



# Scottish Environment Protection Agency

SEPA's main aim is to provide an efficient and integrated environmental protection system for Scotland which will both improve the environment and contribute to the Scottish Ministers' goal of sustainable development.

**Radiological Habits Survey,  
Dumfries and Galloway Coast, 2002**

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## **SUMMARY**

This report presents the results of a survey, conducted in 2002, into the habits and consumption patterns of people living and working along the Dumfries and Galloway coast - an area affected by the wider dispersion of radioactivity in the Irish Sea. Potential exposure pathways include consumption of locally sourced marine foods, livestock that are grazed over tide-washed pasture, harvesting of seaweed, wildfowl and occupancy along intertidal stretches of the coastline. The survey investigated all these pathways and the data obtained on the consumption and occupancy rates of individuals are presented and discussed. Gamma dose measurements were taken at several places within the survey area and these data are also presented and discussed.

Seafood eaten included salmon, haddock, plaice, bass, crab, lobster, Nephrops, scallops (king and queen), mussels and whelks. The main intertidal activities included mollusc collection, bait digging, wildfowling and work related activities (e.g. marsh wardens and coastguards). Several farms were identified within the survey area which used tide-washed pasture for grazing their livestock (cows and sheep). There was no harvesting of seaweed identified.

## **1. BACKGROUND**

### **1.1 Regulation of radioactive waste discharges**

Sources of radiation exposure to members of the public from nuclear sites are subject to a system of control, which safeguards the potentially exposed people. There are three main sources of radiation exposure to members of the public from nuclear sites: discharges of radioactive waste to the aquatic environment, discharges to the atmosphere and direct radiation from the site. Regulation of waste discharges is carried out under the Radioactive Substances Act, 1993, (RSA93) with authorisations that set limits on the quantities and types of radioactivity released. For discharges in Scotland, the Scottish Environment Protection Agency (SEPA) is the primary regulatory authority under RSA93. Sources of direct radiation from sites are regulated by the Nuclear Installations Inspectorate (NII) of the Health and Safety Executive (HSE). This survey was primarily directed at the far-field effects of current and historic liquid discharges from the reprocessing plant at Sellafield in Cumbria. The primary regulatory authority for discharges from Sellafield is the Environment Agency, as the discharging site is in England. SEPA's role in this case is directed at its general duty to protect the environment. In support of this objective, the survey provides information to form the basis of assessments of radiation exposures in Dumfries and Galloway and to help direct environmental monitoring programmes.

### **1.2 The critical group concept**

Radiological protection of the public is based on the concept of a critical group. The critical group is defined as the people who, because of where they live and their habits, receive the highest radiation dose from the site and its discharges. It is the assessed radiation dose to the critical group that is compared to relevant limits and constraints. If the dose to the critical group is acceptable, it follows that the lower doses received by other members of the public will be below any limits and constraints, and overall protection of the public is provided for.

This survey provides information to assist SEPA in determining critical group doses in Scotland.

### **1.3 Dose limits and constraints**

Assessed radiation doses to critical groups are compared to nationally and internationally agreed dose limits, recommendations and constraints. Under current Government policy in Cm 2919 (United Kingdom - Parliament, 1995), these are as follows:

- the principal limit of 1 mSv per year to the public recommended by the International Commission on Radiological Protection (ICRP) (subsidiary limits exist for particular organs of the body)
- the 'source' dose constraint of 0.3 mSv per year which should not be exceeded for a single new source; in addition, the Government accepts that, in general, it should be possible to operate existing facilities within the 0.3 mSv per year constraints
- the 'site' dose constraint of 0.5 mSv per year to be applied to all sources at a single location

## **2. THE SURVEY**

### **2.1 Survey aims**

The Centre for Environment, Fisheries and Aquaculture Science (CEFAS) undertook the survey in 2002 on behalf of SEPA (CEFAS contract C0767 and SEPA contract 230/4126). The aim of the survey was to review habits in Dumfries and Galloway related to public radiation exposure via aquatic pathways resulting from the wider dispersion of radioactivity in the Irish Sea.

The last aquatic habits survey conducted by CEFAS along the Dumfries and Galloway coast was "Radiological Habits Survey – The South Scotland Coast, Aquatic Pathways, 1996" (Tipple and Doddington, 1997).

Fieldwork was conducted in order to obtain specific habits survey data for use in defining critical exposure pathways to the local population and subsequent definition of the critical group(s). General habits survey information for the area was also obtained.

Investigations were carried out to ascertain the following:

- External exposure activities, including angling, mollusc collection and bait digging along the intertidal shoreline.
- Internal exposure from the consumption of food sources from the aquatic environment (including wildfowl and livestock grazed on tide-washed pasture).
- The production, use and destination of local produce.
- Intertidal land use in the area.
- The extent of any unusual practices.
- The use of any natural resources from the aquatic environment (e.g. sand/gravel extraction, use of seaweed as a fertiliser).

The survey team collected information that could be used in the assessment of other pathways such as the inhalation of re-suspended radioactivity in sea spray, the inadvertent ingestion of contaminated seawater and contact with and/or inadvertent ingestion of contaminated sediments.

## **2.2 Survey area**

The survey area was chosen to include the locations where the far-field effects of current and historic discharges from Sellafield were likely to be most pronounced. The area stretched from Caerlaverock Marsh in the east to the Isle of Whithorn in the west (Figure 1). Other surveys provide information on aquatic pathways in the Solway Firth (Thurston and Parr, 1992 and Tipple, Sherlock and Taylor, 2002). The Dumfries and Galloway coast to the west of the Isle of Whithorn has not been studied in this survey, however it is considered unlikely that more important pathways would be found at this distance from Sellafield.

## **2.3 Conduct of the survey**

The fieldwork component of the survey was carried out during the period 16<sup>th</sup>-29<sup>th</sup> August 2002 by three members of staff from the CEFAS laboratory at Lowestoft, according to techniques as described by Leonard *et al* (1982).

People with a local knowledge of the survey area were contacted for information on any aspects relevant to the exposure pathways. These included the Solway Firth Partnership, fishermen, angling clubs, marsh wardens, farmers and wildfowlers.

Individuals who were identified as having the potential to be exposed to radioactivity were contacted and interviewed. For external exposure pathways, where appropriate, gamma dose measurements were taken using a Mini Instrument 6-81 and a compensated Geiger-Muller tube.

Interviews were used to establish individual's consumption rates and occupancy times relevant to each pathway and obtain any general information of possible use to the survey. Using this information, a list of occupations and activities was built up to produce a picture of potential exposure pathways. Emphasis was placed on those individuals who were likely to

be in the most exposed groups. These included boat owners, anglers, bait-diggers and wildfowlers.

### **3. METHODS FOR DATA ANALYSIS**

#### **3.1 Data conversion**

The data collected during the fieldwork was recorded in logbooks. Information on individuals' consumption and external exposure rates was assessed and entered into the habits survey database. Each individual for whom information was obtained was given a unique identifier (the Observation Number) to assist in data sorting. Consumption data were converted to consumption rates in kilograms per year (wet weight) of locally produced food. Where interviewees were unable to provide consumption rates in weight per year, they were asked to estimate the number of units, e.g. the number of fish consumed per year. These data were converted to approximate consumption rates, in kilograms per year, using edible fraction data researched by CEFAS and information supplied by the Beef and Livestock Commission. For the purpose of data analysis, foodstuffs are aggregated into food groups; the food groups found in this survey are shown in Table 1. All data in the text are rounded to 2 significant figures. In the tables and annexes the data are usually presented to 1 decimal place; the exceptions are for values less than 0.05 and external exposure times.

#### **3.2 Determination of critical groups**

The critical group is determined by assessing doses that are representative of the most exposed individuals. The group will change according to the assessment being undertaken. Each assessment will have associated concentrations and/or dose rates distributed in space and time. This survey provides information that can be used to help define the critical group in an assessment but it does not constitute an assessment in itself.

The critical group will be made up of high rate consumers and/or people with high occupancy and/or handling rates. The data from the survey are presented in several ways to provide assessors with options to determine critical groups. The presentations are different for ingestion and external radiation pathways but they have a common feature. The feature is that the habits data are structured into ages and groups of activities with similar attributes. For example, when considering aquatic food, consumption of all species of crustaceans is grouped. For external exposure over intertidal sediments, exposures over a common substrate are chosen. The choice of a group of activities is made when it is reasonable to assume that consistent concentrations or dose rates would apply within the group. In addition to grouping of activities, ingestion data are structured into age groups; from 0 to 1.0 y of age (3 months); more than 1.0 y to 2.0 y (1 year old); more than 2.0 y to 7.0 y (5 year old); more than 7.0 y to 12.0 y (10 year old); more than 12.0 y to 17.0 y (15 year old), because different dose coefficients can apply to different ages. Children over 17 are treated as adults. These age groupings are consistent with those used by the ICRP 72 (1996).

### **Ingestion pathways**

Consumption rate data are presented for individuals and are further characterised in two ways to represent high rate consumers in each food and age group. Firstly, the 97.5 percentile rate is calculated from the observed data, for each of the food groups where consumption occurred, using the Excel mathematical function for calculating percentiles. This 97.5 percentile rate is calculated for all age groups where consumption was noted. Secondly, the 'cut-off' method described by Hunt *et al* (1982) is used for all age groups observations for each of the food groups where consumption occurred. In this case the rate representing high rate consumers is calculated by taking the arithmetic mean of the maximum value and all consumption rates observed within a factor of three of the maximum value (termed the lower threshold value). It accords with the principle expressed by ICRP (ICRP 42, 1984) that the critical group should be small enough to be reasonably homogeneous with respect to age, diet and those aspects of behaviour that affect the doses received.

If, when the top consumption rate value is divided by three, the lower threshold value obtained is above the next highest observation, the next highest suitable observation is used to set the lower threshold but the top value is still included in the mean. CEFAS have called the rate derived by the cut-off method the critical group rate for ease of presentation though the term is not strictly correct. This is because the critical group can only be established when doses are determined taking into account all pathways. Consumption data for fish, crustaceans, molluscs, wildfowl and tide-washed grazed beef and sheep are presented for adults in Tables 2, 3, 4, 5, 6 and 7 and for children in Tables 8, 9, 10, 11, 12 and 13 respectively. For purpose of comparison, values for 97.5 percentile rates based on national data, referred to as 'generic' rates in this report, are shown for the relevant foodstuffs for adults, 15, 10, and 5 year old children in Tables 15, 16, 17 and 18 respectively.

The critical group rate has been calculated from the survey data for children. However, because few child consumers were identified the method should be viewed with caution. For assessment purposes, a theoretical approach may be taken where survey rate data for children's age groups are absent or limited. This involves taking the rates for adults, provided in Table 15, and scaling them by ratios (Table 14). The ratios have been calculated using generic 97.5 percentile consumption rates determined by Defra (Byrom *et al* 1995, MAFF, 1998) for adults, 15 year olds, 10 year olds and children aged 6 – 12 months.

### **External exposure in intertidal areas**

A similar approach is used for occupancy and handling rates in intertidal areas (Tables 19 and 20 respectively). 97.5 percentile rates and critical group rates are determined for groups of activities or substrates with common attributes. However, the critical group rate is taken to be the arithmetic mean of all rates observed within a factor of 1.5 of the maximum value. The factor reflects variations in the doses likely to be received due to natural variations in the interactions of radiations with tissues caused by, for example, differences in anatomy.

A summary of consumption and occupancy rates for adults and children is given in Annex Table 1 and Annex Table 2 respectively.

#### **4. AQUATIC RADIATION PATHWAYS**

##### **4.1 Aquatic survey area**

The aquatic survey area covered the coast from Caerlaverock Marsh in the east to the Isle of Whithorn in the west (Figure 1).

###### *Caerlaverock Merse to Southernness Point*

Caerlaverock merse is a National Nature Reserve (NNR) on the eastern side of the River Nith estuary and is run by Scottish Natural Heritage (SNH) and the Wildfowl and Wetlands Trust (WWT). It is the largest wetland reserve in Britain, comprising 8000 hectares of mudflats and merse. It is a popular site for birdwatchers and tourists. Although wildfowling isn't permitted in the reserve itself it is very popular around its boundary and further up the Nith estuary. Farmers rent tide-washed pasture from the nature reserve for grazing cattle. Haaf netting is popular in the River Nith, with over 40 netters licensed to fish, mainly from the eastern bank. Angling takes place at certain places along the river, mainly around Glencaple, with flounder and dab the main species caught. Fly fishing for salmon and sea trout is also popular in the upper stretches of the river towards Dumfries. Southernness Point is a rocky promontory with a disused lighthouse. There is a large caravan park next to the beach and it is very popular throughout the year, as is the beach for walkers, shellfish collectors and bait diggers.

###### *Southernness Point to Palnackie*

To the west of Southernness Point is Mersehead Sands – an RSPB nature reserve, which has 3 members of staff, 20 volunteer helpers and receives approximately 20,000 day visitors per year. The RSPB own the land, which is mainly sandy beach and saltmarsh with smaller

forested areas. The reserve stretches into the sea and the area below the low-tide mark is leased from the Crown Estates. The reserve is extremely popular with bird watchers and dog walkers. A limited amount of wildfowling and cattle grazing takes place on the merse.

Sandyhills Bay, on Mersehead Sands, but outside the RSPB reserve, was a popular beach with locals for activities including dog walking, angling, metal detecting and sunbathing. A footpath follows the rocky coastline around from Sandyhills Bay to Castlehill Point but access in a vehicle is limited.

The Urr Estuary, on which Palnackie is situated, has a muddy/saltmarsh substrate.

#### *Palnackie to Kirkcudbright*

South of Palnackie are Orchardton Bay and Auchencairn Bay - sheltered sandy areas lying between the rocky outcrops of Almorness Point, Torr Point and Balcary Point. Cockles and mussels can be found at Auchencairn Bay and one individual works fixed engine salmon stake nets.

From Balcary Point to Port Mary, the coastline was rocky making it popular with anglers and commercial winkle pickers. Rascarrel Bay and Orroland were especially good areas for winkle picking.

The Dundrennan military range spanned the coastline from Port Mary in the east to Torrs Point in Kirkcudbright Bay in the west. This area was closed to the general public although sea anglers were given permission to fish there during some organised competitions.

Kirkcudbright Bay, incorporating Manxman's Lake had a variety of different substrates. Lugworm were dug by anglers from the area near the lifeboat station. Peeler crab were collected from the rocky areas and used as bait by anglers.

### *Kirkcudbright to Gatehouse of Fleet*

The town of Kirkcudbright was situated on the east bank of the River Dee. It had a small harbour and marina area and the presence of the fishing industry was noticeable throughout the town. The town was home to 3 lobster fishermen and 2 *Nephrops* trawlers as well as some larger scallop dredgers. The number of scallop dredgers based in Kirkcudbright rose significantly during the king scallop season (November to May). A scallop wholesale company and a winkle (and cockle) wholesale company were based in Kirkcudbright buying the majority of local produce from the surrounding area.

Kirkcudbright had a large sea angling club and a sailing club.

One farmer owned a thin stretch of tide-washed land on the west bank of the Dee Estuary, which he used to graze cattle on over the winter. The Seaward Caravan Park and Nun Mill Bay were located further south on the west bank of the Dee Estuary. They were very popular in the summer months with tourists. Rocky outcrops, rock pools and sandy beaches combined to provide good locations for family days out. Recreational crabbing took place on the rocky area. The area was sparsely populated – the only village being Borgue in the centre of the peninsula, although there were many farms.

The coastline to the south of this large peninsula of land was very rocky and access to the coast was limited to 5 places – Ross Bay, Brighthouse Bay, Kirkandrew's Bay, Carrick Bay and Sandgreen. Anglers accessed the coastline on foot.

At Ross Bay, Brighthouse Bay and Carrick Bay the substrate was sand, giving way to sandy mud at low tide. Anglers used these beaches to dig for lugworm and less commonly for ragworm. Brighthouse Bay, Carrick Bay and Sandgreen were very popular beaches with holiday makers, with between 50 and 100 people on the beach at any one time on warm, summer days. A large caravan park with a private slipway for boats and water sports was

situated at Brighthouse Bay increasing the amount of visitors to the beach and the activities observed there.

At low tide it was possible to walk to the Ardwall Isle from Carrick Bay and commercial winkle pickers and non-commercial mussel collectors often worked in the area, using the rocks around Carrick Bay and the rocks all around the island. At high tide Carrick Bay was also popular with people doing water sports.

#### *Gatehouse of Fleet to Newton Stewart*

The river Water of Fleet runs through the village of Gatehouse of Fleet into Fleet Bay which is a large, sandy bay with several smaller bays around it, before flowing into the Solway Firth. The bay is generally rocky but with many easy access points onto the beaches around it and it was very popular for walking, swimming, bait digging and angling. There were 2 stake nets in the bay, but only 1 was fishing this year. There were several caravan parks situated around the bay, all with easy access down to the beach and these were very popular with caravanners and campers, particularly in the summer months. The coastline west of Ringdoo Point was less rocky and becomes a mixture of mud, sand and stones, becoming more muddy heading upstream of the River Cree. There were 3 stake nets on the east bank of the River Cree, 2 of which were fishing this year. This part of the coastline was popular for shellfish collecting and bait digging. The River Cree had several licensed drag netters (a form of seine netting), whose target species was salmon. There were areas of tide-washed pasture along the eastern bank which were used by some local farmers for grazing cattle and sheep.

#### *Newton Stewart to Isle of Whithorn*

The estuary formed where the River Cree flows into Wigtown Bay is part of the Wigtown Bay Local Nature Reserve, which permits wildfowling along the west shoreline. Wildfowling is also permitted on a smaller area of saltmarsh on the east side of the estuary near Creetown.

South of the Cree Estuary, the saltmarsh coastline extends past Wigtown and the River Bladnoch to South Baltern. Again, wildfowling is permitted on the area north of Wigtown.

South of South Baltern is Innerwell which until recently was a salmon stake net fishery. It is now unused and the stony shoreline was deserted on the occasions the survey team visited.

South of Innerwell is Garlieston which has a small harbour and 1 registered fishing boat. The harbour was a popular location with local anglers for bait digging. From Garlieston to Isle of Whithorn the coastline was mainly rock and with the exception of the occasional walker little activity was observed. Isle of Whithorn was the location of another harbour, larger than that of Garlieston. At the time of the survey it was being used by 4 local fishing boats and frequently contained visiting fishing boats from the Isle of Man. The harbour was very popular with both local and visiting anglers with the main species caught being mullet, pollack and mackerel. Another popular angling location was from the rocks on the Isle of Whithorn headland with the same species being caught.

## **4.2 Commercial fisheries**

There were a diverse range of commercial fisheries in the survey area; they included scallop (king scallops, *Pecten maximus* and queen scallops, *Chlamys opercularis*) and whelk (*Buccinum undatum*) dredging, lobster potting, trawling and potting for *Nephrops* and winkle (*Littorina littorea*) picking from rocky areas such as Carrick Bay and Rascarrel Bay. The main ports used by the commercial fishermen were Kirkcudbright, Palnackie, Garlieston and Isle of Whithorn. Kirkcudbright had 8 boats permanently based there, 3 lobster potters, 2 *Nephrops* trawlers and 3 scallop dredgers; this number rises to 18 in the winter during the king scallop season. Kirkcudbright had 3 inshore potters, 1 *Nephrops* trawler and 1 scallop dredger.

Palnackie had 1 part time whelk potter. Garlieston had 2 laid up scallop dredgers and 1 whelk/crab/lobster potter and the Isle of Whithorn had 2 scallop dredgers, 2 lobster potters and 1 trawler. There was a total ban on cockle collection from within the survey area at the time of the survey; the ban is in place until a Regulating Order and Management Scheme has been agreed to by all fishing interests on the Solway. It is hoped that the fishery will open some time in 2003, with a licensing scheme for the fishery reviewed annually.

## Salmon fishing

Fishing in the local rivers (Dee, Cree, Nith, etc.) was popular, with a variety of methods employed, including haaf netting, stake netting and drag netting. The target species for these fishermen were salmon, although a by-catch of flounder, grey mullet and sea trout was also noted. Two smokehouses in the area were noted who bought this salmon, along with a buyer in Annan, with the remainder being sold to individuals on an *ad hoc* basis or consumed by the fishermen and their families.

### **4.3 Angling and hobby fishing**

Sea angling from the shore was popular, with several local clubs organising regular matches, particularly along the rocky shoreline between Isle of Whithorn and Dundrennan; many of the anglers interviewed dug their own bait. Most of the clubs in the survey area operated a catch and release policy. Gill nets were set for recreational use to catch grey mullet and sea bass at a few places around the coastline; these were likely to catch some salmon and sea trout also.

### **4.4 Wholesalers and retailers**

There were 3 seafood wholesalers identified in the survey area and they bought nearly all the shellfish (scallops and winkles) caught or landed within the survey area; most of this was exported to Europe, particularly France. Whitefish was caught as a by-catch and sold to local fish shops or smokehouses where possible. The remainder was sold through the Troon and Ayr fish markets. All the whelks were exported to Korea after processing in Ireland. Two smokehouses were found within the survey area which sold some local produce (salmon and sea trout), and whose owners also did some fishing (drag netting) for salmon themselves. Local fishmongers were visited and a proportion of their produce was sourced locally; mainly crab, lobster, *Nephrops*, salmon and scallops (king and queen).

#### **4.5 Tide-washed pasture**

Several farms had tide-washed pasture that was used for grazing sheep and/or cattle; most were along the River Cree between Wigtown and Newton Stewart, with 2 farmers renting tide-washed pasture from the Caerlaverock nature reserve. The farms were either dairy, cattle, sheep or a mixture of all 3. The milk was sold to Lockerbie or Paisley and the beef and sheep were sold at various markets, including Newton Stewart, Castle Douglas and Carlisle. Although several dairy farms were identified, none reported any milk consumption from their own cows; this is unusual. All the dairy farmers had young children in their families and said that they wouldn't use the milk since it was unpasteurised.

#### **4.6 Internal exposure**

Consumption of locally caught seafood, wildfowl, sheep and beef grazed over tide-washed pasture by adults and children was identified during this survey.

##### **Adult consumption rates**

Consumption rate data for adults for fish, crustaceans, molluscs, wildfowl, cattle meat and sheep meat are shown in Tables 2, 3, 4, 5, 6 and 7 respectively. For each food group the critical group maximum, minimum, mean and 97.5 percentile consumption rates have been calculated using data obtained from all individuals whose consumption was greater than nil. The results are summarised in Table 15. The table also presents the national generic means and 97.5 percentile consumption rates (Byrom *et al*, 1995, MAFF, 1998) for comparison. The main consumers of seafood from the survey area were commercial fishermen together with their families. The main consumers of wildfowl from the survey area were members of wildfowling clubs and their families. The main consumers of cattle and sheep meat from the survey area were farmers and their families. No consumers or users of any edible marine plant species were identified during the survey.

The main species of fish consumed by adults were plaice, haddock, salmon and grey mullet. A critical group of 20 individuals was identified with a maximum consumption rate of 74 kg/y and a mean of 43 kg/y. The observed 97.5 percentile rate based on 104 observations was 51 kg/y. This compares with the adult generic mean and 97.5 percentile consumption rates for fish of 15 kg/y and 40 kg/y respectively. Critical group fish consumption consisted of a mix of 29% haddock, 29% plaice, 10% grey mullet, 7% thornback ray, 6% mixed fish, 4% dover sole, 3% flounder, 2% cod, pollack and salmon, 1.5% bass, lemon sole, monkfish and turbot and 0.2% sea trout.

The main species of crustaceans consumed by adults were *Nephrops* and lobster. A critical group of 6 individuals was identified with a maximum consumption rate of 27 kg/y and a mean of 20 kg/y. The observed 97.5 percentile rate based on 38 observations was 23 kg/y. This compares with the adult generic mean and 97.5 percentile consumption rates for crustaceans of 3.5 kg/y and 10 kg/y respectively. Critical group crustacean consumption consisted of a mix of 64% *Nephrops*, 20% lobster, 14% crab and 3% velvet swimming crab.

The main species of molluscs consumed were king scallops, whelks and mussels. A critical group of 6 individuals was identified with a maximum consumption rate of 15 kg/y and a mean of 11 kg/y. The observed 97.5 percentile rate based on 18 observations was 15 kg/y. This compares with the adult generic mean and 97.5 percentile consumption rates for molluscs of 3.5 kg/y and 10 kg/y respectively. Critical group mollusc consumption consisted of a mix of 43% whelk, 40% king scallop, 8% mussels and 5% queen scallop and razor shell. No cockle consumption was identified during the survey since their collection was banned. Cockle consumption may need to be considered in future for assessment purposes if the fishery re-opens, particularly given their radiological significance when compared with king and queen scallops. Cockle consumption was low in the 1996 survey (Tipple and Doddington, 1997; a ban on mechanical cockling was in force and only 2 manual collectors were found). The 1992 survey (Doddington and Andrews, 1994) identified a critical group of 16 kg/y for molluscs (including cockles, king and queen scallops, mussels and winkles), with the highest

consumption rates being for cockles. Several commercial winkle collectors were interviewed during the survey, however none of them consumed winkles.

The main species of wildfowl consumed were goose and duck. A critical group of 14 individuals was identified with a maximum consumption rate of 16 kg/y and a mean of 8.8 kg/y. The observed 97.5 percentile rate based on 55 observations was 15 kg/y. No generic rates have been established for wildfowl. Critical group wildfowl consumption consisted of a mix of 46% duck, 44% goose, 9% pheasant and 2% widgeon.

For cattle meat grazed on tide-washed pasture, a critical group of 7 individuals was identified with a maximum consumption rate of 62 kg/y and a mean of 54 kg/y. The observed 97.5 percentile rate based on 7 observations was 62 kg/y. This compares with the adult generic mean and 97.5 percentile consumption rates for cattle meat of 15 kg/y and 45 kg/y respectively.

For sheep meat grazed on tide-washed pasture, a critical group of 10 individuals was identified with a maximum consumption rate of 5.7 kg/y and a mean of 4.5 kg/y. The observed 97.5 percentile rate based on 10 observations was 5.7 kg/y. This compares with the adult generic mean and 97.5 percentile consumption rates for sheep meat of 8 kg/y and 25 kg/y respectively.

### **Children's consumption rates**

Consumption rate data for children for fish, crustaceans, molluscs, wildfowl, cattle meat and sheep meat are shown in Tables 8, 9, 10, 11, 12 and 13 respectively. No children in the infants or one year old age groups were noted to be consuming locally caught seafood, wildfowl, cattle meat or sheep meat. For each food group the critical group maximum, minimum, mean and 97.5 percentile consumption rates have been calculated using data obtained from all individuals whose consumption was greater than nil for 15, 10 and 5 year olds. The results are summarised in Tables 16, 17 and 18 respectively. These tables also

present the national generic means and 97.5 percentile consumption rates (Byrom *et al*, 1995, MAFF, 1998) for comparison.

### **Fifteen year old age group**

For fish, a critical group of 2 individuals was identified with a maximum consumption rate of 8.7 kg/y and a mean of 4.4 kg/y. The observed 97.5 percentile rate based on 2 observations was 8.5 kg/y. This compares with the generic mean and 97.5 percentile consumption rates for fish of 6.5 kg/y and 20 kg/y respectively.

For crustaceans, a critical group of 3 individuals was identified with a maximum consumption rate of 22 kg/y and a mean of 15 kg/y. The observed 97.5 percentile rate based on 5 observations was 21 kg/y. This compares with the generic mean and 97.5 percentile consumption rates for crustaceans of 2.5 kg/y and 6 kg/y respectively.

For molluscs, a critical group of 3 individuals was identified with a maximum consumption rate of 0.9 kg/y and a mean of 0.5 kg/y. The observed 97.5 percentile rate based on 3 observations was 0.9 kg/y. This compares with the generic mean and 97.5 percentile consumption rates for molluscs of 2.5 kg/y and 6 kg/y respectively.

No wildfowl, cattle meat or sheep meat consumption was noted for this age group.

### **10 year old age group**

For fish, a critical group of 3 individuals was identified with a maximum consumption rate of 3.5 kg/y and a mean of 3.5 kg/y. The observed 97.5 percentile rate based on 6 observations was 3.5 kg/y. This compares with the generic mean and 97.5 percentile consumption rates for fish of 6 kg/y and 20 kg/y respectively.

For crustaceans, a critical group of 1 individual was identified with a consumption rate of 21.6 kg/y. This compares with the generic mean and 97.5 percentile consumption rates for crustaceans of 2.5 kg/y and 7 kg/y respectively.

For wildfowl, a critical group of 3 individuals was identified with a maximum consumption rate of 1.4 kg/y and a mean of 1.4 kg/y. The observed 97.5 percentile rate based on 3 observations was 1.4 kg/y. No generic consumption rates have been derived by Byrom et al for this age group.

No mollusc, cattle meat or sheep meat consumption was noted for this age group.

### **5 year old age group**

For fish, a critical group of 3 individuals was identified with a maximum consumption rate of 2.4 kg/y and a mean of 2.0 kg/y. The observed 97.5 percentile rate based on 4 observations was 2.4 kg/y. No generic consumption rates have been derived by Byrom et al for this age group.

For cattle meat, a critical group of 3 individuals was identified with a maximum consumption rate of 3.0 kg/y and a mean of 2.6 kg/y. The observed 97.5 percentile rate based on 3 observations was 3.0 kg/y. No generic consumption rates have been derived by Byrom et al for this age group.

For sheep meat, a critical group of 3 individuals was identified with a maximum consumption rate of 0.2 kg/y and a mean of 0.2 kg/y. The observed 97.5 percentile rate based on 3 observations was 0.2 kg/y. No generic consumption rates have been derived by Byrom et al for this age group.

No crustacean, mollusc or wildfowl consumption was noted for this age group.

## **4.7 External exposure**

### **Intertidal occupancy**

External exposure from artificial radiation to members of the public who frequent intertidal areas depends on the occupancy time and dose rate after subtraction of an appropriate figure for natural background radiation. Dose rates over mud and saltmarsh have a potential for being higher than over coarser substrates. Consequently occupancy times over these substrates are considered to be radiologically more important than similar times over other substrates. Estimates of natural backgrounds used by CEFAS for assessing doses to individuals (FSA and SEPA, 2002) are 0.05 micro Gy/h for sandy substrates, 0.07 micro Gy/h for mud and saltmarsh and 0.06 micro Gy/h for other substrates.

The predominant substrate materials in the intertidal areas of the survey area were mud, sand and tide-washed pasture.

Intertidal activities observed during the survey included walking, mollusc collection, bait digging, coastguard duties and angling. Gamma dose rate measurements were taken at some locations, shown in Table 21, to supplement those which were part of SEPA's scheduled monitoring programme. No houseboats were found during this survey; the 2 identified in the 1996 survey were both no longer used.

Table 19 lists the intertidal occupancy rates observed, grouped by substrate. Commercial shellfish collectors had the largest occupancy times over sand and mud and formed the critical group. A mean time of 1000 h/y over sand and mud was identified for 6 individuals, with a maximum rate of 1050 h/y. A single stake netter formed the critical group over mud, with an annual time of 890 hours. Anglers formed the critical group over rock, with a mean time of 320 h/y for 5 individuals, with a maximum rate of 380 h/y. A marsh warden and a farmer formed the critical group over saltmarsh, with a mean time of 760 h/y for the 2 individuals, with a maximum rate of 830 h/y. People relaxing on the beach and a long netter

formed the critical group over sand, with a mean time of 540 h/y for 4 individuals, with a maximum rate of 600 h/y for the long netter. A dog walker and bird ringer/netter formed the critical group over sand and stones, with a mean time of 210 h/y for 3 individuals, with a maximum rate of 270 h/y.

## **Handling**

Handling sediment while bait digging, mollusc collecting or handling commercial fishing gear can give rise to skin exposure from beta radiation. This needs consideration even though the annual dose limit for skin is a factor of 50 times higher than that for effective dose. There is also a contribution to effective dose due to skin exposure (ICRP 60, 1991). Table 20 shows the most significant observations made during this survey for times spent handling sediment and commercial fishing gear.

Commercial shellfish collectors, bait diggers and a stake net operator formed the critical group for sediment handling, with a mean time of 1000 h/y for 7 individuals and a maximum rate of 1100 h/y. A mean critical group fishing gear handling time of 1900 h/y was identified for 2 individuals, with a maximum time of 2300 h/y; these individuals were both commercial fishermen.

These provide quantitative data that might be of use in the assessment of dose and/or risk to individuals via radiological pathways. Pathways to consider include individuals who may inhale re-suspended radioactivity in sea spray, inadvertently ingest contaminated seawater and/or have contact with and/or inadvertently ingest contaminated sediments while undertaking coastal area activities such as angling, walking, sailing, bait digging and water sports.

## **5. COMBINED PATHWAYS**

In determining habits data for the purposes of assessing radiological doses to the public, it may be necessary to consider a combination of pathways. CEFAS have provided data in Annex Tables 1 and 2 so that the full effect of combining pathways can be assessed for individual observations, given the concentrations and dose rates from a particular assessment. In some circumstances it will be possible to make simplifying assumptions, and define the consumption and external exposure rates appropriate to a series of potential critical groups. Such assumptions will depend on the assessment in question but some initial observations are provided here as a starting point for those undertaking assessments.

On the basis of the information in Annex Table 1, the most extensive combinations of pathways for adult dose assessment are shown in Table 22.

## **6. MATERIALS EXTRACTION**

One aim of the survey was to investigate current or potential materials extraction from within the survey area. The following information was obtained:

- There is a potential for turf cutting from the Creetown Merse, however none is taking place at present and the area is within a Site of Special Scientific Interest.
- No use of seaweed was identified during the survey period. However, an individual has since contacted SEPA to say that he did use seaweed as fertiliser in his kitchen garden and queried whether this practice was an advisable thing to do. He declined from being interviewed by CEFAS by telephone.
- There was no gravel or sand extraction from within the survey area.

## 7. CONCLUSIONS AND RECOMMENDATIONS

### 7.1 Survey findings

Exposure pathways were investigated for 399 individuals.

The adult critical group mean consumption rates of seafood, wildfowl, cattle meat and sheep meat were:

- 43 kg/y for fish
- 20 kg/y for crustaceans
- 11 kg/y for molluscs
- 8.8 kg/y for wildfowl
- 54 kg/y for cattle meat
- 4.5 kg/y for sheep meat

The main aquatic species consumed were plaice, haddock, *Nephrops* and whelks.

The main species of wildfowl consumed were duck and goose.

Both fishing gear and sediment handling times were recorded; the critical group means were 1900 h/y and 1000 h/y respectively.

The critical group mean occupancy times over intertidal areas were:

- 890 h/y for mud
- 1000 h/y for sand and mud
- 320 h/y for rock
- 760 h/y for saltmarsh
- 540 h/y for sand

- 210 h/y for sand and stones

## **7.2 Comparisons with previous survey**

The critical group mean consumption rates from within the survey area show small increases in the consumption of fish, crustaceans and molluscs when compared to the critical group mean consumption rates obtained from the 1996 south Scotland coastal survey. These were fish, 38 kg/y, crustaceans, 15 kg/y and molluscs 8.2 kg/y, compared to this survey's consumption rates of fish 43 kg/y, crustaceans, 20 kg/y and molluscs 11 kg/y. Consumption rates for wildfowl, cattle meat and sheep meat were not considered in the 1996 survey.

Fishing activity and the seafood species consumed were generally similar to the 1996 survey, the main exceptions being that haddock and plaice consumption increased, whilst cod decreased; this probably reflects the declining state of the cod stocks in British waters. For molluscs, whelks were found to be consumed in this survey whereas winkles were not.

The 1996 survey identified a critical group mean intertidal occupancy over saltmarsh of 1400 h/y (based on 1 observation), compared to this survey's figure of 760 h/y; activities undertaken by people in this survey's critical group were similar to those in the 1996 survey i.e. a marsh warden and a farmer. The 1996 survey combined occupancy over mud and a mixture of mud and sand, and identified a critical group mean intertidal occupancy over these 2 substrates of 1000 h/y; this figure included a houseboat dweller with an occupancy of 1300 h/y and stake net operators. This survey did not group these 2 substrates; the critical group mean over mud was 890 h/y by a stake net operator, and over sand and mud 1000 h/y, composed of shellfish collectors. The houseboat identified in the 1996 survey was moored in Garlieston harbour and was found to be no longer present in this survey. The 1996 survey also identified a houseboat on the River Nith that had been occupied during 1995, which was unused in 2002. This survey identified activities over other substrates (rock, sand, and sand & stones) which were not considered in the 1996 report for the purpose of identifying critical groups.

The critical group mean fishing gear handling time in 1996 was 2600 h/y, compared to this survey's figure of 1900 h/y, and the critical group mean sediment handling time was 800 h/y, compared to this survey's figure of 1000 h/y.

### **7.3 Recommendations**

One important objective of habits surveys is to recommend any changes needed to the environmental monitoring programme.

The monitoring programme for the area covered by this survey comprised sampling of sediments, seawater, seaweed, turf and various seafoods (including crab, lobster, winkles, king and queen scallops, plaice and cod) for aquatic pathways (Radioactivity in Food and the Environment, 2002). No milk, sheep meat or cattle meat is currently sampled from the within the area covered by this survey. Gamma dose rates are taken at several points in Kirkcudbright Bay, Rascarrel Bay, Wigtown Bay and Garlieston Bay.

In view of the report's findings it is recommended that:

- The existing aquatic surveillance programme provides adequate coverage of the pathways identified in this survey. However, substitute samples of haddock and whelks should be considered to conform with observed consumer preferences.
- For research purposes, analysis of a sample of milk taken from one of the dairy farms that use tide-washed pasture for grazing their cows should be considered.
- Similarly, a sample of sheep or beef meat taken from one of the farms that use tide-washed pasture for grazing their livestock should be analysed.
- If the cockle fishery re-opens, a short review should be undertaken to update consumption and intertidal occupancy rates.

## **8. ACKNOWLEDGEMENTS**

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## **9. REFERENCES**

Byrom, J., Robinson, C., Simmonds, J. R., Walters, B., and Taylor, R.R., 1995. Food consumption rates for use in generalised radiological dose assessments. *J. Radiol. Prot.* Vol. 15 (4) 335-341.

Doddington, T.C., Andrews, D.J., 1994. Radiation exposure pathways on the Dumfries and Galloway coast resulting from liquid effluent discharges to the Irish Sea, 1992. Fisheries Tech Note RL 3/94. MAFF, Lowestoft.

FSA and SEPA, 2002. Radioactivity in Food and the Environment, 2001. FSA and SEPA, London and Stirling. (7), 193 pp.

Hunt, G. J., Hewett, C. J. and Shepherd, J.G., 1982. The identification of most exposed 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, 1984. A Compilation of the Major Concepts and Quantities in use by ICRP. Pergamon Press, Oxford, (ICRP Publ. 42.).

ICRP, 1991. 1990 Recommendations of the International Commission on Radiological Protection. *Annal. ICRP* 21 (1-3). Pergamon Press, Oxford, 201 pp. (ICRP Publ. 60.).

ICRP, 1996. Age-dependant doses to members of the public from intake of radionuclides. *Annal. ICRP* 26 (1). Elsevier Science, Oxford, (ICRP Publ. 72).

Leonard, D. R. P., Hunt, G. J. and Jones, P. G. W., 1982. Investigations of individual radiation exposures from discharges to the aquatic environment: the technique of habit surveys. pp. 512-517 *In*: 'Proceedings of the Third International Symposium on Radiological Protection - Advances in Theory and Practice', Inverness, 6-11 June 1982, Volume 2. The Society of Radiological Protection.

Tipple, J.R. and Doddington, T.C., 1997. Radiological Habits Survey – The South Scotland Coast, Aquatic Pathways, 1996. Fisheries Tech Note RL 2/97. MAFF, Lowestoft.

Tipple, J. R., Sherlock, M. and Taylor, B., 2002. Radiological Habits Survey – Chapelcross, 2000. RL21/00 SEPA, Stirling.

Thurston, L. M and Parr, J. D., 1992. Investigation of radiation exposure pathways from liquid effluents at Chapelcross: local habits survey 1990. Tech Note, CEFAS, Lowestoft RL 1/92. Confidential report.

United Kingdom – Parliament, 1995. Review of radioactive waste management policy, HMSO, London, 55pp. (Cm 2919).

**Table 1. Typical food groups used in habits surveys**

<b>Green vegetables</b>	Artichoke, Asparagus, Broccoli, Brussel sprout, Cabbage, Calabrese, Cauliflower, Chard, Courgettes, Cucumber, Gherkin, Herbs, Kale, Leaf beet, Lettuce, Marrow, Spinach
<b>Other vegetables</b>	Aubergine, Broad bean, Chilli pepper, French Bean, Mangetout, Pea, Pepper, Runner bean, Sweetcorn, Tomato
<b>Root vegetables</b>	Artichoke, Beetroot, Carrot, Celeriac, Celery, Chicory, Fennel, Garlic, Kohl rabi, Leek, Onion, Parsnip, Radish, Shallot, Spring onion, Swede, Turnip
<b>Potato</b>	
<b>Domestic fruit</b>	Apple, Apricot, Blackberry, Blackcurrant, Boysenberry, Cherry, Damson, Fig, Gooseberry, Grapes, Greengages, Huckleberry, Loganberry, Melon, Nectarines, Peach, Pear, Plum, Pumpkin, Raspberry, Redcurrants, Rhubarb, Rowanberry, Strawberry, Tayberry, Whitecurrant
<b>Milk</b>	Milk, Butter, Cream, Cheese, Yoghurt, Goats milk
<b>Cattle meat †</b>	
<b>Pig meat †</b>	
<b>Sheep meat †</b>	
<b>Wildfowl</b>	Duck, Goose, Pheasant, Widgeon
<b>Eggs</b>	Chicken egg, Duck egg, Goose egg
<b>Wild/free foods</b>	Blackberry, Blackcurrant, Chestnut, Crab apple, Damson, Dandelion root, Elderberry, Nettle, Raspberry, Rowanberry, Samphire, Sloe, Strawberry, Watercress, Wild apple
<b>Honey</b>	
<b>Wild Fungi</b>	Mushrooms
<b>Rabbits/Hare</b>	Hare, Rabbit
<b>Venison †</b>	
<b>Fish (sea)</b>	Bass, Brill, Cod, Common ling, Dab, Dover sole, Flounder, Gurnard, Haddock, Hake, Herring, Lemon sole, Mackerel, Monkfish, Mullet, Plaice, Pollack, Saithe, Salmon, Sea Trout, Squid *, Rays, Turbot, Whitebait, Whiting, Witch
<b>Fish (fresh water)</b>	Brown trout, Rainbow trout, Perch, Pike, Salmon (river), Eels
<b>Crustaceans</b>	Crab, Crawfish, Lobster, Nephrops, Squat Lobster, Prawn, Shrimp
<b>Molluscs</b>	Cockles, Cuttlefish, King scallop, Limpets, Mussels, Oysters, Queen scallop, Razor shell, Whelks, Winkles

**Notes:**

\* Although squid is a mollusc, radiologically it is more akin to fish.

† Including offal.

Table 2. Adult consumption rates (kg/y) of fish in the Dumfries and Galloway coast survey area

Observation number	Bass	Cod	Dab	Dover Sole	Eel	Flounder	Grey Mullet	Haddock	Lemon Sole	Mackerel	Mixed fish	Monkfish	Plaice	Pollack	Red Gurnard	Salmon	Sea Trout	Thornback Ray	Turbot	Whiting	Total
127								17.7								3.3		53.1			74.0
318						23.6	35.4														59.0
46	13.0						13.0						13.0							13.0	52.0
41								7.7	11.8			11.8	7.7			1.4	1.4	7.7			49.4
340								22.1					22.1								44.2
342								22.1					22.1								44.2
343								22.1					22.1								44.2
344								22.1					22.1								44.2
345								22.1					22.1								44.2
346								22.1					22.1								44.2
347								22.1					22.1								44.2
348								22.1					22.1								44.2
349								22.1					22.1								44.2
350								22.1					22.1								44.2
123		3.5		33.6									3.5								40.6
264		17.7												17.7							35.4
399							20.5									6.9					27.4
400							20.5									6.9					27.4
325											26.5										26.5
326											26.5										26.5
42								11.8	11.8												23.6
145				21.9													1.4				23.3
125																22.9					22.9
126																22.9					22.9
10	2.4						2.4									12.8	3.5				21.0
11	2.4						2.4									12.8	3.5				21.0
197	6.9	6.9								6.9											20.7
198	6.9	6.9								6.9											20.7
199	6.9	6.9								6.9											20.7
82											20.7										20.7
87											20.7										20.7
158		4.7		4.7					4.7				4.7								18.9
75							16.6														16.6
83							16.6														16.6
385		3.7												3.5				3.7		3.2	14.2
386		3.7												3.5				3.7		3.2	14.2
387		3.7												3.5				3.7		3.2	14.2
388		3.7												3.5				3.7		3.2	14.2

Table 2 (cont). Adult consumption rates (kg/y) of fish in the Dumfries and Galloway coast survey area

Observation number	Bass	Cod	Dab	Dover Sole	Eel	Flounder	Grey Mullet	Haddock	Lemon Sole	Mackerel	Mixed fish	Monkfish	Plaice	Pollack	Red Gurnard	Salmon	Sea Trout	Thornback Ray	Turbot	Whiting	Total
389		3.7												3.5				3.7		3.2	14.2
390		3.7												3.5				3.7		3.2	14.2
308																13.1					13.1
312		2.4			2.4	2.4								2.4	2.4						11.8
313		2.4			2.4	2.4								2.4	2.4						11.8
332													10.4								10.4
333													10.4								10.4
334													10.4								10.4
329	9.1																				9.1
122						3.1	1.3									4.6					8.9
124						3.1	1.3									4.6					8.9
327											8.8										8.8
328											8.8										8.8
310		4.5												4.2							8.7
182						3.1										3.9	1.6				8.6
184						3.1										3.9	1.6				8.6
48	0.5	1.4				0.5	0.2									5.7					8.2
66	0.5	1.4				0.5	0.2									5.7					8.2
296						4.8										1.0	0.9				6.7
297						4.8										1.0	0.9				6.7
290																5.0	0.9				6.0
291																5.0	0.9				6.0
172																5.9					5.9
261		1.8								1.8				1.8							5.4
262		1.8								1.8				1.8							5.4
363																				5.2	5.2
364																				5.2	5.2
365																				5.2	5.2
366																				5.2	5.2
375											4.5										4.5
376											4.5										4.5
377											4.5										4.5
378											4.5										4.5
298																3.9					3.9
299																3.9					3.9
302																3.9					3.9
303																3.9					3.9
160		1.8												1.8							3.6

**Table 2 (cont). Adult consumption rates (kg/y) of fish in the Dumfries and Galloway coast survey area**

Observation number	Bass	Cod	Dab	Dover Sole	Eel	Flounder	Grey Mullet	Haddock	Lemon Sole	Mackerel	Mixed fish	Monkfish	Plaice	Pollack	Red Gurnard	Salmon	Sea Trout	Thornback Ray	Turbot	Whiting	Total
161		1.8												1.8							3.6
265		3.6																			3.6
266		3.6																			3.6
371		1.7																		1.7	3.4
372		1.7																		1.7	3.4
373		1.7																		1.7	3.4
374		1.7																		1.7	3.4
188																2.0	0.9				2.9
316		1.4																		1.4	2.7
317		1.4																		1.4	2.7
143																2.4					2.4
144																2.4					2.4
367		1.1																		1.1	2.3
368		1.1																		1.1	2.3
369		1.1																		1.1	2.3
370		1.1																		1.1	2.3
146																2.0					2.0
147																2.0					2.0
175																1.1	0.6				1.8
176																1.1	0.6				1.8
173																	1.4				1.4
174																	1.4				1.4
1						1.0															1.0
177																1.0					1.0
178																1.0					1.0
324																0.9					0.9
35			0.7																		0.7
36			0.7																		0.7

**Notes**

Emboldened observations are the critical group consumers

The critical group mean consumption rate of fish caught in the survey area based on the 20 highest adult consumers is 43.0 kg/y

The observed 97.5 percentile rate based on 104 observations is 50.5 kg/y

**Table 3. Adult consumption rates (kg/y) of crustaceans in the Dumfries and Galloway coast survey area**

Observation number	Crab	Lobster	Nephrops	Velvet Swimming Crab	Total
<b>123</b>			<b>27.4</b>		<b>27.4</b>
<b>127</b>	<b>11.8</b>	<b>9.9</b>	<b>1.4</b>		<b>23.1</b>
<b>335</b>	<b>0.8</b>		<b>20.8</b>		<b>21.6</b>
<b>336</b>	<b>0.8</b>		<b>20.8</b>		<b>21.6</b>
<b>46</b>	<b>3.3</b>	<b>3.3</b>	<b>3.3</b>	<b>3.3</b>	<b>13.0</b>
<b>145</b>		<b>9.9</b>	<b>1.4</b>		<b>11.3</b>
340			9.1		9.1
342			9.1		9.1
343			9.1		9.1
344			9.1		9.1
345			9.1		9.1
346			9.1		9.1
347			9.1		9.1
348			9.1		9.1
349			9.1		9.1
350			9.1		9.1
156			8.6		8.6
322	3.3	5.2			8.5
332	2.4	3.7			6.1
333	2.4	3.7			6.1
334	2.4	3.7			6.1
41			5.9		5.9
327	1.8	2.8			4.6
328	1.8	2.8			4.6
325		2.2			2.2
326		2.2			2.2
265	1.0	1.1			2.1
266	1.0	1.1			2.1
399			1.4		1.4
324		1.1			1.1
314		0.5	0.5		0.9
315		0.5	0.5		0.9
312	0.1	0.7			0.8
313	0.1	0.7			0.8
267	0.7				0.7
35	0.2				0.2
36	0.2				0.2
97			0.1		0.1

**Notes**

Emboldened observations are the critical group consumers

The critical group mean consumption rate of crustaceans caught in the survey area based on the 6 highest adult consumers is 19.6 kg/y

The observed 97.5 percentile rate based on 38 observations is 23.4 kg/y

**Table 4. Adult consumption rates (kg/y) of molluscs in the Dumfries and Galloway coast survey area**

Observation number	King Scallop	Mussel	Queen Scallop	Razor Shell	Whelk	Total
<b>150</b>		<b>2.6</b>			<b>12.4</b>	<b>15.0</b>
<b>151</b>		<b>2.6</b>			<b>12.4</b>	<b>15.0</b>
<b>46</b>	<b>3.3</b>		<b>3.3</b>	<b>3.3</b>	<b>3.3</b>	<b>13.0</b>
<b>332</b>	<b>7.5</b>					<b>7.5</b>
<b>333</b>	<b>7.5</b>					<b>7.5</b>
<b>334</b>	<b>7.5</b>					<b>7.5</b>
127	2.6		1.6			4.2
82		3.5				3.5
87		3.5				3.5
41	0.7		0.7			1.4
145	1.3					1.3
156		0.9				0.9
399				0.4		0.4
325		0.3				0.3
326		0.3				0.3
67		0.1				0.1
68		0.1				0.1
314		0.1				0.1

**Notes**

Emboldened observations are the critical group consumers

The critical group mean consumption rate of molluscs caught in the survey area based on the 6 highest adult consumers is 10.9 kg/y

The observed 97.5 percentile rate based on 18 observations is 15.0 kg/y

**Table 5. Adult consumption rates of wildfowl (kg/y) in the Dumfries and Galloway survey area**

Observation number	Duck	Goose	Pheasant	Widgeon	Total
47	11.3	4.4			15.7
8	3.4	5.5	5.6		14.5
9	3.4	5.5	5.6		14.5
399	9.0			2.1	11.1
17	5.1	2.7			7.8
18	5.1	2.7			7.8
70		7.7			7.7
71		7.7			7.7
75	2.2	4.4			6.6
83	2.2	4.4			6.6
122	1.8	4.4			6.2
124	1.8	4.4			6.2
281	5.7				5.7
284	5.7				5.7
298	0.7	2.2			2.9
299	0.7	2.2			2.9
300	0.7	2.2			2.9
301	0.7	2.2			2.9
316	0.5	2.2			2.7
317	0.5	2.2			2.7
98	1.4	1.1			2.5
99	1.4	1.1			2.5
100	1.4	1.1			2.5
101	1.4	1.1			2.5
102	1.4	1.1			2.5
103	1.4	1.1			2.5
104	1.4	1.1			2.5
105	1.4	1.1			2.5
106	1.4	1.1			2.5
107	1.4	1.1			2.5
108	1.4	1.1			2.5
109	1.4	1.1			2.5
110	1.4	1.1			2.5
111	1.4	1.1			2.5
112	1.4	1.1			2.5
113	1.4	1.1			2.5
114	1.4	1.1			2.5
115	1.4	1.1			2.5
116	1.4	1.1			2.5
117	1.4	1.1			2.5
118	1.4	1.1			2.5
119	1.4	1.1			2.5
120	1.4	1.1			2.5
121	1.4	1.1			2.5
352	0.2	2.2			2.4
353	0.2	2.2			2.4
354	0.2	2.2			2.4
355	0.2	2.2			2.4
356	0.2	2.2			2.4

**Table 5 (cont). Adult consumption rates of wildfowl (kg/y) in the Dumfries and Galloway survey area**

Observation number	Duck	Goose	Pheasant	Widgeon	Total
357	0.2	2.2			2.4
358	0.2	2.2			2.4
359	0.2	2.2			2.4
360	0.2	2.2			2.4
361	0.2	2.2			2.4
362	0.2	2.2			2.4

**Notes**

Emboldened observations are the critical group consumers

The critical group mean consumption rate of wildfowl from the survey area based on the 14 highest adult consumers is 8.8 kg/y

The observed 97.5 percentile rate based on 55 observations is 14.5 kg/y

**Table 6. Adult consumption rates of cattle meat (kg/y) grazed on tide-washed pasture in the Dumfries and Galloway coast survey area**

Observation number	Total
<b>30</b>	<b>62.4</b>
<b>31</b>	<b>62.4</b>
<b>32</b>	<b>62.4</b>
<b>25</b>	<b>47.3</b>
<b>26</b>	<b>47.3</b>
<b>27</b>	<b>47.3</b>
<b>28</b>	<b>47.3</b>

**Notes**

Emboldened observations are the critical group consumers

The critical group mean consumption rate of cattle meat grazed on tide-washed pasture from the survey area based on the 7 highest adult consumers is 53.8 kg/y

The observed 97.5 percentile rate based on 7 observations is 62.4 kg/y

**Table 7. Adult consumption rates of sheep meat (kg/y) grazed on tide-washed pasture in the Dumfries and Galloway coast survey area**

Observation number	Total
<b>25</b>	<b>5.7</b>
<b>26</b>	<b>5.7</b>
<b>27</b>	<b>5.7</b>
<b>28</b>	<b>5.7</b>
<b>19</b>	<b>3.8</b>
<b>20</b>	<b>3.8</b>
<b>21</b>	<b>3.8</b>
<b>30</b>	<b>3.7</b>
<b>31</b>	<b>3.7</b>
<b>32</b>	<b>3.7</b>

**Notes**

Emboldened observations are the critical group consumers

The critical group mean consumption rate of sheep meat grazed on tide-washed pasture from the survey area based on the 10 highest adult consumers is 4.5 kg/y

The observed 97.5 percentile rate based on 10 observations is 5.7 kg/y

**Table 8. Children's consumption rates of fish (kg/y) in the Dumfries and Galloway coast survey area**

**Fifteen year old age group**

Observation number	Age	Bass	Cod	Grey Mullet	Pollack	Salmon	Sea Trout	Total
<b>311</b>	<b>12</b>		<b>4.5</b>		<b>4.2</b>			<b>8.7</b>
<b>179</b>	<b>12</b>					<b>0.1</b>		<b>0.1</b>

**Notes**

Emboldened observations are the critical group consumers

The critical group mean consumption rate of fish from the survey area based on the 2 highest fifteen year old age group consumers is 4.4 kg/y

The observed 97.5 percentile rate based on 2 observations is 8.5 kg/y

**Ten year old age group**

Observation number	Age	Bass	Cod	Grey Mullet	Pollack	Salmon	Sea Trout	Total
<b>84</b>	<b>9</b>			<b>3.5</b>				<b>3.5</b>
<b>85</b>	<b>7</b>			<b>3.5</b>				<b>3.5</b>
<b>86</b>	<b>7</b>			<b>3.5</b>				<b>3.5</b>
148	7					0.2		0.2
180	10					0.1		0.1
181	8					0.1		0.1

**Notes**

Emboldened observations are the critical group consumers

The critical group mean consumption rate of fish from the survey area based on the 3 highest ten year old age group consumers is 3.5 kg/y

The observed 97.5 percentile rate based on 6 observations is 3.5 kg/y

**Five year old age group**

Observation number	Age	Bass	Cod	Grey Mullet	Pollack	Salmon	Sea Trout	Total
<b>12</b>	<b>4</b>	<b>0.3</b>		<b>0.3</b>		<b>1.5</b>	<b>0.4</b>	<b>2.4</b>
<b>13</b>	<b>4</b>	<b>0.3</b>		<b>0.3</b>		<b>1.5</b>	<b>0.4</b>	<b>2.4</b>
<b>14</b>	<b>2</b>	<b>0.1</b>		<b>0.1</b>		<b>0.6</b>	<b>0.2</b>	<b>1.0</b>
149	3					0.1		0.1

**Notes**

Emboldened observations are the critical group consumers

The critical group mean consumption rate of fish from the survey area based on the 3 highest five year old age group consumers is 2.0 kg/y

The observed 97.5 percentile rate based on 4 observations is 2.4 kg/y

**Table 9. Children's consumption rates of crustaceans (kg/y) in the Dumfries and Galloway coast survey area**

**Fifteen year old age group**

Observation number	Age	Crab	Lobster	Nephrops	Total
<b>337</b>	<b>12</b>	<b>0.8</b>		<b>20.8</b>	<b>21.6</b>
<b>157</b>	<b>16</b>	<b>3.0</b>	<b>1.9</b>	<b>8.6</b>	<b>13.5</b>
<b>159</b>	<b>12</b>		<b>8.4</b>		<b>8.4</b>
43	12			2.9	2.9
401	15			1.4	1.4

**Notes**

Emboldened observations are the critical group consumers

The critical group mean consumption rate of crustaceans from the survey area based on the 3 highest fifteen year old age group consumers is 14.5 kg/y

The observed 97.5 percentile rate based on 5 observations is 20.8 kg/y

**Ten year old age group**

Observation number	Age	Crab	Lobster	Nephrops	Total
<b>338</b>	<b>9</b>	<b>0.8</b>		<b>20.8</b>	<b>21.6</b>

**Notes**

Emboldened observations are the critical group consumers

The critical group mean consumption rate of crustaceans from the survey area based on the single ten year old age group consumer is 21.6 kg/y

**Table 10. Children's consumption rates of molluscs (kg/y) in the Dumfries and Galloway survey area**

**Fifteen year old age group**

Observation number	Age	Mussel	Queen Scallop	Razor Shell	Total
<b>157</b>	<b>16</b>	<b>0.9</b>			<b>0.9</b>
<b>401</b>	<b>15</b>			<b>0.4</b>	<b>0.4</b>
<b>43</b>	<b>12</b>		<b>0.3</b>		<b>0.3</b>

**Notes**

Emboldened observations are the critical group consumers

The critical group mean consumption rate of molluscs from the survey area based on the 3 highest fifteen year old age group consumers is 0.5 kg/y

The observed 97.5 percentile rate based on 3 observations is 0.9 kg/y

**Table 11. Children's consumption rates of wildfowl (kg/y) in the Dumfries and Galloway survey area**

**Ten year old age group**

Observation number	Age	Duck	Goose	Total
<b>84</b>	<b>9</b>	<b>0.5</b>	<b>0.9</b>	<b>1.4</b>
<b>85</b>	<b>7</b>	<b>0.5</b>	<b>0.9</b>	<b>1.4</b>
<b>86</b>	<b>7</b>	<b>0.5</b>	<b>0.9</b>	<b>1.4</b>

**Notes**

Emboldened observations are the critical group consumers

The critical group mean consumption rate of wildfowl from the survey area based on the 3 highest ten year old age group consumers is 1.4 kg/y

The observed 97.5 percentile rate based on 3 observations is 1.4 kg/y

**Table 12. Children's consumption rates of cattle meat (kg/y) grazed on tide-washed pasture in the Dumfries and Galloway coast survey area**

**Five year old age group**

Observation number	Age	Cattle meat
<b>34</b>	<b>5</b>	<b>3.0</b>
<b>33</b>	<b>3</b>	<b>3.0</b>
<b>29</b>	<b>3</b>	<b>1.9</b>

**Notes**

Emboldened observations are the critical group consumers

The critical group mean consumption rate of cattle meat grazed on tide-washed pasture from the survey area based on the 3 highest five year old age group consumers is 2.6 kg/y

The observed 97.5 percentile rate based on 3 observations is 3.0 kg/y

**Table 13. Children's consumption rates of sheep meat (kg/y) grazed on tide-washed pasture in the Dumfries and Galloway coast survey area**

**Five year old age group**

Observation number	Age	Sheep meat
<b>29</b>	<b>3</b>	<b>0.2</b>
<b>34</b>	<b>5</b>	<b>0.2</b>
<b>33</b>	<b>3</b>	<b>0.2</b>

**Notes**

Emboldened observations are the critical group consumers

The critical group mean consumption rate of sheep meat grazed on tide-washed pasture from the survey area based on the 3 highest five year old age group consumers is 0.2 kg/y

The observed 97.5 percentile rate based on 3 observations is 0.2 kg/y

**Table 14. Ratios for determining consumption rates for children**

Food Group	Ratio child/adult		
	6 - 12 months	10 yr old	15 yr old
Milk	1.333	1	1.083
Cattle Meat	0.222	0.667	0.778
Sheep Meat	0.12	0.4	0.6
Wildfowl	ND	ND	ND
Fish	0.375	0.5	0.5
Crustaceans	0.525*	0.7	0.6
Molluscs	0.525*	0.7	0.6

ND - No data

\* No MAFF (1998) data were available for these rates. Ratios were derived by scaling the 10 year olds crustaceans and mollusc consumption data

**Table 15. Adult aquatic summary table in the Dumfries and Galloway coast survey area**

Food group	Number of observations	No. higher rate consumers	Observed maximum critical consumption rate	Observed lower critical consumption rate	Observed critical group mean consumption rate	Observed 97.5th %ile consumption rate	Generic mean consumption rate	Generic 97.5th %ile consumption rate
Fish	104	20	74.0	26.5	43.0	50.5	15	40
Crustaceans	38	6	27.4	11.3	19.6	23.4	3.5	10
Molluscs	18	6	15.0	7.5	10.9	15.0	3.5	10
Wildfowl	55	14	15.6	5.7	8.8	14.5	ND	ND
Cattle meat	7	7	62.4	47.3	53.8	62.4	15	45
Sheep meat	10	10	5.7	3.7	4.5	5.7	8	25

ND = not determined

**Table 16. 15 year old children's aquatic summary table in the Dumfries and Galloway coast survey area**

Food group	Number of observations	No. higher rate consumers	Observed maximum critical consumption rate	Observed lower critical consumption rate	Observed critical group mean consumption rate	Observed 97.5th %ile consumption rate	Generic mean consumption rate	Generic 97.5th %ile consumption rate
Fish	2	2	8.7	0.1	4.4	8.5	6.5	20
Crustaceans	5	3	21.6	8.4	14.5	20.8	2.5	6
Molluscs	3	3	0.9	0.3	0.5	0.9	2.5	6
Wildfowl	NC	NC	NC	NC	NC	NC	ND	ND
Cattle meat	NC	NC	NC	NC	NC	NC	15	35
Sheep meat	NC	NC	NC	NC	NC	NC	5.5	15

ND = not determined

NC = not consumed

**Table 17. 10 year old children's aquatic summary table in the Dumfries and Galloway coast survey area**

Food group	Number of observations	No. higher rate consumers	Observed maximum critical consumption rate	Observed lower critical consumption rate	Observed critical group mean consumption rate	Observed 97.5th %ile consumption rate	Generic mean consumption rate	Generic 97.5th %ile consumption rate
Fish	6	3	3.5	3.5	3.5	3.5	6	20
Crustaceans	1	1	21.6	21.6	21.6	NA	2.5	7
Molluscs	NC	NC	NC	NC	NC	NC	2.5	7
Wildfowl	3	3	1.4	1.4	1.4	1.4	ND	ND
Cattle meat	NC	NC	NC	NC	NC	NC	15	30
Sheep meat	NC	NC	NC	NC	NC	NC	4	10

NC = not consumed

NA = not applicable

ND = not determined

**Table 18. 5 year old children's aquatic summary table in the Dumfries and Galloway coast survey area**

Food group	Number of observations	No. higher rate consumers	Observed maximum critical consumption rate	Observed lower critical consumption rate	Observed critical group mean consumption rate	Observed 97.5th %ile consumption rate	Generic mean consumption rate	Generic 97.5th %ile consumption rate
Fish	4	3	2.4	1.0	2.0	2.4	ND	ND
Crustaceans	NC	NC	NC	NC	NC	NC	ND	ND
Molluscs	NC	NC	NC	NC	NC	NC	ND	ND
Wildfowl	NC	NC	NC	NC	NC	NC	ND	ND
Cattle meat	3	3	3.0	1.9	2.6	3.0	ND	ND
Sheep meat	3	3	0.2	0.2	0.2	0.2	ND	ND

ND = not determined

NC = not consumed

**Table 19. Intertidal occupancy rates (h/y) in the Dumfries and Galloway coast survey area**

Observation number	Location	Activity	Mud	Sand and mud	Rock	Salt-marsh	Sand	Sand and stones
<b>310</b>	<b>Various/Garlieston Bay</b>	<b>Winkle collecting, bait digging/Angling</b>		<b>1020</b>	80			
<b>314, 315</b>	<b>Various</b>	<b>Winkle collecting</b>		<b>1050</b>				4
<b>319-321</b>	<b>Various</b>	<b>Winkle collecting</b>		<b>1008</b>				
<b>75</b>	<b>River Nith/Caerlaverock NNR</b>	<b>Haaf netting, wildfowling, coastguard/Marsh warden</b>	67			<b>828</b>		
<b>48</b>	<b>Carluith</b>	<b>Checking stake nets</b>	<b>888</b>					
<b>263</b>	<b>Various</b>	<b>Winkle collecting, dog walking</b>		352	<b>260</b>		260	
<b>351</b>	<b>Wigtown Saltmarsh</b>	<b>Tending livestock</b>				<b>685</b>		
44	Carrick Point/Kirkcudbright Bay	Bait digging, dog walking/Angling	78	183	250		140	
391-393	Various	Winkle collecting		650				
72	River Nith/Caerlaverock NNR	Coastguard duties/Marsh warden, wildfowling	60			544		
<b>402</b>	<b>River Cree</b>	<b>Long netting (bank man)</b>					<b>600</b>	
329, 330	Garlieston, various	Bait digging, angling		585				
308	River Nith/Caerlaverock NNR	Haaf netting/Wildfowling	1			520		
<b>12-14</b>	<b>Cardoness Estate beach</b>	<b>Relaxing on beach</b>					<b>520</b>	
<b>265</b>	<b>Kirkcudbright Bay</b>	<b>Bait digging, angling</b>		52	<b>382</b>			
152-155	Southernness Point	Bait digging		416				
197	Auchenlarie Caravan Park	Angling			192		192	
15	Cardoness Estate beach	Dog walking					365	
192	Kirkcudbright Bay area	Dog walking					365	
<b>267</b>	<b>Carrick (Isle Mouth), Kirkcudbright Bay/Various</b>	<b>Bait digging/Angling</b>		26	<b>338</b>			
<b>269</b>	<b>Carrick (Isle Mouth), Kirkcudbright Bay area/Various</b>	<b>Bait digging/Angling</b>		42	<b>320</b>			
399	River Cree, Opp Burnfoot Cottage/Kirkcudbright Bay Merse	Haaf netting, bait digging, checking stake nets/Wildfowling	259			100		
37	Kirkcudbright Bay area	Bait digging, angling	13		250		88	
<b>268</b>	<b>Various</b>	<b>Angling</b>			<b>312</b>			
281	Southernness Point/Kirkconnell Merse	Bait digging/Wildfowling, marsh warden		55		220		
<b>125</b>	<b>Annan, Newbie, Powfoot/Brow well, Southernness</b>	<b>Netting and ringing birds/Bird watching</b>						<b>270</b>
45	Solway Firth	Bird watching				260		
49	Opposite Glencaple	Dog walking				260		
<b>316</b>	<b>Various/Kirkcudbright Bay area</b>	<b>Bait digging, angling/Dog walking</b>		24	36		12	<b>183</b>
264	Various	Angling			240			
312	Brighthouse Bay/Various	Bait digging/Angling		60	120		60	
282, 283	Southernness Point/Kirkconnell Merse	Bait digging/Marsh warden		55		180		
318	Cummertrees, Powfoot/Powfoot to Brow Well	Setting long-lines, bait digging/Wildfowling		36		182		
279	Woodcroft Farm	Tending livestock				213		
324	Auchencairn	Gear handling on the shore					187	
309	Sandgreen Caravan Park	Walking and watersports					183	
<b>317</b>	<b>Kirkcudbright Bay area</b>	<b>Dog walking</b>						<b>183</b>
82	Various/Carrick (Isle Mouth)	Walking/Mussel collecting					150	12

**Table 19 (cont). Intertidal occupancy rates (h/y) in the Dumfries and Galloway coast survey area**

Observation number	Location	Activity	Mud	Sand and mud	Rock	Salt-marsh	Sand	Sand and stones
10	Fleet Bay	Setting, dismantling, checking stake nets, beach cleaning					153	
280	Gibbonhill Farm	Tending livestock				152		
385-387	Various	Angling			150			
8	Caerlaverock NNR	Wildfowling				144		
6, 7	Caerlaverock NNR	Tending livestock				140		
11	Cardoness Estate beach	Playing on beach					130	
401	Opposite Burnfoot Cottage	Checking stake nets, walking	129					
88-90	Balcary Bay/Merse Head Sands	Angling/Playing on beach			54		72	
17	Creetown merse	Wildfowling, dog walking				122		
292	Mersehead RSPB Reserve	Marsh warden, dog walking				20	90	
47	Caerlaverock NNR/Opposite Glencaple	Wildfowling/Dog walking				105		
261	Various	Angling					105	
98-109	Crook of Baldoon and Barsalloch Merse	Wildfowling				104		
394, 395	Powfoot	Dog walking					104	
339	Wigtown Saltmarsh	Tending livestock				100		
396, 397	Orchardton Saltmarsh	Tending livestock				91		
2, 3	Caerlaverock NNR	Marsh warden				90		
298	Near Flatts of Cargen farm/Kirkconnell Merse	Flood bank maintenance, dog walking/Wildfowling		40		10	39	
201-205	Carrick (Isle Mouth)	Mussel collecting, playing on beach			6		80	
143	River Nith	Haaf netting, dog walking	5			78		
191	Kirkcudbright Bay area	Walking and swimming					78	
200	Carrick (Isle Mouth)	Walking					78	
210	Mosyard Bay	Walking					78	
25	Carsewalloch merse	Tending livestock				75		
91-94	Merse Head Sands	Playing on beach					72	
285	Ingleston/Near Ingleston Farm	Tending livestock/Playing on beach		52			18	
367, 368	Balcary Point	Angling			64			
128-142	Annan, Newbie and Powfoot	Netting and ringing birds						60
150, 151	Southernness Point	Bait digging		60				
211, 212	Various	Coastguard duties					60	
371-374	Balcary Point	Angling			60			
122	River Nith/Caerlaverock NNR	Haaf netting/Wildfowling	13			40		
67, 68	Carrick Point/Opp Seaward caravan site	Walking/Mussel collecting			48			4
69	Mersehead RSPB Reserve/Sandylands Bay	Dog walking/Walking				25	25	
206, 207	Brighthouse Bay	Walking					50	
293, 294	Mersehead RSPB Reserve	Marsh warden				25	25	
331	Wigtown Saltmarsh	Marsh warden				50		
16	Fleet Bay	Checking, setting, dismantling stake nets					49	

**Table 19 (cont). Intertidal occupancy rates (h/y) in the Dumfries and Galloway coast survey area**

Observation number	Location	Activity	Mud	Sand and mud	Rock	Salt-marsh	Sand	Sand and stones
266	Kirkcudbright Bay area	Beach combing			48			
363, 364	Balcary Bay	Angling			48			
375-382	Rascarrel Beach	Angling			48			
193	Various	Dog walking					45	
4, 5	Caerlaverock NNR	Marsh warden				40		
50-65	Caerlaverock NNR	Wildfowling				40		
173	River Nith	Haaf netting	40					
35	Carsluith	Bait digging	36					
213-260	Various	Coastguard duties					36	
290	River Nith/Ingleston	Haaf netting/Tending livestock	10	26				
352-361	Wigtown Saltmarsh	Wildfowling				35		
97	Various	Winkle collecting		30				
19, 20	Creetown merse	Tending livestock				25		
307	Near Flatts of Cargen farm	Tending livestock		25				
208, 209	Brighthouse Bay	Dog walking					24	
383, 384	Balcary Point	Angling			24			
167-171	Nun Mill Bay	Mussel collecting, playing on beach			4		16	
277, 278	Woodcroft Farm	Tending livestock				20		
295	Mersehead RSPB Reserve	Tending livestock				20		
160, 161	Ross Bay/Manor Point, Ross Bay	Bait digging/Angling		3	15			
286-289	Near Ingleston Farm	Playing on beach					18	
162	Opp Seaward caravan site/Nun Mill Bay	Angling/Playing on beach			2		15	
186	River Nith	Haaf netting	17					
175	River Nith	Haaf netting	16					
187	Torrs Point	Angling			16			
73, 74	Carrick (Isle Mouth)	Playing on beach					15	
76-81	Carrick (Isle Mouth)	Playing on beach					15	
95, 96	Bishopton Farm	Tending livestock				15		
163-166	Nun Mill Bay	Playing on beach					15	
183	Nun Mill Bay	Walking Metal detecting					12	
185	Nun Mill Bay	Dog walking					12	
189, 190	Kirkcudbright Bay area	Angling					12	
156, 157	Carrick Point	Mussel collecting						10
270-276	St. Ninian's Point	Angling			9			
22-24	Meikle Carse merse	Tending livestock				8		
195, 196	Brighthouse Bay	Bait digging		8				
30, 31	Cassencarie merse	Tending livestock				5		
296	River Nith	Haaf netting	5					

**Table 19 (cont). Intertidal occupancy rates (h/y) in the Dumfries and Galloway coast survey area**

Observation number	Location	Activity	Mud	Sand and mud	Rock	Salt-marsh	Sand	Sand and stones
172	River Nith	Haaf netting	4					
182	River Nith	Haaf netting	4					
177	River Nith	Haaf netting	4					
304-306	River Nith	Haaf netting	2					

**Notes**

Emboldened observations are the critical group consumers

The critical group mean intertidal occupancy over mud based on 1 observation is 888 h/y

The critical group mean intertidal occupancy over sand and mud based on 6 observations is 1024 h/y

The critical group mean intertidal occupancy over rock based on 5 observations is 322 h/y

The critical group mean intertidal occupancy over saltmarsh based on 2 observations is 757 h/y

The critical group mean intertidal occupancy over sand based on 4 observations is 540 h/y

The critical group mean intertidal occupancy over sand and stones based on 3 observations is 212 h/y

The observed 97.5 percentile rate based on 22 observations for mud is 558 h/y

The observed 97.5 percentile rate based on 60 observations for rock is 330 h/y

The observed 97.5 percentile rate based on 84 observations for saltmarsh is 542 h/y

The observed 97.5 percentile rate based on 123 observations for sand is 512 h/y

The observed 97.5 percentile rate based on 37 observations for sand and mud is 1050 h/y

The observed 97.5 percentile rate based on 25 observations for sand and stones is 218 h/y

**Table 20. Handling of sediment rates (h/y) in the Dumfries and Galloway coast survey area**

Observation number	Location	Activity	Gear	Sediment	Total
<b>335</b>	<b>Wigtown Bay</b>	<b>Gear handling</b>	<b>2320</b>		<b>2320</b>
<b>327</b>	<b>Wigtown Bay</b>	<b>Gear handling</b>	<b>1575</b>		<b>1575</b>
340, 341	Wigtown Bay	Gear handling	1470		1470
156, 157	Solway Firth/Carrick Point	Gear handling/Mussel collecting	1200	10	1210
<b>314, 315</b>	<b>Various</b>	<b>Winkle collecting</b>		<b>1054</b>	<b>1054</b>
<b>310</b>	<b>Garlieston Bay, various</b>	<b>Bait digging, winkle collecting</b>		<b>1020</b>	<b>1020</b>
399	River Cree/Kirkcudbright Bay Merse, Opp Burnfoot Cottage	Gear handling/Wildfowling, bait digging, checking stake nets	660	351	1011
<b>319-321</b>	<b>Various</b>	<b>Winkle collecting</b>		<b>1008</b>	<b>1008</b>
<b>48</b>	<b>Carsluith</b>	<b>Gear handling/Checking stake nets</b>	119	<b>888</b>	<b>1007</b>
324	Auchencairn, Balcary Point	Gear handling	990		990
322, 323	Solway Firth	Gear handling	832		832
127	Solway Firth	Gear handling	728		728
391-393	Various	Winkle collecting		650	650
123	Solway Firth	Gear handling	624		624
308	Caerlaverock NNR	Wildfowling		520	520
332-334	Wigtown Bay	Gear handling	520		520
152-155	Southernness Point	Bait digging		416	416
263	Various	Winkle collecting		352	352
318	Cummertrees, Powfoot, Powfoot to Brow Well	Setting long-lines, bait digging, wildfowling		218	218
46	River Cree	Gear handling	200		200
44	Carrick Point	Bait digging		156	156
398	Off Palnackie	Gear handling	150		150
8	Caerlaverock NNR	Wildfowling		144	144
401	Opp Burnfoot Cottage	Gear handling/Checking stake nets	60	69	129
265	Kirkcudbright Bay area	Bait digging		122	122
329	Garlieston	Bait digging		117	117
330	Garlieston	Bait digging		117	117
98-109	Crook of Baldoon and Barsalloch Merse	Wildfowling		104	104
17	Creetown merse	Wildfowling		96	96
75	Caerlaverock NNR	Wildfowling		96	96
281	Kirkconnell Merse, Southernness Point	Wildfowling, bait digging		95	95
150, 151	Southernness Point	Bait digging		60	60

**Table 20 (cont). Handling of sediment rates (h/y) in the Dumfries and Galloway coast survey area**

Observation number	Location	Activity	Gear	Sediment	Total
312	Brighthouse Bay	Bait digging		60	60
282, 283	Southernness Point	Bait digging		55	55
267	Carrick (Isle Mouth), Kirkcudbright Bay	Bait digging		52	52
269	Carrick (Isle Mouth), Kirkcudbright Bay	Bait digging		50	50
298	Kirkconnell Merse	Wildfowling, flood bank maintenance		50	50
10	Fleet Bay	Checking, setting, dismantling stake nets		49	49
16	Fleet Bay	Checking, setting, dismantling stake nets		49	49
47	Caerlaverock NNR	Wildfowling		40	40
50-65	Caerlaverock NNR	Wildfowling		40	40
122	Caerlaverock NNR	Wildfowling		40	40
37	Kirkcudbright Bay area	Bait digging		39	39
35	Carluith	Bait digging		36	36
352-361	Wigtown Saltmarsh	Wildfowling		35	35
97	Various	Winkle collecting		30	30
72	Caerlaverock NNR	Wildfowling		24	24
316	Various	Bait digging		24	24
82	Carrick (Isle Mouth)	Mussel collecting		12	12
195, 196	Brighthouse Bay	Bait digging		8	8
201-205	Carrick (Isle Mouth)	Mussel collecting		6	6
67, 68	Opp Seaward caravan site	Mussel collecting		4	4
167-171	Nun Mill Bay	Mussel collecting		4	4
160, 161	Ross Bay	Bait digging		3	3

**Notes**

Emboldened observations are the critical group consumers

The critical group mean gear handling time based on 2 observations is 1948 h/y

The critical group mean sediment handling time based on 7 observations is 1006 h/y

The observed 97.5 percentile rate based on 19 observations for gear is 1985 h/y

The observed 97.5 percentile rate based on 101 observations for sediment is 1014 h/y

**Table 21. Gamma dose rates (micro Gy/h) in the Dumfries and Galloway coast survey area**

<b>Location</b>	<b>micro Gy/h</b>
NX 657 486 - Nun Mill Bay, Rock	0.1009
NX 657 486 - Nun Mill Bay, Sand	0.0877
NX 637 454 - Brighthouse Bay, Rock	0.0882
NX 635 456 - Brighthouse Bay, Sand	0.0713
NX 575 503 - Carrick Beach, Sand	0.0807
NX 575 503 - Carrick Beach, Sand	0.0877
NX 992 663 - Airds Point, Saltmarsh	0.0975
NX 916 554 - Mersehead Sands, Sand	0.0708
NX 574 500 - Carrick Bay, Sand and mud	0.0754
NX 997 597 - River Nith, Mud	0.0756
NX 994 682 - River Nith, Mud	0.078
NX 485 544 - River Cree, Mud	0.0715
NX 468 593 - Creetown Merse, Saltmarsh	0.0975
NX 558 526 - Fleet Bay, Sand	0.0763
NY 020 651 - Caerlaverock NNR, Saltmarsh	0.0906
NY 084 671 - Brow Well, Mud	0.0742
NX 483 464 - Garlieston Harbour, Sand and mud	0.0682
NX 848 537 - Rockcliffe Beach, Sand	0.0903
NX 822 569 - Palnackie Harbour, Mud	0.0962
NX 837 556 - Kippford, Saltmarsh	0.1061

**Table 22. Combinations of adult groups for consideration in dose assessments**

Combination number	Cattle meat	Sheep meat	Wildfowl	Fish	Crustaceans	Molluscs	Handling fishing gear	Handling sediment	External occupancy over mud	External occupancy over rock	External occupancy over sand and mud	External occupancy over sand	External occupancy over sand and stones	External occupancy over saltmarsh
1				*		*		*				*	*	
2			*	*	*	*	*	*	*					*
3	*	*												*
4								*	*	*	*	*		
5						*		*		*			*	
6			*	*				*			*	*		*
7				*	*			*		*	*	*		
8					*	*		*			*		*	
9					*	*	*	*			*		*	
10				*					*		*			
11			*	*				*		*	*	*	*	
12				*	*		*	*				*		



Figure 1. The Dumfries and Galloway coast aquatic survey area.



**Annex Table 1 (cont). Summary of adult consumption rates (kg/y) and occupancy times (h/y) in the Dumfries and Galloway coast survey area**

Observation number	Sex	Age in years (U if unknown)	Fish	Crustaceans	Molluscs	Wildfowl	Cattle meat	Sheep meat	Handling fishing gear	Handling sediment	External occupancy over sand and mud	External occupancy over mud	External occupancy over net	External occupancy over rock	External occupancy over sand	External occupancy over sand and stone	External occupancy over saltmarsh
46	M	U	52.0	13.0	13.0				200								
47	M	50				15.7				40							105
48	M	U	8.2						119	888	888						
49	F	45															260
50	M	40								40							40
51	M	40								40							40
52	M	40								40							40
53	M	40								40							40
54	M	40								40							40
55	M	40								40							40
56	M	40								40							40
57	M	40								40							40
58	M	40								40							40
59	M	40								40							40
60	M	40								40							40
61	M	40								40							40
62	M	40								40							40
63	M	40								40							40
64	M	40								40							40
65	M	40								40							40
66	F	U	8.2														
67	M	U			0.1					4				48		4	
68	F	47			0.1					4				48		4	
69	M	49													25		25
70	M	50				7.7											
71	F	50				7.7											
72	M	59								24		60					544
73	M	35													15		
74	F	36													15		
75	M	30	16.6			6.6				96		67					828
81	F	36													15		
82	F	49	20.7		3.5					12					150	12	
83	F	28	16.6			6.6											
87	F	35	20.7		3.5												
88	M	55												54	72		



**Annex Table 1 (cont). Summary of adult consumption rates (kg/y) and occupancy times (h/y) in the Dumfries and Galloway coast survey area**

Observation number	Sex	Age in years (U if unknown)	Fish	Crustaceans	Molluscs	Wildfowl	Cattle meat	Sheep meat	Handling fishing gear	Handling sediment	External occupancy over sand and mud	External occupancy over mud	External occupancy over net	External occupancy over rock	External occupancy over sand	External occupancy over sand and stone	External occupancy over saltmarsh
128	M	45														60	
129	M	45														60	
130	M	45														60	
131	M	45														60	
132	M	45														60	
133	M	45														60	
134	M	45														60	
135	M	45														60	
136	M	45														60	
137	M	45														60	
138	M	45														60	
139	M	45														60	
140	M	45														60	
141	M	45														60	
142	M	45														60	
143	M	67	2.4									5					78
144	F	62	2.4														
145	F	44	23.3	11.3	1.3												
146	F	38	2.0														
147	M	41	2.0														
150	M	44			15.0					60	60						
151	F	37			15.0					60	60						
152	M	40								416	416						
153	M	40								416	416						
154	M	40								416	416						
155	M	40								416	416						
156	M	40		8.6	0.9				1200	10						10	
158	F	38	18.9														
160	M	U	3.6							3	3			15			
161	F	U	3.6							3	3			15			
162	M	35												2	15		
163	F	32													15		
164	M	66													15		
165	F	65													15		
167	M	61								4				4	16		

**Annex Table 1 (cont). Summary of adult consumption rates (kg/y) and occupancy times (h/y) in the Dumfries and Galloway coast survey area**

Observation number	Sex	Age in years (U if unknown)	Fish	Crustaceans	Molluscs	Wildfowl	Cattle meat	Sheep meat	Handling fishing gear	Handling sediment	External occupancy over sand and mud	External occupancy over mud	External occupancy over net	External occupancy over rock	External occupancy over sand	External occupancy over sand and stone	External occupancy over saltmarsh
168	F	60								4				4	16		
169	F	34								4				4	16		
172	M	74	5.9									4					
173	M	63	1.4									40					
174	F	59	1.4														
175	M	66	1.8									16					
176	F	62	1.8														
177	M	32	1.0									4					
178	F	30	1.0														
182	M	63	8.6									4					
183	M	62													12		
184	F	60	8.6														
185	F	58													12		
186	M	76										17					
187	M	62												16			
188	F	72	2.9														
189	M	46													12		
190	M	17													12		
191	F	94													78		
192	M	55													365		
193	M	44													45		
195	M	33								8	8						
196	M	33								8	8						
197	M	54	20.7											192	192		
198	F	54	20.7														
199	M	30	20.7														
200	M	57													78		
201	M	34								6				6	80		
202	F	33								6				6	80		
206	M	U													50		
207	F	U													50		
208	M	U													24		
209	F	U													24		
210	M	U													78		
211	F	49													60		

**Annex Table 1 (cont). Summary of adult consumption rates (kg/y) and occupancy times (h/y) in the Dumfries and Galloway coast survey area**

Observation number	Sex	Age in years (U if unknown)	Fish	Crustaceans	Molluscs	Wildfowl	Cattle meat	Sheep meat	Handling fishing gear	Handling sediment	External occupancy over sand and mud	External occupancy over mud	External occupancy over net	External occupancy over rock	External occupancy over sand	External occupancy over sand and stone	External occupancy over saltmarsh
212	M	52													60		
213	M	U													36		
214	M	U													36		
215	M	U													36		
216	M	U													36		
217	M	U													36		
218	M	U													36		
219	M	U													36		
220	M	U													36		
221	M	U													36		
222	M	U													36		
223	M	U													36		
224	M	U													36		
225	M	U													36		
226	M	U													36		
227	M	U													36		
228	M	U													36		
229	M	U													36		
230	M	U													36		
231	M	U													36		
232	M	U													36		
233	M	U													36		
234	M	U													36		
235	M	U													36		
236	M	U													36		
237	M	U													36		
238	M	U													36		
239	M	U													36		
240	M	U													36		
241	M	U													36		
242	M	U													36		
243	M	U													36		
244	M	U													36		
245	M	U													36		
246	M	U													36		





**Annex Table 1 (cont). Summary of adult consumption rates (kg/y) and occupancy times (h/y) in the Dumfries and Galloway coast survey area**

Observation number	Sex	Age in years (U if unknown)	Fish	Crustaceans	Molluscs	Wildfowl	Cattle meat	Sheep meat	Handling fishing gear	Handling sediment	External occupancy over sand and mud	External occupancy over mud	External occupancy over net	External occupancy over rock	External occupancy over sand	External occupancy over sand and stone	External occupancy over saltmarsh
324	M	50	0.9	1.1					990				<b>187</b>				
325	M	68	<b>26.5</b>	2.2	0.3												
326	M	68	<b>26.5</b>	2.2	0.3												
327	M	40	8.8	4.6					<b>1575</b>								
328	M	40	8.8	4.6													
329	M	35	9.1							117	585						
330	M	35								117	585						
331	F	45															50
332	M	51	10.4	6.1	<b>7.5</b>				520								
333	M	69	10.4	6.1	<b>7.5</b>				520								
334	M	69	10.4	6.1	<b>7.5</b>				520								
335	M	38		<b>21.6</b>					<b>2320</b>								
336	F	38		<b>21.6</b>													
339	M	U															100
340	M	61	<b>44.2</b>	9.1					1470								
341	M	45							1470								
342	M	61	<b>44.2</b>	9.1													
343	M	U	<b>44.2</b>	9.1													
344	M	U	<b>44.2</b>	9.1													
345	M	U	<b>44.2</b>	9.1													
346	M	U	<b>44.2</b>	9.1													
347	M	U	<b>44.2</b>	9.1													
348	M	U	<b>44.2</b>	9.1													
349	M	U	<b>44.2</b>	9.1													
350	M	U	<b>44.2</b>	9.1													
351	M	40															<b>685</b>
352	M	U				2.4				35							35
353	M	U				2.4				35							35
354	M	U				2.4				35							35
355	M	U				2.4				35							35
356	M	U				2.4				35							35
357	M	U				2.4				35							35
358	M	U				2.4				35							35
359	M	U				2.4				35							35
360	M	U				2.4				35							35

**Annex Table 1 (cont). Summary of adult consumption rates (kg/y) and occupancy times (h/y) in the Dumfries and Galloway coast survey area**

Observation number	Sex	Age in years (U if unknown)	Fish	Crustaceans	Molluscs	Wildfowl	Cattle meat	Sheep meat	Handling fishing gear	Handling sediment	External occupancy over sand and mud	External occupancy over mud	External occupancy over net	External occupancy over rock	External occupancy over sand	External occupancy over sand and stone	External occupancy over saltmarsh
361	M	U				2.4				35							35
362	F	U				2.4											
363	M	U	5.2											48			
364	M	U	5.2											48			
365	F	U	5.2														
366	F	U	5.2														
367	M	36	2.3											64			
368	M	39	2.3											64			
369	F	U	2.3														
370	F	U	2.3														
371	M	26	3.4											60			
372	M	27	3.4											60			
373	F	25	3.4											60			
374	F	25	3.4											60			
375	M	50	4.5											48			
376	M	30	4.5											48			
377	M	30	4.5											48			
378	M	25	4.5											48			
379	F	U												48			
380	F	U												48			
381	F	U												48			
382	F	U												48			
383	M	35												24			
384	M	36												24			
385	M	U	14.2											150			
386	M	U	14.2											150			
387	M	U	14.2											150			
388	F	U	14.2														
389	F	U	14.2														
390	F	U	14.2														
391	F	25								650	650						
392	M	28								650	650						
393	M	30								650	650						
394	M	45													104		
395	F	45													104		

**Annex Table 1 (cont). Summary of adult consumption rates (kg/y) and occupancy times (h/y) in the Dumfries and Galloway coast survey area**

Observation number	Sex	Age in years (U if unknown)	Fish	Crustaceans	Molluscs	Wildfowl	Cattle meat	Sheep meat	Handling fishing gear	Handling sediment	External occupancy over sand and mud	External occupancy over mud	External occupancy over net	External occupancy over rock	External occupancy over sand	External occupancy over sand and stone	External occupancy over saltmarsh
396	M	46															91
398	M	58							150								
399	M	45	<b>27.4</b>	1.4	0.4	<b>11.1</b>			660	351		259					100
400	F	44	<b>27.4</b>														
402	M	56													<b>600</b>		

**Annex Table 2. Summary of children's consumption rates (kg/y) and occupancy times (h/y) in the Dumfries and Galloway coast survey area**

Observation number	Sex	Age in years	Fish	Crustaceans	Molluscs	Wildfowl	Cattle meat	Sheep meat	Handling fishing gear	Handling sediment	External occupancy over mud	External occupancy over rock	External occupancy over sand	External occupancy over sand and stone
<b>Infants</b>														
77	F	0											15	
<b>Five year old age group</b>														
14	M	2	1.0										520	
78	F	2											15	
289	F	2											18	
29	M	3					1.9	0.2						
33	F	3					3.0	0.2						
149	M	3	0.1											
12	M	4	2.4										520	
13	F	4	2.4										520	
76	F	4											15	
205	M	4								6	6	80		
288	F	4											18	
34	F	5					3.0	0.2						
170	F	5								4	4	16		
79	F	6											15	
94	M	6											72	
276	M	6										9		
<b>Ten year old age group</b>														
85	F	7	3.5			1.4								
86	M	7	3.5			1.4								
148	M	7	0.2											
275	M	7										9		
166	F	8											15	
181	F	8	0.1											
287	F	8											18	
84	F	9	3.5			1.4								
93	M	9											72	
171	M	9								4	4	16		
338	F	9		21.6										
180	F	10	0.1											
204	F	10								6	6	80		
80	F	11											15	
203	F	11								6	6	80		

**Annex Table 2 (cont). Summary of children's consumption rates (kg/y) and occupancy times (h/y) in the Dumfries and Galloway coast survey area**

Observation number	Sex	Age in years	Fish	Crustaceans	Molluscs	Wildfowl	Cattle meat	Sheep meat	Handling fishing gear	Handling sediment	External occupancy over mud	External occupancy over rock	External occupancy over sand	External occupancy over sand and stone
<b>Fifteen year old age group</b>														
43	F	12		2.9	0.3									
159	F	12		8.4										
179	F	12	0.1											
274	F	12										9		
311	M	12	8.7											
337	F	12		21.6										
92	M	13											72	
268	M	14										312		
91	F	15											72	
401	M	15		1.4	0.4				60	69	129			
157	M	16		13.5	0.9				1200	10				10

