

Cefas contract report C2848

Summary of Radiological Habits Surveys in England and Wales, 2002 to 2012

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Summary of Radiological Habits Surveys in England and Wales, 2002 to 2012

G.P. Papworth and C.J. Garrod

Peer reviewed by F.J. Clyne

Approved for publication by W.C. Camplin

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The public may be exposed to radiation as a result of the operations of nuclear licensed sites, such as nuclear power stations, either through the permitted discharges of liquid or gaseous radioactive wastes into the local environment, or from radiation emanating directly from the sites. Radiological habits surveys are investigations of the 'habits' of people that may influence their exposure to this radiation and include, for example, the consumption of locally produced foods and occupancy within the immediate vicinity of a site. These habits data, together with concentrations of radioactivity in food and the environment and dose coefficients, can be used to estimate public exposure to radiation. Site specific habits surveys can also be used to direct monitoring programmes by identifying appropriate samples and measurements to be taken.

In England and Wales, the Environment Agency, the Food Standards Agency and the Office for Nuclear Regulation are responsible for monitoring nuclear sites and protecting the public from the potential effects of radiation arising from their activities. Between 2002 and 2012 the Centre for Environment Fisheries and Aquaculture Science (Cefas) undertook a series of habits surveys around nuclear sites on behalf of, and under a collaborative agreement between these three bodies or their forerunner organisations, in order to support their respective roles in protecting the public from the effects of radiation.

A separate report was produced for each habits survey and these are available on the Cefas website (www.cefas.defra.gov.uk). Full details of the survey methods and data analysis are given in these reports.

For each habits survey, areas were defined in order to cover each of the three main possible sources of exposure. These were, an aquatic area relating to liquid discharges, a terrestrial area relating to deposition from gaseous discharges, and a direct radiation area relating to ionising radiation emanating directly from the site. The direct radiation survey areas were also applicable to direct exposure arising from gaseous releases. The aquatic survey areas were based on hydrographic information and varied for each site. The terrestrial survey areas were 5 km from the site centre for all sites and the direct radiation survey area was generally 1 km from the nuclear licensed site boundary.

The potential exposure pathways that were investigated during the habits surveys included the consumption of foods from the aquatic and terrestrial survey areas; occupancy over intertidal substrates; handling of fishing gear and sediment; occupancy within the direct radiation survey area; occupancy in and on water. Any new or unusual pathways were also investigated. In the habits survey reports data were presented separately for adults, children, infants and women of childbearing age. High rates of consumption, intertidal occupancy and handling were identified using established methods. These rates can be used in dose assessments. Additionally, profiles of integrated habits data were presented specifically for use in total dose assessments.

This report provides a summary of the main findings of the surveys conducted to date under the collaborative agreement. A total of 33 habits surveys were completed at 21 different licensed nuclear sites, which are shown in Figure 1. A list of the sites, grouped by sector of the nuclear industry, and the years in which the surveys were undertaken at each site, are presented in Table 1.

Data presented in this summary report

This report is divided into sections based on the various sectors within the nuclear industry.

A brief description of the operations at each site is presented together with an overview of the aquatic, terrestrial and direct radiation survey areas.

The main results for each survey are presented in graphical form. Graphs are presented showing, where applicable:

- The mean consumption rates for the high-rate groups for aquatic foods.
- The mean rates for the high-rate groups for intertidal occupancy and handling of fishing gear and sediments.
- The mean consumption rates for the high-rate groups for terrestrial foods.
- The maximum indoor, outdoor and total occupancy rates in the direct radiation survey area in three zones measured from the boundary of the licensed site: 0 - 0.25 km; >0.25 - 0.5 km; >0.5 - 1 km.

The high-rate groups were determined using the 'cut-off' method described by Hunt *et.al.* (1982), with a cut-off value of one third the maximum rate. Hence, the mean for the high-rate group was calculated by taking the arithmetic mean of the values between the maximum observed rate and one third of the maximum observed rate.

The results presented are primarily for adults only (but see the notes to accompany the graphs, below). Where more than one survey has been undertaken at a site the results are shown on the same graph so that the rates can be compared between the surveys. Where unusual pathways were identified, such as the use of seaweed as a fertiliser, or occupancy in close proximity to sewage sludge, these are noted in the text but quantitative data are not presented. Occupancy in water and on water was recorded at most sites but these are considered minor pathways of exposure and the data are not presented.

Notes to accompany the graphs:

- Data for direct radiation includes results for all ages.
- Prior to 2007 data for intertidal occupancy and handling includes all ages. From 2007 onwards the data are for adults only.
- Prior to 2010 the adult age group included 17-year-olds and above. From 2010 onwards the adult age group included 16-year-olds and above.
- Freshwater fish from waters subject only to gaseous discharges are classified as a terrestrial food group, whereas freshwater fish from waters subject to liquid discharges are classified as an aquatic food group.

Total dose

During the period under review, methods were developed to estimate doses integrated across all pathways (*i.e.* total dose) using profiles of consumption and occupancy data (Camplin *et al.*, 2005). The estimates of total dose have been published in the Radioactivity in Food and the Environment (RIFE) series (for example, EA, FSA, NIEA and SEPA, 2012) and in the Summary of Radioactivity in Food and the Environment 2004-2008 report (EA, FSA, NIEA and SEPA, 2010).

Trends in total dose at each site for the period 2004 to 2011 are shown at the end of the sections for each sector of the nuclear industry. The factors influencing the trends are identified where possible.

Comparison of observed and generic consumption rates

In the habits survey reports the observed mean consumption rates for the high-rate groups for each food group are compared with mean consumption rates based on national statistics, which are referred to as generic rates. A summary of the observed rates versus the generic rates, for the food groups for which generic data is available, for each survey, is presented in Section 8. Particularly high observed consumption rates are also noted.

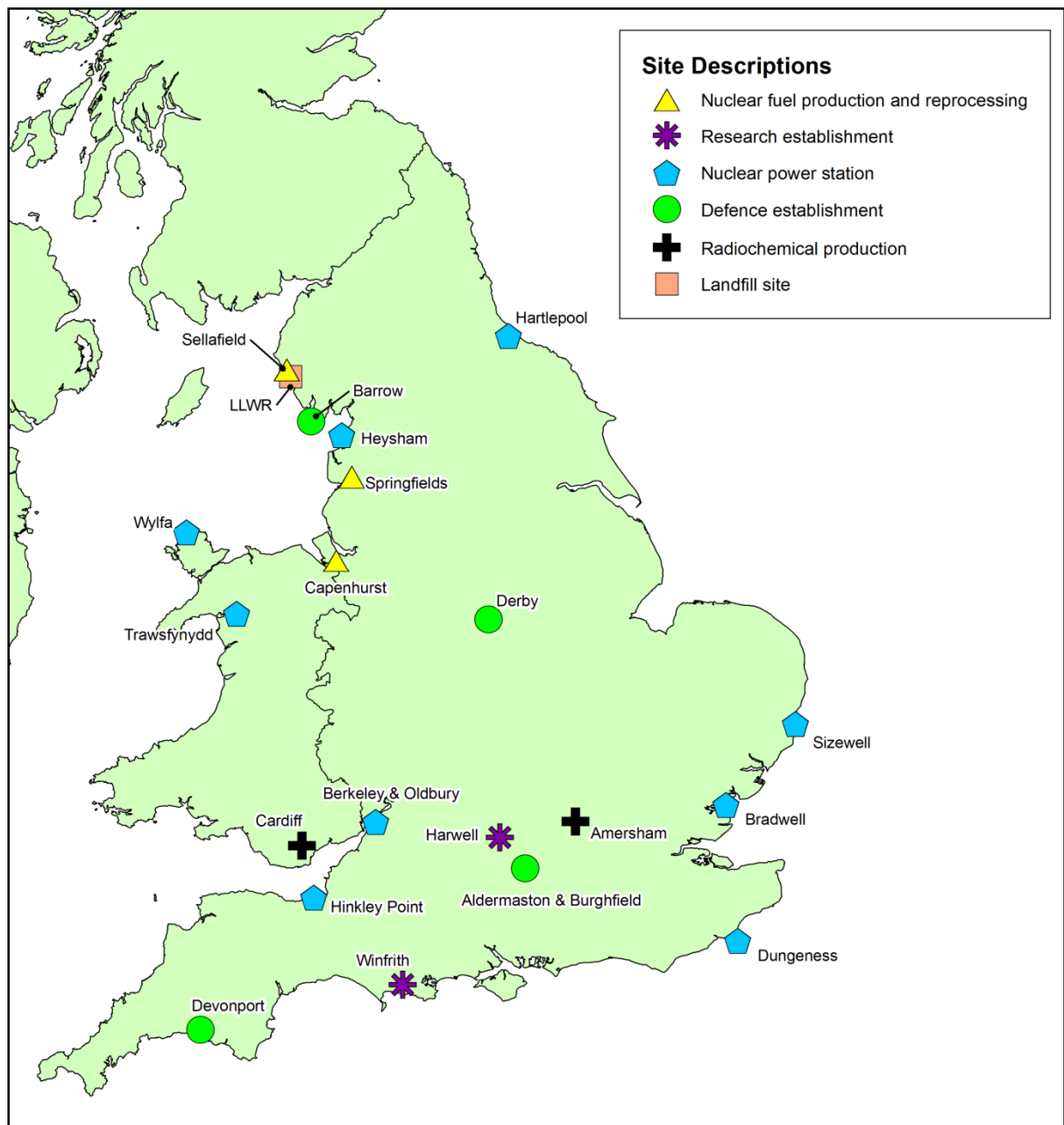


Figure 1. Nuclear licensed sites in England and Wales where habits surveys have been conducted

Table 1. Years in which habits surveys have been undertaken at nuclear licensed sites in England and Wales between 2002 and 2012

Site	Year of habits survey
<i>Nuclear fuel production and reprocessing</i>	
Capenhurst	2008
Sellafield	2003 and 2008 (annual reviews 2004, 2005, 2006, 2007, 2009, 2010, 2011 and 2012)
Springfields	2006 and 2012
<i>Research establishments</i>	
Harwell	2007
Winfrith	2003
<i>Nuclear power stations</i>	
Berkeley and Oldbury	2007
Bradwell	2007
Dungeness	2005 and 2010
Hartlepool	2002 and 2008
Heysham	2006 and 2011
Hinkley Point	2006 and 2010
Sizewell	2005 and 2010
Trawsfynydd	2005
Wylfa	2004 and 2009
<i>Defence establishments</i>	
Aldermaston and Burghfield	2002 and 2011
Barrow	2012
Devonport	2004 and 2011
Derby	2009
<i>Radiochemical production</i>	
Amersham	2004 and 2009
Cardiff	2003
<i>Landfill site</i>	
Low Level Waste Repository	2002 and 2012

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In the period between 2002 and 2012 habits surveys have been conducted at three sites in England involved with the production and reprocessing of nuclear fuel. These are located at:

Capenhurst in Cheshire
Sellafield in West Cumbria
Springfields near Preston

Capenhurst

At the time of the survey there were two adjacent nuclear licensed sites at Capenhurst. Urenco UK Ltd operated one site which produced enriched uranium for nuclear power stations. Sellafield Ltd operated the other site which was involved in the dismantling and decommissioning of redundant facilities, including a former uranium enrichment facility which ceased operations in 1982. These were considered as one site for the purpose of the habits survey.

Sellafield

The main operations at the Sellafield site are: fuel reprocessing at the Magnox Reprocessing Plant and the Thermal Oxide Reprocessing Plant (THORP); decommissioning and clean-up of redundant nuclear facilities; and waste treatment and storage. The Calder Hall Magnox nuclear power station ceased electricity production in March 2003, and at the time of the habits survey in 2003, it was being prepared for decommissioning. At the time of the habits survey in 2008, it was undergoing decommissioning. Located within the Sellafield site, the Windscale site was undergoing decommissioning at the time of both surveys.

Springfields

The main activities at the Springfields site are the production of uranium hexafluoride, the fabrication of oxide fuels for Advanced Gas-Cooled and Light Water reactors, as well as intermediate fuel products such as powders, granules and pellets. Other activities included the recovery of uranium from residues and decommissioning redundant plants. At the time of the 2006 habits survey, the site manufactured Magnox fuel. However, this ceased in 2008.

2.1 Capenhurst

One habits survey has been undertaken in the period between 2002 and 2012; this was in 2008. The main results from this survey are presented in Figure 2.

Aquatic survey area

The aquatic survey area covered the discharge ditch, from the Capenhurst site discharge outfall to its confluence with the Rivacre Brook; and the Rivacre Brook, downstream from this confluence to where it meets the Mersey Estuary. The drainage ditch and the brook were narrow and shallow and no commercial fishing or angling was identified. The only activity identified for adults in the aquatic survey area was walking over sand and stones in the Rivacre Brook. Additionally, children were identified playing in the brook. The consumption of aquatic foods was not identified.

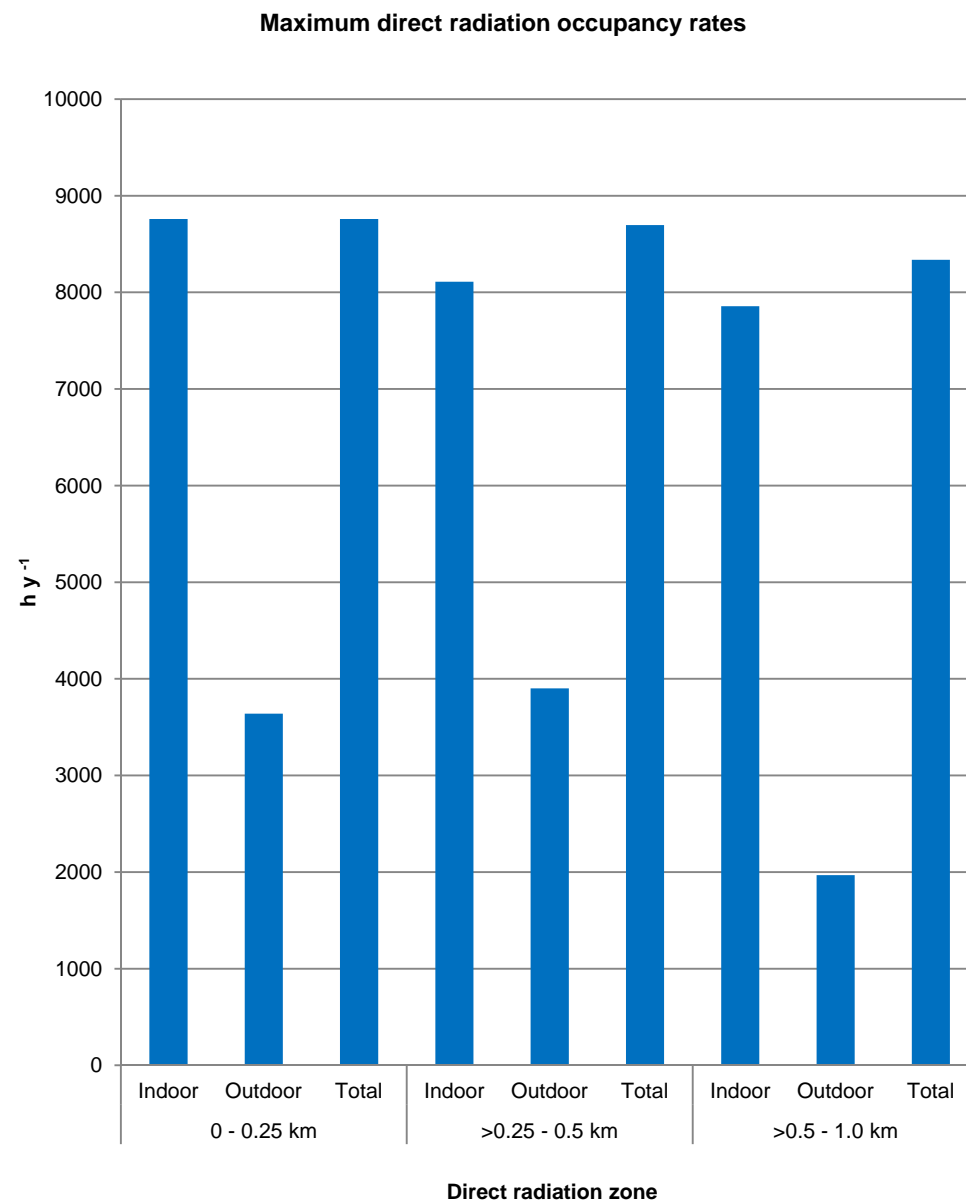
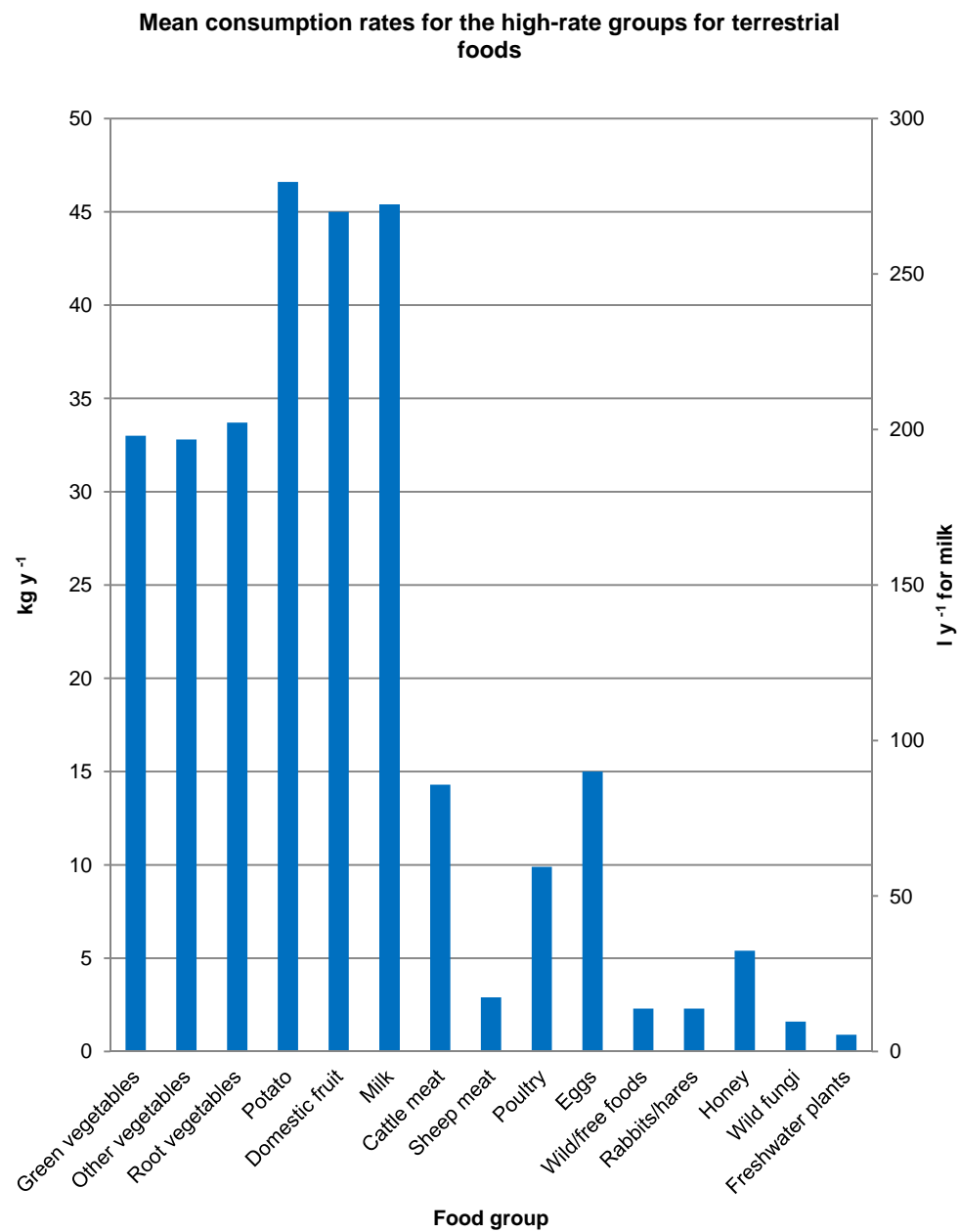
Terrestrial survey area

The land in the terrestrial survey area was a mix of agricultural and urban areas. Twenty-eight farms were identified in the area, over half of which produced milk (from dairy cattle). Farmers and their families were consuming beef, lamb, milk, chickens and chicken eggs produced commercially on their farms. One smallholding was identified in the survey area producing organic beef cattle, duck eggs and chicken eggs. The smallholder's family and friends consumed beef, duck eggs, chicken eggs, chickens and turkeys. One market garden was identified where watercress and a wide variety of vegetables were produced. Seven allotment sites were identified where a wide variety of fruit and vegetables were grown. Four beekeepers were identified who kept hives in the survey area.

Direct radiation survey area

The direct radiation survey area covered the area within 1 km from a continuous external nuclear licensed site boundary around the two sites at Capenhurst. Residential areas included the village of Capenhurst, the hamlet of Ledsham and part of the Sutton Green housing estate. Many businesses and farms were located within the direct radiation survey area. The highest outdoor occupancy rate was for a farmer in the >0.25 – 0.5 km zone who lived and worked in the area. The highest indoor and total occupancy rates were for residents in the 0 – 0.25 km zone.

Figure 2. Consumption and occupancy rates from the 2008 Capenhurst habits survey



2.2 Sellafield

Two full habits surveys have been undertaken in the vicinity of the Sellafield site in the period between 2002 and 2012; these were in 2003 and 2008. The main results from these habits surveys are summarised in Figure 3. Additionally, annual reviews of shellfish consumption and intertidal occupancy have been undertaken each year, except in 2003 and 2008.

Aquatic survey area

The aquatic survey area was the same for all of the Sellafield surveys. It covered the intertidal areas between Parton and Tarn Bay, and extended 11 km offshore. The lower reaches of the rivers Ehen and Calder, and the Ravenglass Estuary including the lower reaches of the rivers Irt, Mite and Esk were also investigated. The main target species for commercial fishing were *Nephrops*, common lobster and brown crab. A new mussel fishery was identified, that commenced in 2007. There was a significant decrease in the mean consumption rate for the high-rate groups for crustaceans in 2008 compared to 2003. There was a decrease in the occupancy over mud and sand in 2008, which was attributed to two commercial shellfish collectors who were identified in 2003 but who had ceased collecting shellfish in 2008. The occupancy over salt marsh also decreased in 2008 because an individual spending 400 h y⁻¹ over salt marsh in 2003 spent time over different substrates in 2008. In 2008, the handling rates of commercial fishing gear increased due to a greater number of trawling vessels operating in the area closer to their home port of Whitehaven as a result of increases in fuel prices. Four people were identified using seaweed as a fertiliser in the 2003 survey, compared to one person in the 2008 survey.

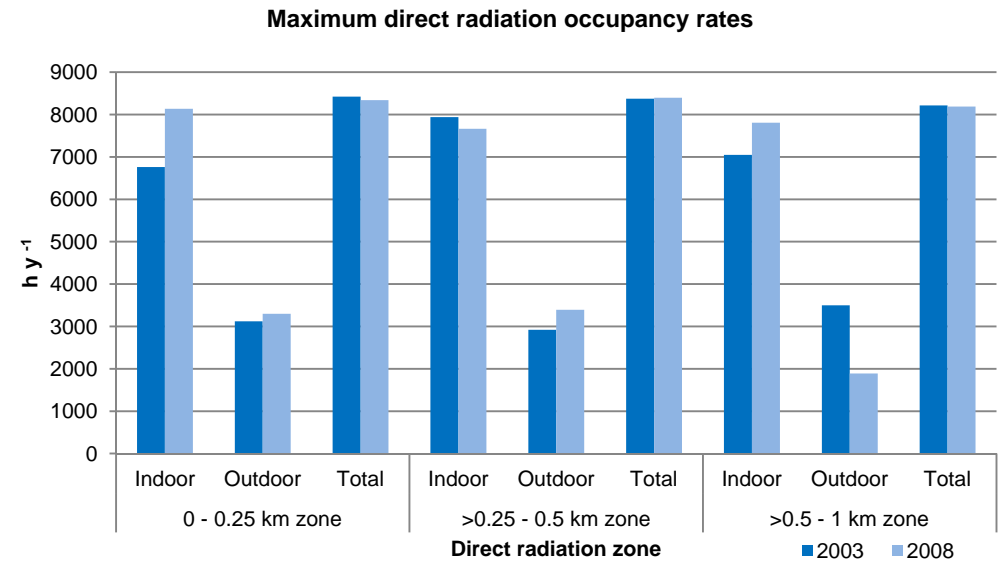
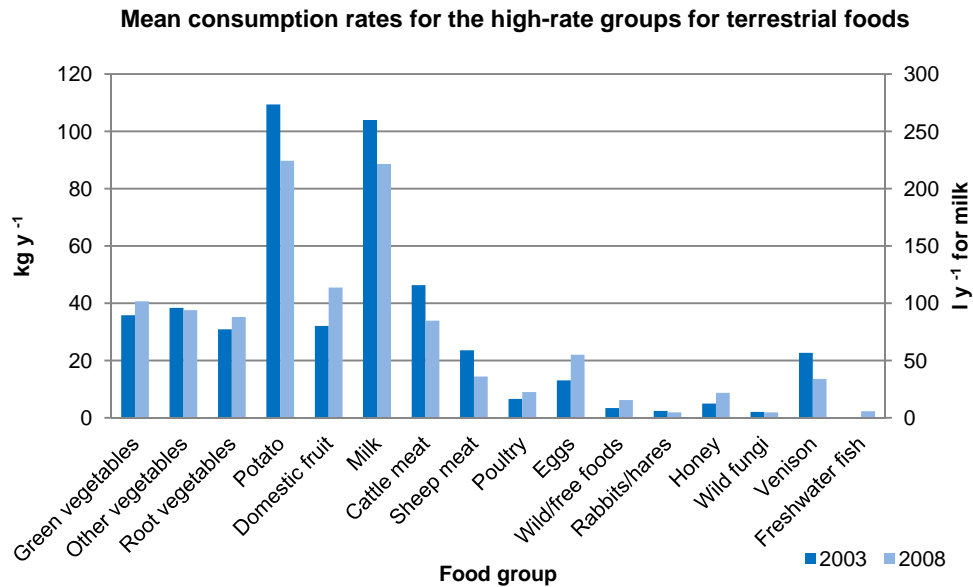
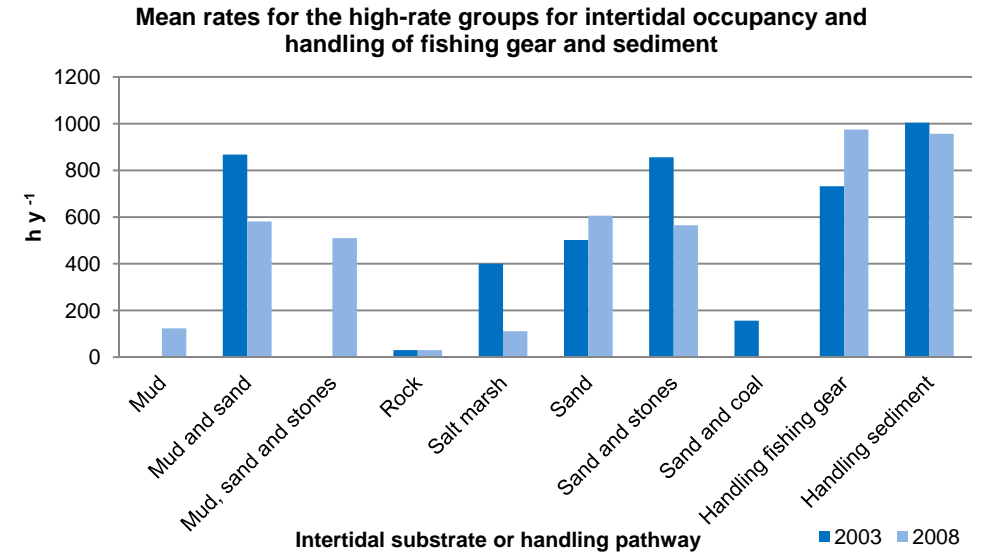
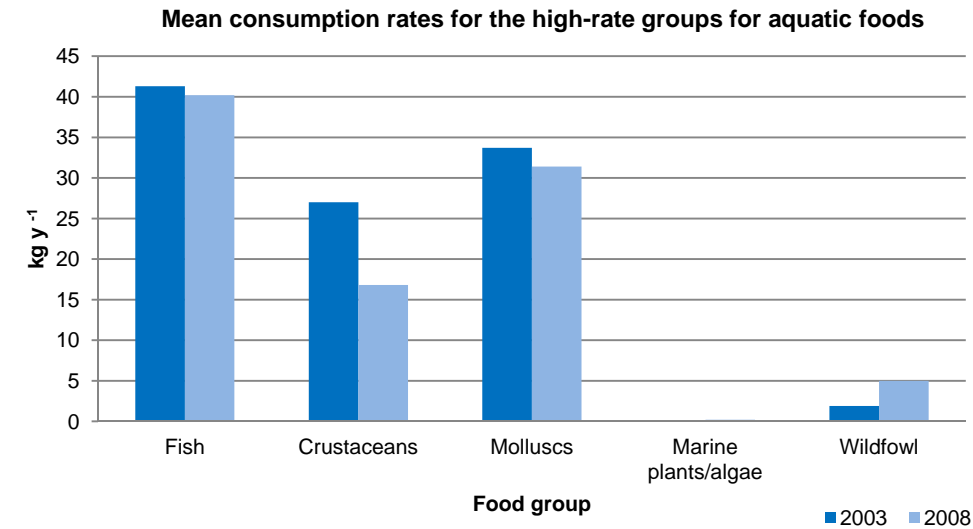
Terrestrial survey area

The land within the terrestrial survey area was predominantly agricultural; farms were mainly producing beef cattle, milk (from dairy cattle) and lambs. The main change noted in 2008, compared to 2003, was that several farms were no longer producing milk but were producing beef cattle and lambs instead. No allotment sites were identified in the terrestrial survey area, although residents were interviewed that grew a variety of fruit and vegetables in their gardens. Significant decreases in the mean consumption rate for the high-rate group for cattle meat, sheep meat and venison were identified in 2008.

Direct radiation survey area

The land within the survey area was predominantly agricultural with a small number of residences. The residences, commercial activities and leisure activities identified in 2003 and 2008 were broadly similar. The highest outdoor occupancy and total occupancy rates in 2003 and 2008 were for a farmer. The highest indoor occupancy rates in 2003 and 2008 were for residents.

Figure 3. Consumption, occupancy and handling rates from the 2003 and 2008 Sellafield habits surveys



2.3 Springfields

Two habits surveys have been undertaken in the vicinity of the Springfields site in the period between 2002 and 2012; these were in 2006 and 2012. The main results from these habits surveys are summarised in Figure 4.

Aquatic survey area

The aquatic survey area in 2006 and 2012 was defined as the tidal waters and intertidal area of the Ribble Estuary and its tributaries east of a line extending from Fairhaven on the north bank to Marshside Sands on the south bank. The eastern extent of the survey area was at the A6 road bridge at Frenchwood which was the approximate tidal limit. A small amount of commercial fishing for brown shrimps, white fish and salmon occurred at the western end of the survey area. The cockle fishery on the sand flats of the estuary was closed in 2006 and was only open for about 45 days in 2012. The significant decreases in the mean consumption rates for the high-rate groups for fish and for crustaceans in 2012 were attributed to a reduction in fishing in the winter months by the high-rate consumers identified in 2006. The occupancy over sand decreased significantly in 2012 due to the closure of a sand extraction works since 2006. In 2006, occupancy on board one houseboat was identified and in 2012 two additional houseboats were identified.

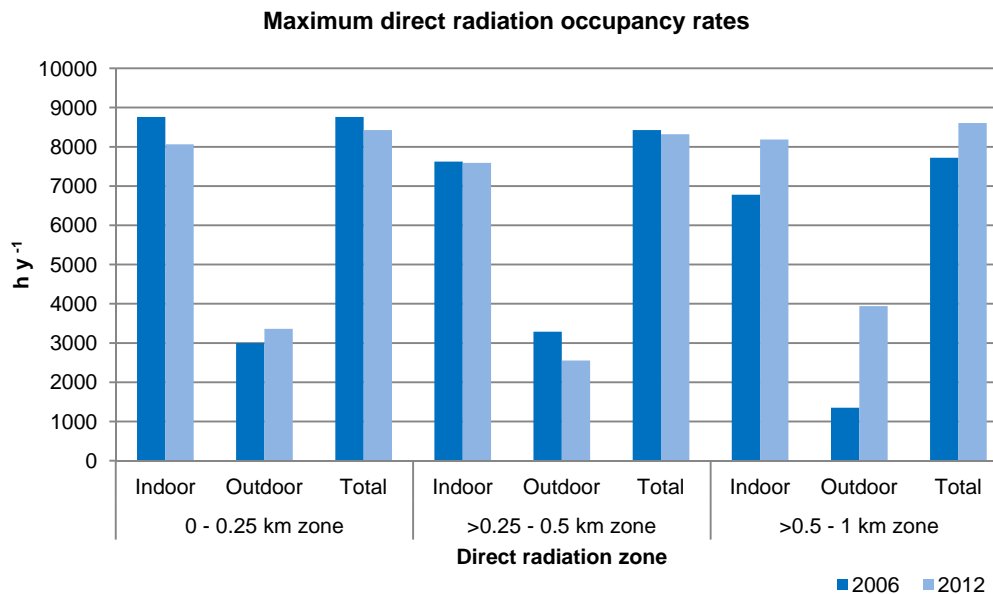
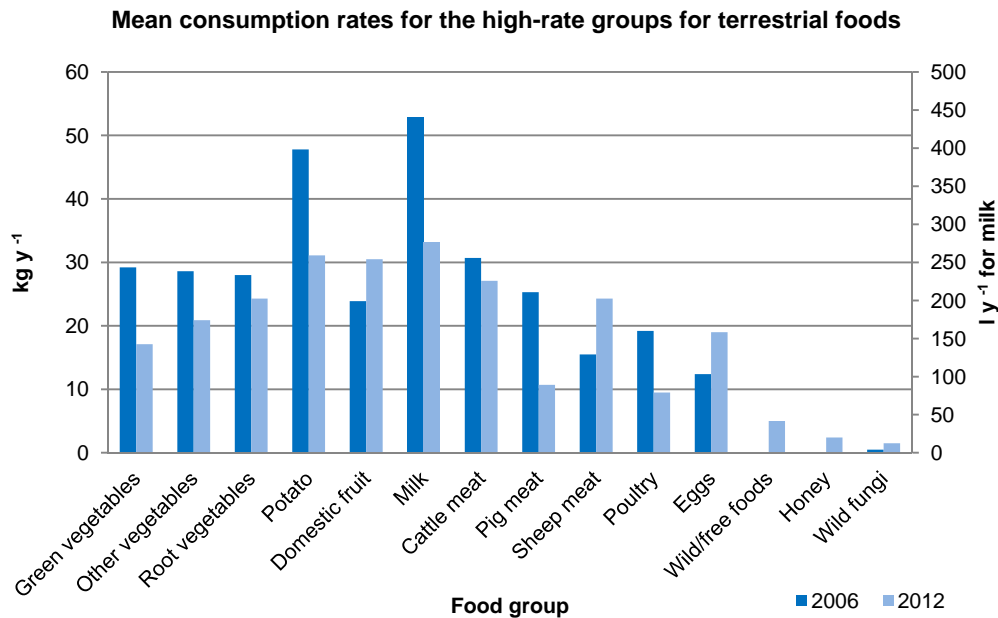
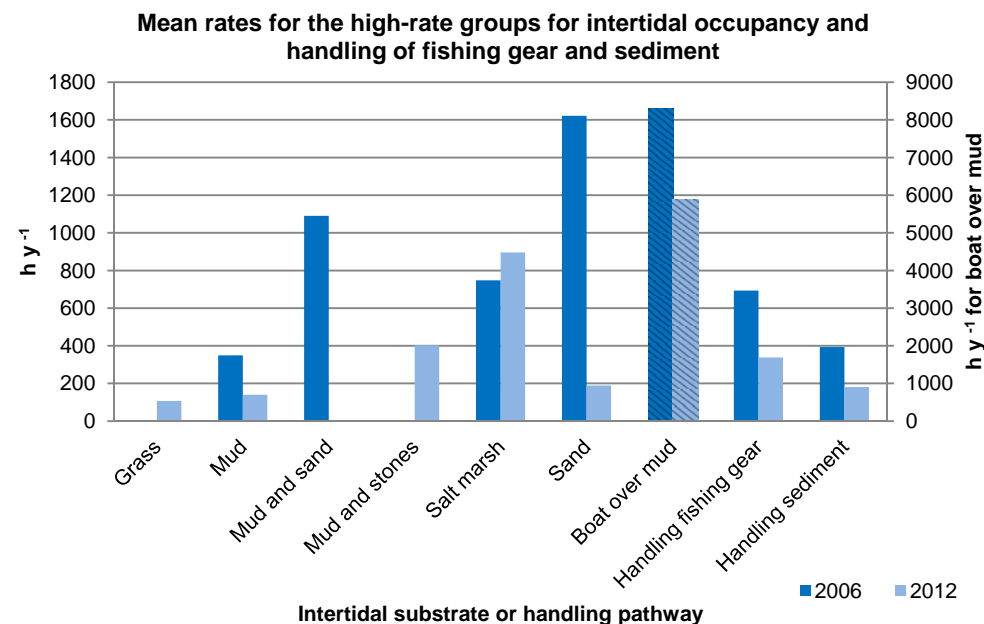
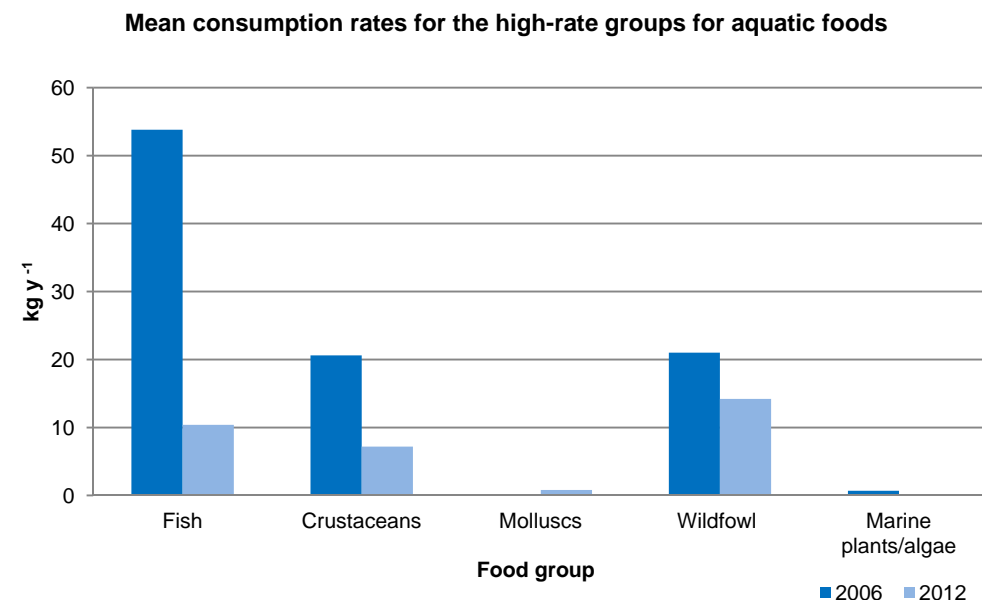
Terrestrial survey area

The land in the terrestrial survey area was a mix of agricultural and urban areas. In 2006 and 2012 the farms mainly produced a mix of milk (from dairy cattle), beef cattle and lambs. Pigs, chickens (for eggs and meat), turkeys and arable crops were also produced. In both surveys, four large allotment sites were identified. The most significant increases in the mean consumption rates for the high-rate groups in 2012 were for sheep meat and eggs, and the most significant decreases in the mean consumption rates for the adult high-rate groups were for potatoes, milk, pig meat and poultry. The decrease in the consumption of pig meat was attributed to high-rate consumers who were interviewed in 2006 but were no longer living in the area in 2012.

Direct radiation survey area

The main residential areas in the survey area were the villages of Lea Town to the south-east and Clifton to the south of the site. The activities identified in the direct radiation survey area in 2006 and 2012 were similar and included people residing, working, farming, attending an allotment plot, attending school and visiting. The highest occupancy rates in 2006 and 2012 were for a mix of residents and farmers.

Figure 4. Consumption, occupancy and handling rates from the 2006 and 2012 Springfields habits surveys



2.4 Total doses for the nuclear fuel production and reprocessing sites

The estimated annual total doses for Capenhurst, Sellafield and Springfields from 2004 to 2011 are presented in Figure 5. The data and information on total dose are taken from the RIFE report series (for example, EA, FSA, NIEA and SEPA, 2012) and from the Summary of Radioactivity in Food and the Environment report (EA, FSA, NIEA and SEPA, 2010).

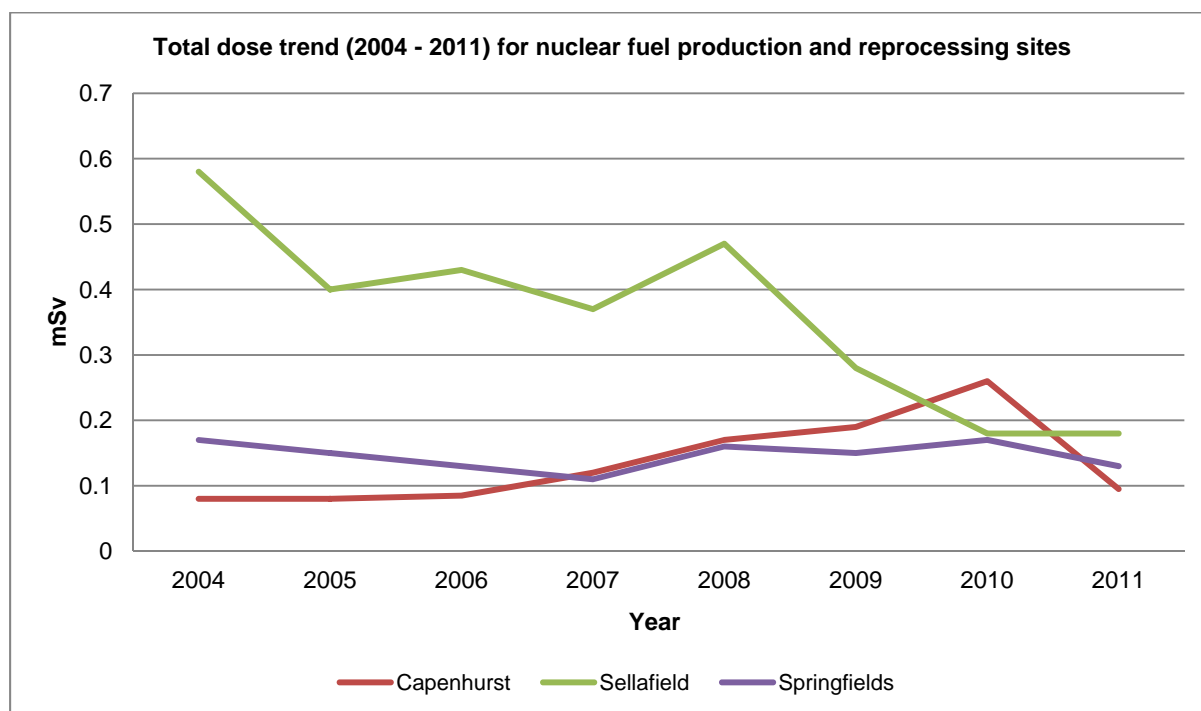


Figure 5. Total radiation exposures around the nuclear fuel production and reprocessing sites due to radioactive waste discharges and direct radiation (2004 – 2011)

For Capenhurst, the total doses from 2004 to 2011 use the 2008 habits survey data. The most exposed group throughout this period were identified as local inhabitants living near to the site. The decrease in the total dose in 2011 was due to a lower estimate of direct radiation from the site.

The total doses for Sellafield are predominantly driven by the consumers of seafood. There has been a downwards trend in the total dose since 2004 due to a combination of factors, such as, a decrease in the consumption rates of molluscs, changes in the proportions of the individual species consumed, and a general reduction in concentrations in seafood of both naturally-occurring and artificial radionuclides from the non-nuclear and nuclear industries respectively.

For Springfields, the total doses from 2004 to 2011 use the 2006 habits survey data. The most exposed group throughout this period were adult houseboat dwellers at the Beconsall boatyard. The changes in the total dose trend for Springfields were primarily due to variations in gamma dose rates over sediment.

3 RESEARCH ESTABLISHMENTS

Habits surveys have been conducted at two research establishments in England in the period between 2002 and 2012. These are located at:

Harwell in Oxfordshire

Winfrith in Dorset

Harwell

The nuclear site forms part of the Harwell Science and Innovation Campus. The site opened in 1946 and was once the headquarters of the UK civil nuclear research programme, providing a range of reactors and other research facilities. In the early 1990s, the last research reactors were shut down and at the time of the habits survey the site was being decommissioned and restored. Some areas of land that were previously part of the licensed site have been delicensed.

Winfrith

The nuclear site at Winfrith opened in 1957 as a reactor research and development facility. The last operational reactor closed in 1995 and the site has been undergoing decommissioning since then. Some areas of land that were previously part of the licensed site have been delicensed.

3.1 Harwell

One habits survey has been undertaken in the period between 2002 and 2012; which was in 2007. The main results from this habits survey are summarised in Figure 6.

Aquatic survey area

The aquatic survey area extended from Sutton Courtenay downstream along the River Thames to Day's Lock, a distance of approximately 10 km. Foods consumed from the aquatic survey area were freshwater fish and crustaceans. The only foods consumed by the respective high-rate groups for these food groups were perch and signal crayfish. One hobby fisherman was identified who was fishing for crayfish using traps. No sediment handling was identified during the survey. Occupancy for workers at the Didcot Sewage Treatment Works was investigated because at the time of the survey, one of the tenants at the Harwell site had applied for authorisation to release liquid discharges to the water utility company's foul sewer. Other tenants were also expected to apply for similar authorisations. Occupancy in close proximity to sewage and sewage products was identified.

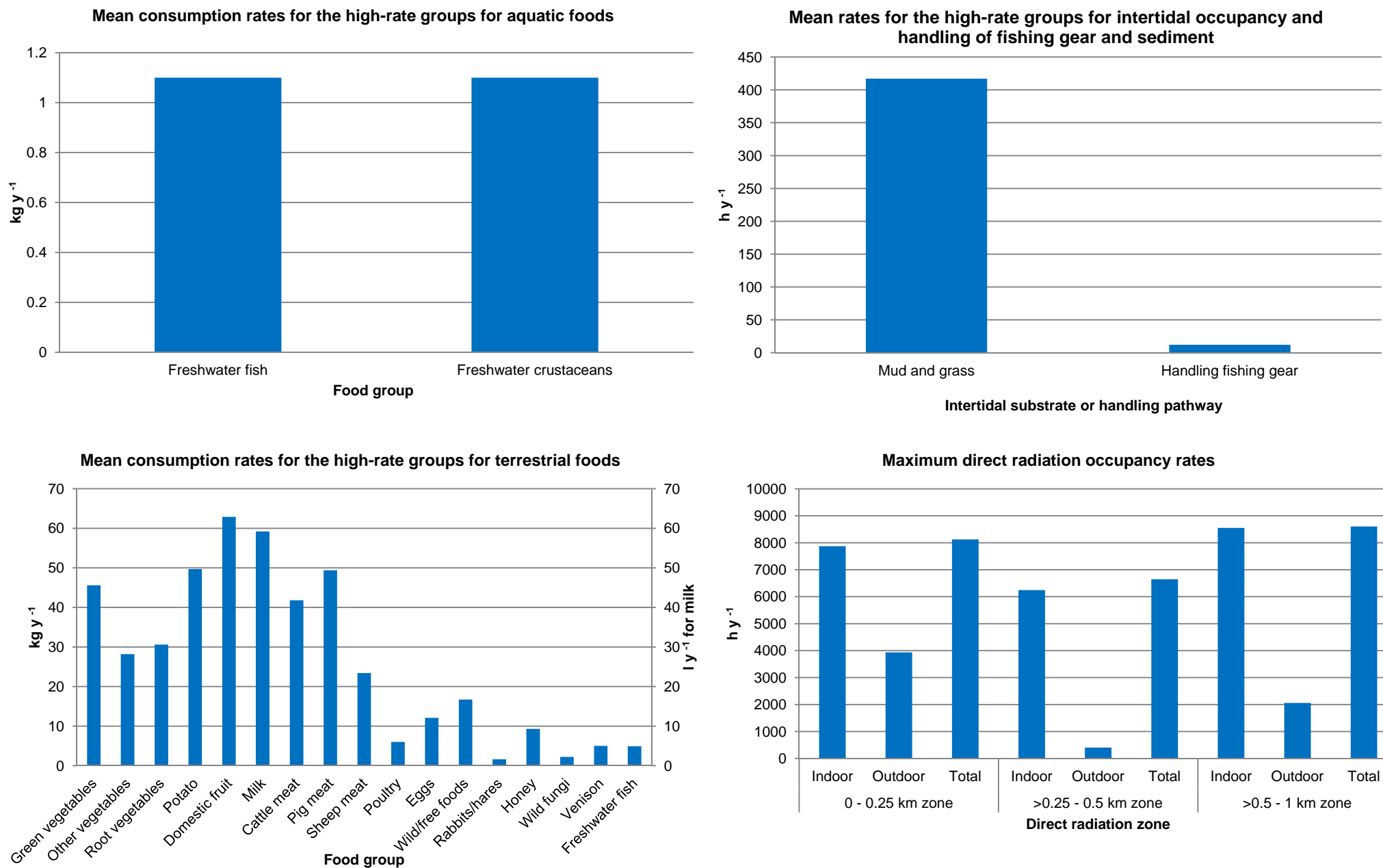
Terrestrial survey area

Land in the terrestrial survey area was predominantly agricultural, with numerous villages and watercourses. Food production was identified at 19 farms in the area (producing beef cattle, pigs, lamb, milk (from dairy cattle), chickens eggs, fruit and arable crops), five allotment sites and several private gardens. Honey was produced from the hives of five beekeepers. Freshwater fish were being caught at several locations within the terrestrial survey area. Rainbow trout from a trout farm and from a stocked sport fishery were being consumed and wild brown trout caught from streams were being consumed. Two vineyards were identified where wine was produced, which was sold locally. Flour milled from cereal grown on a farm in the area was also for sale. Human consumption of well water and borehole water was identified at approximately 260 residential and business properties.

Direct radiation survey area

At the time of the survey, the Harwell Science and Innovation Campus was being developed and regenerated as a major business and science centre. There were several small residential areas within, or close to, the campus. Outside the campus the area was predominantly farmland. In all three zones in the direct radiation survey area, the highest indoor, outdoor and total occupancy rates were for residents, some of whom worked at home.

Figure 6. Consumption, occupancy and handling rates from the 2007 Harwell habits survey



3.2 Winfrith

One habits survey has been undertaken in the period between 2002 and 2012; which was in 2003. The main results from this habits survey are summarised in Figure 7.

Aquatic survey area

The aquatic survey area covered all intertidal areas between Portland Bill and St Alban's Head. There were approximately 30 commercial fishing boats (<10 metres) operating within the survey area, which were mainly potting for brown crabs, spider crabs, common lobsters and common prawns. Commercial diving for scallops was carried out offshore at Lulworth Banks and Shambles Bank and an inshore scallop bed was being left to regenerate at the time of the survey. Portland Bill was a popular location for divers and anglers. There was an oyster farm in the estuary of the Fleet Lagoon where approximately one million oysters were reared annually. These were mostly Pacific oysters. A mussel fishery was identified in Pool Harbour.

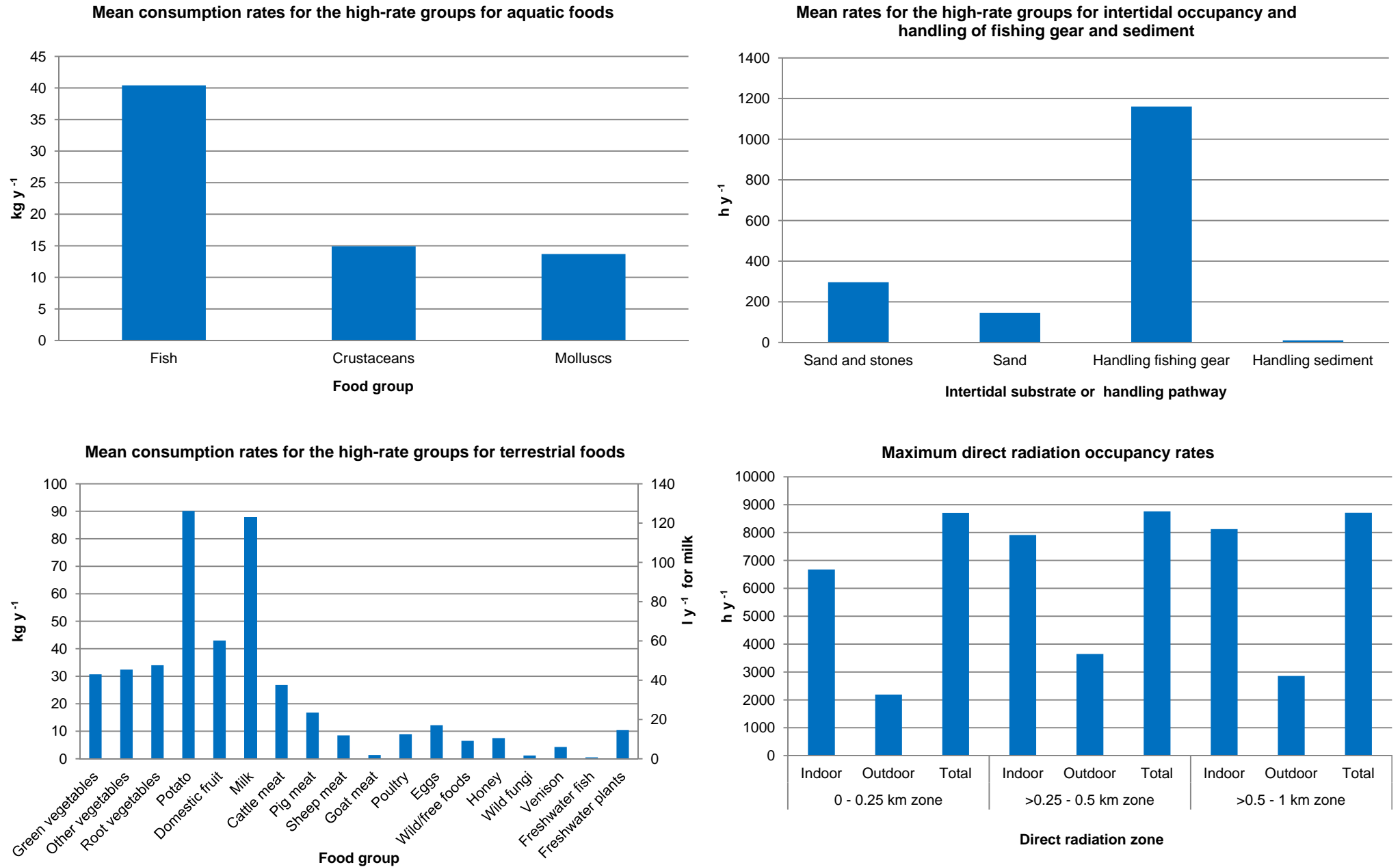
Terrestrial survey area

The terrestrial survey area included a number of small villages. Most of the land was agricultural and the farms mainly produced a mix of milk (from dairy cattle and sheep), beef cattle, lamb, pig, chicken eggs, arable and salad crops. A fish farm was identified where rainbow trout were reared. There were two allotment sites within the survey area, with a combined total of approximately 35 allotment plot holders. Fruit and vegetables were grown commercially at a smallholding. Two families kept goats for milk and secondary products including cheese, yoghurt and ice cream. There were five shooting clubs in the area, whose members shot pheasants, duck, geese, partridge and deer, mainly for consumption by themselves and their families.

Direct radiation survey area

The direct radiation survey area included two hamlets, East Burton and East Knighton, and six working farms. The majority of observations were for people who worked at the Winfrith Technology Centre and Dorset Police Headquarters, although the highest total occupancy rates were for residents and farmers.

Figure 7. Consumption, occupancy and handling rates from the 2003 Winfrith habits survey



3.3 Total doses for the research establishment sites

The estimated annual total doses for Harwell from 2004 to 2011 are presented in Figure 8. The data and information on total dose are taken from the RIFE report series (for example, EA, FSA, NIEA and SEPA, 2012) and from the Summary of Radioactivity in Food and the Environment report (EA, FSA, NIEA and SEPA, 2010).

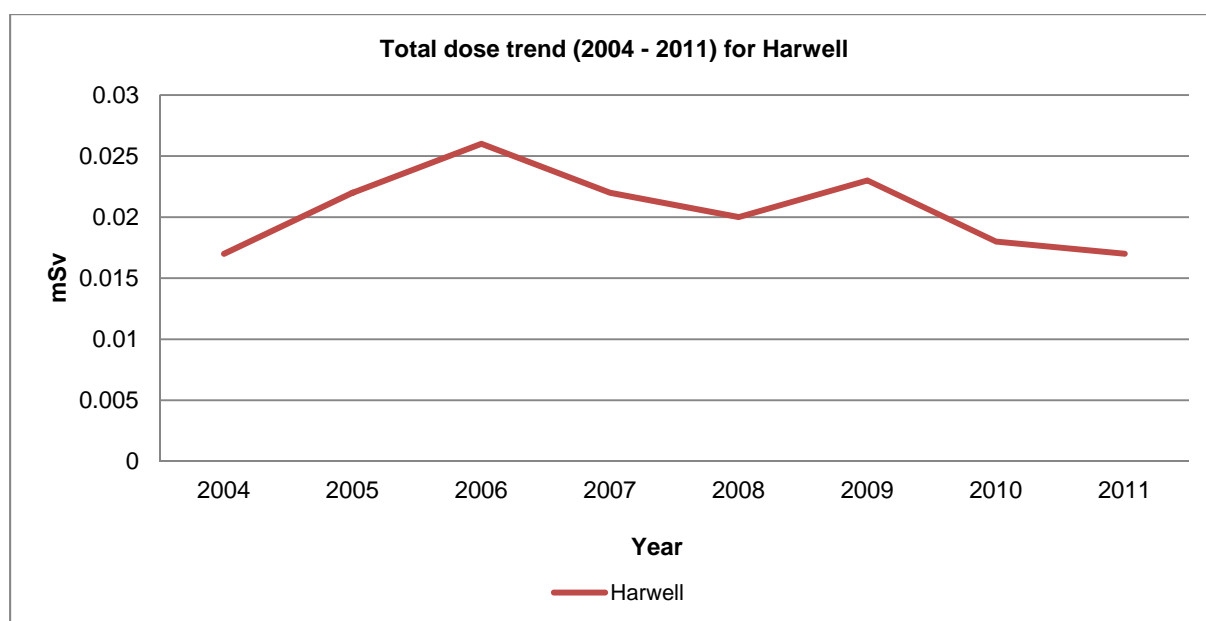


Figure 8. Total radiation exposures for Harwell due to radioactive waste discharges and direct radiation (2004 – 2011)

For Harwell, the total doses from 2004 to 2011 use the 2007 habits survey data. The dominant contribution to the total dose at Harwell throughout this period was direct radiation and the most exposed people were the prenatal children of local inhabitants. The total doses remained broadly similar from year to year, and were very low, less than 2 per cent of the dose limit.

For Winfrith, the total doses from 2004 to 2011 use the 2003 habits survey data. The total doses remained broadly similar from year to year, and were very low, less than 0.5 per cent of the dose limit. Any data below 0.005 mSv is recorded as <0.005, and therefore any trends cannot be displayed graphically.

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Habits surveys have been conducted at nine nuclear power station sites in England and Wales in the period between 2002 and 2012. These are located at:

Berkeley and Oldbury, in Gloucestershire and South Gloucestershire respectively

Bradwell in Essex

Dungeness in Kent

Hartlepool in County Durham

Heysham in Lancashire

Hinkley Point in Somerset

Sizewell in Suffolk

Trawsfynydd in Snowdonia

Wylfa in Anglesey

Berkeley and Oldbury

Berkeley has twin Magnox reactors, one of which ceased electricity production in 1988 and the second in 1989. It was the first commercial power station in the UK to be decommissioned. At the time of the habits survey the decommissioning was well underway. Oldbury was generating electricity from twin Magnox reactors at the time of the habits survey but it has since ceased electricity generation.

Bradwell

The nuclear power station at Bradwell has twin Magnox reactors which ceased generating electricity in 2002 after 40 years in operation. At the time of the habits survey, defuelling had been completed and the station was undergoing decommissioning.

Dungeness

At Dungeness there are two separate nuclear power stations, Dungeness A and Dungeness B. Dungeness A has two Magnox reactors and it was generating electricity at the time of the habits survey in 2005. The station ceased electricity production in 2006 and at the time of the habits survey in 2010 it was undergoing decommissioning. Dungeness B has two Advanced Gas-Cooled Reactors and is expected to cease power generation in 2018 (edfenergy.com).

Hartlepool

The nuclear power station at Hartlepool has twin Advanced Gas-Cooled Reactors and began generating electricity in 1983. The power station is expected to generate electricity until 2019 (edfenergy.com).

Heysham

There are two separate nuclear power stations; Heysham 1 and Heysham 2. Each station has two Advanced Gas-Cooled Reactors. Heysham 1 began operation in 1983 and is expected to continue generating until 2019 (edfenergy.com). Heysham 2 began operation in 1988 and is expected to continue to generate electricity until 2023 (edfenergy.com).

Hinkley Point

There are two separate nuclear power stations at Hinkley Point; the A station and the B station. Hinkley Point A has two Magnox reactors and ceased generating electricity in 2000. This station completed defueling in 2004 and at the time of both habits surveys was undergoing decommissioning. Hinkley Point B has two Advanced Gas-Cooled Reactors and is estimated that it will cease to generate electricity in 2023 (edfenergy.com).

Sizewell

There are two separate nuclear power stations at Sizewell; the A station and the B station. Sizewell A has two Magnox reactors which ceased generating electricity in 2006. Sizewell B has the only Pressurised Water Reactor in the UK and is expected to continue generating electricity until 2035 (edfenergy.com).

Trawsfynydd

Trawsfynydd has twin Magnox reactors which ceased generating electricity in 1991. The reactors were defuelled by 1995 and at the time of the habits survey the site was undergoing decommissioning.

Wylfa

At the time of the habits surveys the station was generating electricity from twin Magnox reactors. Reactor 2 ceased generating electricity on 25 April 2012 and reactor 1 is expected to generate electricity until 2014 (nda.gov.uk).

4.1 Berkeley and Oldbury

One habits survey has been undertaken in the period between 2002 and 2012; which was in 2007. The main results from this survey are summarised in Figure 9. Due to the close proximity of the Berkeley and Oldbury sites, the aquatic survey area was the same for both sites and the data from the terrestrial survey areas for both sites were presented together. Direct radiation pathways for Berkeley and Oldbury were considered separately.

Aquatic survey area

The aquatic survey area covered both shores of the River Severn, upriver as far as Broadoak and downriver as far as the Severn Bridge on the east bank and Portskewett on the west bank. The main fishing effort was for salmon, although in 2007, the fixed engines used by several salmon fishermen were damaged due to flooding in the River Severn and the catches were low. Elver fishing was popular in the survey area. One company was exporting live elvers to Holland and Scandinavia to restock rivers and fish farms. Shore angling and wildfowling were popular within the survey area, with one angling club and one wildfowling club identified. Two farmers and their families were consuming beef cattle that were grazing on salt marsh.

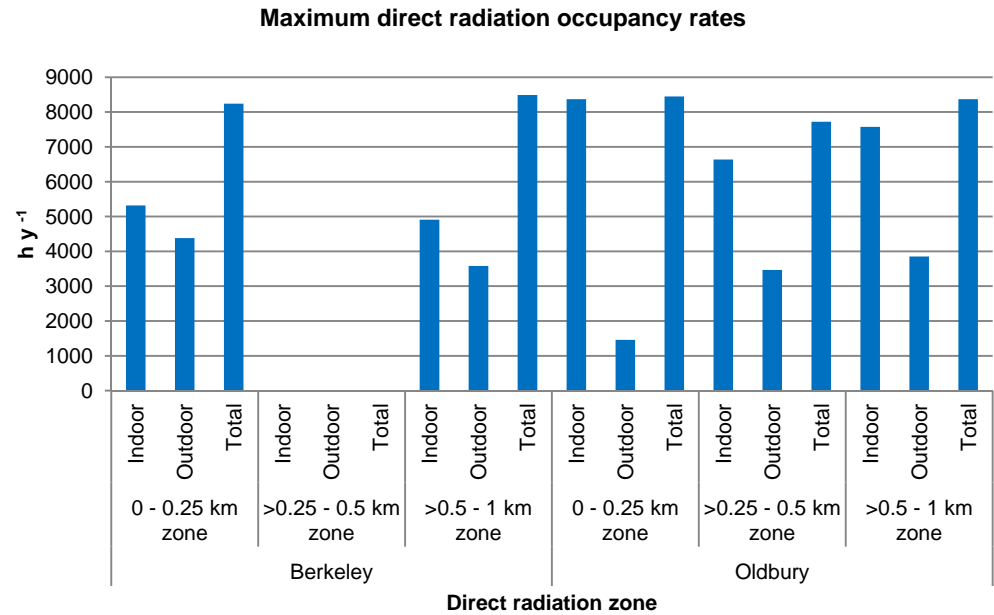
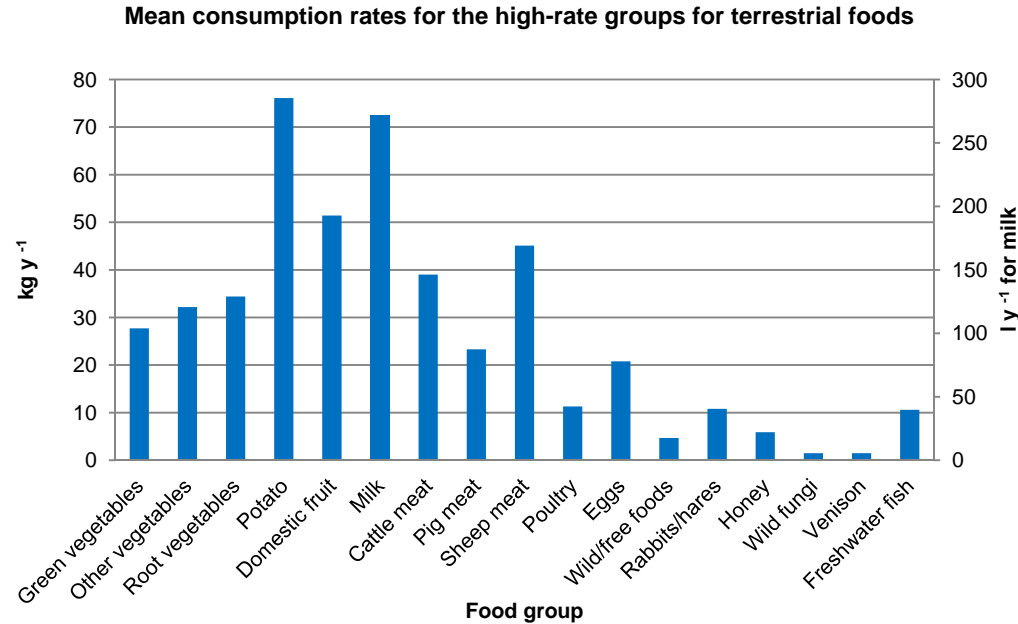
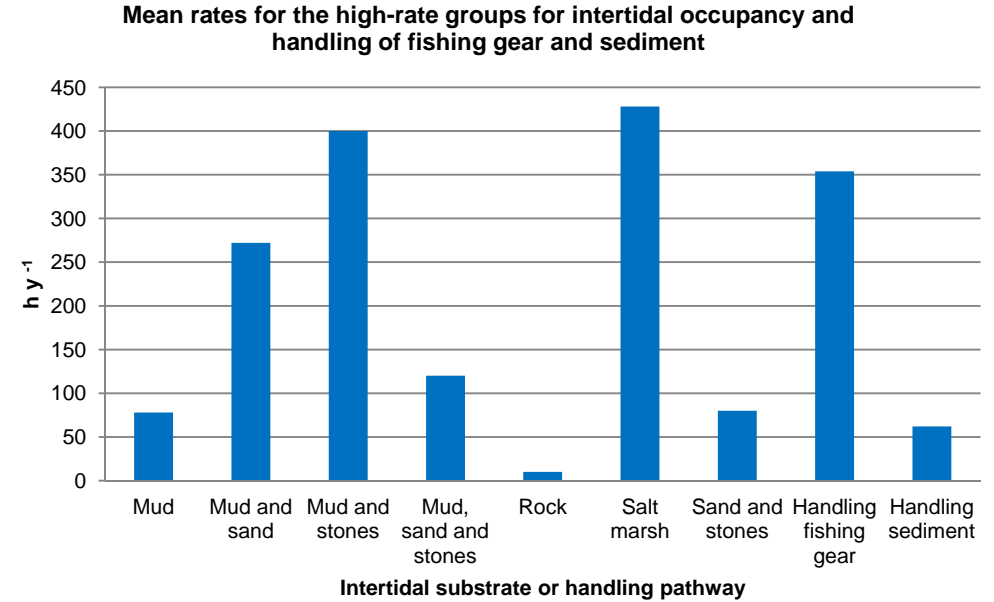
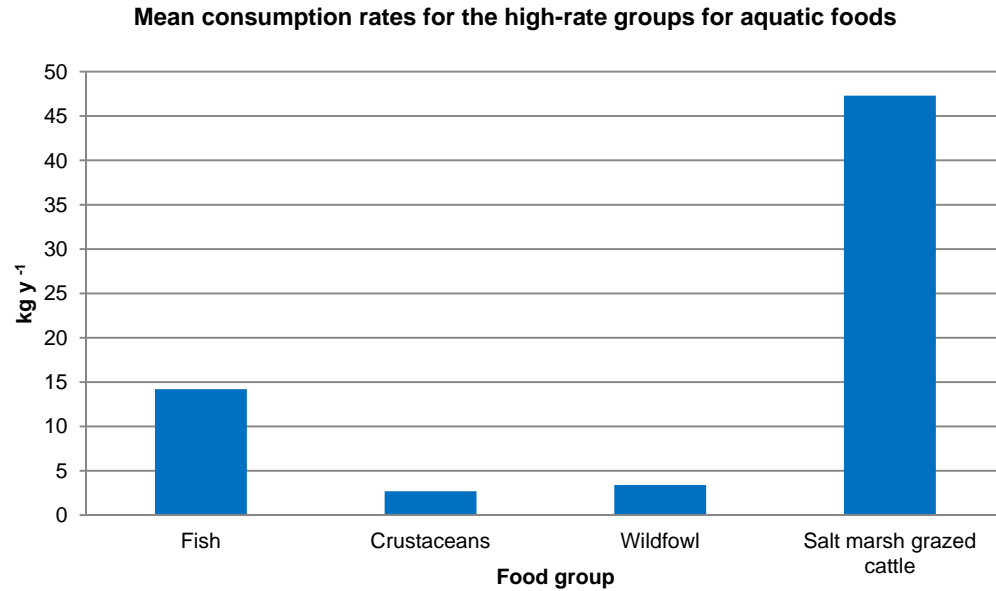
Terrestrial survey area

The land in the terrestrial survey area around Berkeley and Oldbury was predominantly agricultural, with numerous working farms. The farms produced beef cattle, milk (from dairy cattle), sheep, deer, chickens eggs and arable crops. Three allotment sites were located in the area, where a wide range of fruit and vegetables were grown. One freshwater trout fishery was located in the terrestrial survey area and the consumption of rainbow trout was identified. Three beekeepers kept hives in the survey area.

Direct radiation survey area

The direct radiation survey areas around the Berkeley site and around the Oldbury site were sparsely populated with only five residences and 11 residences, respectively. The only leisure activity observed in both areas was horse riding. In the Berkeley survey area, one commercial business and one farm was identified, and in the Oldbury area, two commercial businesses and two working farms were identified. No residential properties were identified in the >0.25 to 0.5 km zone in the Berkeley area.

Figure 9. Consumption, occupancy and handling rates from the 2007 Berkeley and Oldbury habits survey



4.2 Bradwell

One habits survey has been undertaken in the period between 2002 and 2012; which was in 2007. The main results from this survey are summarised in Figure 10.

Aquatic survey area

The aquatic survey area spanned the north and south shores of the River Blackwater Estuary from Maldon, downstream to the east side of Mersea Island on the north shore, and St Peter's Flat on the south shore. Commercial fishing included trawling and gill netting for a variety of fish species and dredging for oysters. The fish species caught in the survey area were Dover sole, bass, grey mullet, cod and thornback rays. Three companies reared oysters on a large scale. Seed oysters from outside the area were used to supplement the natural spawning in the estuary. The salt marsh areas were used for grazing livestock in the spring and summer and by wildfowling associations in the autumn and winter. Several people were consuming two species of marine plants that grew on the salt marsh area; samphire and leaf beet. The harvesting of sea salt was also identified in the area. Ten houseboats were identified at Tollesbury and 12 houseboats were identified at Mersea Island.

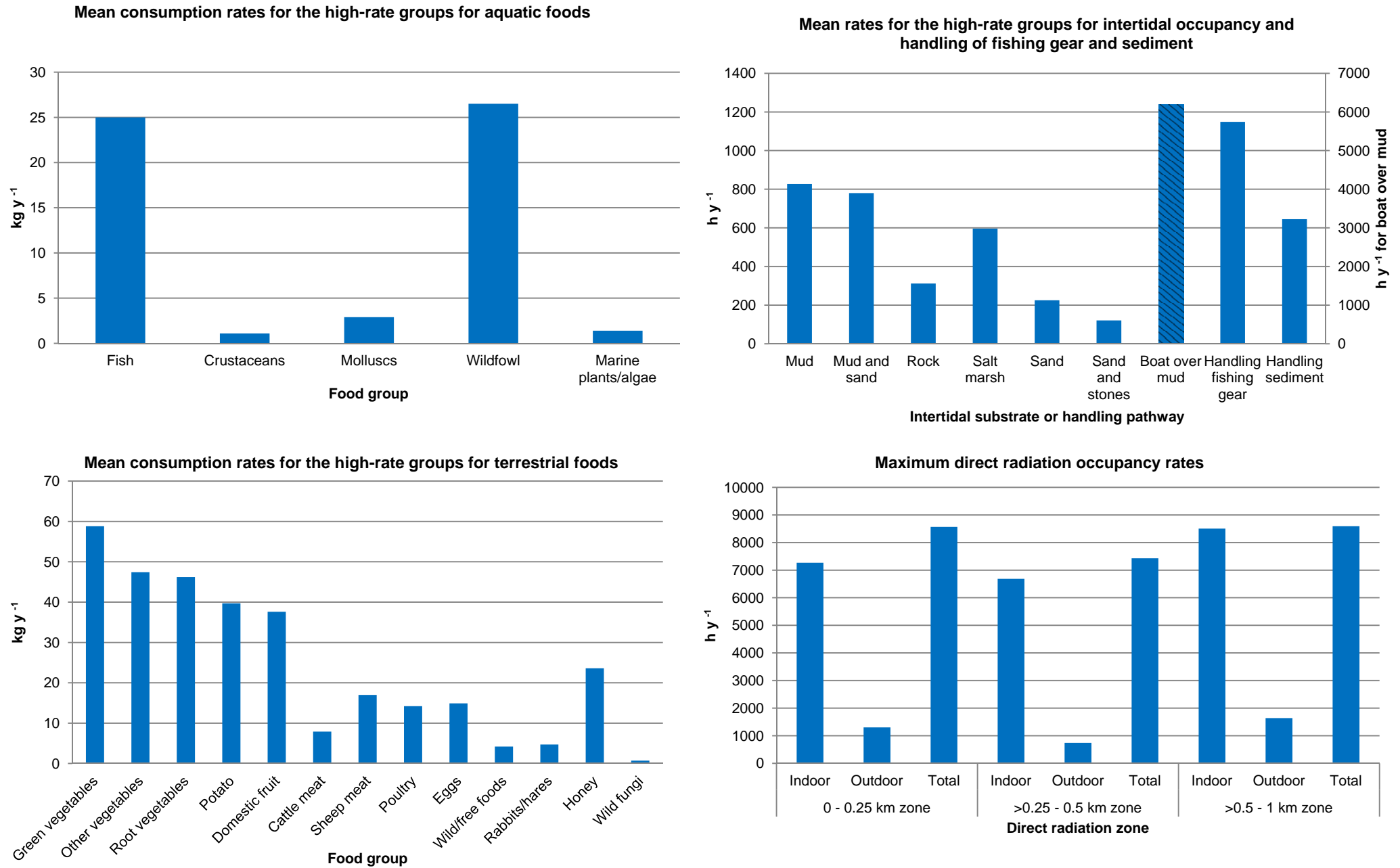
Terrestrial survey area

The land in the terrestrial survey area was predominately agricultural, although the estuary and the adjoining salt marshes took up a considerable portion of the terrestrial area. Twenty-two farms were identified that produced a mixture of beef cattle, sheep, chicken eggs and arable crops. One allotment site was identified where a range of fruit and vegetables was produced. One beekeeper kept five hives in the survey area. A wide variety of wild foods and game were being consumed.

Direct radiation survey area

The direct radiation survey area included a small village called Bradwell Waterside, and there were several other residences scattered around the survey area. Leisure activities included angling, bird watching, dog walking, walking, sailing and canoeing. The highest occupancy rates were for residents in all of the direct radiation zones.

Figure 10. Consumption, occupancy and handling rates from the 2007 Bradwell habits survey



4.3 Dungeness

There have been two habits surveys undertaken in the period between 2002 and 2012; these were in 2005 and 2010. The main results from these surveys are summarised in Figure 11. Dungeness A and B were considered together as a single site for purpose of the habits surveys.

Aquatic survey area

The aquatic survey area in 2005 and 2010 covered the intertidal area of the southern coast of England from Less Ness Ledge, in the west, to Copt Point in the east, and the adjacent area of sea up to the northern boundary of the English Channel Traffic Separation Zone. The commercial and hobby fishing methods were similar in both surveys with an estimated 55 commercial boats based within the aquatic survey area and a significant dredge fishery for king scallops. In 2010, compared with 2005, there was a significant increase in the mean consumption rate for the high-rate group for fish which was attributed to a retired fisherman who ate fish and shellfish two or three times per day. In 2005, full-time occupancy on board a boat resting on mud was identified, but in 2010, people were only identified spending short periods on board boats resting on mud. In 2005, a new sea wall was being constructed in the survey area, which resulted in high occupancy rates over sand. However, in 2010, this work was near completion and the workers were spending time working on concrete as opposed to sand, which reduced the occupancy rates.

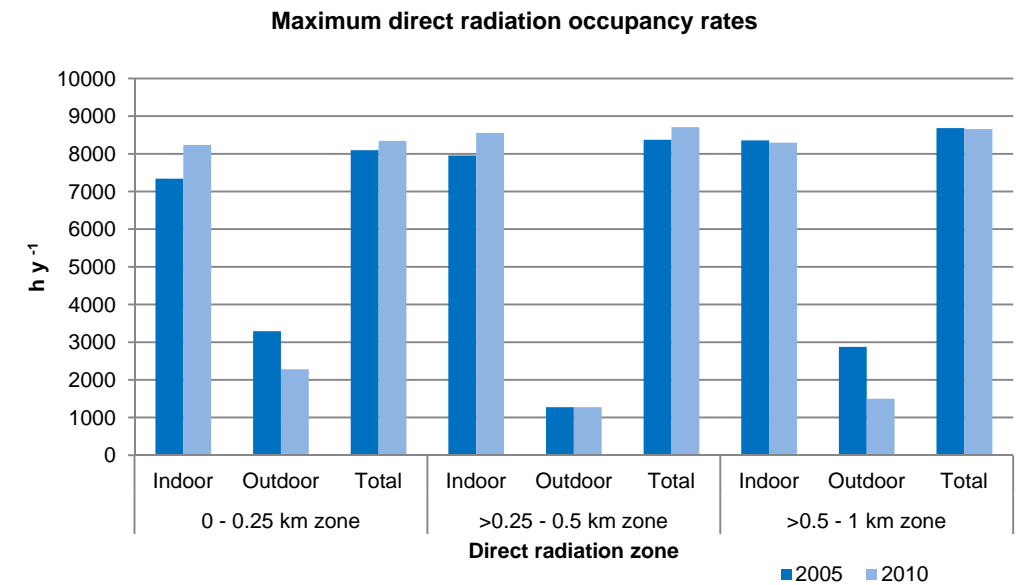
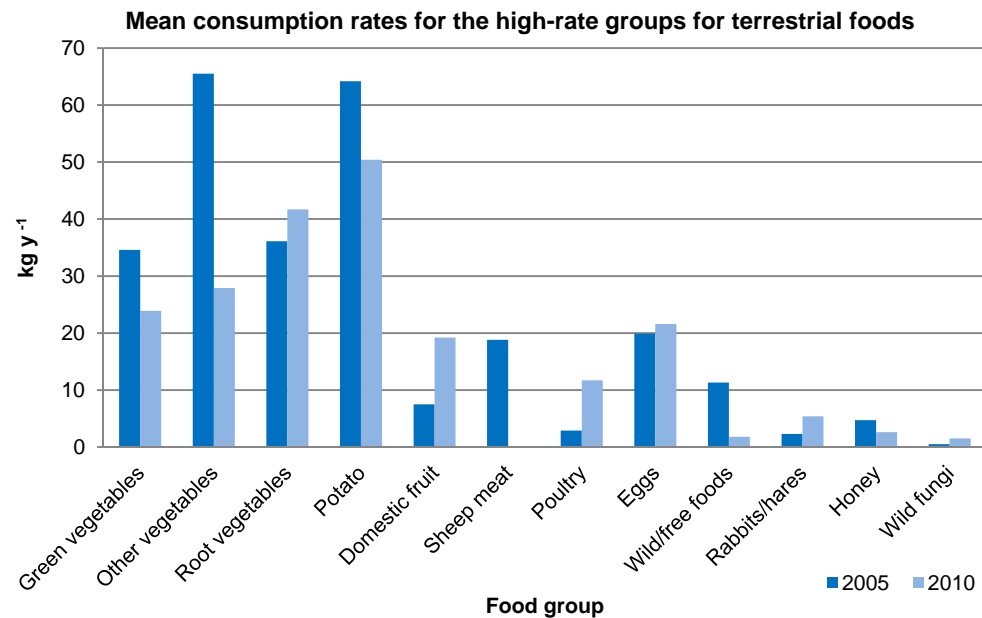
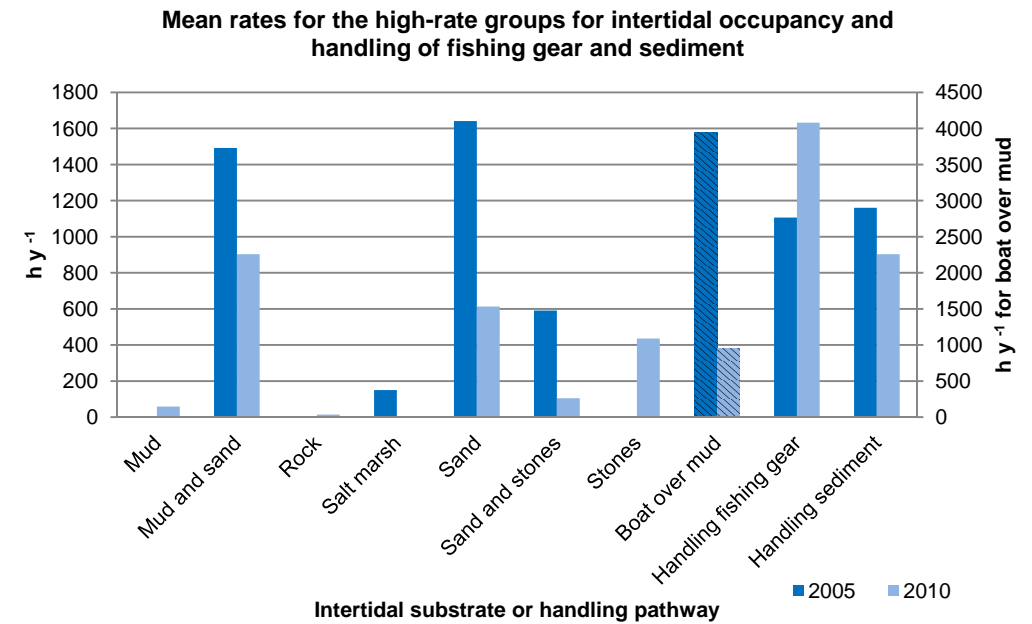
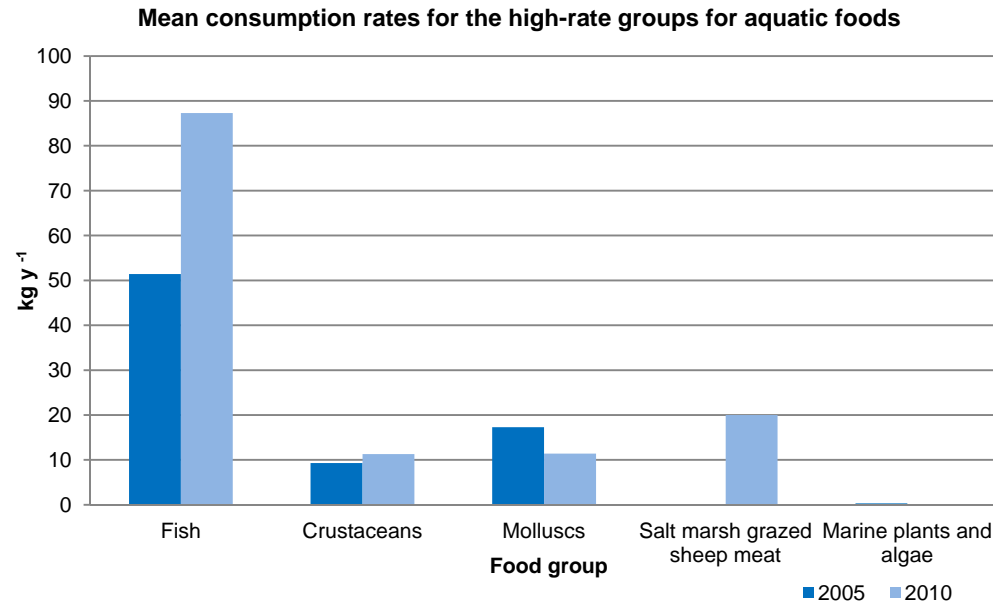
Terrestrial survey area

Activities in the terrestrial survey area in 2010 were very similar to those in 2005. Farmers in the area were producing lamb and arable crops and smallholders were producing lamb and beef. In both surveys, one allotment site was identified and several gardeners were producing small amounts of fruit and vegetables. The decrease in the mean consumption rate for the high-rate group for lamb in 2010 was because one family who were identified consuming lamb from their farm in 2005 were no longer consuming lamb in 2010. The increase in the mean consumption rate for the high-rate group for poultry and for rabbits/hares in 2010 was attributed to the identification of a game shooter and a family member in 2010 who were consuming large amounts of partridge, mallard and rabbit.

Direct radiation survey area

Activities identified in the direct radiation survey area in 2005 and in 2010 were broadly similar and included people living in the area, working in the area, bird watching, angling, staying at holiday homes and undertaking conservation duties. In all three zones in 2005 and 2010 the highest indoor, outdoor and total rates were for residents.

Figure 11. Consumption, occupancy and handling rates from the 2005 and 2010 Dungeness habits surveys



4.4 Hartlepool

There have been two habits surveys undertaken in the period between 2002 and 2012; these were in 2002 and 2008. The main results from these surveys are summarised in Figure 12.

Aquatic survey area

The aquatic survey area in 2002 and 2008 covered the area from Parton Rocks in the north to Saltburn Scar in the south and extended 3 km offshore. It also included the tidal River Tees from its mouth to the tidal barrage. Approximately 80-100 registered fishing boats were based in the survey area, with about half of these engaged in full time commercial fishing. The main fishing activity was potting for common lobsters and brown crabs. Commercial winkle collectors were identified operating in the survey area in 2008, but not in 2002. Shore and boat angling were very popular all year round in both surveys. The significant increase in the mean occupancy rate for the high-rate group for sand and coal was attributed to several commercial sea coal collectors who were interviewed in 2008 but not in 2002. The significant decrease in the mean occupancy rate for the high-rate group for mud was attributed to commercial peeler crab collectors who were interviewed in 2002 but not in 2008. It was reported that this activity was still being undertaken at the time of the 2008 survey but no one was observed during the survey.

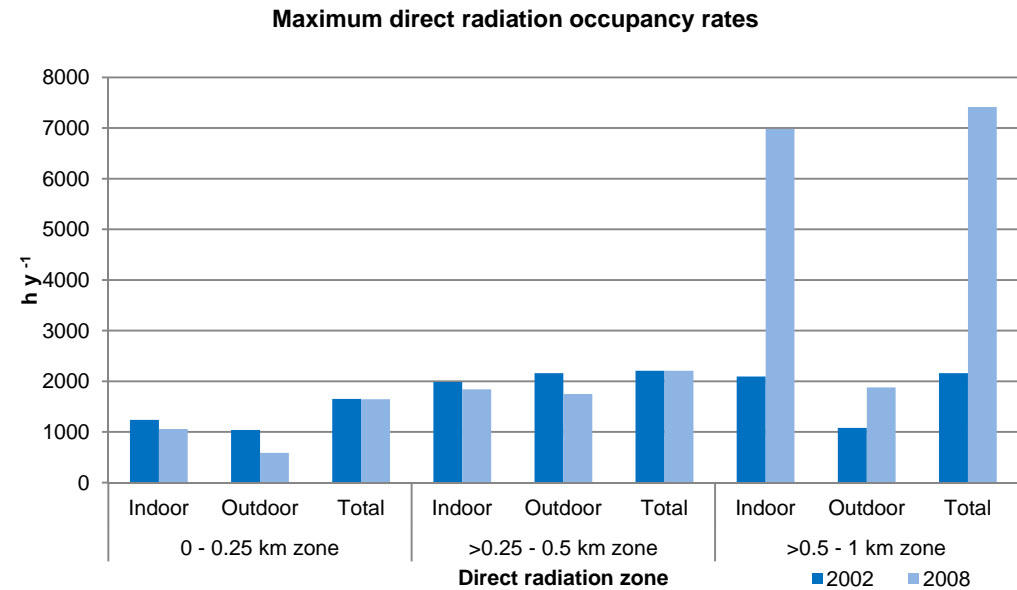
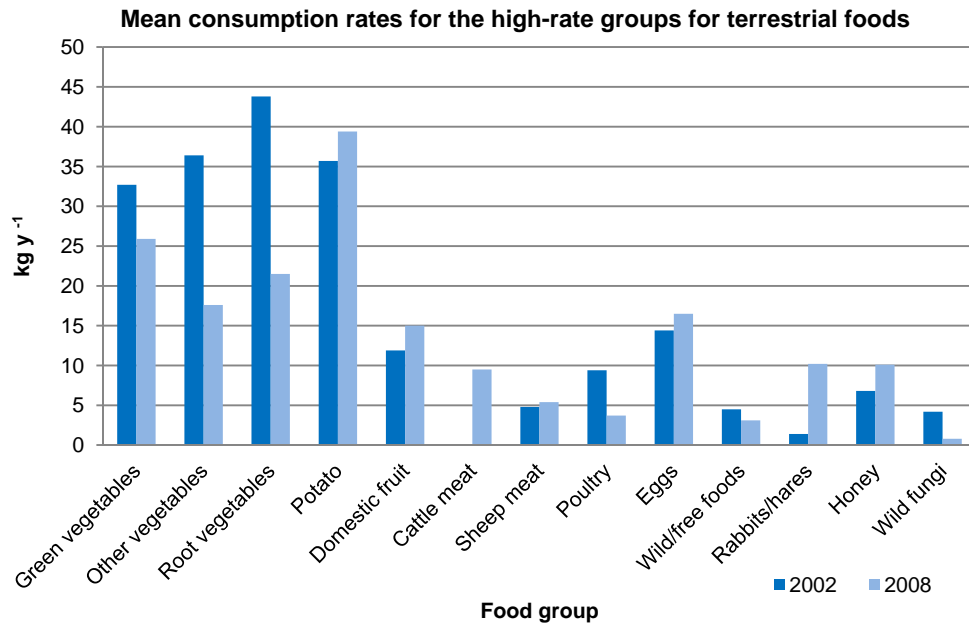
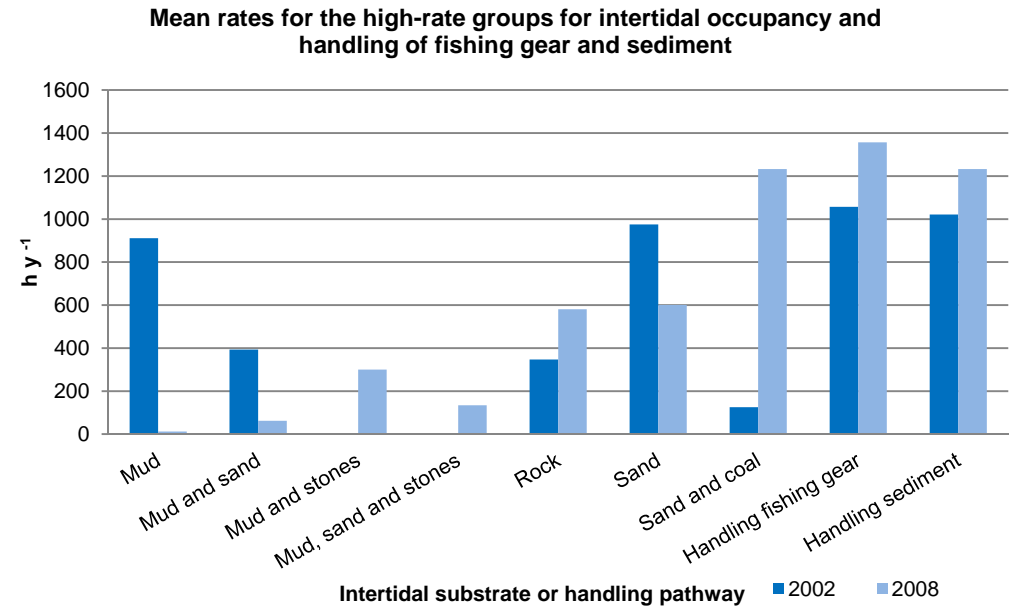
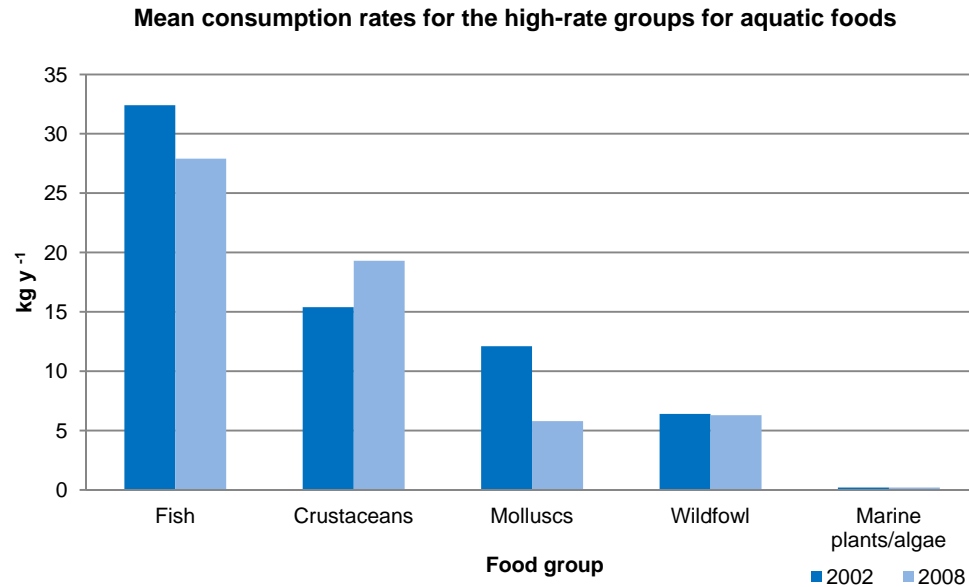
Terrestrial survey area

The terrestrial survey area was heavily industrialised and urbanised. Five working farms and a country estate were identified. The farms and the estate were producing a mixture of beef cattle, sheep and arable crops. One of the farms kept pigs in 2002, but no longer kept them in 2008. The consumption of beef, lamb and poultry were identified in both surveys. However, the family who were consuming beef in 2002 reported that this was a rare occurrence and they were unable to provide consumption rates. Approximately 260-300 allotment plots were identified in both surveys. They were well used and maintained, with a wide variety of fruit and vegetables were grown and consumed. In addition, chickens, ducks and geese were kept for eggs and meat.

Direct radiation survey area

The large increase in the indoor occupancy rate and the total occupancy rate within the >0.5 – 1 km zone in 2008 were attributed to two residents who were not identified living in the area in 2002. Commercial activities observed during both surveys were the same and included businesses, nature organisations and a small amount of farming.

Figure 12. Consumption, occupancy and handling rates from the 2002 and 2008 Hartlepool habits surveys



4.5 Heysham

There have been two habits surveys undertaken in the period between 2002 and 2012; in 2006 and 2011. The main results from these surveys are summarised in Figure 13. For the purpose of the habits surveys, Heysham 1 and Heysham 2 were considered together as one site.

Aquatic survey area

The aquatic survey area in 2006 and 2011 was defined as the waters and intertidal areas of Morecambe Bay to the north-east of a line extending from South East Point on Walney Island, to Rossall Point in Fleetwood. Walney Channel and the estuaries of the rivers Leven, Kent, Lune and Wyre were included in the survey area. A wide variety of small scale commercial fishing activities were identified in the survey area. The significant decreases in occupancy rates over mud, mud and sand, sand, and sand and stones in 2011 compared to 2006 were attributed to: changing substrates due to shifting sediments; decline in fishing activities; commercial bait digging not being identified in 2011; completion of major sea defence works; reduction in cockle and mussel collection.

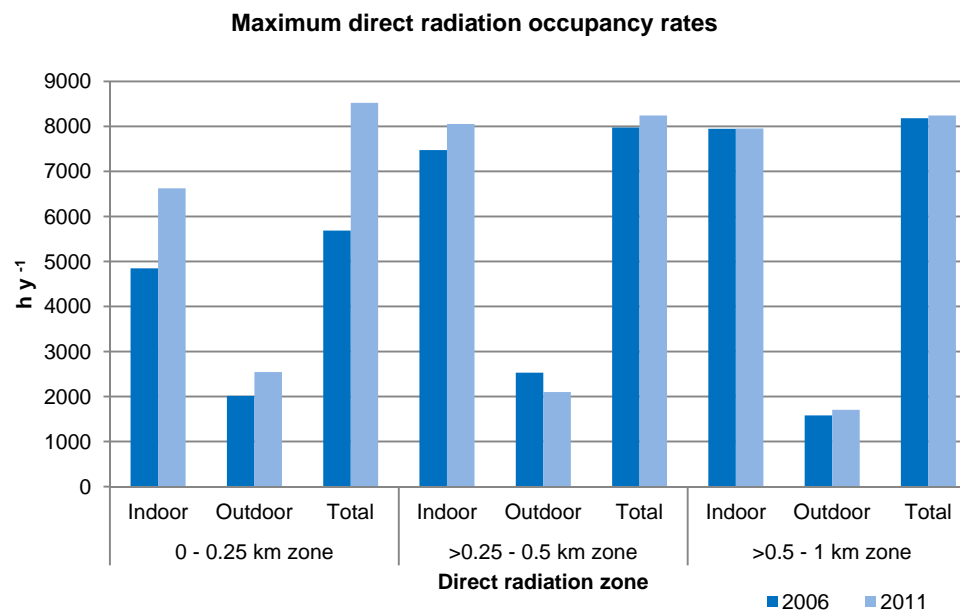
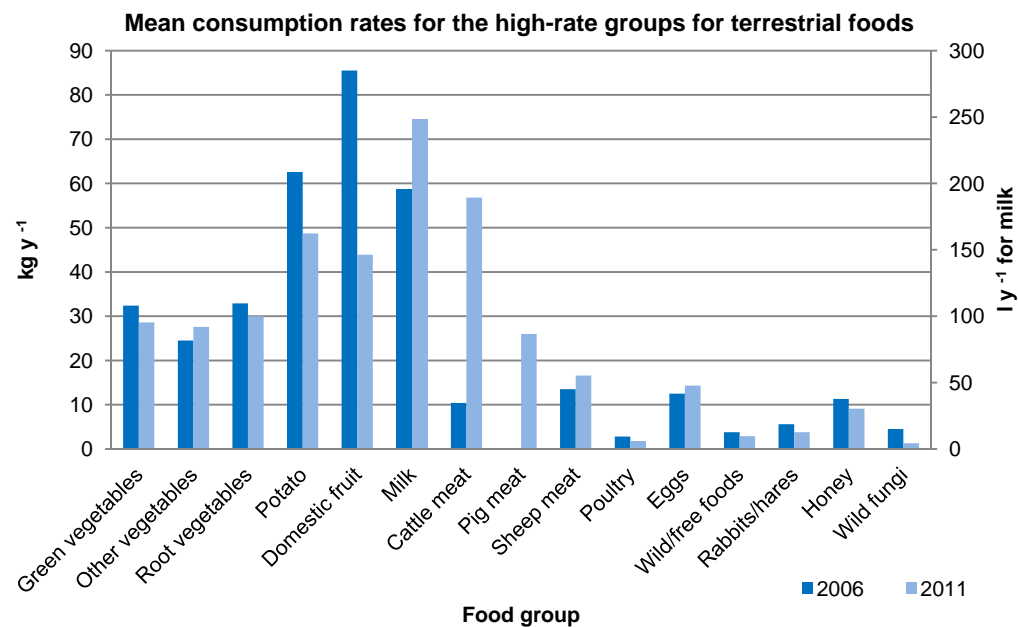
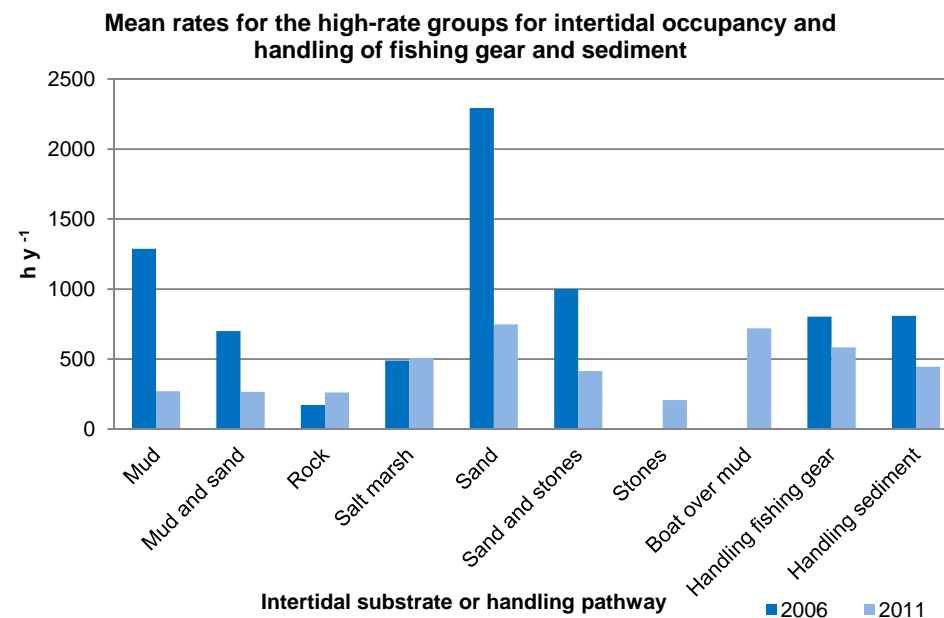
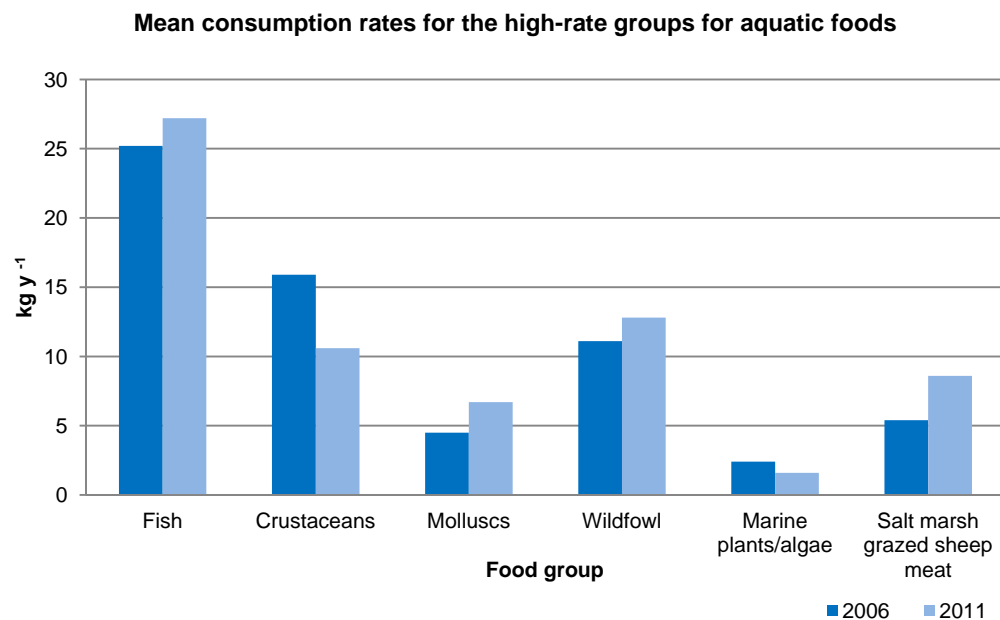
Terrestrial survey area

The land in the terrestrial survey area was predominately agricultural. Ten working farms were identified in the 2006 survey and an additional three farms were identified in the 2011 survey. The principle types of farm produce were a mix of milk (from dairy cattle), beef cattle, lambs and pigs. There were areas of salt marsh where farmers grazed their livestock. In both surveys, one allotment site was identified and several allotment holders kept chickens for their eggs. In 2011 compared to 2006, there were relatively large increases in the consumption rates for milk and cattle meat and relatively large decreases in the consumption rates for potato, domestic fruit and wild fungi. The decrease in wild fungi was attributed to unsuitable weather conditions. In 2011 it was reported that one allotment holder occasionally collected seaweed for use as a fertiliser on their allotment plot.

Direct radiation survey area

The land within the direct radiation survey area was a mix of residential areas, industrial areas, a nature reserve, a caravan park and a golf course. Activities in the direct radiation survey area in 2006 and 2011 were similar and included people residing, working, carrying out nature conservation duties, dog walking and angling. The highest occupancy rates were for residents and workers in both surveys.

Figure 13. Consumption, occupancy and handling rates from the 2006 and 2011 Heysham habits surveys



4.6 Hinkley Point

There have been two habits surveys undertaken in the period between 2002 and 2012; these were in 2006 and 2010. The main results from these surveys are summarised in Figure 14. For the purpose of the habits surveys, the Hinkley Point A and B stations were considered together as one site.

Aquatic survey area

The aquatic survey area in 2006 and 2010 covered the intertidal areas along the Somerset coast between Brean Down and Blue Anchor, and the adjacent sea area up to 9 km offshore. Only one commercial fisherman was identified operating in the survey area in 2011, compared to six in 2006, which was due to a decline in catches and fishermen retiring from the industry. This resulted in a decrease in the mean consumption rate for the high-rate group for fish and a decrease in the mean rate for the high-rate groups for occupancy over mud and sand, and for handling fishing gear. Occupancy on board a boat resting on mud decreased significantly in 2010. In 2006, occupancy on board houseboats that were resting on mud was identified, but in 2010, the houseboats were permanently afloat because the berths had been dredged. In 2010, four people were identified collecting seaweed to use as a fertiliser on land where fruit and vegetables were grown, compared to two people in the 2006 survey.

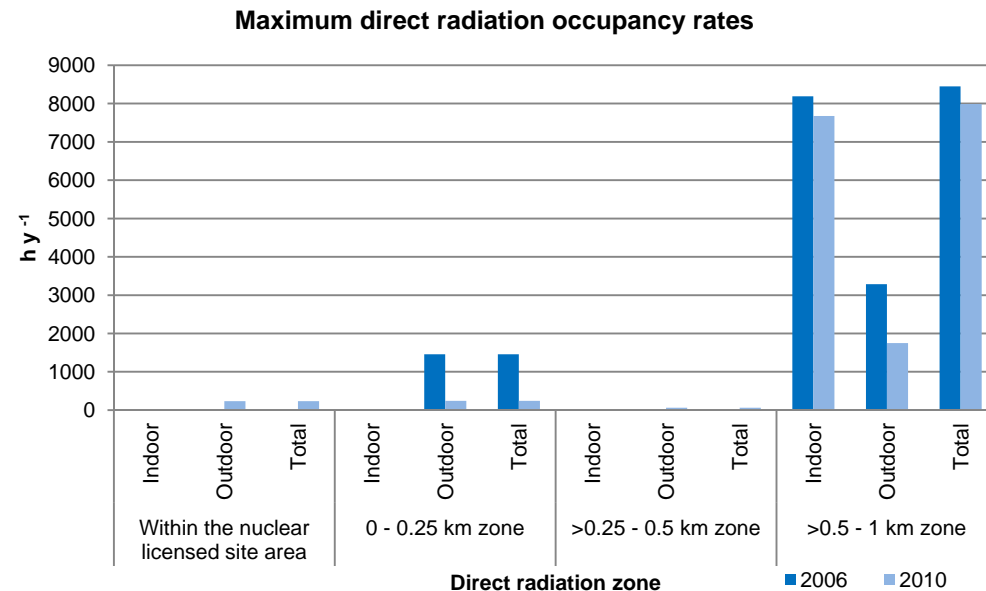
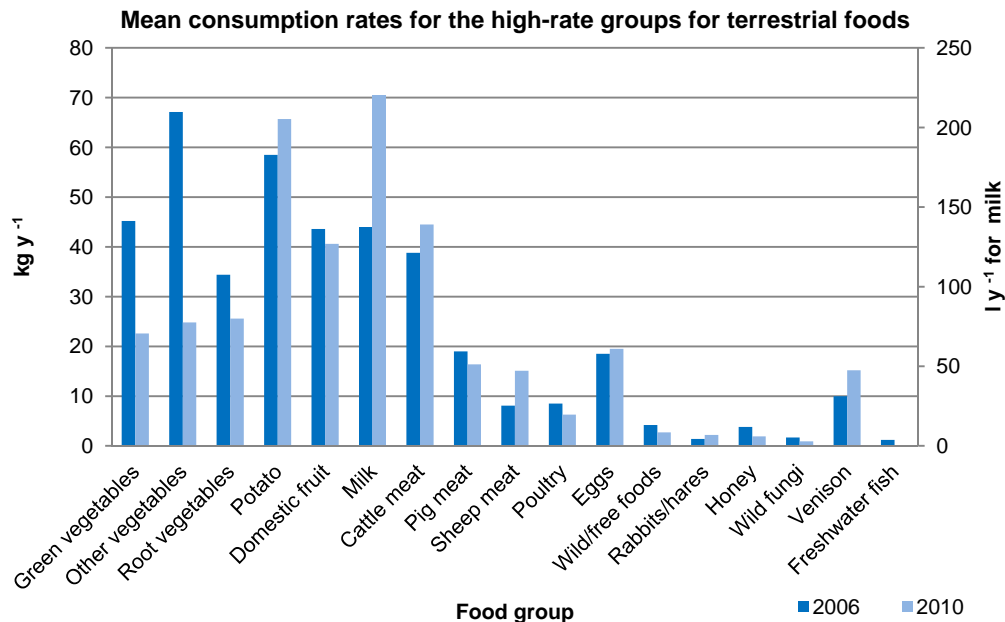
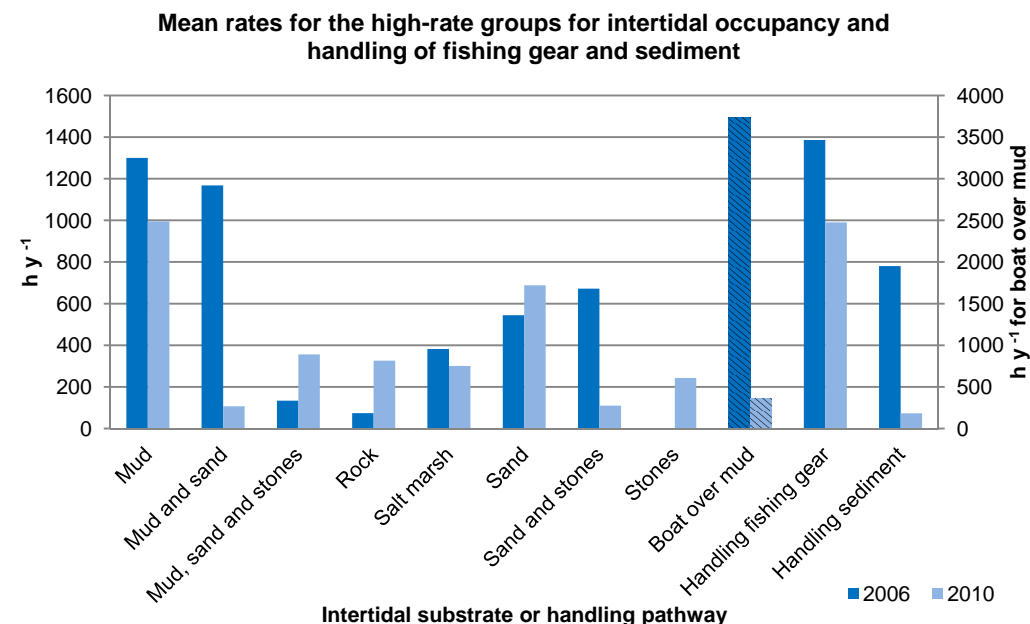
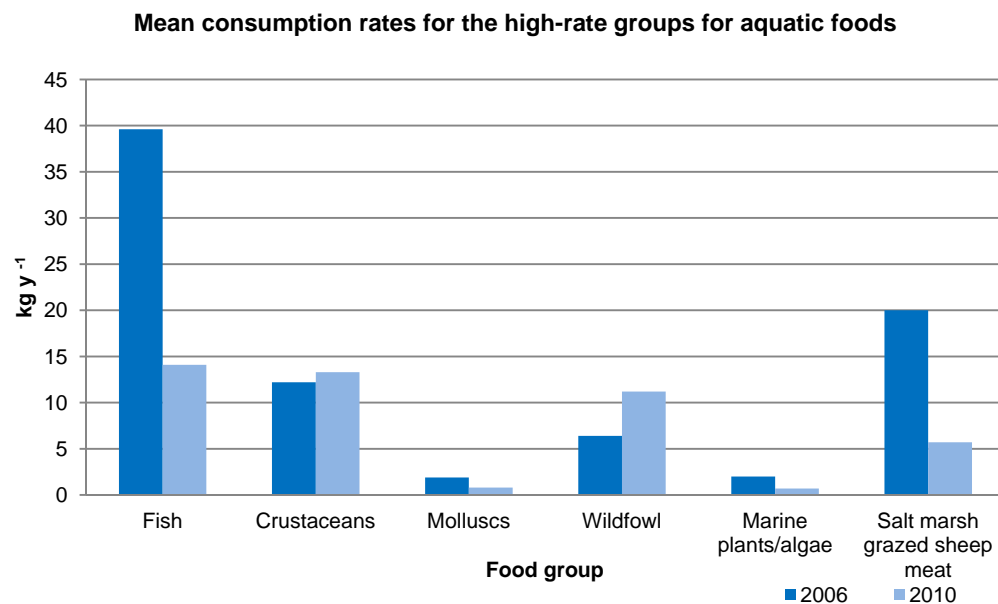
Terrestrial survey area

The land in the terrestrial survey area was predominantly agricultural, with several villages. Activities were very similar to those in 2006. The principal types of farm produce remained a mix of beef cattle, dairy cattle, sheep, pigs, broiler chickens and chicken eggs. In both surveys, one allotment site was identified and several gardeners were producing a variety of fruit and vegetables and some kept chickens for eggs. The increase in the mean consumption rate for the high-rate group for milk was due to one farming family who were consuming more milk in 2010 than in 2006.

Direct radiation survey area

The direct radiation survey area was sparsely populated, and in both surveys the area was extended to 1.1 km in order to include residences just outside the 1 km area usually used in habits surveys. Activities identified in the direct radiation survey area in 2006 included people living in the area, farming, angling and beachcombing. The activities identified in 2010 were similar, with the addition of bird watching, and within the nuclear licensed site area, nature conservation activities were noted.

Figure 14. Consumption, occupancy and handling rates from the 2006 and 2010 Hinkley Point habits surveys



4.7 Sizewell

There have been two habits surveys undertaken in the period between 2002 and 2012; these were in 2005 and 2010. The main results from these surveys are summarised in Figure 15. For the purpose of the habits surveys, the Sizewell A and B stations were considered together as one site.

Aquatic survey area

The aquatic survey area in 2005 and 2010 covered the intertidal areas along the Suffolk coast from Southwold, in the north, to North Weir Point at the southern tip of Orford Ness shingle spit, in the south, and the adjacent sea area up to 10 km offshore. In 2010, 27 commercial fishing boats were identified compared to 24 in 2005. A wide variety of fishing methods were used to catch a mix of demersal fish species including mackerel, herring, sprat, cod, bass, shrimps, brown crab and common lobster. The most significant changes in the intertidal occupancy rates were that no activities were recorded taking place over mud and stones, over stones, or on board boats resting on mud in 2005, although there were in 2010.

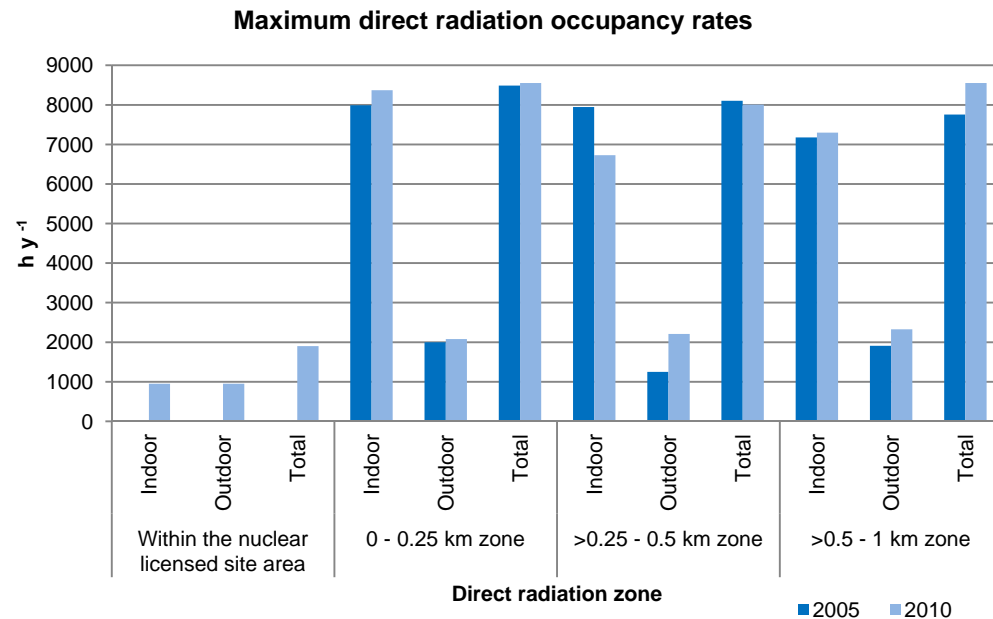
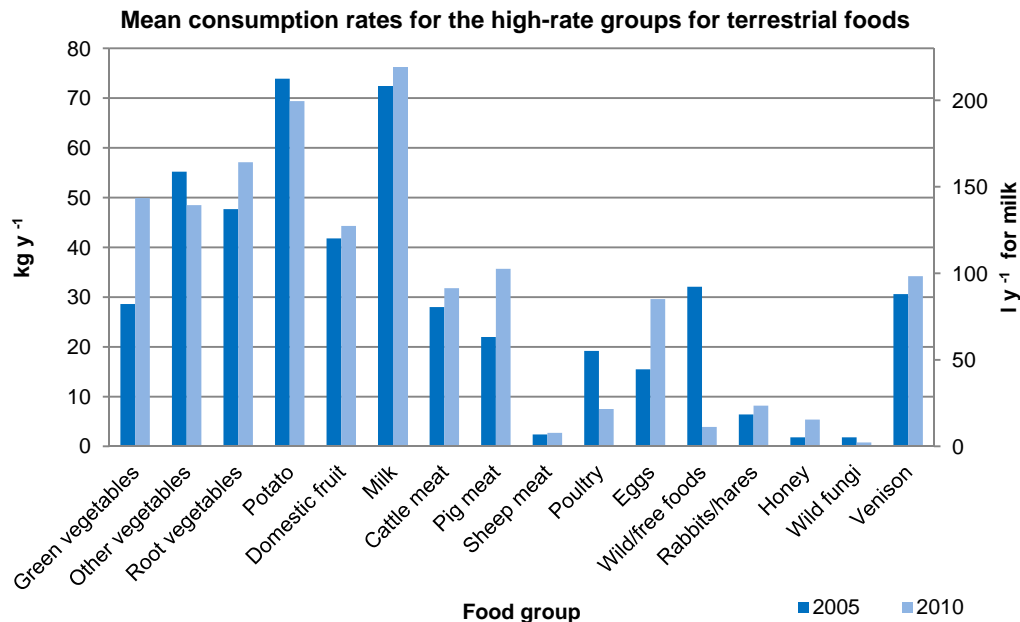
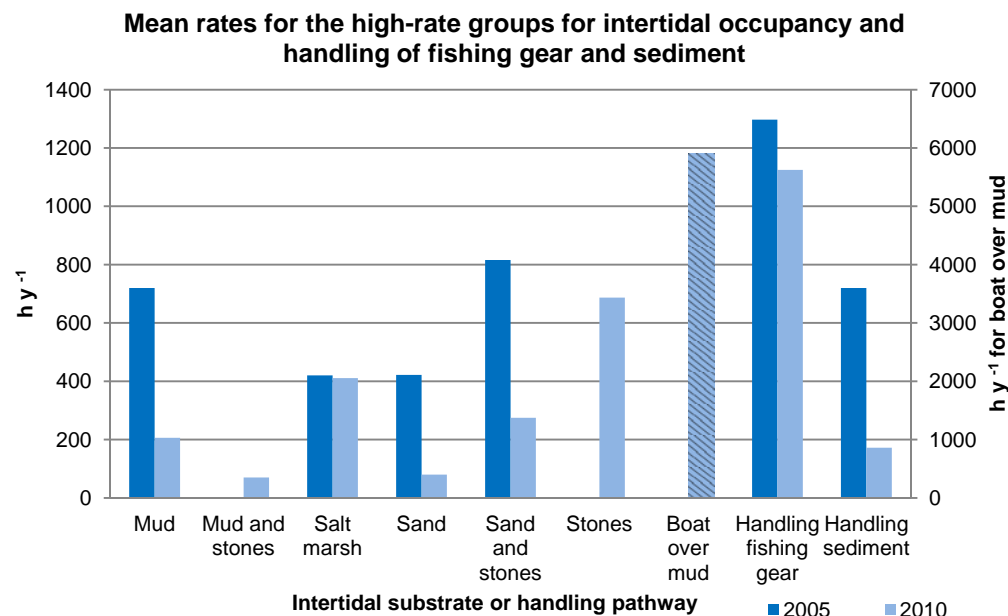
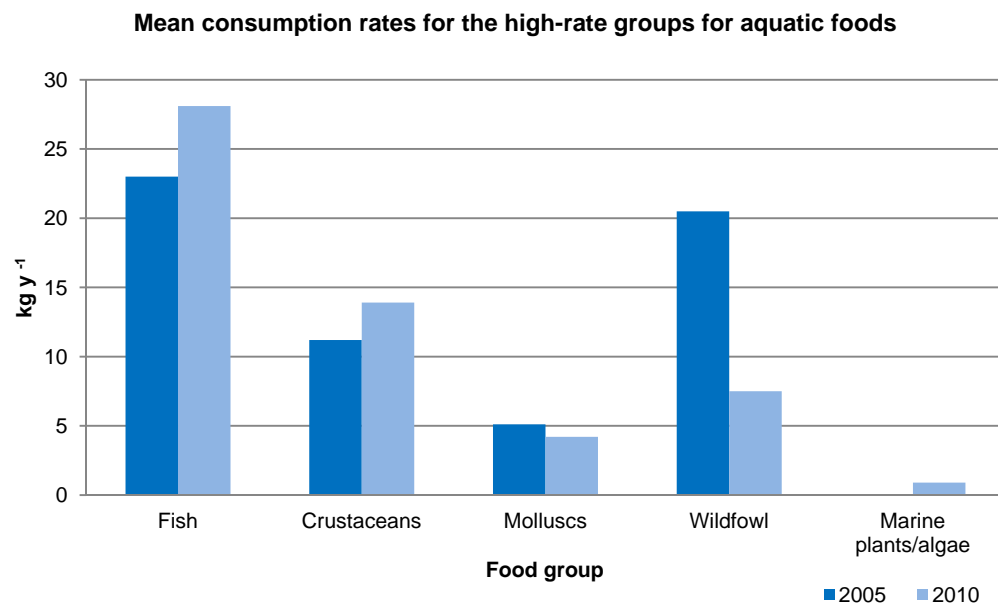
Terrestrial survey area

The land around the Sizewell site was predominantly agricultural with scattered patches of woodland, heath and marsh. Activities in the terrestrial survey area in 2010 were broadly similar to those in 2005 except that a commercial dairy farm identified in 2005 had switched to rearing beef cattle in 2010. There was no commercial dairy farming in the survey area in 2010, although one farmer kept a few cows for milk for his own family's consumption. Otherwise, the principal types of farm produce continued to be a mix of beef cattle, pigs, lambs and arable crops. In both surveys, two allotment sites were identified and the allotment holders and several gardeners were producing a variety of fruit and vegetables and some kept chickens for eggs. The steep decline in the mean consumption rate for the high-rate group for wild/free foods was due to one family that used large amounts of blackberries for home-made wine in 2005 who had stopped making wine in 2010.

Direct radiation survey area

In 2010, two people were identified working within the nuclear licensed site area who were not Sizewell site employees or contractors. No occupancy data were obtained for this area in 2005. In 2005 and 2010 the highest total, indoor and outdoor rates in all three of the zones outside the nuclear licensed site area were for residents.

Figure 15. Consumption, occupancy and handling rates from the 2005 and 2010 Sizewell habits surveys



4.8 Trawsfynydd

One habits survey has been undertaken in the period between 2002 and 2012; which was in 2005. The main results from this survey are summarised in Figure 16.

Aquatic survey area

The aquatic survey area covered the whole of Lake Trawsfynydd and its shoreline, and the River Prysor from where it leaves the lake to its confluence with the River Dwyrdd. Commercial fishing was not permitted in Lake Trawsfynydd or in the River Prysor. Angling from the shore and from boats was very popular. The lake was stocked with rainbow trout from outside the survey area at a rate of 500 kg per fortnight between the months of January and October. Large quantities of rainbow trout were consumed by the anglers and their families. The only other species of fish from the lake that were consumed by anglers was brown trout, but this was consumed in small quantities.

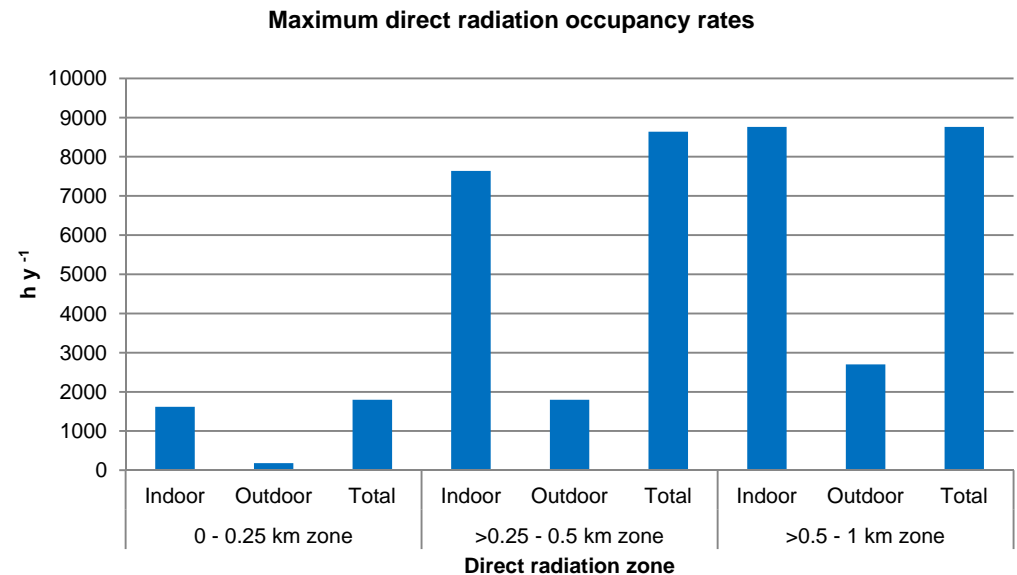
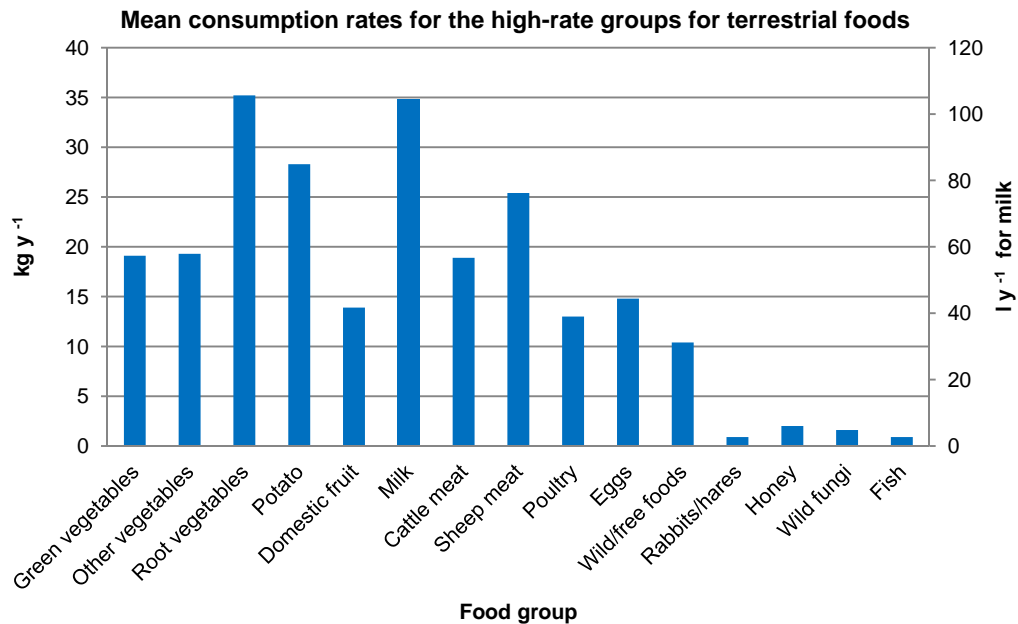
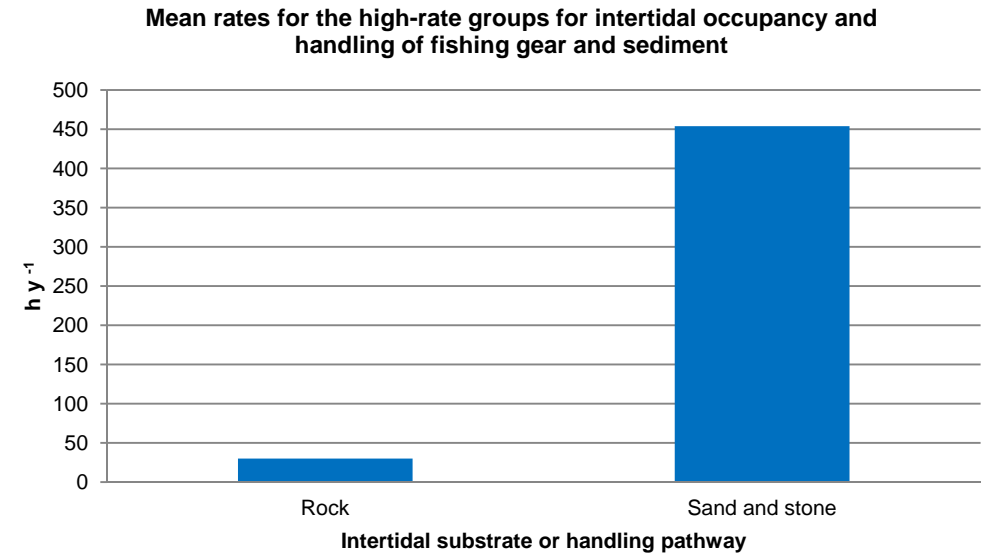
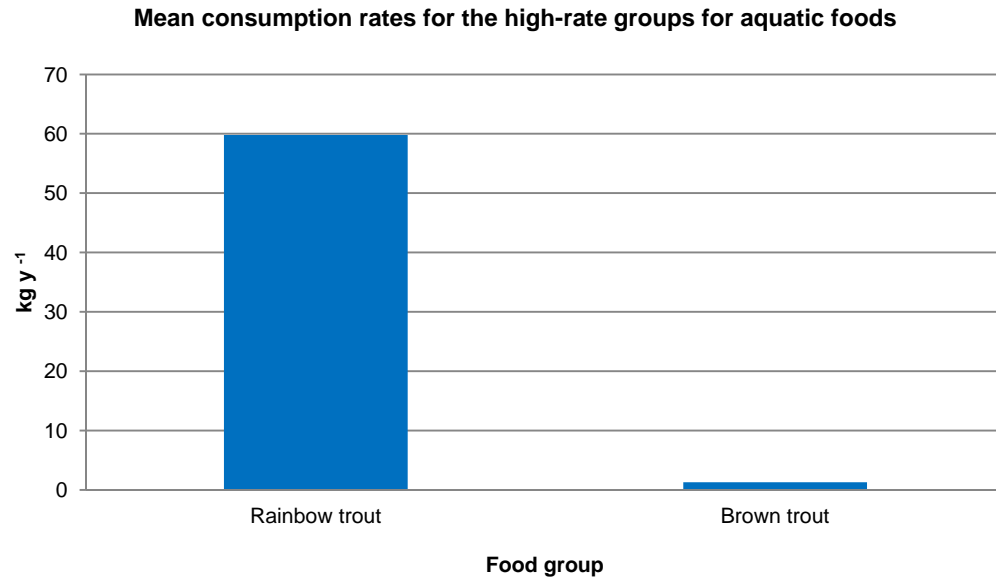
Terrestrial survey area

The land around the Trawsfynydd site was diverse. Large parts of the survey area were covered with woodland, and to the east and south-west the area was mountainous. Lake Trawsfynydd was located to the south of the site and there were also many small lakes, rivers and streams in the survey area. Thirty-six working farms were located in the area producing a mix of beef cattle, lambs, chickens (for meat and eggs), milk (from dairy cattle) and arable crops. Three smallholdings were also identified in the area, two of which kept a small number of sheep and one kept turkeys.

Direct radiation survey area

The direct radiation survey area covered an area 1.5 km from the site boundary in order to include residents that were interviewed during a habits survey in 2001, so that comparisons could be made. The direct radiation survey area was sparsely populated with two farms, approximately 25 residences, a public house and a caravan park. In the inner zone, the highest occupancy rate was for people working and in the other two zones, the highest occupancy rates were for residents.

Figure 16. Consumption, occupancy and handling rates from the 2005 Trawsfynydd habits survey



4.9 Wylfa

There have been two habits surveys undertaken in the period between 2002 and 2012; these were in 2004 and 2009. The main results from these surveys are summarised in Figure 17.

Aquatic survey area

The aquatic survey area in 2004 and 2009 covered the intertidal areas along the northern coast of Anglesey from Carmel Head in the west, to Point Lynas in the east, and the adjacent sea area up to 6 km offshore. The types of activities identified in 2009 were for the most part similar to those identified in 2004. The main commercial fishing activity in the survey area was potting for brown crab, common lobster and common prawns. Small scale commercial rod and line fishing for bass was also identified. Shore angling and boat angling was very popular and occurred at many locations within the survey area. Porth Wnal, where the cooling water from Wylfa power station was discharged, was a favourite location for many bass anglers. Seaweed that collected on the power station cooling water intake screens was sent to a commercial composting company on Anglesey. Additionally, in the 2009 survey, one individual was identified collecting seaweed for use as a fertiliser on vegetables, which were consumed by four people; this was not identified in 2004.

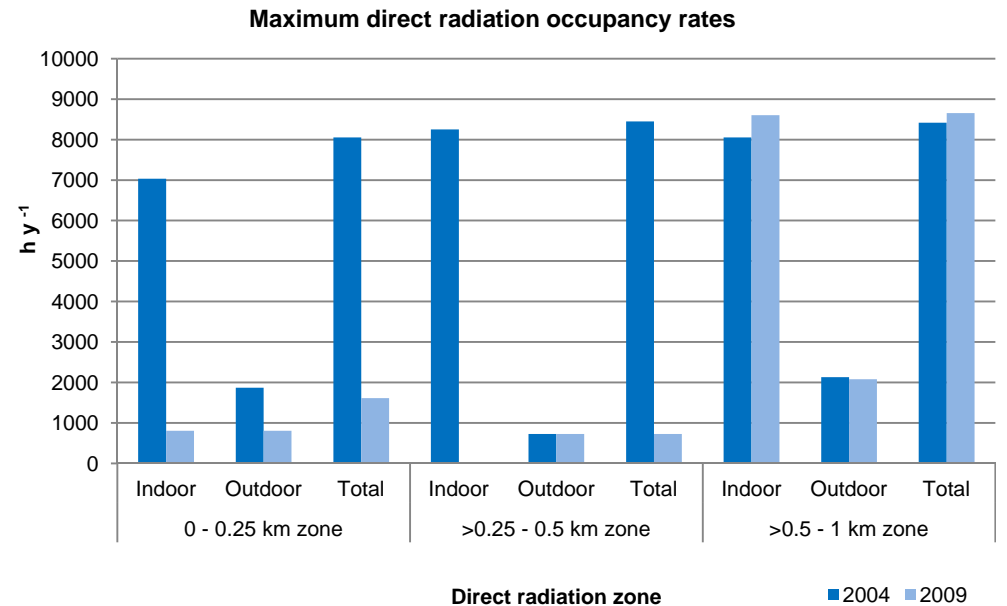
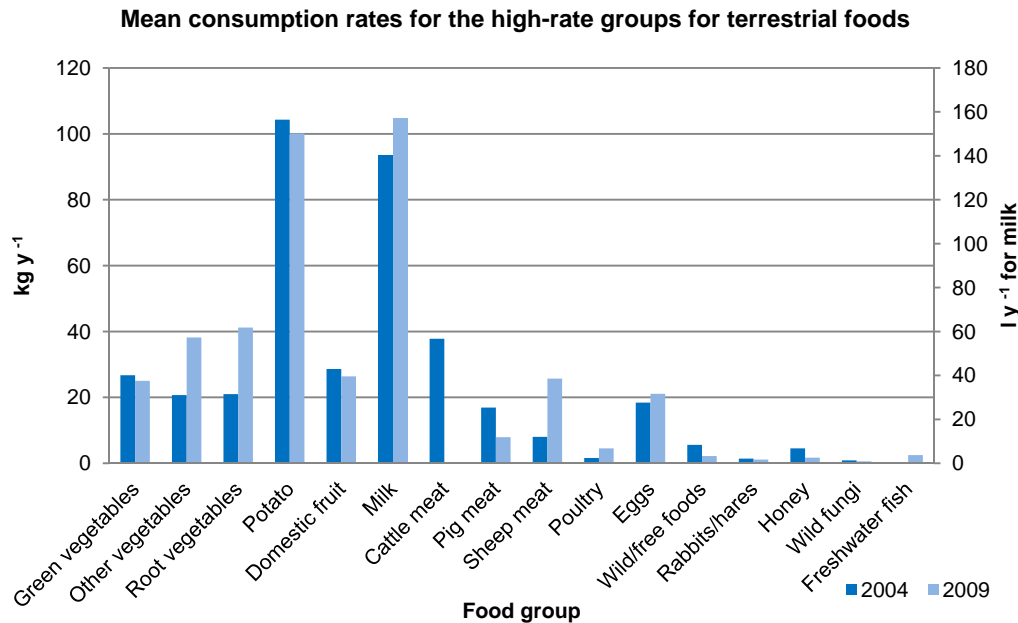
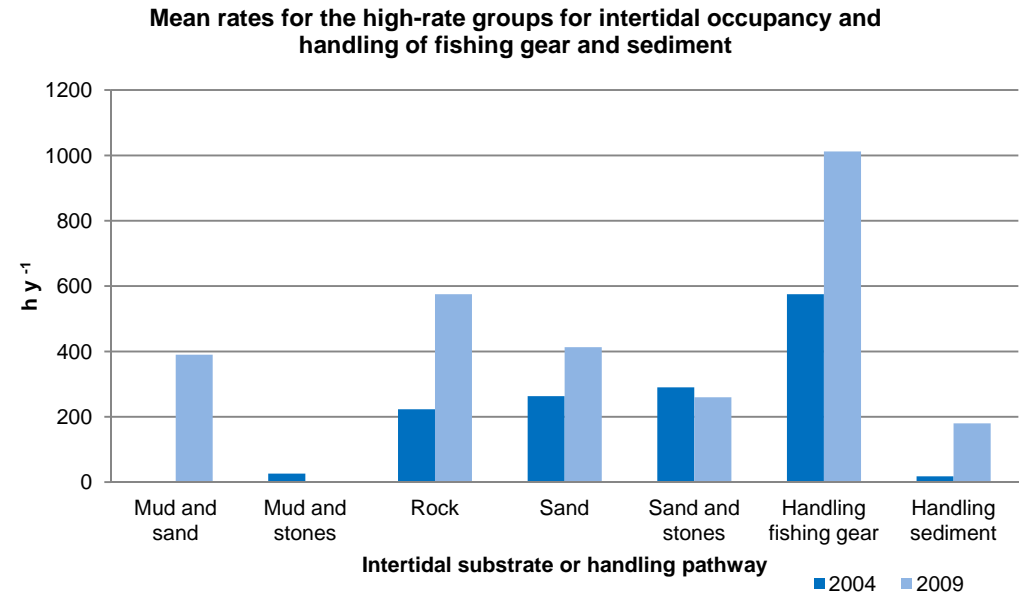
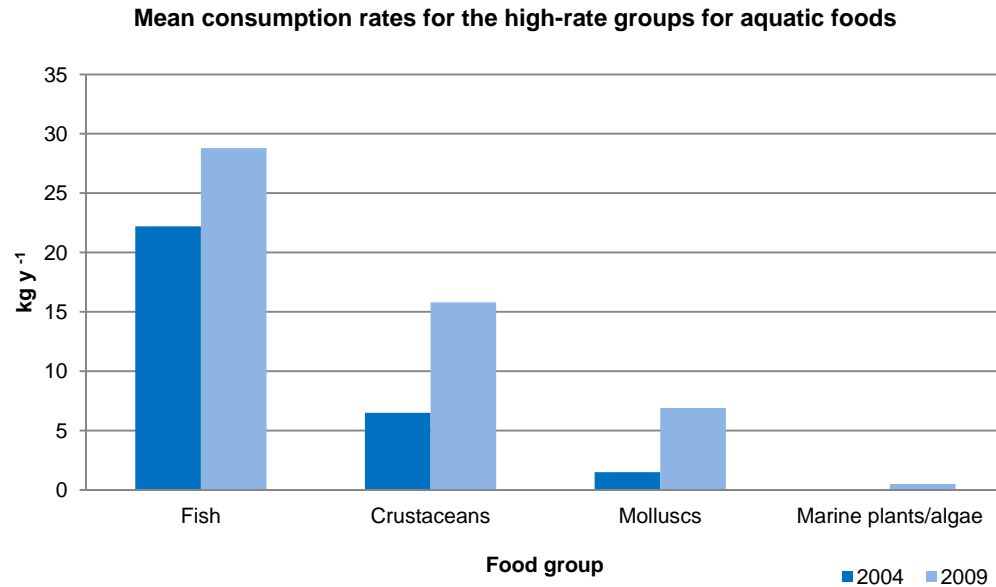
Terrestrial survey area

Activities in the terrestrial survey area in 2009 were very similar to those in 2004. The principal types of farm produce remained a mix of beef cattle, milk (from dairy cattle) and lambs, with a limited amount of arable crops, mainly for use as animal feed. No smallholdings were identified in 2004 but in 2009 three properties were classified as smallholdings since the householders kept small numbers of beef cattle or sheep. In 2009 compared to 2004, there was an increase in the mean consumption rate for the high-rate group for sheep meat due principally to the consumption of large quantities of lamb by a smallholder and his family. This increase was against a general decline in the number of sheep meat consumers from 39 in 2004 to 25 in 2009, which was attributed to the increasing cost and inconvenience of having home produced meat sent back from the abattoir to the producer. Cattle meat was no longer consumed in 2009, for the same reason. The decline in honey production was attributed to the collapse of the bee colonies.

Direct radiation survey area

There was a marked decline in residential activities between 2004 and 2009 since eleven properties had been bought up for a proposed new build programme on land adjacent to the existing site, and were no longer occupied. The commercial activities and leisure activities were broadly similar in 2004 and 2009.

Figure 17. Consumption, occupancy and handling rates from the 2004 and 2009 Wylfa habits surveys



4.10 Total doses for the nuclear power station sites

The annual total dose trends for the nuclear power stations in England and Wales for 2004 to 2011 are presented in Figure 18 and Figure 19. The data and information on total dose are taken from the RIFE report series (for example, EA, FSA, NIEA and SEPA, 2012) and from the Summary of Radioactivity in Food and the Environment report (EA, FSA, NIEA and SEPA, 2010).

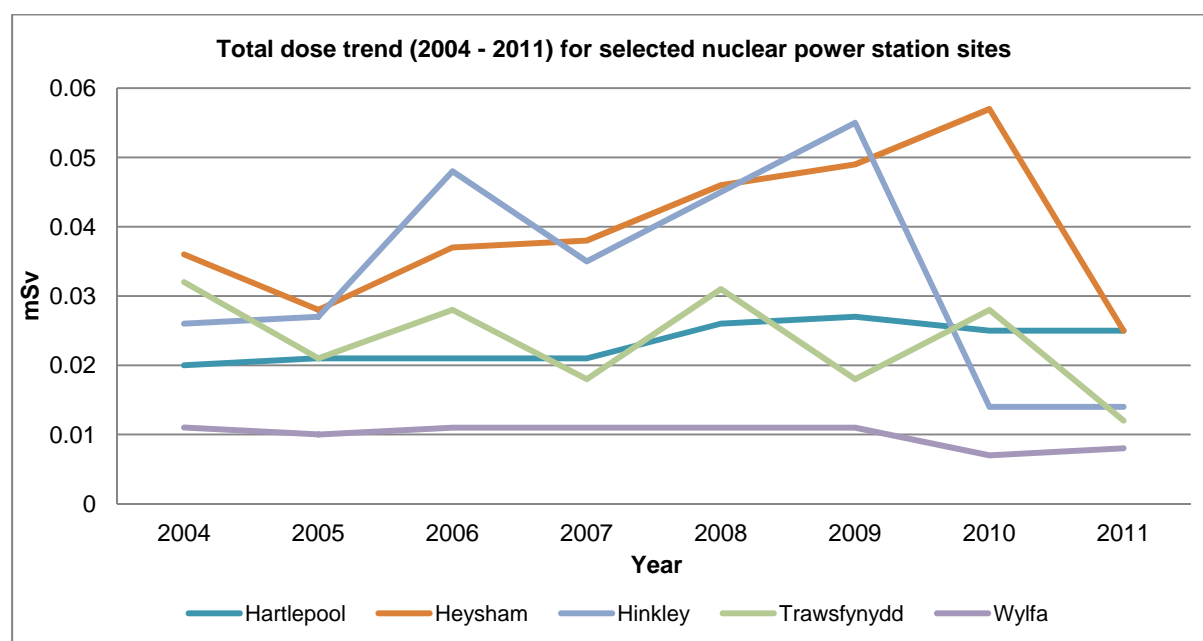


Figure 18. Total radiation exposures around nuclear power stations due to radioactive waste discharges and direct radiation (2004 – 2011)

For Hartlepool, the most exposed group from 2004 to 2011 was people living near to the site whose dose was from direct radiation from the site.

For Heysham, the total doses from 2004 to 2010 use the 2006 habits survey data. The most exposed group during this period were adults who spent time on local beaches. In the 2011 habits survey there was a significant decrease in the occupancy rates on beaches so the most exposed group changed in 2011 to mollusc consumers, which resulted in a significant decrease in the total dose.

Adults who spent a large amount of time on local beaches at Hinkley Point were the most exposed group over the period from 2004 to 2011. The significant reduction in dose in 2010 was mainly due to a decrease in the occupancy on beaches noted in the 2010 habits survey.

From 2004 to 2010 the most exposed group at Trawsfynydd were local infants who were subject to direct radiation from the site and also consumed milk. In 2011 the most exposed group was adults and the majority of the dose was received from the consumption of fish combined with external exposure from activity in lakeside sediment.

For Wylfa, from 2004 to 2009, the most exposed group were local inhabitants who lived near the site. In 2010 and 2011, the most exposed group was local adults consuming marine plants and algae. The total doses remained similar from year to year and were low.

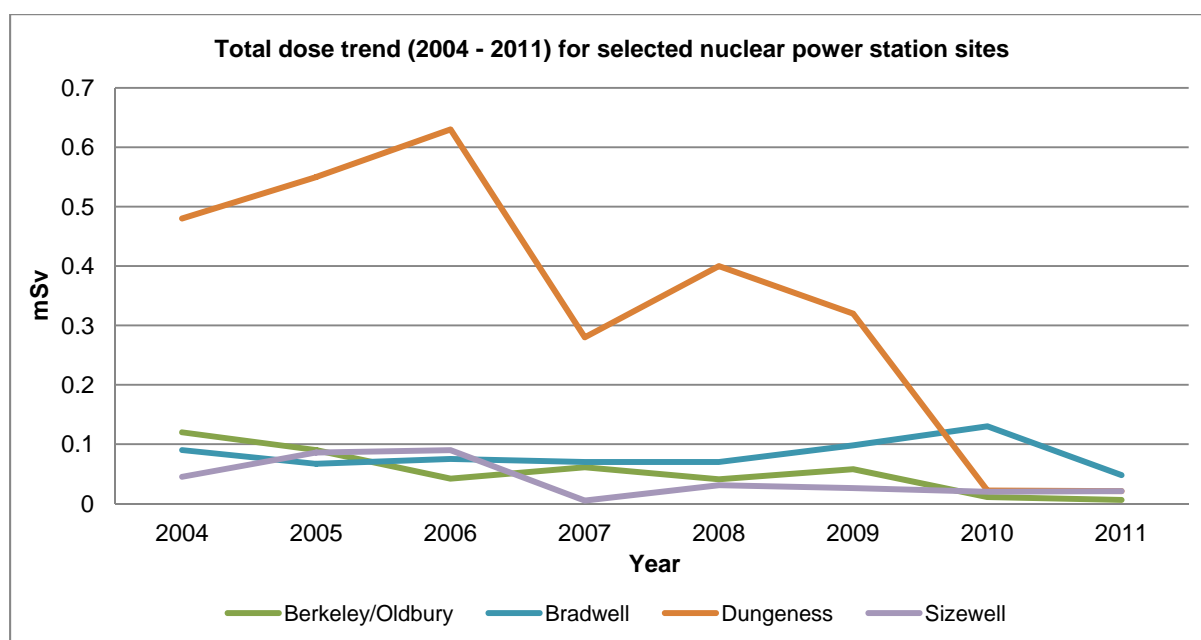


Figure 19. Total radiation exposures around nuclear power stations due to radioactive waste discharges and direct radiation (2004 – 2011)

For Berkeley and Oldbury, the total doses from 2004 to 2011 use the 2007 habits survey data. Over the period from 2004 to 2010, the most exposed group were local inhabitants who lived close to the site. In 2011, the most exposed group was people who spend time over intertidal areas.

For Bradwell, the total doses from 2004 to 2011 use the 2007 habits survey data. Over the period from 2004 to 2011, the most exposed group were local inhabitants who lived close to the site. The lower value in 2011 was due to a decrease in the estimate of direct radiation from the site and any variations over time in total dose were attributed to changes in the estimate of direct radiation.

The dose at Dungeness was almost entirely due to direct radiation from the site. Adults living near to the site were the most exposed group from 2004 to 2011. Following the shutdown of the Magnox reactors in 2006, this dose has declined significantly.

The dominant contribution to total dose at Sizewell was from direct radiation. The dose from this pathway decreased in 2007 since Sizewell A ceased generation in 2006. The most exposed group from 2004 to 2011 was people living near to the site.

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5 DEFENCE ESTABLISHMENTS

Habits surveys have been conducted at four defence establishments in England in the period between 2002 and 2012. These are located at:

Aldermaston and Burghfield in West Berkshire

Barrow in Cumbria

Devonport in Devon

Derby in Derbyshire

Aldermaston and Burghfield

Aldermaston and Burghfield are separate nuclear sites, but due to their close proximity, the habits surveys covered both sites. Aldermaston provided advanced research, design and manufacturing facilities for the components of the UK's nuclear deterrent. The final assembly and maintenance of nuclear warheads was carried out at Burghfield, as well as their decommissioning.

Barrow

BAE Systems Marine Ltd own and operate the nuclear site at Barrow, where they build, test and commission new nuclear powered submarines. At the time of the habits survey in 2012, one submarine was nearing completion and was afloat in the Devonshire Dock and other submarines were in various stages of construction within the Devonshire Hall.

Devonport

The Devonport site comprises two defence establishments: the Devonport Royal Dockyard and Her Majesty's Naval Base (HMNB) Devonport. At the time of the habits surveys, operations at the Devonport Royal Dockyard included refitting, refuelling, repairing and maintaining the Royal Navy's nuclear powered submarines. Operations at HMNB Devonport included the engineering, logistics and infrastructure support for the ships and submarines of the Devonport Flotilla.

Derby

The Rolls-Royce site at Raynesway in Derby is owned and operated by Rolls-Royce Marine Power Operations Ltd (RRMPOL). At the time of the habits survey, RRMPOL operated two adjacent nuclear licensed sites at Derby, the Neptune/Radioactive Components Facilities site and the Nuclear Fuel Production site (the manufacturing site). The Neptune site accommodated the core design, development, testing and examination of radioactive components. On the manufacturing site the reactor cores and other components were fabricated.

5.1 Aldermaston and Burghfield

There have been two habits surveys undertaken in the period between 2002 and 2012; these were in 2002 and 2011. The main results from these surveys are summarised in Figure 20.

Aquatic survey area

There was a change to the aquatic survey area in 2011. In 2002, a section of the River Thames between Pangbourne and Mapledurham was included in the survey area, but the Pangbourne outfall closed in 2005 and the River Thames no longer received liquid discharges from the Aldermaston site, so this area was not included in the 2011 survey. Two people consumed signal crayfish from the aquatic survey area in 2002 and the mean consumption rate for the high-rate group was 1.2 kg y^{-1} (this is not presented in Figure 20). The consumption of foods from the aquatic survey area was not identified in 2011. There was a significant increase in the mean bankside occupancy rate for the high-rate group for grass in 2011 compared to 2002. This increase was attributed to a new angling syndicate that had formed, with a number of keen members who fished within the aquatic survey area. Occupancy rates for adults in close proximity to sewage sludge were recorded in 2011 but not in 2002.

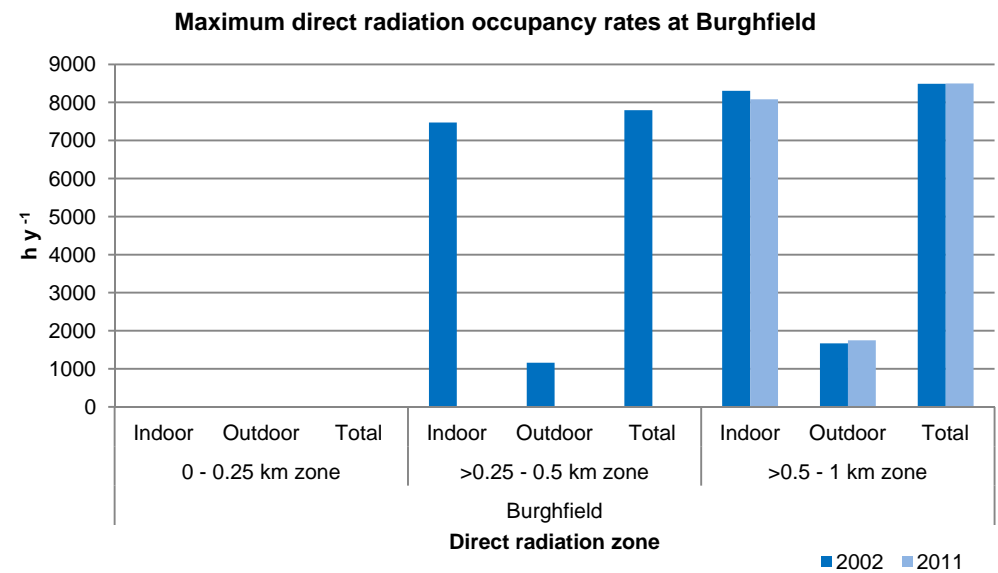
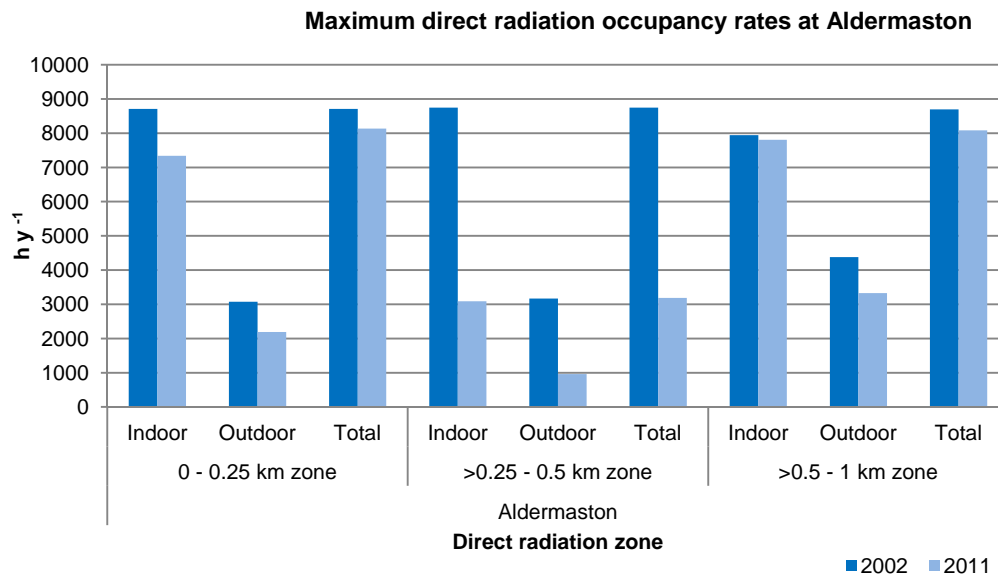
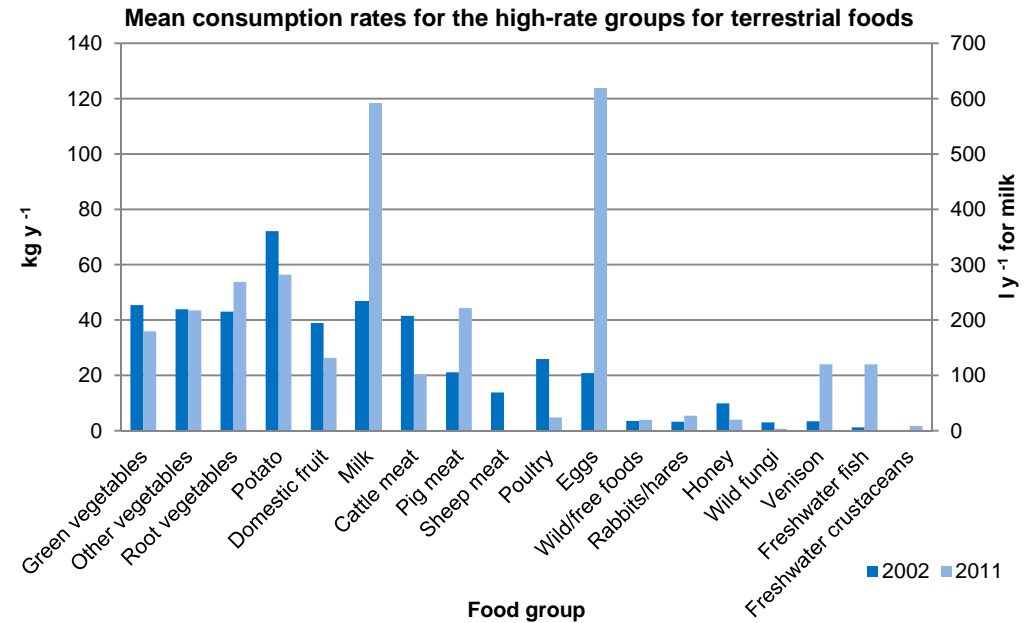
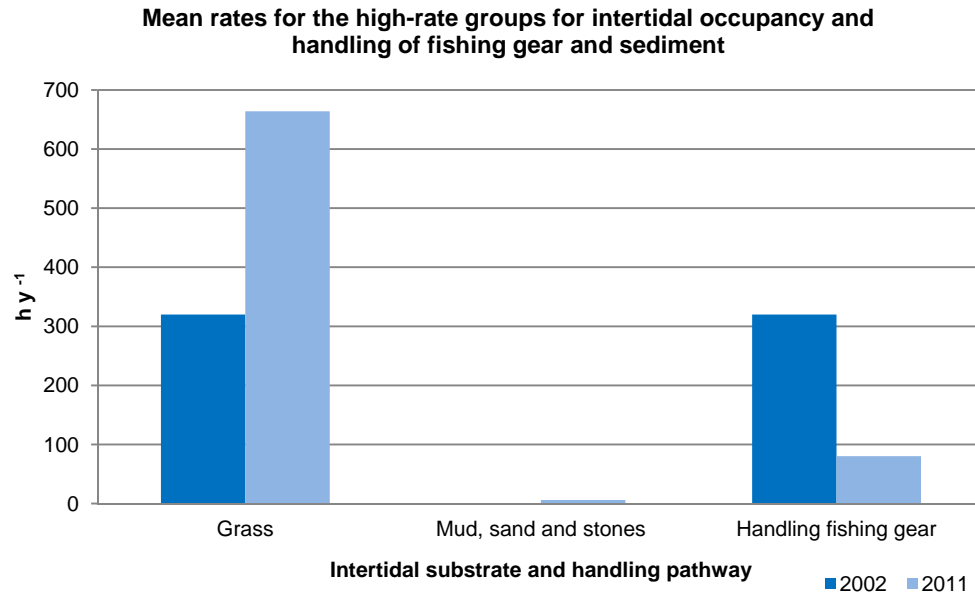
Terrestrial survey area

The terrestrial survey area in 2011 was very slightly different to that in 2002 since the position taken as the centre of the Aldermaston site in 2011 was approximately 250 metres south of the position used in 2002. There had been some notable changes to farming practices in 2011 compared to 2002. The principal types of farm produce continued to be a mix of beef cattle, lambs, milk (from dairy cattle), pigs, poultry, eggs and arable crops, but six farms had stopped keeping dairy cattle and three had stopped keeping beef cattle, switching instead to arable crops. Ten of the farms identified in 2002 had become residences in 2011; the land was taken over by other farms or they grew horse feed and kept horses. The steep increase in the mean consumption rate for the high-rate group for milk was due to a single high rate consumer who lived on a dairy farm, and the increase for egg consumption was attributed to new people involved in egg production who consumed large amounts of their own produce.

Direct radiation survey area

As the two sites are greater than 2 km apart, they have separate direct radiation survey areas. The significant decreases in the highest occupancy times in the $>0.25 - 0.5 \text{ km}$ zone at Aldermaston were attributed to residents who were interviewed in 2002, but declined to be interviewed in 2011. At Burghfield, residents were interviewed in the $>0.25 - 0.5 \text{ km}$ zones in 2002, however the residential properties in this zone were derelict in 2011.

Figure 20. Consumption, occupancy and handling rates from the 2002 and 2011 Aldermaston and Burghfield habits surveys



5.2 Barrow and the south-west Cumbrian coast

One habits survey has been undertaken in the period between 2002 and 2012; which was in 2012. The main results from this survey are summarised in Figure 21.

Aquatic survey area

The aquatic survey area covered the intertidal areas along the coast of Cumbria between Tarn Point in the north and Roosebeck in the south, and the adjacent sea area up to 10 km offshore. The Duddon Estuary, Walney Channel and the shore of Walney Island were included. The discharges from the Barrow nuclear site are minor compared with those from other nuclear sites located on the north-west coast of England. The coast and sea area in the vicinity of Barrow-in-Furness and south-west Cumbria may be affected by discharges of liquid radioactive waste from these sites, most notably Sellafield, and the results of this survey are also relevant to those sites. Commercial fisheries in the area were limited and only one full-time commercial fisherman and a few part-time fishermen were identified. Several different commercial fishing activities were identified and most were on a very small scale. Three wildfowling clubs were identified whose members shot a wide variety of wildfowl for consumption. Sheep were identified grazing on salt marsh at seven farms in the aquatic survey area, two of which were also in the terrestrial survey area. Two houseboats were identified; both the vessels were kept on the upper shore and they rested on mud and sand for most of the time. Occupancy rates were obtained for employees and a contractor working in close proximity to sewage, sewage sludge and sewage cake at a treatment works that received liquid waste from the site via a sewer.

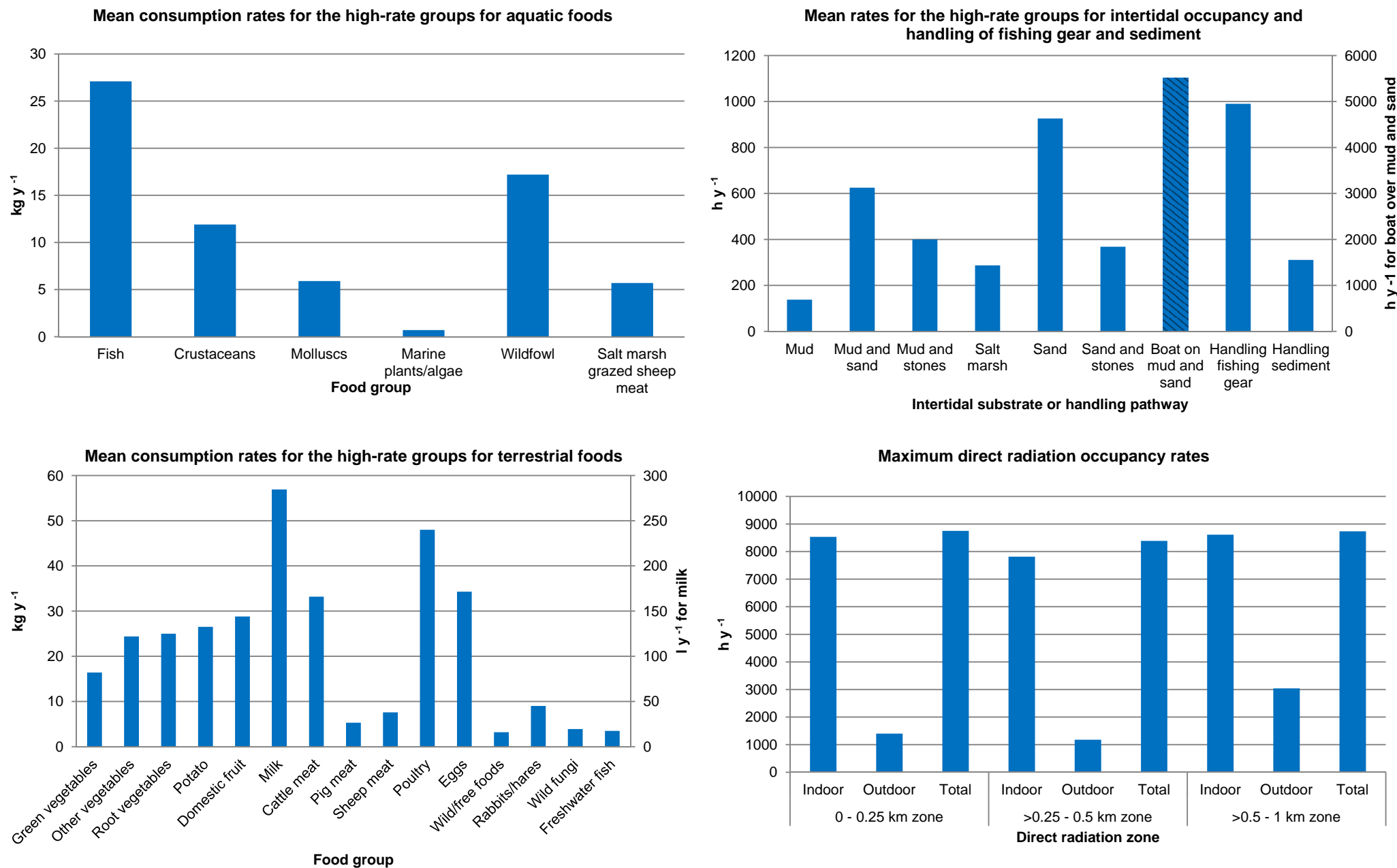
Terrestrial survey area

Fifteen farms and smallholdings were identified that farmed the land in the terrestrial survey area. They produced milk (from dairy cattle), beef cattle, lambs and geese. The farmers and their families consumed foods that were produced commercially on their land and also other foods that they produced solely for their own consumption. Seventeen allotment sites with approximately 740 plots in total were identified where a variety of fruit and vegetables were grown.

Direct radiation survey area

Occupancy rates were obtained for residents, visitors, children attending school, and people working and undertaking recreational activities in the area. With the exception of the highest outdoor occupancy rate in the 0 – 0.25 km zone, which was for a worker, the highest indoor, outdoor and total occupancy rates in the 0 – 0.25 km, >0.25 – 0.5 km and >0.5 – 1.0 km zones were for residents, one of whom also attended school in the area.

Figure 21. Consumption, occupancy and handling rates from the 2012 Barrow and south-west Cumbrian coast habits surveys



5.3 Devonport

There have been two habits surveys undertaken in the period between 2002 and 2012; these were in 2004 and 2011. The main results from these surveys are summarised in Figure 22. For the purposes of the habits surveys the Devonport Royal Dockyard and HMNB Devonport were considered together as a single site.

Aquatic survey area

The aquatic survey area in 2004 and 2011 covered the tidal waters and intertidal areas north of a line extending from Cawsand to the western end of the Plymouth Breakwater, along the breakwater and from the eastern end of the breakwater to Staddon Point. The survey area included Plymouth Sound, the Hamoaze and the tidal stretches of the rivers Lynher, Tamar, Tavy and Plym. A number of fishing restrictions applied to the aquatic survey area since the rivers were important nursery and conservation areas and there was a large amount of shipping activity. In 2004, occupancy rates were obtained for people living on houseboats that were resting on mud at low tide. In 2011, it was reported that people were living on houseboats in the area but the survey team were not permitted access to the boatyards/marinas and therefore quantitative data could not be obtained. Occupancy rates were obtained for employees working in close proximity to sewage sludge at the sewage treatment works in 2004 and 2011. One allotment holder was identified using seaweed as a fertiliser in 2004 and 2011.

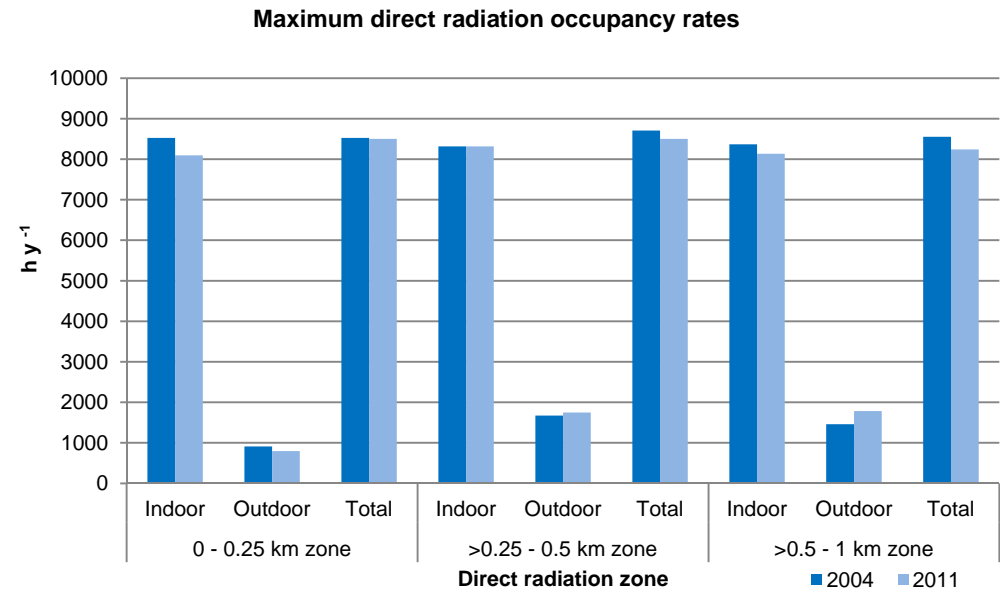
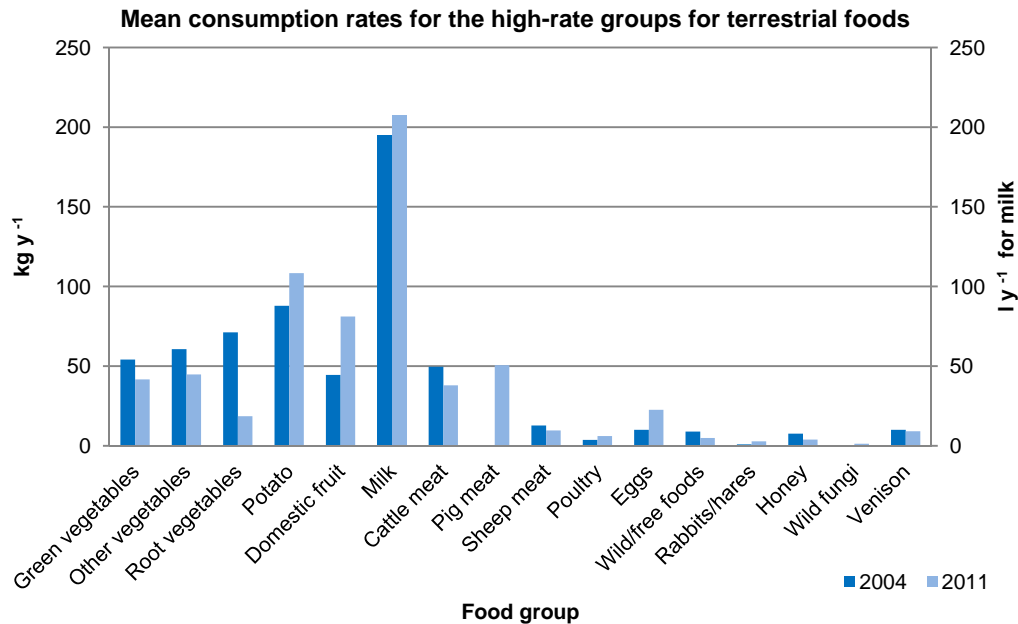
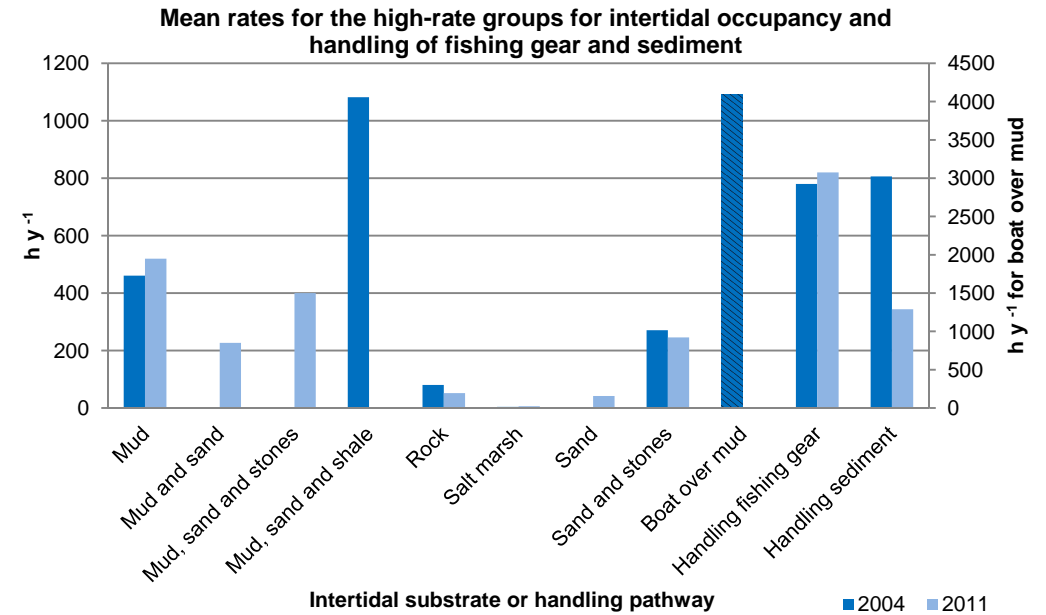
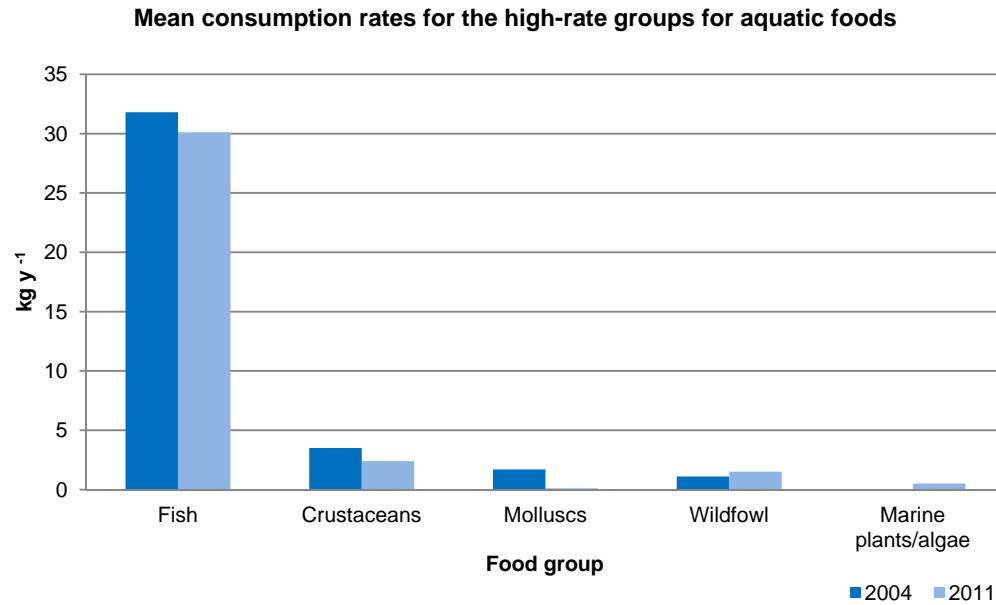
Terrestrial survey area

Activities in the terrestrial survey area were broadly similar in 2011 and 2004. The principal types of farm produce continued to be a mix of beef cattle, lambs, milk (from dairy cattle), and arable crops. Small changes were identified in 2011; one farmer who produced beef cattle in 2004 had switched to growing arable crops in 2011 and one farmer who produced a small amount of geese and turkeys for sale in 2004 had switched to producing a small number of pigs in 2011. Of the 20 allotment sites that were identified in 2004, 19 were still open and one was no longer in use in 2011.

Direct radiation survey area

Activities identified in the direct radiation survey area in 2004 and 2011 were similar and included people residing, working, visiting, attending school and attending day care. In 2004 and 2011 the highest indoor, outdoor and total rates were for residents, with the exception of the highest outdoor occupancy rate in the >0.5 – 0.1 km zone in 2011, which was for employees.

Figure 22. Consumption, occupancy and handling rates from the 2004 and 2011 Devonport habits surveys



5.4 Derby

One habits survey has been undertaken in the period between 2002 and 2012; which was in 2009. The main results from this survey are summarised in Figure 23.

Aquatic survey area

The aquatic survey area covered the River Derwent and its banks from the Raynesway Bridge, upstream of the discharge point, to the B5010 (Station Road) bridge, downstream. The only riverbank activity leading to occupancy over river washed substrates was angling. A single angling club had the rights to fish in this part of the River Derwent and they operated a strict catch and release policy. Interviewees reported that some individuals were fishing for and consuming coarse fish from the River Derwent within the aquatic survey area but this was not observed by the survey team. Occupancy in close proximity to sewage and sewage products at the Megaloughton Lane Sewage Treatment Works was identified.

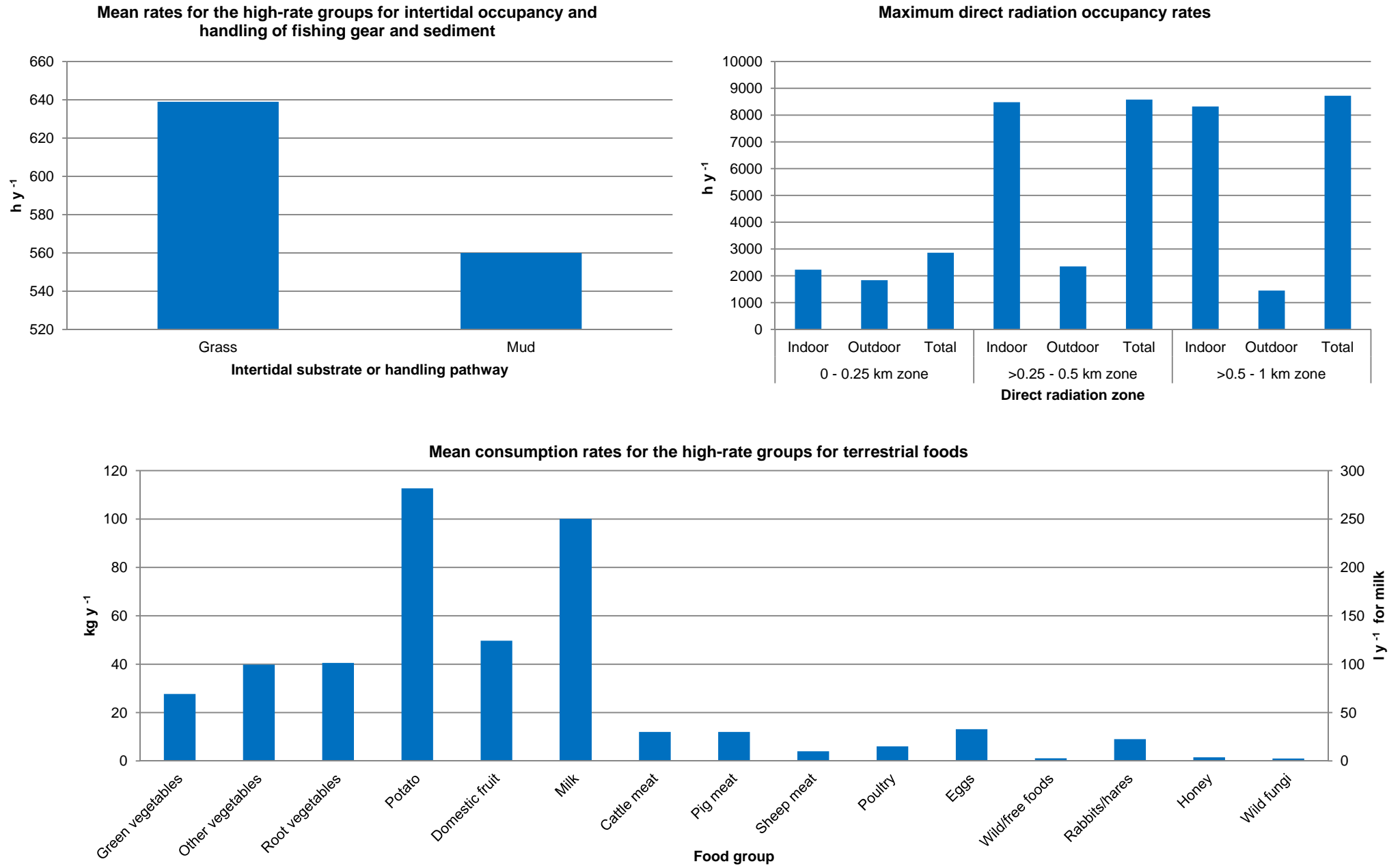
Terrestrial survey area

The city of Derby occupied a large proportion of the terrestrial survey area, particularly in the northern, southern and western sectors. The remainder of the land, predominantly in the eastern sector, was agricultural. Nine working farms were identified in the area, producing a mix of milk (from dairy cattle), beef cattle, sheep, pigs and arable crops. Farmers and their families were identified consuming milk, pork, beef, lamb, and pheasants produced or shot on their farms. Some farmers kept chickens, ducks and geese for eggs for their own families' consumption. One smallholding was identified in the survey area, which produced goats' milk, chicken eggs, goose eggs and chicken meat. The smallholder and their family were identified consuming all of the aforementioned produce. Twenty-four allotment sites, with approximately 1800 plots, were located within the terrestrial survey area.

Direct radiation survey area

The land within the direct radiation survey area was predominantly commercial and residential. The highest total occupancy rate was for a resident; the highest outdoor occupancy rate was for one person who worked in the area and the highest indoor occupancy rate was for a resident. Occupancy rates were also recorded for people undertaking recreational activities and children at a primary school.

Figure 23. Consumption, occupancy and handling rates from the 2009 Derby habits survey



5.5 Total doses for the defence establishment sites

The data and information on total dose are taken from the RIFE report series (for example, EA, FSA, NIEA and SEPA, 2012) and from the Summary of Radioactivity in Food and the Environment report (EA, FSA, NIEA and SEPA, 2010).

Public radiation doses from all sources were less than 0.5 per cent (<0.005 mSv) of the dose limits at all of the defence establishment sites. Any data below 0.005 mSv is recorded as <0.005 , and therefore any trends cannot be displayed graphically.

The most exposed group at Aldermaston and Burghfield has varied over the period from 2004 to 2011, alternating between infants consuming milk and adults spending time over riverbanks.

Total doses have not been estimated for Barrow since a full survey was only completed in 2012.

For Derby, total doses were first performed after the completion of a full habits survey in 2009. From 2009 to 2011 the most exposed group was infants consuming water abstracted from the River Derwent. Although this pathway was not quantified during the 2009 habits survey, it has been included in the total dose assessment as river water is known to be abstracted.

The most exposed group at Devonport have predominantly been adults spending time over river sediments (which included occupancy on houseboats resting on sediments), with the exception of 2005 and 2011 when adult fish consumers were the most exposed group.

Habits surveys have been conducted at two radiochemical production sites in England and Wales in the period between 2002 and 2012. These are located at:

Amersham in Buckinghamshire

Cardiff in Wales

Amersham

The nuclear licensed site houses a wide range of plants for manufacturing radiopharmaceutical products containing radionuclides such as fluorine-18 and technetium-99m, for use in medicine and research.

Cardiff

The site at Cardiff manufactures radioactively labelled materials for use in research and medical diagnostic kits. It is located on the outskirts of Cardiff, approximately 7 km north-west of the main city centre.

6.1 Amersham

There have been two habits surveys undertaken in the period between 2002 and 2012; these were in 2004 and 2009. The main results from these surveys are summarised in Figure 24.

Aquatic survey area

The aquatic survey area covered sections of the Grand Union Canal and the River Colne, including their banks. The northern limit of the survey area for the canal and the river was the Maple Lodge Sewage Treatment Works. The southern limit of the aquatic survey area for the canal was Denham Deep Lock, and for the river was the confluence of the River Colne and the River Misbourne. The types of activities identified in 2009 were for the most part similar to those identified in 2004. No interviewees were consuming aquatic foods from the aquatic survey area in 2004 or 2009. In both years there were unconfirmed reports of people removing fish from the Grand Union Canal, which was thought to be for consumption. No interviewees were undertaking activities involving the handling of fishing gear or sediment in 2004 or 2009. Occupancy in close proximity to sewage sludge and sewage cake bio-solids was recorded for employees at the Maple Lodge Sewage Treatment Works, which receives liquid discharges from the Amersham site.

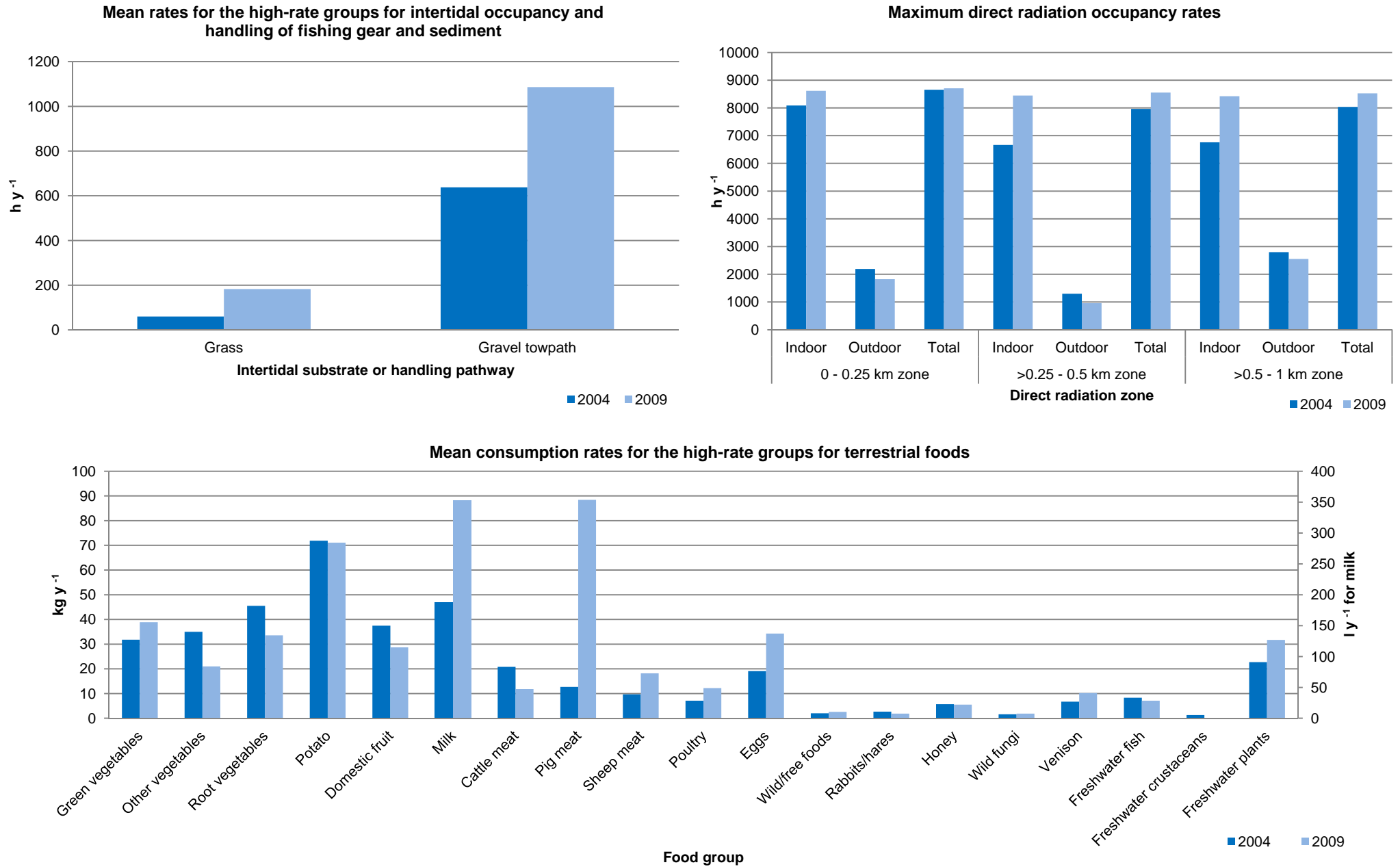
Terrestrial survey area

The north-western part of the terrestrial survey area was largely urban, encompassing the town of Amersham and a small part of the town of Chesham. The village of Little Chalfont was located directly east of the site, Chorleywood was located to the southeast and Chalfont St Giles was located to the south. There were large areas of agricultural land and woodland in between the urban areas. The production and consumption of food from the terrestrial survey area in 2009 was very similar to that in 2004. The types of farming remained a mix of beef cattle, milk (from dairy cattle and goats), sheep, pigs, poultry, chickens for eggs and watercress. The large increase in the mean rate for the high-rate group for pig meat was due to a pig farmer who was consuming large quantities of pork and pork products from his farm. The large increase in the mean consumption rate for the high-rate group for milk was due to the identification in 2009 of new milk consumers at a dairy farm and at a household where goats were kept for milk.

Direct radiation survey area

Activities in the direct radiation survey area in 2009 were very similar to those in 2004. There were no changes in the residential areas, and the commercial and educational activities identified during both surveys were the same. In the 2004 and 2009 surveys the highest total, indoor and outdoor rates in all three zones were for residents. In 2004 and 2009 in the >0.5 – 1 km zone, the highest outdoor occupancy rates was for a farmer who lived and worked in the area.

Figure 24. Consumption, occupancy and handling rates from the 2004 and 2009 Amersham habits surveys



6.2 Cardiff

One habits survey has been undertaken in the period between 2002 and 2012; which was in 2003. The main results from this survey are summarised in Figure 25.

Aquatic survey area

The aquatic survey area covered all intertidal areas between Lavernock Point and Gold Cliff, as well as the Whitchurch Brook and the River Taff downstream of the overflow from the Ystradyfodwg and Pontypridd sewer. At the time of the habits survey, only four commercial boats were registered for the Cardiff area and only three of these were working on a regular basis. Trawling was the main method of fishing, with one fisherman potting for lobsters. There was no evidence of mollusc collection in the survey area. Angling from the shore and boats was popular in the survey area and the main species being consumed were Dover sole, bass, cod and whiting. One wildfowling club was identified whose members were shooting on a regular basis. Employees at the Cardiff East Waste Water Treatment Works were identified spending time in close proximity to sewage sludge and sewage granules.

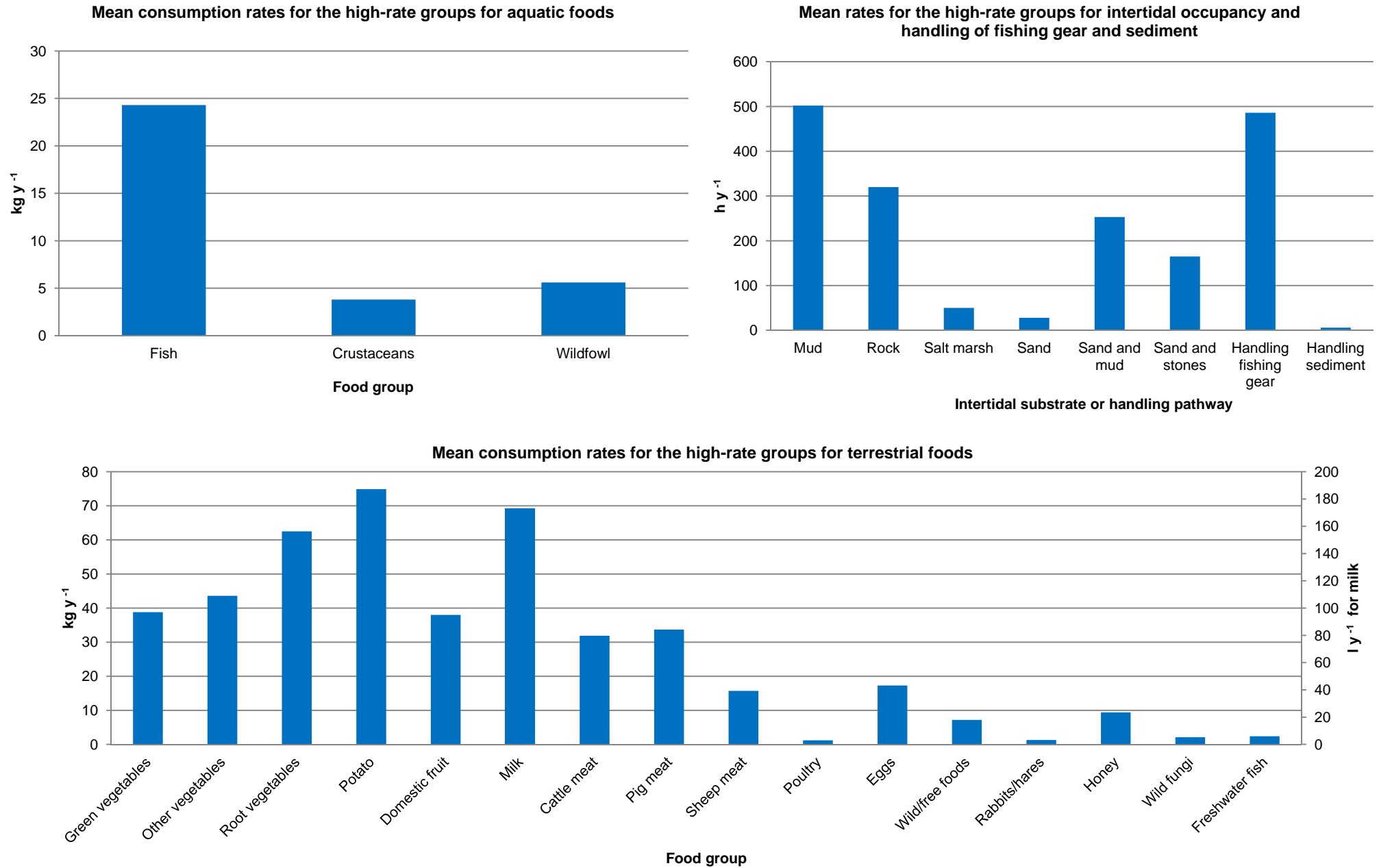
Terrestrial survey area

The terrestrial survey was highly urbanised and included parts of Cardiff and large villages, interspersed with some farms. In total 19 working farms were identified producing a mix of beef cattle, lambs, milk (from dairy cattle), pigs and arable crops. Locally reared beef and lamb were consumed by six of the farming families and pork was consumed by the family who kept pigs. Two families from the dairy farms were drinking milk from their herds. There were 19 separate allotment sites, with an estimated total of 800 plots. Wild/free foods, especially blackberries, were abundant throughout the survey area. Blackberries grew around the edges of most of the 19 allotment sites as well as in hedges along the roads in the rural parts of the survey area.

Direct radiation survey area

A direct radiation survey was not included because the Nuclear Installations Inspectorate confirmed that no radionuclides used on site would give rise to a direct radiation dose offsite.

Figure 25. Consumption, occupancy and handling rates from the 2003 Cardiff habits survey



6.3 Total doses for the radiochemical production sites

The estimated annual total doses for Amersham and Cardiff from 2004 to 2011 are presented in Figure 26. The data and information on total dose are taken from the RIFE report series (for example, EA, FSA, NIEA and SEPA, 2012) and from the Summary of Radioactivity in Food and the Environment report (EA, FSA, NIEA and SEPA, 2010).

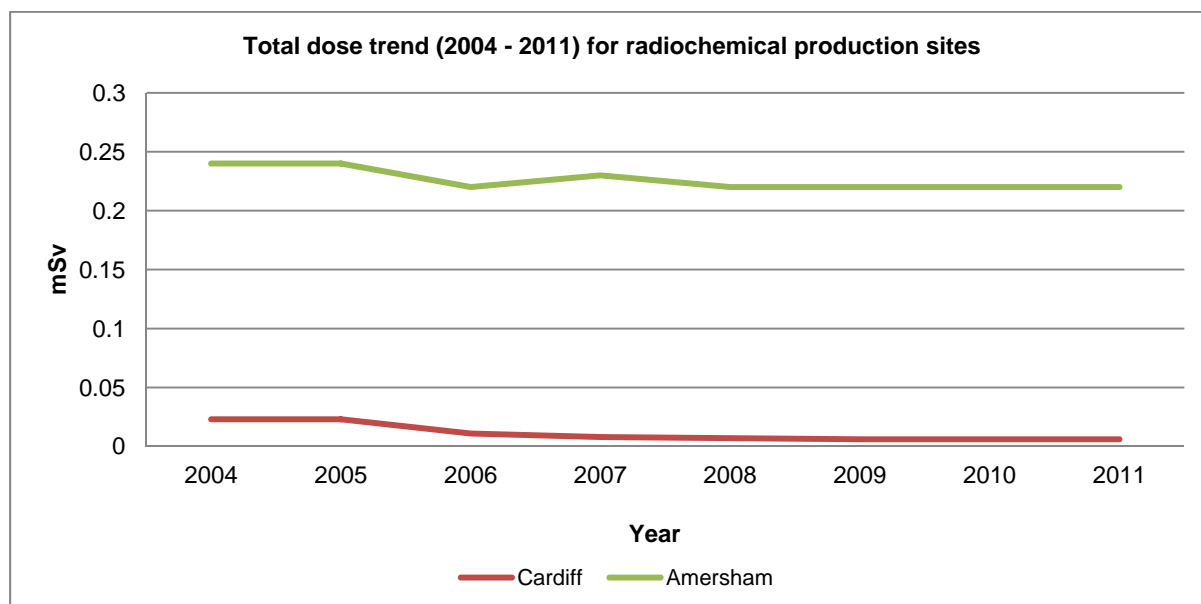


Figure 26. Total radiation exposures around the radiochemical production sites due to radioactive waste discharges and direct radiation (2004 – 2011)

For Amersham, the dose is primarily due to the direct radiation to local adult inhabitants close to the site. Total doses remained broadly similar throughout the period from 2004 to 2011.

The dominant contributions to exposure at Cardiff were the low levels of external radiation emitted from radionuclides in the intertidal sediment, which were mostly due to radioactive sources other than from the site in Cardiff. The most exposed group were predominantly prenatal children of adults who spend time over intertidal sediments or consumed fish. The most significant reductions in the total dose, prior to 2007, were largely due to lower concentrations of tritium and carbon-14 in seafood. Since 2007, the total doses continued to decrease over time, and in recent years were consistently low.

Habits surveys have been conducted at one landfill site in the period between 2002 and 2012. This was at the Low Level Waste Repository (LLWR) site located near the village of Drigg on the coast of Cumbria in north-west England, approximately 5 km to the south-east of the Sellafield nuclear site. The LLWR is the UK's national low-level waste disposal facility. The main function of the LLWR is to receive low-level solid radioactive wastes from all UK nuclear sites (except Dounreay) and many non-nuclear sites.

7.1 Low Level Waste Repository

There have been two habits surveys undertaken in the period between 2002 and 2012; these were in 2002 and 2012. The main results from these surveys are summarised in Figure 27.

Aquatic survey area

The aquatic survey area in 2012 was defined as the waters and intertidal areas between Parton and Tarn Bay, and extended 11 km offshore. The lower reaches of the rivers Ehen, Calder, Irt, Mite and Esk were also included. An aquatic survey area was not included in the 2002 survey. Approximately 15 commercial trawlers were based at Whitehaven Harbour, which is the main fishing port in the survey area. The trawlers mainly fished for *Nephrops* with a by-catch of mixed demersal fish species. Three individuals were identified potting full-time for brown crabs and common lobsters within the survey area. Several local individuals collected winkles commercially and there was commercial mussel dredging in operation near Ravenglass. Two wildfowling clubs were identified whose members were shooting in the survey area. Seaweed was identified being applied as a fertiliser for fruit and vegetable growing by five families in 2002, and by two families in 2012.

Terrestrial survey area

The land in the terrestrial survey area was predominantly agricultural. Activities in the terrestrial survey area in 2012 were broadly similar to those in 2002. The principal types of farm produce continued to be a mix of milk (from dairy cattle), beef cattle and lambs. In both surveys, one small allotment site was identified. The increase in the mean consumption rate for the high-rate group for poultry was attributed to one individual who shot and consumed large quantities of game. Blackberries, crab apples, elderflowers, rosehips, sloes, hazelnuts and mushrooms were growing wild in the survey area and these were being collected and consumed.

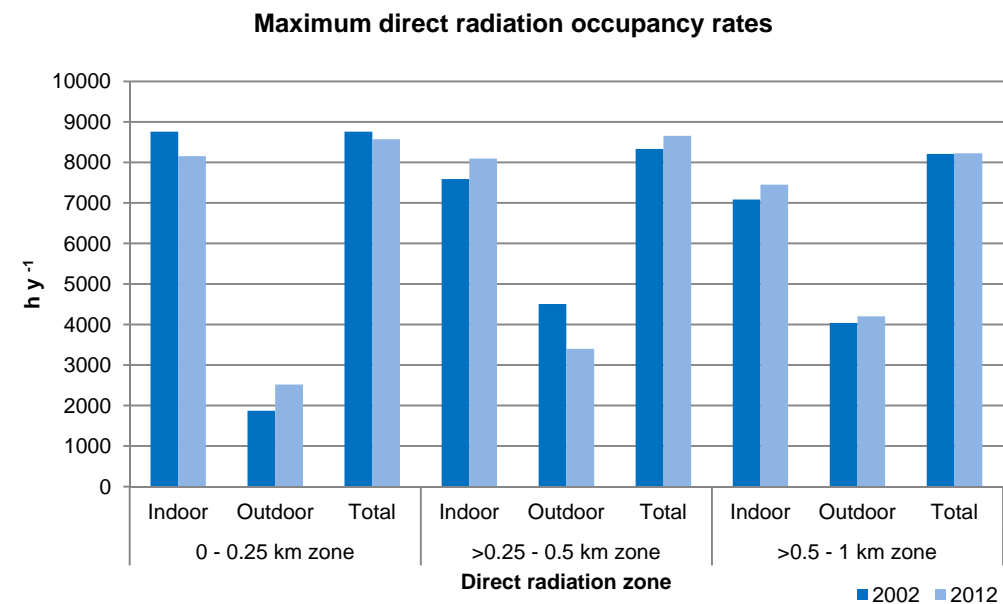
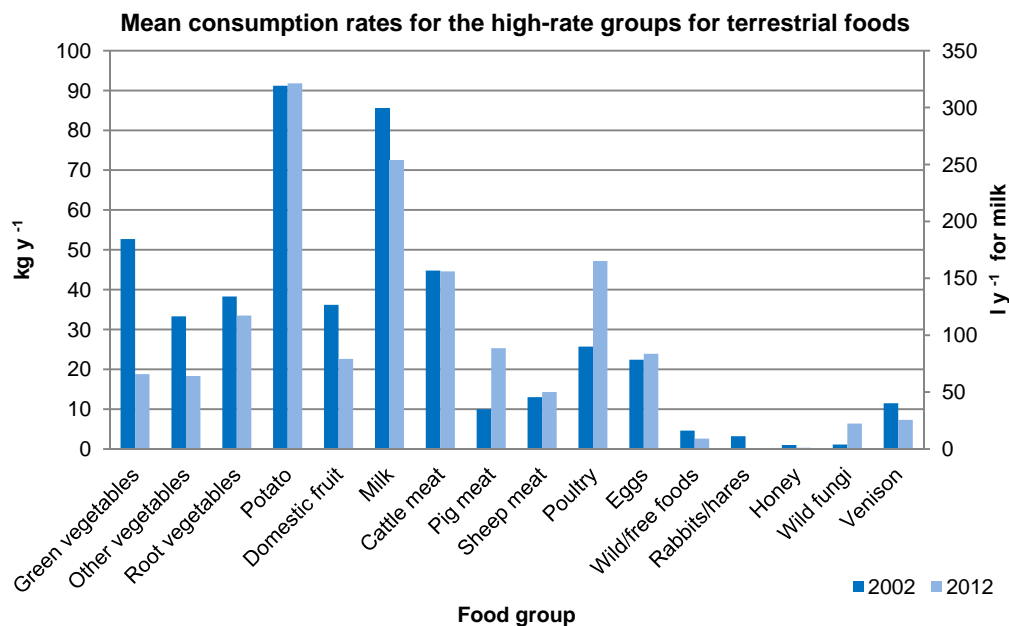
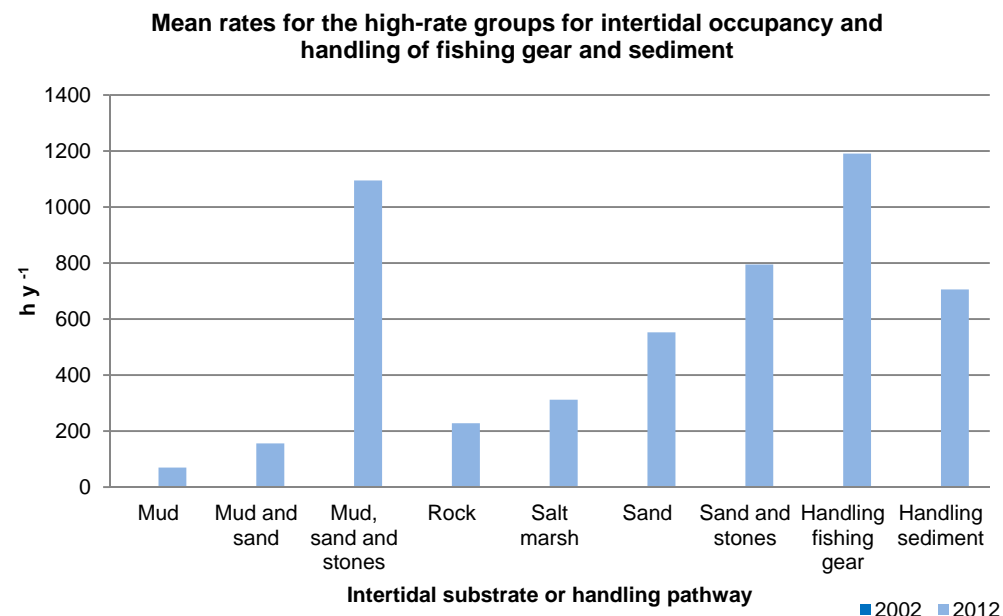
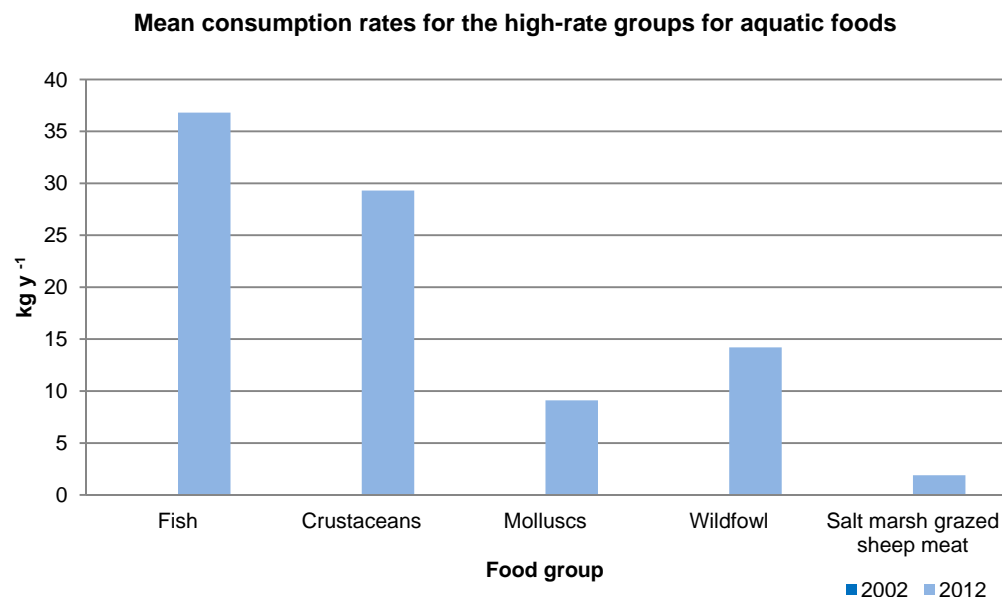
Direct radiation survey area

Activities identified in the direct radiation survey area in 2002 and 2012 were similar and included people residing, working, dog walking, bait digging and angling. Additionally in 2012, collecting shellfish and beachcombing were also identified.

Total dose

The total dose for LLWR is dominated by the effects of the legacy of discharges from Sellafield and Whitehaven. For total doses based only on gaseous releases and direct radiation from LLWR, the most exposed group have consistently been people spending time near the site (EA, FSA, NIEA and SEPA, 2012).

Figure 27. Consumption, occupancy and handling rates from the 2002 and 2012 LLWR habits surveys



8 COMPARISON OF OBSERVED AND GENERIC CONSUMPTION RATES

Mean consumption rates for adults based on national statistics have been derived by the Ministry of Agriculture, Fisheries and Food (now a part of the Department for Environment, Food and Rural Affairs) and the Food Standards Agency (Byrom *et al.*, 1995 and FSA, 2002), and these are referred to as generic rates in the habits survey reports. The generic rates are used as a baseline for comparison with the observed rates. The tables below compare the observed rates for each habits survey with the generic rates. Only food groups where generic rates have been determined are included in the tables. The fish, crustacean and mollusc food groups include marine species only. Where the observed mean consumption rate for the high rate group is greater than or equal to 20 per cent above the generic mean a green upward arrow is depicted; where it is within 20 per cent above or below the generic mean a yellow sideways arrow is depicted and where it is greater than 20 per cent less than the generic mean a red downward arrow is depicted.

Generic means

Table 2. Generic consumption rates

	Fish	Crustaceans	Molluscs	Green veg	Other veg	Root veg	Potato	Domestic fruit	Milk	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild Fungi
Generic Mean (kg y ⁻¹)	15	3.5	3.5	15	20	10	50	20	95	15	15	8	10	8.5	7	6	2.5	3

Nuclear fuel production and reprocessing sites

Table 3. Comparison of observed consumption rates with the generic consumption rates

Site	Fish	Crustaceans	Molluscs	Green veg	Other veg	Root veg	Potato	Domestic fruit	Milk	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild Fungi
Capenhurst - 2008	-	-	-	↑	↑	↑	→	↑	↑	→	-	↓	→	↑	↓	↓	↑	↓
Springfields - 2006	↑	↑	-	↑	↑	↑	→	↑	↑	↑	↑	↑	↑	↑	-	-	-	↓
Springfields - 2012	↓	↑	↓	→	→	↑	↓	↑	↑	↑	↓	↑	→	↑	↓	-	→	↓
Sellafield - 2003	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	-	↑	↓	↑	↓	↓	↑	↓
Sellafield - 2008	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	-	↑	→	↑	→	↓	↑	↓

Research establishments

Table 4. Comparison of observed consumption rates with the generic consumption rates

Site	Fish	Crustaceans	Molluscs	Green veg	Other veg	Root veg	Potato	Domestic fruit	Milk	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild Fungi
Harwell - 2007	-	-	-	↑	↑	↑	→	↑	↓	↑	↑	↑	↓	↑	↑	↓	↑	↓
Winfrith - 2003	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	→	→	→	↑	→	-	↑	↓

Nuclear power stations

Table 5. Comparison of observed consumption rates with the generic consumption rates

Site	Fish	Crustaceans	Molluscs	Green veg	Other veg	Root veg	Potato	Domestic fruit	Milk	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild Fungi
Berkeley-Oldbury - 2007	→	↓	-	↑	↑	↑	↑	↑	↑	↑	↑	↑	→	↑	↓	↑	↑	↓
Bradwell - 2007	↑	↓	→	↑	↑	↑	→	↑	-	↓	-	↑	↑	↑	↓	↓	↑	↓
Dungeness - 2005	↑	↑	↑	↑	↑	↑	↑	↓	-	-	-	↑	↓	↑	↑	↓	↑	↓
Dungeness - 2010	↑	↑	↑	↑	↑	↑	→	→	-	-	-	-	↑	↑	↓	→	→	↓
Hartlepool - 2002	↑	↑	↑	↑	↑	↑	↓	↓	-	-	-	↓	→	↑	↓	↓	↑	↑
Hartlepool - 2008	↑	↑	↑	↑	→	↑	↓	↓	-	↓	-	↓	↓	↑	↓	↑	↑	↓
Heysham - 2006	↑	↑	↑	↑	↑	↑	↑	↑	↑	↓	-	↑	↓	↑	↓	→	↑	↑
Heysham - 2011	↑	↑	↑	↑	↑	↑	→	↑	↑	↑	↑	↑	↓	↑	↓	↓	↑	↓
Hinkley Point - 2006	↑	↑	↓	↑	↑	↑	→	↑	↑	↑	↑	→	→	↑	↓	↓	↑	↓
Hinkley Point - 2010	→	↑	↓	↑	↑	↑	↑	↑	↑	↑	→	↑	↓	↑	↓	↓	↓	↓
Sizewell - 2005	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↓	↑	↑	↑	→	↓	↓
Sizewell - 2010	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↓	↓	↑	↓	↑	↑	↓
Trawsfynydd - 2005	↑	-	-	↑	→	↑	↓	↓	→	↑	-	↑	↑	↑	↑	↓	→	↓
Wylfa - 2004	↑	↑	↓	↑	→	↑	↑	↑	↑	↑	→	→	↓	↑	↓	↓	↑	↓
Wylfa - 2009	↑	↑	↑	↑	↑	↑	↑	↑	↑	-	↓	↑	↓	↑	↓	↓	↓	↓

Defence establishments

Table 6. Comparison of observed consumption rates with the generic consumption rates

Site	Fish	Crustaceans	Molluscs	Green veg	Other veg	Root veg	Potato	Domestic fruit	Milk	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild Fungi
Aldermaston and Burghfield - 2002	-	-	-	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↓	↓	↑	→
Aldermaston and Burghfield - 2011	-	-	-	↑	↑	↑	→	↑	↑	↑	↑	↑	↓	↑	↓	→	↑	↓
Barrow - 2012	↑	↑	↑	→	↑	↑	↓	↑	↑	↑	↓	→	↑	↑	↓	↑	-	↑
Derby - 2009	-	-	-	↑	↑	↑	↑	↑	↑	→	→	↓	↓	↑	↓	↑	↓	↓
Devonport -2004	↑	→	↓	↑	↑	↑	↑	↑	↑	↑	-	↑	↓	→	↑	↓	↑	↓
Devonport -2011	↑	↓	↓	↑	↑	↑	↑	↑	↑	↑	↑	↑	↓	↑	↓	↓	↑	↓

Radiochemical production

Table 7. Comparison of observed consumption rates with the generic consumption rates

Site	Fish	Crustaceans	Molluscs	Green veg	Other veg	Root veg	Potato	Domestic fruit	Milk	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild Fungi
Amersham - 2004	-	-	-	↑	↑	↑	↑	↑	↑	↑	→	↑	↓	↑	↓	↓	↑	↓
Amersham - 2009	-	-	-	↑	→	↑	↑	↑	↑	→	↑	↑	↑	↑	↓	↓	↑	↓
Cardiff - 2003	↑	→	-	↑	↑	↑	↑	↑	↑	↑	↑	↑	↓	↑	→	↓	↑	↓

Landfill site

Table 8. Comparison of observed consumption rates with the generic consumption rates

Site	Fish	Crustaceans	Molluscs	Green veg	Other veg	Root veg	Potato	Domestic fruit	Milk	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild Fungi
LLWR - 2002	-	-	-	↑	↑	↑	↑	↑	↑	↑	↓	↑	↑	↑	↓	↓	↓	↓
LLWR - 2012	↑	↑	↑	↑	→	↑	↑	→	↑	↑	↑	↑	↑	↑	↓	-	↓	↑

During the period from 2002 to 2012 there were notably high mean consumption rates for the high-rate groups of some food groups for particular surveys. These are described below. The 'observed mean consumption rates' referred to are the observed mean consumption rates for the high-rate groups for the relevant food group. Relatively high consumption rates are frequently identified in habits surveys and this is primarily because people who produce foods within the survey areas, such as fishermen, shellfish collectors, farmers, gardeners and beekeepers are targeted in the surveys and these food producers often consume high quantities of their own produce.

Aquatic food groups

Of all the surveys conducted during the period between 2002 and 2012, the observed mean consumption rate for fish was highest at Dungeness in 2010, at 87 kg y⁻¹, which was significantly higher than the generic mean of 15 kg y⁻¹ for fish. The 2012 habits survey at LLWR had the highest observed mean consumption rate for crustaceans, at 29 kg y⁻¹ compared with the generic mean of 3.5 kg y⁻¹. The observed mean consumption rate for molluscs was highest at Sellafeld in 2003, at 34 kg y⁻¹, (over nine times the generic mean of 3.5 kg y⁻¹) and the second highest was at Sellafeld in 2008 at 31 kg y⁻¹.

Terrestrial food groups

Of all the surveys conducted during the period between 2002 and 2012, the observed mean consumption rate for green vegetables was highest at Bradwell in 2007, at 59 kg y⁻¹ compared with the generic mean of 15 kg y⁻¹. The highest observed mean consumption rate for milk was at Aldermaston and Burghfield in 2011. This was 590 l y⁻¹, approximately six times higher than the generic mean of 95 l y⁻¹. The 2009 habits survey at Amersham had the highest observed mean consumption rate for pig meat, at 88 kg y⁻¹ compared with the generic mean of 15 kg y⁻¹. For poultry, the highest observed mean consumption rate was 48 kg y⁻¹ at Barrow in 2012, compared with the generic mean of 10 kg y⁻¹. The highest observed mean consumption rate for eggs was 120 kg y⁻¹ from the Aldermaston and Burghfield survey in 2011, which was significantly higher than the generic mean of 8.5 kg y⁻¹. The 2005 habits survey at Sizewell had the highest observed mean consumption rate of wild/free foods, at 32 kg y⁻¹ compared to the generic mean of 7 kg y⁻¹. The observed mean consumption rate for honey was the highest at Bradwell in 2007, at 24 kg y⁻¹ which was over nine times the generic mean of 2.5 kg y⁻¹.

Information about the diets and activities of people that may influence their exposure to radiation from nuclear licensed sites is obtained during habits surveys. In the years from 2002 to 2012, integrated habits surveys have been undertaken under a collaborative agreement between the Environment Agency, the Food Standards Agency and the Office for Nuclear Regulation. These surveys considered exposure to all sources of radiation, including liquid and gaseous discharges and direct radiation. The information obtained in the surveys has been used to estimate the doses to the members of the public in the vicinity of nuclear sites. During the period under review, methods have been developed to estimate total doses using profiles of consumption and occupancy data, and total dose has become the primary measure of exposure to radiation that is presented in the RIFE reports.

The results from the habits surveys undertaken at the 21 different nuclear licensed sites in England and Wales show that the range of foods and the rates at which they are consumed vary at different sites. For certain aquatic foods this is due to the aquatic environment in the vicinity of the nuclear site. For example, at inland sites there is little or no consumption of aquatic foods, whereas the coastal sites generally have high consumption rates of fish and shellfish. Even at coastal sites there can be large variation between the type and amount of shellfish consumed. For example, the consumption rates of molluscs at Sellafield are consistently high, whereas at other sites such as Devonport, Hinkley Point and Berkeley/Oldbury molluscs are consumed in very small quantities or not at all.

The consumption rates and occupancy rates also vary between surveys undertaken at the same sites in different years. In the aquatic survey areas, differences have been noted where there have been changes in fishing practices, for example at Hinkley Point, where a reduction in the number of fishermen resulted in a decrease in the consumption rate of fish and decreases in the rates for intertidal occupancy and handling fishing gear. In the terrestrial survey areas, differences in farming practices or the habits of farming families have resulted in changes in consumption rates, for example, the consumption rates of milk at Amersham almost doubled between 2003 and 2009, whereas at Springfields, milk consumption reduced dramatically between 2006 and 2012.

This summary of habits surveys demonstrates that there are significant differences between the observed mean consumption rates for the high-rate groups and the generic mean consumption rates for most food groups. It also shows that the observed mean consumption rates vary between sites and between years at the same site.

Site-specific surveys undertaken at regular intervals provide more accurate and up-to-date consumption rates than data from national statistics. Site-specific habits data are used to provide realistic assessment of doses to the public near nuclear sites and are also used to direct and improve the current monitoring programmes.

This report was undertaken on behalf of the Environment Agency, the Food Standards Agency and the Office for Nuclear Regulation. Gratitude is expressed to the project officers for these organisations who provided guidance during the drafting of the report.

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Head office
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Pakefield Road, Lowestoft,
Suffolk NR33 0HT UK

Tel +44 (0) 1502 56 2244
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