Cefas

Radiological Habits Survey: Sellafield Review, 2006

Shellfish consumption and intertidal occupancy review

Environment Agency

FOOD STANDARDS AGENCY

HSE Health & Safety Executive

2007

Environment Report RL 11/07

Radiological Habits Survey: Sellafield Review, 2006

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2007

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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 contracts C1659, RB103 and C1666 respectively.
EA Project PO070206680, FSA Project RP0183 and HSE Project NS/X/374

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1. Introduction

This report describes a review of public radiation exposure pathways due to liquid radioactive waste discharges from the British Nuclear Group (Sellafield) Limited (BNGSL), and the United Kingdom Atomic Energy Authority (UKAEA) Windscale sites. It is also relevant to marine discharges from the Drigg low-level waste repository site. The review, carried out during September 2006, specifically investigated the consumption of crustaceans and molluscs and occupancy over intertidal substrates by members of the Sellafield Fishing Community (SFC). People who have had high shellfish consumption and/or high intertidal occupancy rates in the past were re-interviewed and contacts for new potential interviewees were sought, usually from information provided by existing interviewees.

Reviews are conducted annually because of the importance of the shellfish consumption and intertidal occupancy pathways in the Sellafield area. Also, consumption and occupancy rates have been known to vary significantly from year to year with some people giving up shellfish consumption, collection or fishing and new individuals being identified. The last full habits survey in the vicinity of Sellafield was conducted by the Centre for Environment, Fisheries & Aquaculture Science (Cefas) in 2003 (Clyne *et al*, 2004). Prior to this and in 2004 and 2005, annual reviews of crustacean and mollusc consumption and occupancy over intertidal substrates have also been conducted.

During 2006, in addition to direct interviewing, several of the higher rate consumers of local molluscs and crustaceans logged their relevant seafood consumption and intertidal occupancies for two-week periods every three months. This logging data can be used to check the validity of the interview data if consumption rates were considered to be unreasonably high. The results of this review could be used to direct changes to the Food Standards Agency's and the Environment Agency's environmental monitoring programmes in the Sellafield area.

2. Survey area

The effects of discharges of liquid radioactive waste from Sellafield can be detected throughout the Irish Sea, with a general decrease in concentrations as the distance from the source increases (EA, EHS, FSA and SEPA, 2006). The survey area, shown in Figure 1, was between Parton to the north of Sellafield and Tarn Bay to the south and up to 11 km off shore.

Figure 1. The Sellafield aquatic review area

3. Conduct of the survey

Individuals known to have had high rates of crustacean and mollusc consumption and/or intertidal occupancy in previous reviews were re-visited and interviewed. During the interviews, individuals were asked to estimate crustacean and mollusc consumption rates and occupancy rates over intertidal areas for themselves and members of their families. Individuals interviewed as a result of their high crustacean or mollusc consumption rates or intertidal occupancy rates were also asked to provide consumption rates for fish in order to determine an appropriate combination of pathways for the purpose of dose assessment for the SFC group (see Appendix 4 of Radioactivity in Food and the Environment, 2005, (RIFE 11) (EA, EHS, FSA and SEPA, 2006). Information was also obtained about the locations of where their local seafood came from and where their intertidal occupancy most commonly took place. As mentioned previously, selected high rate consumers identified from previous surveys and reviews had also been logging their seafood consumption and intertidal occupancy for four fortnightly periods during the year.

The habits of 29 adults were recorded during the fieldwork. Their crustacean and mollusc consumption rates and intertidal occupancy rates are shown in Tables 1 to 3, respectively. The full set of data collected can be seen in Annex 1.

4. Data analysis

4.1 Internal exposure

The mean consumption rates of the critical groups eating Sellafield coastal shellfish were 20 kg/y for crustaceans based on eight observations (maximum rate 30 kg/y) and 40 kg/y for molluscs based on five observations (maximum rate 52 kg/y).

The main species consumed were crabs, lobsters, *Nephrops*, winkles, mussels and cockles, with small amounts of brown shrimps, limpets, Pacific oysters, razor shells and whelks. From observations of consumption preferences of the critical groups for different species in 2006, assessments can be based on the following:

- Crustaceans - 50% crab, 30% *Nephrops* and 20% lobster
- Molluscs - 50% winkles and 50% other molluscs

The 2006 SFC critical group mean consumption rate identified in this review for molluscs was approximately 20 % higher than that identified in the 2005 review. The 2006 critical group mean consumption rate for crustaceans was unchanged from that of the 2005 review. The 2005 rates currently being used for dose assessments are:

- 20 kg/y crustaceans (60% crab, 20% lobster and 20% *Nephrops*)
- 33 kg/y molluscs (60% winkles and 40% other molluscs)

The percentage species distribution for crustaceans shows a decrease in crab consumption, an increase in *Nephrops* consumption and no change in lobster consumption. The percentage species distribution for molluscs showed a decrease in winkle consumption leading to an increase in the consumption of other molluscs.

Figures 2 and 3 show how the critical group mean consumption rates for crustaceans and molluscs have changed in the last ten years. The source data for the production of these charts are the RIFE SFC five year averaging data shown in Annex 2.

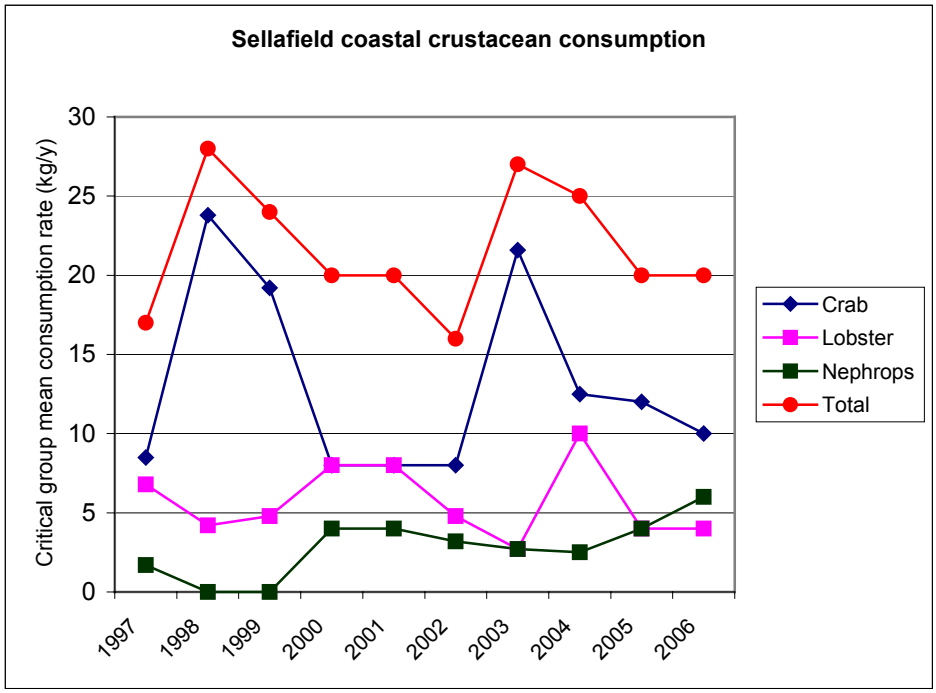

Figure 2. Critical group mean consumption rates of crustaceans 1997 to 2006.

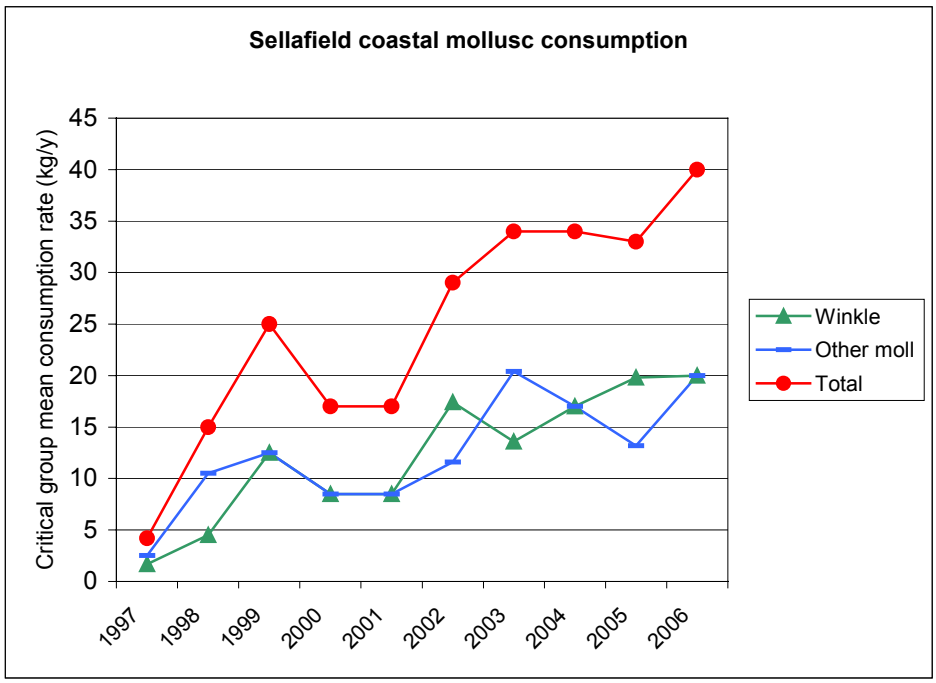

Figure 3. Critical group mean consumption rates of molluscs 1997 to 2006.

Since the review did not target consumers of fish, not enough data was collected to generate a dependable critical group value. Therefore, the fish consumption rate from the full habits survey at Sellafield in 2003 of 41 kg/y will be retained. Fish consumption rates obtained during interviews with members of the Sellafield Fishing Community during the 2006 review can be seen in Annex 1.

4.2 External exposure

In 2006, intertidal occupancy rates were noted for two different substrate types. These rates and substrates are shown in Table 3. The substrates were mud and sand, and sand and stones.

Four individuals (collecting cockles, bait digging, angling, long-lining and conducting boat maintenance) formed the critical group over mud and sand with a mean occupancy time of 580 h/y. The maximum occupancy time over mud and sand was 730 h/y for a cockle collector/angler.

Eight individuals (winkle collecting, angling, set-netting, long-lining, walking and dog walking) formed the critical group over sand and stones with a mean occupancy time of 340 h/y. The maximum occupancy time over sand and stones was 500 h/y for an individual who was angling, set-netting and long-lining.

These rates compare with occupancy rates identified during the 2005 review of 790 h/y over mud and sand for eight individuals (maximum time 1200 h/y) and 540 h/y over sand and stones for four individuals (maximum time 750 h/y).

As handling of sediment and fishing gear and the intertidal occupancy of other Sellafield groups (as defined in Appendix 4 in EA, EHS, FSA and SEPA, 2006) were not specifically targeted, recommended rates for handling, and occupancy over salt marsh will remain as they were in RIFE 11. These were 1000 h/y for handling sediment, 730 h/y for handling fishing gear and 400 h/y occupancy over salt marsh.

5 Conclusions

The overlap between pathways, shown in Table 4, has been considered for the purpose of dose assessment. One individual is a member of four critical groups and other observations are members of two or three critical groups for the following pathways; crustaceans, molluscs and occupancy over mud and sand, and sand and stones. They also consumed fish. As occupancy over sand and stones is conservatively covered by considering occupancy over mud and sand, it is recommended that a direct combination of critical group mean rates for fish, crustacean and mollusc consumption and occupancy over mud and sand is made.

The 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 site. The relevant matrix for the Sellafield adults' profiled habits data is shown in Annex 3. It is based on data from the full 2003 habits survey at Sellafield, which has been updated with crustacean and mollusc consumption rates and intertidal occupancy rates from the 2004, 2005 and 2006 Sellafield reviews. Therefore data shown in Annex 3 are not comparable with data from Annex 1. 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 will in future be made using these profiles and reported in the Radioactivity in Food and the Environment Reports (See Appendix 7 in EA, EHS, FSA and SEPA, 2006).

6 Recommendations

In view of the importance of shellfish consumption and intertidal occupancy pathways at Sellafield and the fact that consumption and occupancy may vary from year to year, it is recommended that the annual shellfish consumption and intertidal occupancy review of the SFC be continued.

7 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., McTaggart, K.A. and Tipple, J.R., 2004. Radiological Habits Survey: Sellafield, 2003. EA, FSA and HSE, Warrington, London and Bootle.

EA, EHS, FSA and SEPA, 2006. Radioactivity in Food and the Environment, 2005. EA, EHS, FSA and SEPA, Warrington, Belfast, London and Stirling. RIFE(11).

Table 1. Adults' consumption rates of crustaceans in the Sellafield area (kg/y)

Observation number	Brown shrimp	Crab	Lobster	*Nephrops*	Total
29 - 30		**18.2**	**5.2**	**6.4**	**29.9**
16	**1.3**	**4.1**	**2.1**	**17.7**	**25.2**
23		**18.4**	**1.4**		**19.8**
15				**17.7**	**17.7**
21	**1.5**	**15.7**			**17.2**
26 - 27		**2.1**	**8.2**		**10.3**
22		7.9			7.9
4 - 6		3.4	1.6	0.6	5.6
25		4.5			4.5
7 - 8	0.7	2.0	0.8		3.6
17		0.9	1.6		2.5
18 - 20				2.1	2.1
24		0.3			0.3
1 - 2				0.3	0.3
10 - 11	0.1				0.1

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of crustaceans based on the 8 highest adult consumers is 20.0 kg/y

The observed 97.5 percentile rate based on 24 observations is 29.9 kg/y

Table 2. Adults' consumption rates of molluscs in the Sellafield area (kg/y)

Observation number	Cockle	Limpet	Mussel	Pacific oyster	Razor shell	Whelk	Winkle	Total
9	**21.6**		**22.3**	**0.2**			**8.4**	**52.4**
2		**0.1**	**11.9**				**32.7**	**44.7**
1			**11.9**				**32.7**	**44.6**
21	**2.9**				**1.0**		**29.4**	**33.2**
25	**7.3**		**16.6**				**1.0**	**24.9**
23	5.9		2.9				0.5	9.4
29-30	2.6		3.5					6.1
16	1.8		1.8	0.5	1.0			5.0
4 - 6						2.9		2.9
7			0.7		1.3		0.6	2.5
8			0.7		1.3		0.6	2.5
17	0.8						1.4	2.3
15	1.8							1.8
12 - 14							1.5	1.5
26	0.9							0.9
3	0.2						0.3	0.5

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of molluscs based on the 5 highest adult consumers is 40.0 kg/y

The observed 97.5 percentile rate based on 21 observations is 48.5 kg/y

Table 3. Intertidal occupancy rates in the Sellafield area (h/y)

Observation number	Location[a]	Activity[a]	Mud and sand	Sand and stones
15	Braystones and Drigg,Ravenglass**/various locations/Braystones**	Bait digging, collecting shellfish**/angling, long-lining/set-netting**	105	**497**
21	**Ravenglass/various locations**	**Collecting cockles/collecting winkles, angling**	**728**	**416**
29	**Nethertown and Whitehaven Harbour/St Bees to Sellafield**	**Bait digging/angling**	**416**	**416**
10	**Braystones**	**Long-lining, bait digging, angling/**beach combing	**688**	48
23	**Ravenglass/Whitehaven Harbour**/Whitehaven Beach	**Boat maintenance/bait digging/**collecting winkles	**504**	24
7	**Braystones**	**Angling**		**416**
17	Various locations/Drigg/Ravenglass	Collecting crabs, collecting winkles, angling/bait digging/collecting mussels		101
1	Ravenglass/Barrow Mouth**/Whitehaven**	Collecting mussels/collecting winkles**/dog walking**	132	**220**
16	Ravenglass/**Braystones**	Collecting cockles**/angling**	15	**297**
8	**Braystones**	**Collecting winkles**		**208**
18	**St. Bees and Parton**	**Walking**		**206**
12	Braystones, Whitehaven/Braystones	Collecting winkles, angling/long-lining, bait digging		124
9	Ravenglass/various locations	Collecting cockles and mussels/collecting winkles	156	
25	St Bees and Ravenglass	Walking		156
3	Caulderton	Walking		80

Notes

Emboldened observations are the critical group members

The critical group intertidal occupancy rate over mud and sand based on 4 observations is 584 h/y

The observed 97.5 percentile rate based on 8 observations for mud and sand is 721 h/y

The critical group intertidal occupancy rate over sand and stones based on 8 observations is 335 h/y

The observed 97.5 percentile rate based on 14 observations for sand and stones is 471 h/y

[a] The forward slash (/), separates the locations of, and activities taking place on, the separate substrates for that individual

Table 4. Aquatic combinations for the Sellafield area

	Internal exposure Consumption rates (kg/y)			Intertidal exposure (h/y) Occupancy	
Observation number	Fish	Crustaceans	Molluscs	Mud and sand	Sand and stones
21	59.0	**17.2**	**33.2**	**728**	**416**
16	49.6	**25.2**	5.0	15	**297**
29	47.0	**29.9**	6.1	**416**	**416**
30	47.0	**29.9**	6.1		
25	44.2	4.5	**24.9**		156
22	29.5	7.9			
15	27.2	**17.7**	1.8	105	**497**
12	23.7		1.5		124
13	23.7		1.5		
10	23.0	0.1		**688**	48
11	21.8	0.1			
17	18.6	2.5	2.3		101
23	12.9	**19.8**	9.4	**504**	24
4	12.4	5.6	2.9		
18	5.8	2.1			**206**
26		**10.3**	0.9		
27		**10.3**			
7		3.6	2.5		**416**
8		3.6	2.5		**208**
2		0.3	**44.7**		
1		0.3	**44.6**	132	**220**
9			**52.4**	156	

NOTES
Emboldened text represents members of the most exposed sub-groups within each pathway

Annex 1. Adults' consumption rates (kg/y or l/y) and occupancy rates (h/y) in the Sellafield area

Observation number	Sex (U if unknown)	Age in years (U if unknown)	Fish	Crustaceans	Molluscs	Intertidal occupancy over mud and sand	Intertidal occupancy over sand and stones
1	M	49		0.3	**44.6**	132	**220**
2	M	18		0.3	**44.7**		
3	M	67			0.5		80
4	M	67	12.4	5.6	2.9		
5	F	68	12.4	5.6	2.9		
6	F	35	12.4	5.6	2.9		
7	M	U		3.6	2.5		**416**
8	F	U		3.6	2.5		**208**
9	M	U			**52.4**	156	
10	M	U	23.0	0.1		**688**	48
11	F	U	21.8	0.1			
12	M	62	23.7		1.5		124
13	F	64	23.7		1.5		
14	M	41			1.5		
15	M	59	27.2	**17.7**	1.8	105	**497**
16	F	53	49.6	**25.2**	5.0	15	**297**
17	M	22	18.6	2.5	2.3		101
18	M	U	5.8	2.1			**206**
19	F	U	14.7	2.1			
20	F	U	13.1	2.1			
21	M	56	59.0	**17.2**	**33.2**	**728**	**416**
22	F	U	29.5	7.9			
23	M	25	12.9	**19.8**	9.4	**504**	24
24	M	45	3.9	0.3			
25	M	U	44.2	4.5	**24.9**		156
26	M	U		**10.3**	0.9		
27	F	U		**10.3**			
29	M	25		**29.9**	6.1	**416**	**416**
30	M	47		**29.9**	6.1		

Notes

Emboldened observations are rates included in the critical groups.

Annex 2. RIFE SFC 5 year averaging data

	FISH					CRUSTACEANS					MOLLUSCS				EXTERNAL		Habits source data	
Year (and report)	kg/y	Species	Cod	Plaice	Other fish	kg/y	Species	Crab	Lobster	*Nephrops*	kg/y	Species	Winkles	Other molluscs	h/y	Substrate	Consumption	External
1994 (AEMR 45)	26.0	plaice and cod	13.0	13.0	0.0	12.0	Crabs and Lobsters	6.0	6.0	0.0	9.7	winkles and other molluscs	4.9	4.9	0		1993/94 Survey	1993/94 Survey
1995 (RIFE 1)	26.0	plaice and cod	13.0	13.0	0.0	8.6	Crabs and Lobsters (75%:25%)	6.5	2.2	0.0	12.0	winkles and other molluscs	6.0	6.0	0		1995 Review (crus + moll)	
1996 (RIFE 2)	25.0	plaice and cod	12.5	12.5	0.0	12.0	Crabs and Lobsters (60%:40%)	7.2	4.8	0.0	12.0	winkles and other molluscs (60%:40%)	7.2	4.8	0		1996 Review	1997 Review
1997 (RIFE 3)	37.0	plaice and cod (25%:75%)	27.8	9.3	0.0	17.0	Crabs, Lobsters and *Nephrops* (50%:40%:10%)	8.5	6.8	1.7	4.2	winkles and other molluscs (40%:60%)	1.7	2.5	0		1997 Review	
1998 (RIFE 4)	45.0	plaice and cod (50%:50%)	22.5	22.5	0.0	28.0	Crabs and Lobsters (85%:15%)	23.8	4.2	0.0	15.0	winkles and other molluscs (30%:70%)	4.5	10.5	1100	Sand and mollusc beds	1998 Survey	1999 Survey
1999 (RIFE 5)	43.0	plaice and cod (50%:50%)	21.5	21.5	0.0	24.0	Crabs and Lobsters (80%:20%)	19.2	4.8	0.0	25.0	winkles and other molluscs (50%:50%)	12.5	12.5	1000	Sand and mollusc beds	1999 Review	2000 Review
2000 (RIFE 6)	31.0	cod and other fish (40%:60%)	12.4	0.0	18.6	20.0	Crabs, Lobsters and *Nephrops* (40%:40%:20%)	8.0	8.0	4.0	17.0	winkles and other molluscs (50%:50%)	8.5	8.5	1000	Sand and mollusc beds	2000 Review	2001 Review
2001 (RIFE 7)	31.0	cod and other fish (40%:60%)	12.4	0.0	18.6	20.0	Crabs, Lobsters and *Nephrops* (40%:40%:20%)	8.0	8.0	4.0	17.0	winkles and other molluscs (50%:50%)	8.5	8.5	900	Sand and mollusc beds	2001 Review	2002 Review
2002 (RIFE 8)	51.0	cod and other fish (40%:60%)	20.4	0.0	30.6	16.0	Crabs, Lobsters and *Nephrops* (50%:30%:20%)	8.0	4.8	3.2	29.0	winkles and mussels (60%:40%)	17.4	11.6	1200	Mud and sand	2002 Review	2003 Review
2003 (RIFE 9)	41.0	cod and other fish (60%:40%)	24.6	0.0	16.4	27.0	Crabs, Lobsters and *Nephrops* (80%:10%:10%)	21.6	2.7	2.7	34.0	winkles and other molluscs (40%:60%)	13.6	20.4	870	Mud and sand	2003 Survey	2003 Survey
2004 (RIFE 10)	41.0	cod and other fish (60%:40%)	24.6	0.0	16.4	25.0	Crabs, Lobsters and *Nephrops* (50%:40%:10%)	12.5	10.0	2.5	34.0	winkles and other molluscs (50%:50%)	17.0	17.0	1000	Mud and sand	2004 Review	2004 Review
2005 (RIFE 11)	41.0	cod and other fish (60%:40%)	24.6	0.0	16.4	20.0	Crabs, Lobsters and *Nephrops* (60%:20%:20%)	12.0	4.0	4.0	33.0	winkles and other molluscs (60%:40%)	19.8	13.2	790	Mud and sand	2005 Review	2005 Review
2006 (RIFE 12)	41.0	cod and other fish (60%:40%)	24.6	0.0	16.4	20.0	Crabs, Lobsters and *Nephrops* (50%:20%:30%)	10.0	4.0	6.0	40.0	winkles and other molluscs (50%:50%)	20.0	20.0	580	Mud and sand	2006 Review	2006 Review

5-YEAR AVERAGES

5 year period	Fish	Cod	Plaice	Other fish	Crustaceans	Crab	Lobster	*Nephrops*	Molluscs	Winkles	Other molluscs	External
1994-98	31.8	17.8	14.1	0.0	15.5	10.4	4.8	0.3	10.6	4.8	5.7	220
1995-99	35.2	19.5	15.8	0.0	17.9	13.0	4.6	0.3	13.6	6.4	7.3	420
1996-00	36.2	19.3	13.2	3.7	20.2	13.3	5.7	1.1	14.6	6.9	7.8	620
1997-01	37.4	19.3	10.7	7.4	21.8	13.5	6.4	1.9	15.6	7.1	8.5	800
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

SUGGESTED 5 YEAR AVERAGES TO USE IN RIFE 12 DOSE CALCULATIONS

	kg/y
Fish	**43 kg/y**
Crabs	**13 kg/y**
Lobsters	**5.1 kg/y**
Nephrops	**3.7 kg/y**
Winkles	**18 kg/y**
Other molluscs	**16 kg/y**
External	**890 h/y (mud and sand)**

Annex 3. Summary of adults' profiled habits data (2003 - 2006) in the Sellafield area

Profile Name	Number of Individuals	Pathway Name	Crustacea	Direct[4]	Eggs	Fish - Fresh	Fish - Sea	Fruit - Domestic	Fruit and nuts - Wild	Gamma ext - Sediment[1]	Honey	Meat - Cow	Meat - Game[2]	Meat - Poultry	Meat - Sheep	Milk	Mollusca	Mushrooms	Occupancy IN water	Occupancy ON water	Plume (IN; 0-0.25km)[3]	Plume (MID; 0.25-0.5km)[3]	Plume (OUT; 0.5-1km)[3]	Vegetables - Green	Vegetables - Other Domestic	Vegetables - Potatoes	Vegetables - Root
			kg	-	kg	kg	kg	kg	kg	h	kg	kg	kg	kg	kg	l	kg	kg	h	h	h	h	h	kg	kg	kg	kg
Crustacean consumers	11		18.9				25.4			390			1.4				6.5			409								
Occupants for direct radiation	74			1.0	3.7		0.6	0.8	0.5	47		6.0	0.1	0.5	1.6	46.8		0.1		8	892	909	1658	0.8	1	7.2	1
Egg consumers	58			0.4	13.1		0.6	4.8	0.8	14		10.9		1.9	3.1	92.0		0.2			1017	868	504	6.2	4.7	30.2	6
Fresh fish consumers	10				1.2	0.2	1.4			32			0.3	2.0				0.1								33.3	
Sea fish consumers	25		6.9				42.0			328			0.6				4.1			146								
Domestic fruit consumers	13				6.4			32.1	0.3	24	1.5			3.1	1.6			0.1		12				15.3	25.5	65.9	21.4
Wild fruit and nut consumers	13			0.6	10.0		0.1	3.7	3.4			7.3	0.2	1.0	2.0	8.0		0.4				2167	1812	8.7	3.7	36	10.9
Occupants for exposure - Sediment	51		1.4				6.5			791			0.2				1.0			32		7					
Honey consumers	4							42.1	0.7	78	5.0			2.8						40				3.5	12.9	12.3	19
Cattle meat consumers	28			0.3	5.2		0.1	1.4	0.5			46.3	0.1	2.4	6.4	113.9		0.2			819	457	1014	0.1	2	28.8	2.8
Game meat consumers	3												25.7	6.1													
Poultry meat consumers	24			0.3	6.2		0.2	10.2	0.6	13	0.3	17.7	3.4	6.6	6.3	57.8		0.3		7	689	533	504	2.5	6.9	31.9	6.4
Sheep meat consumers	6			0.7	8.9			5.4	2.0			49.8	0.5	3.9	23.6	139.0		0.4				2134	2018	0.3	2.4	1.5	1.9
Milk consumers	35			0.4	4.8		0.4	1.7	0.4	18		12.7		0.9	2.0	260.0					1357	1030	465	0.7	0.2	16.4	3.6
Mollusc consumers	7		5.2				19.5			301							39.5			210							
Mushroom consumers	9			0.2	6.6			11.1	1.3	13	0.1			0.6	1.7	46.1	0.1	2.1					1621	12	7.6	35.3	15.1
Occupants in water	13									2									92								
Occupants on water	7		10.2	0.1			20.4			296							7.1			872		6					
Occupants for plume pathways (inner area)	8			1.0	10.8		0.2		0.4	33		14.2		1.3	2.8	165.9					7372					3.2	
Occupants for plume pathways (middle area)	9			1.0	11.5			4.3	1.6	13		15.7		1.2	7.9	156.2		0.1				7136				36.8	1.1
Occupants for plume pathways (outer area)	19			1.0	3.4		0.6	1.1	0.9			10.0	0.1	0.9	1.3	38.2		0.5					6305	0.1	2.3	0.5	0.2
Green vegetable consumers	14			0.1	11.7		1.2	17.8	0.6					0.7	1.5			0.3					71	35.8	26.3	81.3	31.4
Other domestic vegetable consumers	9			0.1	9.3			21.4	0.1					1.0	2.3			0.2					111	32.8	38.4	93.2	35
Potato consumers	36			0.1	6.4		0.6	5.5	0.3	1		10.5		2.4	0.9	43.1		0.2				401	28	10.5	9.6	109.4	11.4
Root vegetable consumers	21				7.8		0.8	16.5	1.2	15	0.3	4.5		1.0	1.0	29.6		0.2		8			48	25.5	19.8	65.4	30.9

Notes

1. Gamma ext - Sediment includes occupancy over coal & sand, sand, sand & mud, sand & stone and salt marsh
2. Game meat includes wildfowl, rabbits/hares and vension
3. Plume times are the sums of individuals' indoor and outdoor times
4. Expressed as proportion of group who are present within 1km of site

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