigg; dog walking at Braystones, Sellafield and Parton; beachcombing at Braystones and Sellafield; collecting crabs for bait at Nethertown.

Brown shrimps were collected at Seamill and Whitehaven North Beach but since this involved wading out into shallow water and pushing a net it was not classed as an intertidal activity. Therefore, this activity does not appear in the intertidal occupancy table.

The adults' intertidal occupancy rates from the 2013 Sellafield full survey are presented in Table D and a comparison between the 2013 and 2014 mean rates of the high-rate groups for occupancy over each intertidal substrate is shown in Figure 4.

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	3	2	96	81	94
Mud and sand	7	4	234	163	222
Mud, sand and stones	14	5	490	316	438
Rock	4	4	105	74	103
Salt marsh	7	4	312	208	312
Sand	104	31	1035	546	861
Sand and stones	37	8	828	486	747

Figure 4. Comparison between the 2013 and 2014 mean rates of the high-rate groups for occupancy over each intertidal substrate



In 2014, compared with 2013, there were increases in the following mean intertidal occupancy rates for the high-rate groups:

- From 160 h y⁻¹ to 180 h y⁻¹ for mud and sand
- From 320 h y⁻¹ to 370 h y⁻¹ for mud, sand and stones
- From 210 h y⁻¹ to 250 h y⁻¹ for salt marsh
- From 550 h y⁻¹ to 810 h y⁻¹ for sand
- From 490 h y⁻¹ to 560 h y⁻¹ for sand and stones

In 2014, compared with 2013, there were decreases in the following mean intertidal occupancy rates for the high-rate groups:

- From 81 h y⁻¹ to 63 h y⁻¹ for mud
- From 74 h y⁻¹ to 70 h y⁻¹ for rock

Children's intertidal occupancy rates

Table E presents a summary of the children's 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 E. Summary of children's 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	5	3	28	28	28

Only one activity was identified being undertaken by individuals in the child age group high-rate groups over one intertidal substrate, which was playing on sand at Braystones.

No infants were identified spending time on intertidal substrates during the survey.

7. USE OF HABITS DATA FOR DOSE ASSESSMENTS

7.1 Aquatic combinations for adults in the Sellafield Fishing Community

Table 6 presents the consumption rates and occupancy rates for people who appear in at least one of the high-rate groups for crustaceans, molluscs or intertidal substrates. The table shows that several individuals are members of multiple high-rate groups. For example, observation number 3 is in the high-rate group for crustaceans, molluscs, and occupancy over rock, over sand, and over sand and stones, and also consumes significant amounts of fish. 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 2014 will be based on combinations of consumption and intertidal occupancy pathways identified from Table 7.

As in previous years, since several individuals were undertaking activities over multiple substrates, the occupancy rates over five substrates (mud; mud and sand; mud, sand and stones; sand; sand and stones) have been combined into a single substrate called 'mud and sand'. Rock and salt marsh are not included in the combined substrate since rock is not assessed and salt marsh is assessed separately. The mean rate for the high-rate group for the reclassified 'mud and sand' substrate is 1100 h y⁻¹. For comparison, the mean rate for the high-rate group for the reclassified 'mud and sand' substrate in 2013 was 760 h y⁻¹.

7.2 Sellafield 5-year averages

Annex 3a shows the Sellafield Fishing Community consumption and occupancy rates 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. Annex 3b presents the 5-year averages of the data in Annex 3a. The 5-year average (2010 - 2014) of the high-rate group data (for fish, crustaceans, molluscs and intertidal occupancy) will be used in the RIFE-20 assessments in order to provide a longer term trend of dose to members of the Sellafield Fishing Community group.

7.3 Profiled habits data

The environment agencies and the Food Standards Agency have considered ways of using habits data to estimate 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 estimated using these profiles and reported in the RIFE reports (e.g. EA, FSA, NRW, NIEA and SEPA, 2014).

The matrix for the 2014 Sellafield adults' profiled habits data is presented in Annex 4. It is based on data from the 2013 Sellafield full habits survey (aquatic, terrestrial and direct radiation pathways), which has been updated with data from the 2014 Sellafield annual review. All pathways and observations from the original 2013 profiled habits matrix were retained and for the 2014 profiles, only data asked about during the 2014 review were updated; that is, intertidal occupancy and consumption of crustaceans, molluscs and fish. If data were collected for new interviewees, these were added as new observations, and if it was known that an individual who had been interviewed in previous years had stopped their activity, then their data was deleted. Because the profiles have been created using the data from 2013 and 2014, the profiled data shown in Annex 4 are not comparable with the data presented in Annex 1.

8. SUMMARY AND RECOMMENDED DATA FOR USE IN RIFE-20 DOSE ASSESSMENTS

The survey investigated the consumption of shellfish and intertidal occupancy, relating to liquid discharges from the Sellafield nuclear site.

The mean rates for the adult high-rate groups from the 2014 Sellafield Review are as follows:

- Crustaceans 36 kg y⁻¹
- Molluscs 11 kg y⁻¹
- Occupancy over mud 63 h y⁻¹
- Occupancy over mud and sand 180 h y⁻¹
- Occupancy over mud, sand and stones 370 h y⁻¹
- Occupancy over rock 70 h y⁻¹
- Occupancy over salt marsh 250 h y⁻¹
- Occupancy over sand 810 h y⁻¹
- Occupancy over sand and stones 560 h y⁻¹

In comparison to 2013, the mean consumption rate for the adult high-rate group for crustaceans in 2014 increased by 11 kg y⁻¹ and for molluscs decreased by 4 kg y⁻¹. For occupancy over intertidal substrates, the mean rates for the high-rate groups increased in 2014 compared with 2013 by 13 h y⁻¹ for mud and sand, by 49 h y⁻¹ for mud, sand and stones, by 40 h y⁻¹ for salt marsh, by 262 h y⁻¹ for sand, and by 73 h y⁻¹ for sand and stones, and decreased by 18 h y⁻¹ for mud, and by 4 h y⁻¹ for rock.

The following recommendations for data to be used in RIFE-20 dose assessments are for adults only.

For the 'Sellafield Fishing Community' dose assessment, the mean consumption rates for the adult high-rate groups and species breakdown are:

- Fish (retained from the 2013 survey) 56 kg y⁻¹ - cod 40% and other fish 60%
- Crustaceans 36 kg y⁻¹ - 35% common lobster, 25% brown crab, 40% other crustaceans (including *Nephrops* and brown shrimp)
- Molluscs 11 kg y⁻¹ - 65% winkles and 35% other molluscs (including limpets, mussels and razor shells)
- Occupancy over an intertidal substrate termed 'mud and sand' (mud; mud and sand; mud, sand and stones; sand; and sand and stones combined) 1100 h y⁻¹

For the 'Sellafield Fishing Community 5-year average' dose assessment:

- Cod 15 kg y⁻¹
- Other fish 31 kg y⁻¹
- Crabs 8.9 kg y⁻¹
- Lobsters 6.9 kg y⁻¹
- Other crustaceans 12 kg y⁻¹
- Winkles 7.4 kg y⁻¹
- Other molluscs 6.4 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) 880 h y⁻¹

For the 'Fisherman's Nets and Pots' dose assessment:

- Handling fishing gear 1100 h y⁻¹ (mean rate for the high-rate group retained from the 2013 survey)

For the 'Bait Digging and Mollusc Collection' dose assessment:

- Handling sediment 460 h y⁻¹ (mean rate for the high-rate group retained from the 2013 survey)

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Table 1. Adults' consumption rates of crustaceans from the Sellafield aquatic survey area (kg y⁻¹)

Observation number	Brown crab	Brown shrimp	Common lobster	Common prawn	Nephrops	Total
3	7.8	30.8	14.7	-	-	53.4
6	11.8	4.4	11.8	-	11.8	39.8
7	11.8	4.4	11.8	-	11.8	39.8
4	7.8	23.6	7.3	-	-	38.8
5	7.8	8.8	14.7	-	-	31.4
1	8.3	-	16.2	-	-	24.5
2	8.3	-	16.2	-	-	24.5
18	7.8	-	9.8	-	-	17.6
26	-	-	-	-	10.9	10.9
45	2.2	-	4.7	2.8	-	9.7
20	-	-	0.4	-	9.2	9.5
21	-	-	-	-	9.2	9.2
22	-	-	-	-	9.2	9.2
46	2.2	-	4.7	0.7	-	7.6
27	-	-	-	-	7.0	7.0
47	2.2	-	4.7	-	-	6.9
48	2.2	-	4.7	-	-	6.9
19	-	-	0.4	-	3.6	4.0
30	-	-	-	-	0.9	0.9
31	-	-	-	-	0.9	0.9
13	-	-	-	-	0.7	0.7
14	-	-	-	-	0.7	0.7
15	-	-	-	-	0.7	0.7
37	0.3	-	0.2	-	-	0.5
39	0.3	-	0.2	-	-	0.5
40	0.3	-	0.2	-	-	0.5
38	-	-	0.2	-	-	0.2

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of crustaceans based on the 7 high-rate adult consumers is 36.0 kg y⁻¹

The observed 97.5th percentile rate based on 27 observations is 44.5 kg y⁻¹

Table 2. Adults' consumption rates of molluscs from the Sellafield aquatic survey area (kg y⁻¹)

Observation number	Cockle	Limpet	Mussel	Queen scallop	Razor shell	Whelk	Winkle	Total
3	-	-	7.5	-	1.8	-	8.5	17.8
42	-	1.2	-	-	-	-	8.0	9.2
4	-	-	-	-	1.8	-	4.3	6.1
5	-	-	2.5	-	-	-	-	2.5
26	-	-	-	2.0	-	-	-	2.0
1	-	-	-	-	-	1.2	-	1.2
30	-	-	-	-	1.0	-	-	1.0
41	-	-	-	-	-	-	0.4	0.4
37	0.1	-	-	-	-	-	-	0.1
39	0.1	-	-	-	-	-	-	0.1

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of molluscs based on the 3 high-rate adult consumers is 11.0 kg y⁻¹

The observed 97.5th percentile rate based on 10 observations is 15.9 kg y⁻¹

Table 3. Children's consumption rates of crustaceans from the Sellafield area (kg y^{-1})

Child age group (6 - 15 years old)

Observation number	Age	<i>Nephrops</i>
28	9	7.0
29	8	7.0

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of crustaceans for the child age group based upon the 2 high-rate consumers is 7.0 kg y^{-1}

The observed 97.5th percentile rate based on 2 observations is 7.0 kg y^{-1}

Table 4. Adults' intertidal occupancy rates in the Sellafield 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
53	River Irt	Wildfowling	75	-	-	-	-	-	-
	River Irt	Walking	-	-	-	-	25	-	-
54	River Irt	Wildfowling	75	-	-	-	-	-	-
	River Irt	Walking	-	-	-	-	25	-	-
55	River Irt	Wildfowling	75	-	-	-	-	-	-
	River Irt	Walking	-	-	-	-	25	-	-
49	Carleton Marsh and Newbiggin Marsh	Wildfowling	26	-	-	-	-	-	-
	Carleton Marsh and Newbiggin Marsh	Dog walking	-	-	-	-	39	-	-
37	Saltcoats	Dog walking	-	176	-	-	-	-	-
	Saltcoats	Dog walking	-	-	-	-	176	-	-
	River Irt	Collecting cockles	-	-	-	-	-	1	-
38	Saltcoats	Dog walking	-	176	-	-	-	-	-
	Saltcoats	Dog walking	-	-	-	-	176	-	-
41	Whitehaven Outer Harbour	Bait digging	-	176	-	-	-	-	-
	Braystones, Drigg and Eskmeals	Bait digging and walking	-	-	-	-	-	572	-
	Coulderton and Nethertown	Collecting winkles	-	-	-	-	-	-	52
18	Ravenglass	Boat maintenance and walking	-	-	365	-	-	-	-
13	Ravenglass	Walking	-	-	78	-	-	-	-
	Parton	Walking	-	-	-	-	-	-	78
5	Drigg	Hooking crabs and lobsters	-	-	-	105	-	-	-
	Parton and Seamill	Angling	-	-	-	-	-	-	156
3	Whitey Rock (Whitehaven North Beach)	Collecting mussels and winkles	-	-	-	35	-	-	-
	Whitehaven North Beach	Collecting razor shells	-	-	-	-	-	573	-
	Braystones	Bait digging and attending set nets	-	-	-	-	-	-	-
	Coulderton, Nethertown and Braystones	Angling	-	-	-	-	-	-	820
39	Coulderton and Drigg	Attending crab pots	-	-	-	-	-	-	-
	River Irt	Tending livestock	-	-	-	-	320	-	-
40	River Irt	Collecting cockles	-	-	-	-	-	1	-
	River Irt	Tending livestock	-	-	-	-	320	-	-
19	Braystones and Drigg	Attending set nets	-	-	-	-	-	1104	-
	Ravenglass	Collecting cockles (for 4 h y^{-1})	-	-	-	-	-	-	-
	Braystones and Sellafield	Dog walking and beachcombing	-	-	-	-	-	-	-
21	Braystones and Drigg	Angling	-	-	-	-	-	-	699
	Nethertown	Collecting crabs for bait	-	-	-	-	-	-	-
	Braystones and Drigg	Attending set nets	-	-	-	-	-	1100	-
	Braystones and Sellafield	Dog walking and beachcombing	-	-	-	-	-	-	208
23	Sellafield	Angling	-	-	-	-	-	-	-
	Braystones and Drigg	Attending set nets	-	-	-	-	-	1100	-
24	Braystones and Drigg	Attending set nets	-	-	-	-	-	990	-
25	Braystones and Drigg	Attending set nets	-	-	-	-	-	990	-
22	Braystones and Drigg	Attending set nets	-	-	-	-	-	550	-
	Braystones and Sellafield	Dog walking	-	-	-	-	-	-	138

Table 4. Adults' intertidal occupancy rates in the Sellafield 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
51	Seascale to Sellafield or Drigg	Dog walking	-	-	-	-	-	548	-
52	Seascale to Sellafield or Drigg	Dog walking	-	-	-	-	-	548	-
16	Tarn Bay	Dog walking	-	-	-	-	-	365	-
17	Drigg	Dog walking	-	-	-	-	-	365	-
45	Seascale to Sellafield or Drigg	Dog walking	-	-	-	-	-	365	-
50	Seascale to Sellafield or Drigg	Dog walking	-	-	-	-	-	365	-
43	Seascale and Drigg	Dog walking	-	-	-	-	-	260	-
44	Seascale and Drigg	Dog walking	-	-	-	-	-	260	-
30	Braystones	Bait digging, collecting razor shells and playing	-	-	-	-	-	38	-
	Braystones	Collecting seaweed	-	-	-	-	-	-	4
31	Braystones	Playing	-	-	-	-	-	12	-
8	Parton	Dog walking	-	-	-	-	-	-	548
11	Parton	Dog walking	-	-	-	-	-	-	456
10	Parton	Dog walking	-	-	-	-	-	-	274
12	Whitehaven North Beach	Dog walking	-	-	-	-	-	-	260
9	Parton and Whitehaven North Beach	Dog walking	-	-	-	-	-	-	208
15	Parton	Walking	-	-	-	-	-	-	52
6	Parton	Collecting winkles	-	-	-	-	-	-	20

Notes

Emboldened observations are the high-rate individuals

The mean intertidal occupancy rate over mud based on 4 high-rate observations is 63 h y^{-1}

The observed 97.5th percentile rate based on 4 observations for mud is 75 h y^{-1}

The mean intertidal occupancy rate over mud and sand based on 3 high-rate observations is 176 h y^{-1}

The observed 97.5th percentile rate based on 3 observations for mud and sand is 176 h y^{-1}

The mean intertidal occupancy rate over mud, sand and stones based on 1 observation is 365 h y^{-1}

The observed 97.5th percentile rate based on 2 observations for mud, sand and stones is 358 h y^{-1}

The mean intertidal occupancy rate over rock based on 2 high-rate observations is 70 h y^{-1}

The observed 97.5th percentile rate based on 2 observations for rock is 103 h y^{-1}

The mean intertidal occupancy rate over salt marsh based on 4 high-rate observations is 248 h y^{-1}

The observed 97.5th percentile rate based on 8 observations for salt marsh is 320 h y^{-1}

The mean intertidal occupancy rate over sand based on 10 high-rate observations is 808 h y^{-1}

The observed 97.5th percentile rate based on 20 observations for sand is 1102 h y^{-1}

The mean intertidal occupancy rate over sand and stones based on 5 high-rate observations is 559 h y^{-1}

The observed 97.5th percentile rate based on 15 observations for sand and stones is 778 h y^{-1}

Table 5. Children's intertidal occupancy rates in the Sellafeld aquatic survey area (h y^{-1})

Child age group (6 - 15 years old)

Observation number	Age	Location	Activity	Sand
32	13	Braystones	Playing	28
35	11	Braystones	Playing	28
36	6	Braystones	Playing	28
33	12	Braystones	Playing	8
34	11	Braystones	Playing	8

Notes

Emboldened observations are the high-rate individuals

The mean intertidal occupancy rate over sand for the child age group based on 3 high-rate observations is 28 h y^{-1}

The observed 97.5th percentile rate based on 5 observations for sand is 28 h y^{-1}

Table 6. Aquatic combinations for adults in the Sellafeld Fishing Community

Observation number	Consumption rates (kg y ⁻¹)			Intertidal occupancy rates (h y ⁻¹)						
	Fish	Crustaceans	Molluscs	Mud	Mud and sand	Mud, sand and stones	Rock	Salt marsh	Sand	Sand and stones
3	106.1	53.4	17.8	-	-	-	35	-	573	820
6	47.2	39.8	-	-	-	-	-	-	-	20
7	47.2	39.8	-	-	-	-	-	-	-	-
4	35.4	38.8	6.1	-	-	-	-	-	-	-
5	70.8	31.4	2.5	-	-	-	105	-	-	156
1	15.6	24.5	1.2	-	-	-	-	-	-	-
2	15.6	24.5	-	-	-	-	-	-	-	-
18	17.7	17.6	-	-	-	365	-	-	-	-
21	17.7	9.2	-	-	-	-	-	-	1100	208
22	17.7	9.2	-	-	-	-	-	-	550	138
19	70.8	4.0	-	-	-	-	-	-	1104	699
37	-	0.5	0.1	-	176	-	-	176	1	-
39	-	0.5	0.1	-	-	-	-	320	1	-
40	-	0.5	-	-	-	-	-	320	-	-
38	-	0.2	-	-	176	-	-	176	-	-
42	-	-	9.2	-	-	-	-	-	-	-
41	-	-	0.4	-	176	-	-	-	572	52
53	-	-	-	75	-	-	-	25	-	-
54	-	-	-	75	-	-	-	25	-	-
55	-	-	-	75	-	-	-	25	-	-
49	-	-	-	26	-	-	-	39	-	-
23	-	-	-	-	-	-	-	-	1100	-
24	-	-	-	-	-	-	-	-	990	-
25	-	-	-	-	-	-	-	-	990	-
51	-	-	-	-	-	-	-	-	548	-
52	-	-	-	-	-	-	-	-	548	-
8	-	-	-	-	-	-	-	-	-	548
11	-	-	-	-	-	-	-	-	-	456
10	-	-	-	-	-	-	-	-	-	274

Notes

Values in high-rate groups are emboldened

Annex 1. Adults' consumption rates (kg y^{-1}) and occupancy rates (h y^{-1}) in the Sellafield area

[illegible]

Annex 1. Adults' consumption rates (kg y^{-1}) and occupancy rates (h y^{-1}) in the Sellafeld area

Observation number	Sex	Age (years)	Fish	Crustaceans	Molluscs	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
52	F	54	-	-	-	-	-	-	-	-	548	-
53	M	U	-	-	-	75	-	-	-	25	-	-
54	M	U	-	-	-	75	-	-	-	25	-	-
55	M	U	-	-	-	75	-	-	-	25	-	-

Notes

Emboldened observations are the high-rate individuals

U = Unknown

Annex 2. Children's consumption rates (kg y^{-1}) and occupancy rates (h y^{-1}) in the Sellafield area

Child age group (6 - 15 years old)

Observation number	Sex	Age (years)	Crustaceans	Intertidal occupancy over sand
28	M	9	7.0	-
29	M	8	7.0	-
32	F	13	-	28
33	F	12	-	8
34	F	11	-	8
35	M	11	-	28
36	F	6	-	28

Notes

Emboldened observations are the high-rate individuals

Annex 3a. Sellafeld 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 or other crustaceans	Species Composition	Total	Winkles	Other molluscs	Substrate	h y ⁻¹	Consumption	Occupancy
1994 (AEMR 45)	Plaice and Cod (50%:50%)	26	13.0	13.0	0	Crabs and Lobsters (65%:35%)	12	7.8	4.2	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	13.0	13.0	0	Crabs and Lobsters (75%:25%)	8.6	6.5	2.2	0	Winkles and other molluscs (50%:50%)	12	6.0	6.0	-	0	1995 Review (crust and moll) and 1993/4 survey (fish)	-
1996 (RIFE 2)	Plaice and Cod (50%:50%)	25	12.5	12.5	0	Crabs and Lobsters (60%:40%)	12	7.2	4.8	0	Winkles and other molluscs (60%:40%)	12	7.2	4.8	-	0	1995 Review (crust and moll) and 1996 logging data (fish)	-
1997 (RIFE 3)	Plaice and Cod (25%:75%)	37	27.8	9.3	0	Crabs, Lobsters and Nephrops (50%:40%:10%)	17	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	22.5	22.5	0	Crabs and Lobsters (85%:15%)	28	23.8	4.2	0	Winkles and other molluscs (30%:70%)	15	4.5	10.5	Sand and mollusc beds	1100	1998 Survey	1998 Survey
1999 (RIFE 5)	Plaice and Cod (50%:50%)	43	21.5	21.5	0	Crabs and Lobsters (80%:20%)	24	19.2	4.8	0	Winkles and other molluscs (50%:50%)	25	12.5	12.5	Sand and mollusc beds	1000	1999 Review	1999 Review
2000 (RIFE 6)	Cod and other fish (40%:60%)	31	12.4	0	18.6	Crabs, Lobsters and Nephrops (40%:40%:20%)	20	8.0	8.0	4.0	Winkles and other molluscs (50%:50%)	17	8.5	8.5	Sand and mollusc beds	1000	2000 Review	2000 Review
2001 (RIFE 7)	Cod and other fish (40%:60%)	31	12.4	0	18.6	Crabs, Lobsters and Nephrops (40%:40%:20%)	20	8.0	8.0	4.0	Winkles and other molluscs (50%:50%)	17	8.5	8.5	Sand and mollusc beds	900	2000 Review	2000 Review
2002 (RIFE 8)	Cod and other fish (40%:60%)	51	20.4	0	30.6	Crabs, Lobsters and Nephrops (50%:30%:20%)	16	8.0	4.8	3.2	Winkles and mussels (60%:40%)	29	17.4	11.6	Mud and sand	1200	2002 Review	2002 Review
2003 (RIFE 9)	Cod and other fish (60%:40%)	41	24.6	0	16.4	Crabs, Lobsters and Nephrops (80%:10%:10%)	27	21.6	2.7	2.7	Winkles and other molluscs (40%:60%)	34	13.6	20.4	Mud and sand	870	2003 Survey	2003 Survey
2004 (RIFE 10)	Cod and other fish (60%:40%)	41	24.6	0	16.4	Crabs, Lobsters and Nephrops (50%:40%:10%)	25	12.5	10.0	2.5	Winkles and other molluscs (50%:50%)	34	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	24.6	0	16.4	Crabs, Lobsters and Nephrops (60%:20%:20%)	20	12.0	4.0	4.0	Winkles and other molluscs (60%:40%)	33	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	24.6	0	16.4	Crabs, Lobsters and Nephrops (50%:20%:30%)	20	10.0	4.0	6.0	Winkles and other molluscs (50%:50%)	40	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	24.6	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	10.0	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	10.0	0	30.0	Crabs, Lobsters and Nephrops (30%:50%:20%)	16	4.8	8	3.2	Winkles and other molluscs (60%:40%)	28	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	10.0	0	30.0	Crabs, Lobsters and Nephrops (50%:30%:20%)	22	11.0	6.6	4.4	Winkles and other molluscs (20%:80%)	22	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	10.0	0	30.0	Crabs, Lobsters and Nephrops (40%:30%:30%)	27	10.8	8.1	8.1	Winkles and other molluscs (60%:40%)	12	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	9.3	0	27.8	Crabs, Lobsters and Nephrops (30%:20%:50%)	29	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
2013 (RIFE 19)	Cod and other fish (40%:60%)	56	22.4	0	33.6	Crabs, Lobsters and Nephrops (20%:5%:75%)	25	5.0	1.2	18.8	Winkles and other molluscs (85%:15%)	15	12.8	2.2	Mud and sand	760	2013 Survey	2013 Survey
2014 (RIFE 20)	Cod and other fish (40%:60%)	56	22.4	0	33.6	Crabs, Lobsters and other crustaceans (25%:35%:40%)	36	9.0	12.6	14.4	Winkles and other molluscs (65%:35%)	11	7.2	3.8	Mud and sand	1100	2014 Review (crust and moll) 2013 Survey (fish)	2014 Review

Annex 3b. Sellafeld 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 or other crustaceans	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
2009-13	42.6	12.3	0.0	30.3	23.8	8.1	5.9	9.8	17.2	9.3	7.9	856
2010-14	45.8	14.8	0.0	31.0	27.8	8.9	6.9	12.0	13.8	7.4	6.4	884

Annex 4. Summary of adults' profiled consumption data (kg y⁻¹ or l⁻¹) and occupancy data (h y⁻¹) in the Sellafield area. (2013 Sellafield full habits survey data updated with the 2014 Sellafield Review data)

Profile Name	Number of individuals	Pathway Name																																
		Crustacea		Direct ^a	Eggs	Fish - Freshwater		Fish - Sea	Fruit - Domestic	Fruit and nuts - Wild	Gamma ext - saltmarsh ^b	Gamma ext - sediments ^c	Honey	Marine plants/algae	Meat - Cow	Meat - Game ^d	Meat - Pig	Meat - Poultry	Meat - salt marsh grazed sheep	Meat - Sheep	Meat - Wildfowl	Milk	Mollusca	Mushrooms	Occupancy IN water	Occupancy ON water	Plume (IN; 0-0.25 km) ^e	Plume (MID; >0.25-0.5 km) ^e	Plume (OUT; >0.5-1 km) ^e	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	kg	kg	kg	l	kg	kg	h	h	h	h	h	kg	kg	kg	kg	
Crustacean consumers	18	29.3	-	-	-	26.2	-	-	-	87	-	-	-	-	-	-	-	-	-	-	-	-	1.5	-	-	840	-	-	-	-	-	-	-	-
Occupants for direct radiation	79	0.29	1.00	1.8	-	2.0	1.1	0.37	-	76	-	-	1.7	-	0.28	0.25	-	0.61	-	3.8	-	-	-	-	4	240	740	2090	1.9	3.8	9.8	2.3	-	
Egg consumers	25	0.04	0.40	15.3	0.23	3.8	6.9	2.4	-	22	-	-	5.7	3.6	-	2.6	-	3.2	0.95	-	<0.01	0.17	2	<1	640	1420	530	4.7	6.5	50.4	5.5	-		
Freshwater fish consumers	4	-	-	17.8	1.4	3.3	2.3	6.8	-	-	-	-	-	0.23	-	0.68	-	-	-	-	-	0.23	-	-	-	-	-	-	2.9	-	165.1	8.8	-	
Sea fish consumers	12	19.4	0.08	-	-	54.4	-	-	-	340	-	-	-	-	-	-	-	-	-	-	-	3.1	-	-	220	-	-	23	-	-	-	-	-	
Domestic fruit consumers	8	-	0.25	3.9	-	-	32.7	0.99	-	<1	-	-	17.7	-	-	8.9	-	1.4	-	64.8	0.07	0.43	-	-	-	-	-	210	14.1	21.3	55.5	17.7	-	
Wild fruit and nut consumers	11	0.09	0.36	14.3	0.51	7.3	4.0	5.3	-	28	-	-	6.1	8.1	-	4.5	-	3.9	2.2	-	0.02	0.08	4	-	-	-	1470	1260	3.0	2.4	63.3	3.2	-	
Occupants over saltmarsh	4	0.43	-	-	-	-	-	-	250	89	-	-	-	-	-	-	-	1.9	-	-	-	0.05	-	-	-	-	-	-	-	-	-	-	-	
Occupants over sediment	15	5.5	0.27	-	-	17.8	0.20	0.03	-	930	-	-	-	-	-	-	-	-	-	6.9	1.4	-	-	75	40	-	-	52	2.3	3.0	1.9	3.2	-	
Honey consumers	4	-	-	3.4	-	-	7.3	0.79	-	3	0.23	-	-	-	-	0.68	-	-	-	-	182.5	-	-	-	-	-	-	-	13.8	6.8	-	3.6	-	
Marine plants and algae consumers	2	0.70	-	-	-	-	-	-	-	120	-	0.11	-	-	-	-	-	-	-	-	-	-	0.12	<1	-	-	-	-	-	-	-	-	-	
Cattle meat consumers	17	-	0.24	4.5	-	-	5.1	0.47	-	1	-	-	38.1	-	8.9	0.82	-	4.5	0.16	30.5	0.03	-	-	-	1080	-	-	-	1.3	-	59.0	2.5	-	
Game meat consumers	3	0.32	-	17.6	-	22.3	11.8	5.2	-	100	-	-	11.8	29.3	-	15.4	-	2.8	8.0	-	0.08	-	13	-	-	-	-	-	7.0	8.9	11.8	-	-	
Pig meat consumers	14	-	0.14	-	-	-	-	0.06	-	-	-	-	13.5	-	17.3	0.50	-	3.1	0.19	-	-	-	-	-	-	-	-	920	1.3	-	1.3	2.1	-	
Poultry meat consumers	6	0.16	-	8.8	-	11.2	12.6	3.1	-	52	-	-	5.9	14.7	-	20.5	-	1.4	4.0	-	0.04	-	7	-	-	-	-	-	9.3	7.9	40.1	4.8	-	
Salt marsh grazed sheep consumers	6	0.28	-	-	-	-	-	-	170	59	-	-	-	-	-	-	1.9	-	-	-	-	0.03	-	-	-	-	-	-	-	-	-	-	-	
Sheep meat consumers	26	-	0.08	3.0	-	-	3.9	0.78	-	1	-	-	19.4	-	5.8	0.54	-	9.4	0.10	19.9	0.02	0.04	-	-	-	-	620	-	0.86	0.55	7.5	1.7	-	
Wildfowl consumers	4	0.24	-	13.2	-	16.7	8.8	3.9	10	85	-	-	8.9	22.3	-	12.3	-	2.1	10.2	-	0.06	-	10	-	-	-	-	-	5.3	6.7	8.8	-	-	
Milk consumers	15	-	0.13	1.8	-	0.48	8.9	0.87	-	43	0.06	-	9.5	-	-	0.68	-	0.75	-	184.9	0.03	-	-	-	40	-	230	8.5	7.9	13.0	8.2	-	-	
Mollusc consumers	3	30.7	-	-	-	47.2	-	-	-	460	-	-	-	-	-	-	-	-	-	-	-	11.0	-	-	52	-	-	-	-	-	-	-	-	
Mushroom consumers	2	-	-	8.9	-	-	49.9	0.45	-	-	-	-	-	-	-	-	-	-	-	-	-	1.7	-	-	-	-	-	-	39.6	58.9	82.8	46.7	-	
Occupants IN Water	2	-	-	-	-	-	-	-	-	260	-	-	-	-	-	-	-	-	-	-	-	-	-	79	7	-	-	-	-	-	-	-	-	
Occupants ON Water	18	12.8	-	-	-	11.0	-	-	-	-	-	-	-	-	-	-	-	-	0.31	-	0.07	-	-	-	1670	-	-	-	-	-	-	-	-	
Occupants for plume pathways (0 - 0.25 km)	2	-	1.00	20.8	-	-	1.0	2.0	-	8	-	-	24.9	-	-	-	-	3.0	-	-	-	-	-	-	-	7070	-	-	-	-	-	131.6	-	
Occupants for plume pathways (>0.25 - 0.5 km)	6	-	1.00	8.2	-	1.1	3.2	1.4	-	75	-	-	5.2	-	-	-	-	5.7	-	-	-	-	-	-	-	-	7770	-	4.1	4.5	4.2	0.44	-	
Occupants for plume pathways (>0.5 - 1 km)	18	-	1.00	1.4	-	0.86	0.48	0.89	-	16	-	-	-	-	1.2	1.1	-	0.14	-	11.1	-	-	-	<1	-	-	6800	1.6	2.8	7.4	2.7	-	-	
Green vegetable consumers	15	-	0.33	2.1	-	0.48	11.1	0.40	-	44	0.06	-	-	-	-	0.96	-	-	-	62.5	-	0.23	-	40	-	1050	21.6	28.0	27.2	24.1	-	-	-	
Other domestic vegetable consumers	6	-	0.50	3.0	-	1.2	18.7	0.32	-	110	-	-	-	-	-	-	-	-	-	34.6	-	0.57	-	-	100	-	160	31.1	59.0	41.1	42.4	-	-	
Potato consumers	16	-	0.25	9.5	0.35	0.82	9.1	2.2	-	<1	-	-	10.9	0.06	-	4.2	-	1.3	-	-	-	0.27	-	-	1150	-	-	6.3	8.7	124.3	9.7	-	-	
Root vegetable consumers	10	-	0.50	1.8	-	0.73	13.2	0.28	-	64	-	-	-	-	-	-	-	-	-	20.7	-	0.34	-	-	61	-	1570	24.4	39.3	38.6	33.9	-	-	

Notes:

^aExpressed as the proportion of the profile members who are exposed to direct radiation.

^bGamma ext - saltmarsh only includes occupancy over saltmarsh.

^cGamma ext - sediments represents occupancy over mud; mud and sand; mud, sand and stones; sand; sand and stones.

^dGame meat includes venison and rabbits/hares.

^ePlume times are the sums of individuals' indoor and outdoor times.

The data used for these profiles is the 2013 Sellafield Habits Survey data updated with the 2014 Sellafield Review data.

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

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