



Shellfish consumption and intertidal occupancy review, Sellafield, 2004.

This note describes a review of public radiation exposure pathways due to liquid radioactive waste discharges from the British Nuclear Fuels plc (BNFL), Sellafield and the United Kingdom Atomic Energy Authority (UKAEA), Windscale sites. It is also relevant to marine discharges from the Drigg waste disposal site. The review, carried out during July 2004, specifically targeted mollusc and crustacean consumption and intertidal occupancy rates 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 new individuals were sought, usually from information provided by the known individuals. Reviews are conducted annually because of the importance of the shellfish consumption and intertidal occupancy pathways at Sellafield. Also, consumption and occupancy rates have been known to vary significantly from year to year with some people giving up shellfish collection or fishing and new individuals appearing.

The last full survey in the vicinity of Sellafield was conducted in 2003 (Clyne *et al*, 2004). Prior to this, annual reviews of crustacean and mollusc consumption and external exposure pathways have also been conducted by the Centre for Environment, Fisheries and Aquaculture Science (CEFAS). The 2004 review used two techniques to collect data: direct interviewing and logging of selected high rate consumers. The logging data was used to check the validity of the interview data when consumption rates were considered to be excessive. The results of this review could be used to direct changes to the Food Standard Agency's and the Environment Agency's environmental monitoring programme in the Sellafield area.

Definition of 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, 2004). The area of this review, shown in Figure 1, has been chosen to include consumption of seafood caught and collected and intertidal activities in the local area from Parton in the north to Tarn Bay in the south. As with previous surveys and reviews, Sellafield coastal seafood has been defined as that which is caught within 11 km of the shore.

Conduct of the survey

Individuals with known high rate shellfish consumption and/or intertidal occupancy from the previous survey were re-visited and interviewed. In addition, five new observations were identified with high consumption and/or intertidal occupancy rates. During the interviews individuals were asked to estimate for themselves and members of their families their seafood consumption rates, and their occupancy times over intertidal areas. Information was also obtained about the sources of seafood consumed and the locations where their intertidal occupancy most commonly took place. Selected high rate consumers identified from previous surveys and reviews had also been logging their seafood consumption and external occupancy for four fortnightly periods during the year.

The habits of 41 individuals were recorded during the fieldwork. Most of these were adults. Few child observations were made and those that were made were generally of low significance, taking into account relative dose coefficients. The analysis was therefore limited to adults. The results are shown in Tables 1 to 3.

Data analysis

Internal exposure

In addition to mollusc and crustacean consumption data the interviews also provided some observations for fish consumption. However, these were regarded as being too few to generate a dependable updated fish critical group value and the fish consumption rate of 41 kg/y from the 2003 survey will be retained.

In 2004 the mean consumption rates of the critical groups eating Sellafield coastal shellfish were, 25 kg/y for crustaceans based on 10 observations (maximum rate 39 kg/y) and 34 kg/y for molluscs based on seven observations (maximum rate 53 kg/y).

The main species consumed were crabs, lobsters, *Nephrops*, winkles, mussels and cockles. From observations of consumption preferences of the critical groups for different species, assessments can be based on the following:

Crustaceans - 50% crab, 40% lobster and 10% *Nephrops*

Molluscs - 50% winkles and 50% other molluscs

The SFC mean consumption rates identified in this report compare favourably with those identified in 2003 survey which are currently being used for dose assessments. These are:

- 27 kg/y crustaceans (80% crab, 10% lobster and 10% *Nephrops*)
- 34 kg/y molluscs (40% winkles and 60% other molluscs)

However, the species distribution for crustaceans shows a decrease in crab consumption and an increase in lobster consumption. The species distribution for molluscs showed a small increase in winkle consumption and a slight decrease consumption of other molluscs. The trends in critical group mean consumption rates of crustaceans and molluscs over the last ten years are shown in Figures 2 and 3. The source data for the production of these charts are from the RIFE SFC five year averaging data shown in Annex 1.

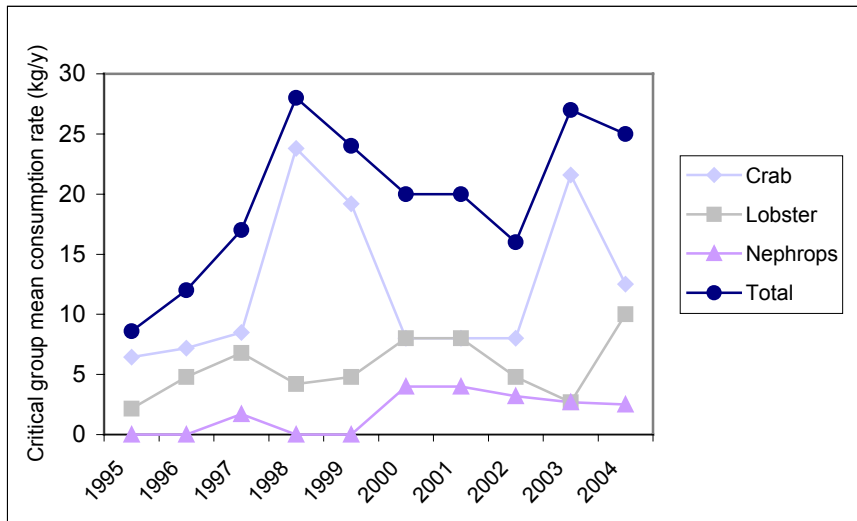


Figure 2. Critical group consumption rates of crustaceans 1995 to 2004.

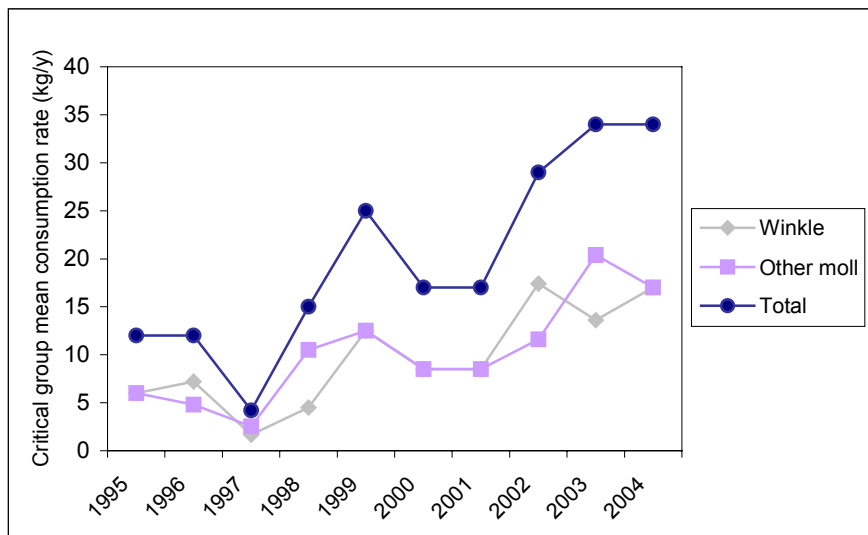


Figure 3. Critical group consumption rates of molluscs 1995 to 2004.

External exposure

Intertidal occupancy was noted over three substrate types in the survey area shown in Table 3. These were mud and sand, rock and sand/sand and stones. Nine individuals, bait digging, walking and shellfish collecting over mud and sand, formed the critical group for this substrate type with a mean occupancy time of 1000 h/y. The maximum occupancy time over mud and sand was 1500 h/y for three commercial mollusc collectors. Five individuals, angling, bait

digging and walking over sand/sand and stones, formed the critical group for this substrate type with a mean occupancy time of 610 h/y. The maximum occupancy time over sand/sand and stones was 1100 h/y for an individual who was angling and bait digging. The maximum occupancy over rock was 220 h/y for a shellfish collector. This was the only observation over rock.

These compare with occupancy times identified during the 2003 survey of 870 h/y over mud and sand for 14 individuals (maximum time 1600 h/y), 590 h/y over sand/sand and stones for 17 individuals (maximum time 1100 h/y) and 30 h/y over rock for 2 individuals (maximum time 30 h/y)

As handling of sediment and fishing gear and intertidal occupancy of other Sellafield groups were not specifically targeted, the handling times and occupancy over salt marsh will remain the same as those identified during the 2003 survey. These were 1000 h/y for handling sediment, 730 h/y for handling fishing gear and 400 h/y occupancy over salt marsh.

Conclusions

The overlap between pathways, shown in Table 4, has been considered. Some individuals are members of two of the critical groups for the following pathways; crustaceans, molluscs and occupancy over mud and sand. They also feature in the third pathway outside the critical group and consume fish. Therefore, it is recommended that a direct combination of critical rates for these pathways is made.

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.

References

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

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This report was reviewed by Fiona Clyne prior to issue.

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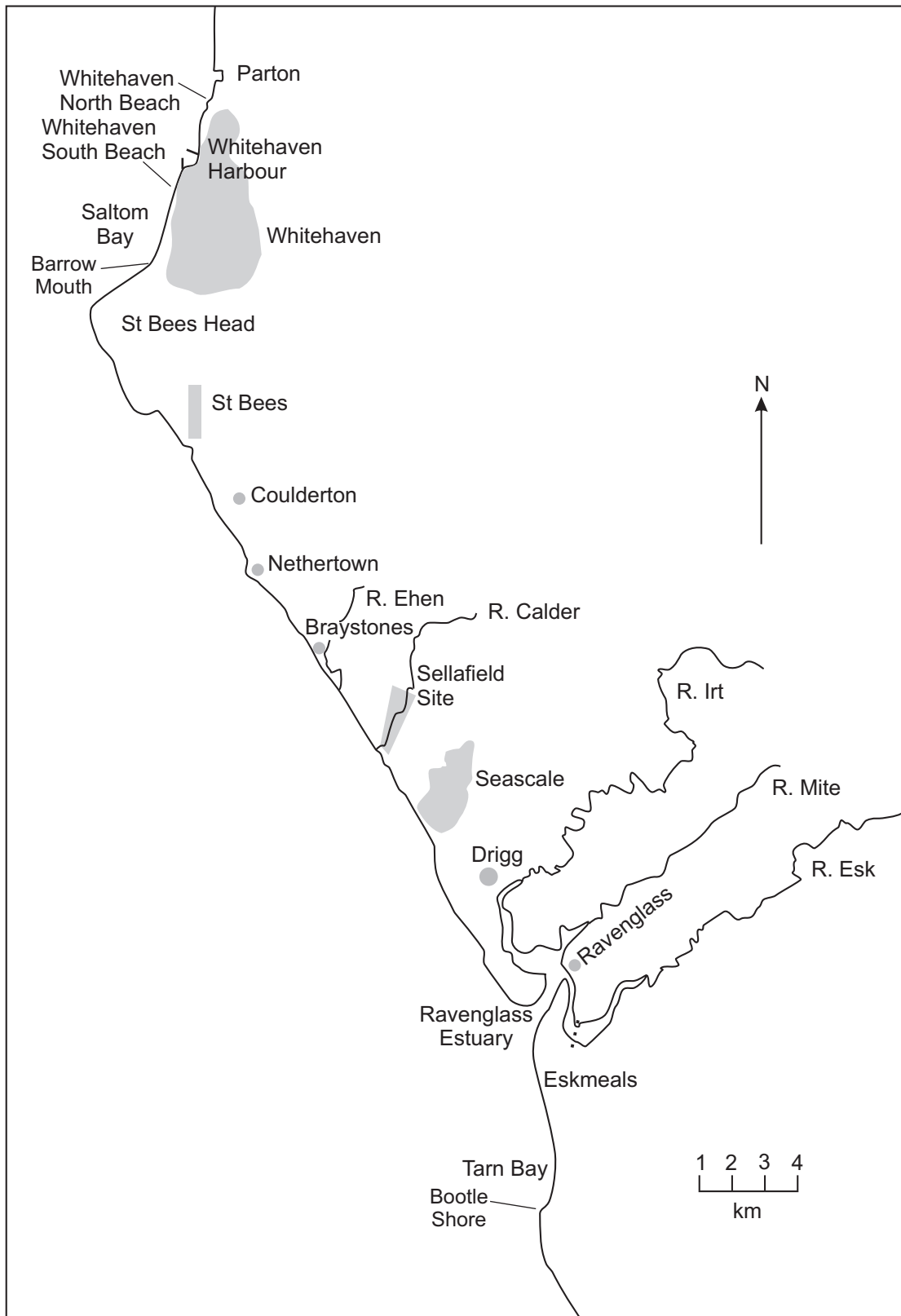


Figure 1. The Sellafeld aquatic review area

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

Observation number	Common prawn	Crab	Lobster	<i>Nephrops</i>	Total
19-20		11.1	27.9		39.0
11-12		32.4			32.4
32		4.0	0.4	17.5	21.8
33		2.0	0.4	17.5	19.8
27		9.8	9.3		19.1
26		8.7	9.3		18.0
37-38		8.8	5.4		14.3
7		12.0			12.0
21-23				9.1	9.1
13-14		6.7	2.3		9.0
24-25			2.4		2.4
1		1.3	0.8		2.0
3-4	0.3	1.4			1.8
34-35		0.7	0.2	0.2	1.1
28		1.0			1.0
10	0.4				0.4

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of crustaceans based on the 10 highest adult consumers is 25.0 kg/y

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

Observation number	Cockle	Limpet	Mussel	Razor shell	Whelk	Winkle	Total
8	12.2		16.3			24.9	53.3
1	6.5		19.5			14.8	40.8
13	12.4					24.8	37.2
14	12.4					24.8	37.2
32	17.5		10.0				27.4
30		5.3	2.1			16.0	23.4
29	2.7		9.1		3.9	2.6	18.2
11	7.9					7.4	15.4
12	7.9					7.4	15.4
2						10.6	10.6
7			4.9			3.7	8.5
33	3.1		0.7				3.7
37					0.9		0.9
38					0.9		0.9
34				0.2		0.2	0.5

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of molluscs based on the 7 highest adult consumers is 33.9 kg/y

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

Observation number	Location	Activity	Mud and sand	Rock	Sand/sand and stones
2	Bootle/Nethertown/Coulderton	Mollusc collecting	1456		
3	Bootle/Nethertown/Coulderton	Mollusc collecting	1456		
6	Bootle/Nethertown/Coulderton	Mollusc collecting	1456		
31	Drigg/Eskmeals/Braystones/Sellafield	Bait digging/angling	1095		620
33	Parton/Drigg/Braystones	Shellfish collecting/angling	948		416
1	Bootle/Nethertown/Coulderton	Mollusc collecting	832		
28	Drigg	Walking	750		
11	Barrow Mouth/Whitehaven	Mollusc collecting	584		
13	Barrow Mouth/Whitehaven	Mollusc collecting	584		
8	Ravenglass/St Bees	Mollusc collecting	72		
34	Whitehaven/Drigg/Braystones	Shellfish collecting/bait digging/angling/walking	52		468
32	Ravenglass/Braystones	Shellfish collecting/angling	24		440
7	Barrow Mouth/Whitehaven	Mollusc collecting	24		
36	Braystones	Angling/bait digging			1089
29	Ravenglass to Whitehaven	Walking			325
30	Coulderton/Netherton	Walking			252
35	Whitehaven/Braystones/Drigg	Bait digging/walking/angling			156
38	Seascale	Walking			130
39	Seascale	Walking			130
40	Seascale	Walking			130
41	Seascale	Walking			130
37	Seascale	Preparing for commercial fishing			104
26	Parton	Crustacean/mollusc collecting		221	

Notes

Emboldened observations are the critical group members

The critical group intertidal occupancy over mud and sand based on 9 observations is 1017.9 h/y

The critical group intertidal occupancy over sand/sand and stones based on 5 observations is 606.6 h/y

The critical group intertidal occupancy over rock based on 1 observation is 221.0 h/y

Table 4. Aquatic combinations for the Sellafield area

Observation number	Internal exposure (kg/y) Consumption rates			External exposure (h/y) Occupancy		
	Fish	Crustaceans	Molluscs	Mud and sand	Rock	Sand/sand and stones
32	108.1	21.8	27.4			440
33	60.4	19.8	3.7	948		416
37	24.5	14.3	0.9			104
38	24.5	14.3	0.9			
7	23.1	12.0	8.5	24		
35	18.0	1.1				
34	18.0	1.1	0.5			468
11	17.1	32.4	15.4	584		
12	17.1	32.4	15.4			
13	13.6	9.0	37.2	584		
14	13.6	9.0	37.2			
29	0.5		18.2			
19		39.0				
20		39.0				
27		19.1				
26		18.0			221	
8			53.3			
1		2.0	40.8	832		
30			23.4			252
2			10.6	1456		
3		1.8		1456		
6				1456		
28		1.0		750		
31				1095		620
36						1089

Notes

Emboldened observations are the critical group members

Annex 1. Source data for Figures 1 and 2 taken from the RIFE SFC five year averaged data

Sellafield crustacean consumption				
	Crab	Lobster	<i>Nephrops</i>	Total
1995	6.5	2.2	0.0	8.6
1996	7.2	4.8	0.0	12.0
1997	8.5	6.8	1.7	17.0
1998	23.8	4.2	0.0	28.0
1999	19.2	4.8	0.0	24.0
2000	8.0	8.0	4.0	20.0
2001	8.0	8.0	4.0	20.0
2002	8.0	4.8	3.2	16.0
2003	21.6	2.7	2.7	27.0
2004	12.5	10.0	2.5	25.0

Sellafield mollusc consumption			
	Winkle	Other moll	Total
1995	6.0	6.0	12.0
1996	7.2	4.8	12.0
1997	1.7	2.5	4.2
1998	4.5	10.5	15.0
1999	12.5	12.5	25.0
2000	8.5	8.5	17.0
2001	8.5	8.5	17.0
2002	17.4	11.6	29.0
2003	13.6	20.4	34.0
2004	17.0	17.0	34.0