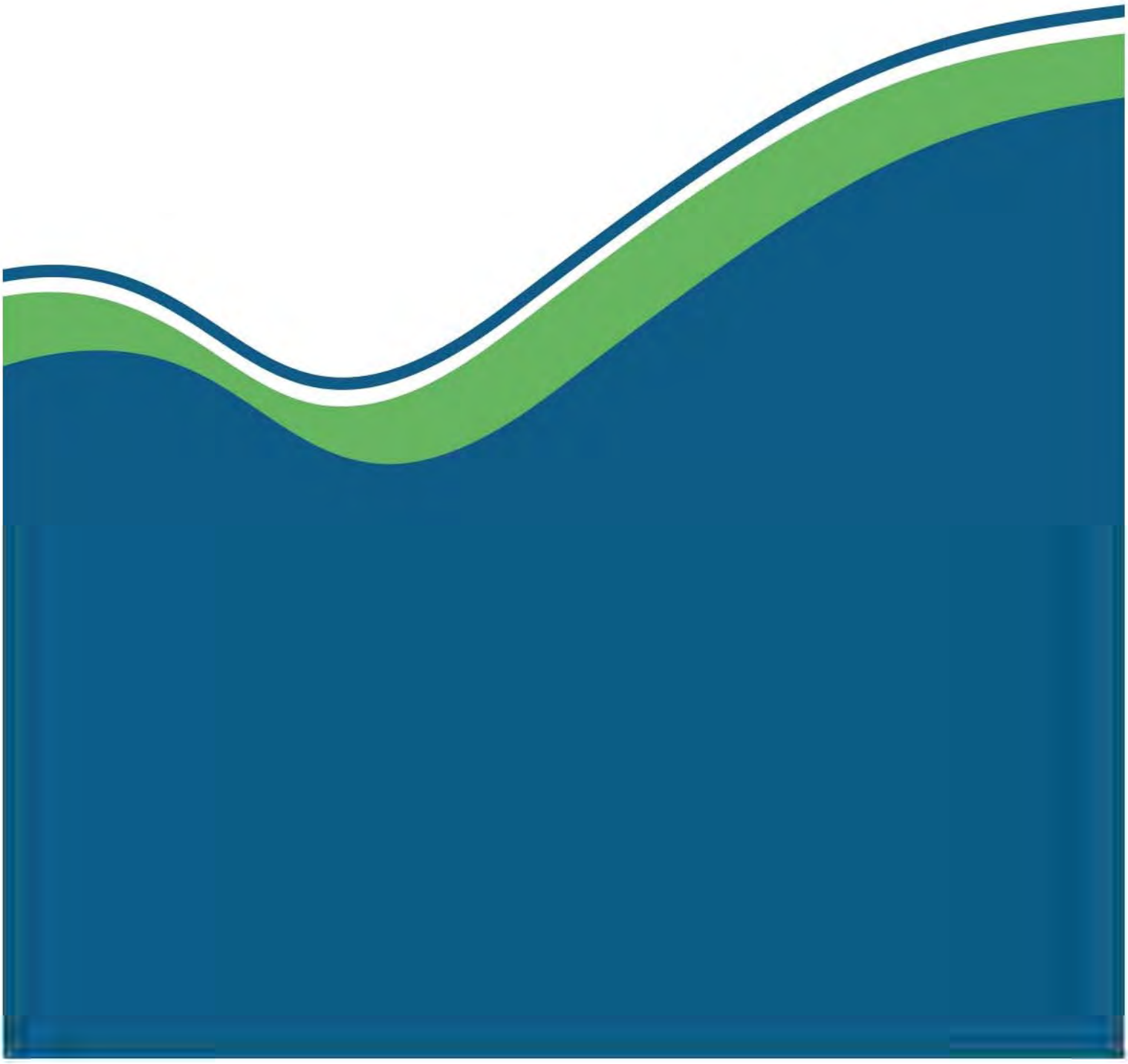
Radiological Habits Survey: Dunnet Bay, 2009



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Environment Report RL 14/13

Final report

Radiological Habits Survey: Dunnet Bay, 2009

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SUMMARY

A survey of the habits and consumption patterns of members of the public was undertaken in the Dunnet Bay area in 2009 in order to collect information for use in determining the probability of people encountering radioactive particles, which are present in the marine environment and originate from the Dounreay nuclear research facility. The survey area covered the intertidal areas and waters of Dunnet Bay and its terrestrial environs. Dunnet beach was the primary focus of the survey but Murkle beach and Peedie beach were also included.

The physical characteristics of the survey area and the access points to the coast are described and quantitative data for intertidal occupancy rates, handling rates of fishing gear and sediments, occupancy rates in and on water, consumption rates of aquatic foods and consumption rates of terrestrial foods originating close to the shore, for members of the public, are presented.

A wide range of intertidal activities, mainly recreational pursuits, were recorded taking place on Dunnet beach, which was the largest beach in the survey area. Zone 2 was the busiest part of Dunnet beach and activities in this area included playing, sitting on the beach, building sandcastles, eating picnics, sunbathing and paddling, as well as swimming, surfing and body boarding offshore. People were undertaking activities along the whole length of Dunnet beach, which included dog walking, walking, bird watching, angling and collecting seaweed. People were collecting shells and stones on Dunnet beach and it was reported that fossils were collected on the shingle area at the southern end of the beach. An annual beach clean was undertaken by contractors along Dunnet beach. Winkles were collected in Zone 7 and bait digging was a popular activity in Zone 8. Activities that could result in the inadvertent ingestion of sand included eating picnics on the beach, children playing with sand, playing ball games and quad biking. Additionally, there were occasional very strong winds where sand was blown into the faces of people on the beach. A small number of people were angling, walking, dog walking and horse riding on Murkle beach and were walking and dog walking on Peedie beach. Fishing activities included creeling for crabs and lobsters on the northern and the southern sides of Dunnet Bay and bag-netting for salmon on the southern side of the bay.

In warm weather people typically wore shorts and short sleeved shirts and either flip-flops, sandals or were barefoot. Children generally had a greater area of skin exposed and often wore bathing costumes. In cooler weather people were predominantly fully clothed and typically wore trousers, shirts, jackets and sturdy shoes.

The consumption of small amounts of aquatic foods, including fish, crustaceans, molluscs and seaweed, caught or collected from Dunnet Bay were recorded. The consumption of small amounts of terrestrial wild foods was identified; wild fungi were collected from the Dunnet beach sand dunes and watercress was collected from the stream at the southern end of Dunnet beach.

1 INTRODUCTION

Radioactive particles, which may contain small fragments of irradiated fuel, from the Dounreay nuclear research facility in Caithness have been found on the shore in several places along the Caithness coastline during monitoring work conducted by Dounreay Site Restoration Ltd and its predecessor, the United Kingdom Atomic Energy Authority. In the Dunnet Bay area, one particle was found on Dunnet beach during 2005 and two particles were detected on Murkle beach, one in 2007 and another in 2009. These were all classified as 'minor particles' that would have no significant health effects if in contact with the skin or ingested (DPAG, 2006).

The Scottish Environment Protection Agency (SEPA) is responsible for protecting the environment and the public from the effects of artificial sources of radioactivity. In order to evaluate the chance of somebody coming into contact with a radioactive particle that may be present in the environment, it is necessary to have information on the behaviour of individuals that may bring them in to contact with a particle. Members of the public could be exposed to particles in three main ways:

- By skin contact
- By ingestion of particles, either through consumption of foods or inadvertent ingestion of sediment or seawater
- By inhalation of particles suspended in the air or sea spray

The Centre for Environment, Fisheries & Aquaculture Science (Cefas) has previously conducted surveys of human habits in the Dounreay area for SEPA's routine nuclear monitoring programme, most recently in 2008 (Clyne *et al*., 2011) and in 2003 (Tipple *et al*. 2004). However, since these surveys considered habits relating to routine discharges from the Dounreay site and covered a large area, they provided only general information for the Dunnet Bay area.

SEPA commissioned Cefas to undertake a habits survey in the Dunnet Bay area in 2009 in order to specifically investigate those activities where members of the public could be exposed to radioactive particles from the Dounreay nuclear site. This report presents the results of the survey, which can be used to aid the targeting of future beach monitoring work in Dunnet Bay, and can also be used in conjunction with information on the density of particles in the environment, to calculate the probability of members of the public encountering a particle.

2 THE SURVEY

2.1 Survey aim and objectives

The survey aim and objectives were provided by SEPA. The aim of the habits survey was to identify activities undertaken on the intertidal areas and waters of Dunnet Bay, and the consumption of foods from the Dunnet Bay area, in order to assist SEPA in assessing the potential for a member of the public to be exposed to a radioactive particle.

The survey objectives were to investigate the following:

- Intertidal activities where people come into contact with sediments
- Activities involving the handling of fishing gear and the handling of sediment
- Activities taking place in and on the water
- Activities which are novel or specific to the Dunnet Bay area
- The typical clothing worn during these activities in order to provide an indication of the area of skin exposed
- If people have a preference for spending time on a particular area of Dunnet beach
- The collection and consumption of aquatic foods from the whole of Dunnet Bay
- The collection and consumption of terrestrial wild foods from the immediate terrestrial area surrounding Dunnet Bay
- Access points to the shoreline
- Beach sediment types

2.2 Conduct of the survey

Prior to the survey, information relating to activities in Dunnet Bay and access to the beaches was obtained from internet searches, Ordnance Survey maps, and from previous habits surveys undertaken around the Dounreay nuclear site.

The fieldwork was carried out from 22nd to 29th July 2009, which included one weekend, and was during the school summer holiday. Interviews were conducted with people encountered in the survey area, and where possible, people were asked about their intertidal activities, handling of fishing gear and sediment, activities in and on the water, consumption of foods, and any other information of possible use to the survey. Interviews were generally conducted between the hours of 9 am and 5 pm since information gained from regular beach users confirmed that this was the main time that people used the beaches. Nevertheless, interviews that were conducted during the day covered activities undertaken in the evening. The beaches in Dunnet Bay were visited at various times of the day and various states of the tide in order to identify the range of activities taking place. Castletown

Harbour and Dwarwick Pier were also visited to identify any commercial and non-commercial fisheries occurring within Dunnet Bay. General information, such as access to the shoreline, beach sediment types and daily weather conditions was also recorded.

2.3 Survey area

The survey area, located approximately 20 km east of the Dounreay nuclear site, encompassed the intertidal areas and waters of Dunnet Bay and its terrestrial environs (see Figure 1). Three beaches were within the survey area; Dunnet beach, which was the primary focus of the survey, Murkle beach and Peedie beach. Dwarwick Pier and Castletown Harbour were also included.

The beach sediment types in this report are as recorded at the time of the survey. However, it should be noted that these may change over time.

Dunnet beach

Dunnet beach is predominantly sand and is approximately 3 km long. It is backed by sand dunes. At low tide there is a vast expanse of exposed sand. The Mean High Water Springs (MHWS) mark is approximately 50 m from the upper edge of the beach, and the Mean Low Water Springs (MLWS) mark is approximately 300 m from the upper edge of the beach (see Figure 2).

Numerous access points to Dunnet beach were identified and these are shown in Figure 2. There were three major access points to the beach, which were near the three main car parks located off the A836 road, and there were eight minor access points, which were reached via footpaths and were spread along the beach. National Grid References for the major and minor access points are listed below, from north to south:

Major access points	**Minor access points**
ND 2189 7049 (Near the Seadrift Visitors Centre and car park)	ND 2181 7076
ND 2150 6896 (Near the mid-sands parking area)	ND 2183 7070
ND 2014 6820 (Near the Castletown parking area)	ND 2190 7036
	ND 2187 7005
	ND 2184 6996
	ND 2054 6825
	ND 2044 6821
	ND 1995 6832

Figure 1. The location of the survey area in relation to the Dounreay nuclear site

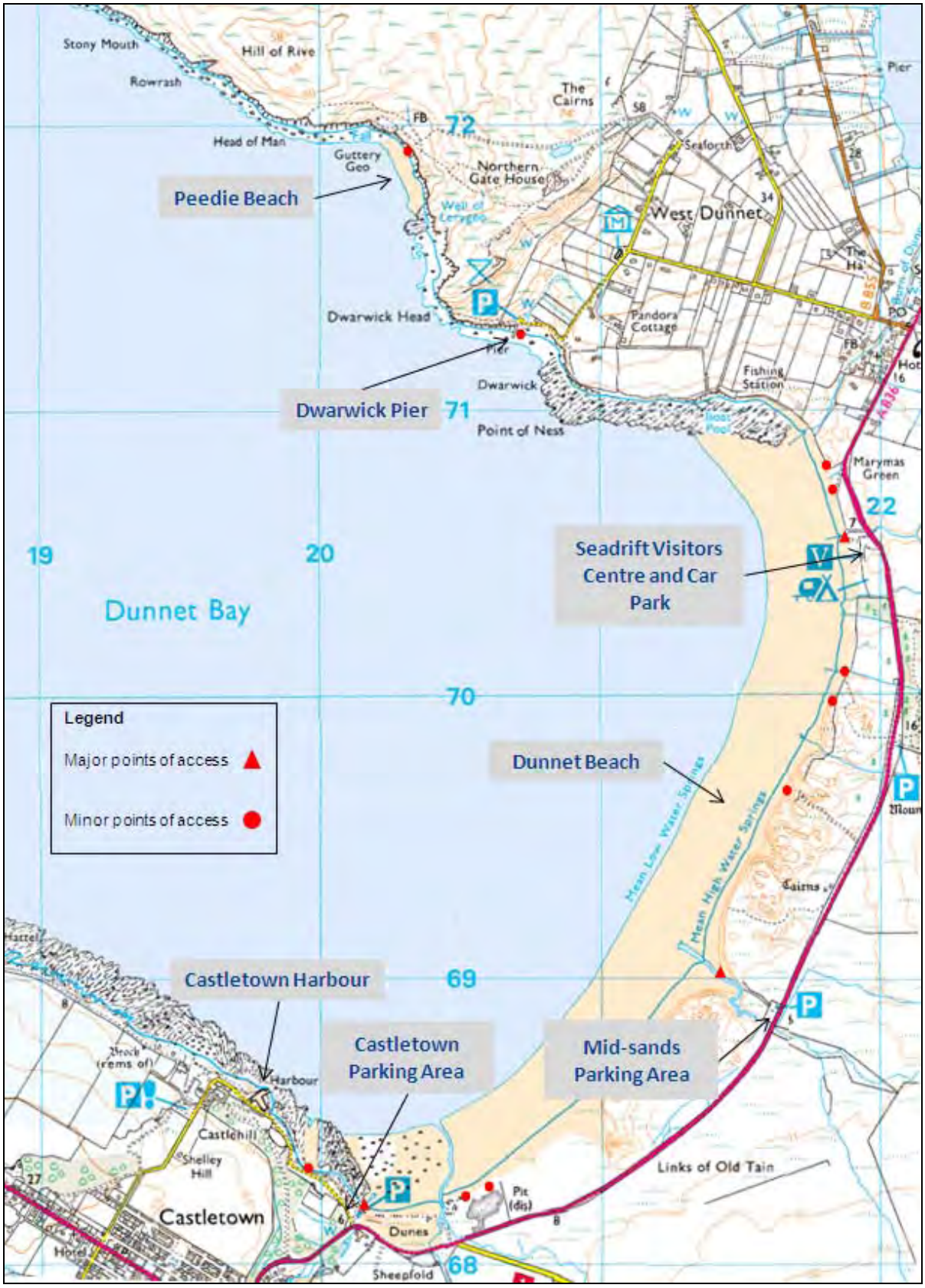

Figure 2. Ordnance Survey 1:25000 map showing Dunnet beach, Peedie beach and their access points

The northern extent of Dunnet beach is bordered by a large rocky area that forms part of Dunnet Head, and on the middle to lower shore there was a large area of worm casts (see Figure 3).

Figure 3. The northern part of Dunnet beach

Dunnet beach was relatively flat and large areas of sand remained wet on the falling tide. On the mid to lower shore there were slight undulations in the sand where sea water collected and water from various streams and burns drained onto the beach, which created shallow gullies and sand banks (see Figure 4). The wet sand was generally observed to be firm and people walking on the sand hardly disturbed the surface, although there were also areas of soft sand where footprints left a deeper impression. Above the strand line the sand remained generally dry except in periods of rain. At the foot of the higher dunes there were areas of soft loose sand and around the lower dunes there were firmer areas where the surface of the sand formed a crust. An array of seaweed, shells, flotsam and jetsam were observed along the strandline.

The sand dunes were for the most part high, steep sided and were predominantly covered with thick grass with patches of soft sand (see Figure 5). The dunes were eroding in places, particularly near the sandy paths through the dunes.

Figure 4. The main area of Dunnet beach

Figure 5. Dunnet beach sand dunes

To the south of Dunnet beach, near Castletown, there were areas of flat shelving rocks interspersed with distinct areas of sand, stones, seaweed and rock pools (see Figure 6).

Figure 6. The southern part of Dunnet beach

West of this area was a very small sand beach (see Figure 7), which was popular with bait diggers due to the abundance of lug worms (*Arenicola marina*).

Figure 7. Bait digging area at the southern end of Dunnet beach

Murkle beach

Murkle beach is situated on the southwest coast of Dunnet Bay (see Figure 1). The area was accessed via a minor road and a farm track, both of which terminated close to Murkle beach. No designated parking areas were identified close by and the nearest place to park was a lay-by on the main road, approximately 1 km from the beach. Two access points to the beach were identified, one near the end of the road at NGR ND 166 693 and the other at the end of the track at NGR ND 167 692. These are shown in Figure 8.

The beach at Murkle Bay was 0.5 km long and had rocks at either end. The beach was gently sloping and was predominantly sand on the upper shore. The mid and lower shore was sand and stones, and there was an area of large stones covered with seaweed on the southern part of the lower shore (see Figure 9). The Mean Low Water Springs (MLWS) mark and Mean High Water Springs (MHWS) mark are a distance of approximately 25m and 150 m from the upper edge of the beach, respectively.

Figure 8. Ordnance Survey 1:25000 map of Murkle beach

Figure 9. Murkle beach

Peedie beach

Peedie beach is located in a very small secluded cove on the northeast coast of Dunnet Bay (see Figure 1). There was no road access to the area but the beach could be reached by walking from Dwarwick Pier or West Dunnet. The sand beach was interspersed with rocks and was backed by cliffs (see Figure 10).

Figure 10. Peedie beach

Dwarwick Pier and Castletown Harbour

Dwarwick Pier is located to the southeast of Peedie beach (see Figure 2). There was an access road and a parking area and commercial and non-commercial fishermen frequently used the stone pier and adjacent slipway. During the survey, people were observed launching angling boats and creel boats from the slipway and several small open boats were observed moored along the pier. The shore either side of the pier was a mixture of large boulders and shelving rocks.

Castletown Harbour is located at the southern end of Dunnet Bay (see Figure 2). It is a small walled harbour with a slipway, and during the survey, several small fishing boats and two small open boats for servicing static fishing gear were observed moored in the harbour.

3 OBSERVATIONS

3.1 Headcount and weather conditions observed during the survey

The number of people observed and the activities that these people were undertaking on the intertidal areas and in the waters of Dunnet Bay were recorded each time a location was visited during the fieldwork. The results are presented in Appendix 1. Head counts were obtained during the periods listed for all people observed in order to provide an overview of the number of people using the beaches at different times and also to provide a record of the number of people that were observed but not interviewed. Occasionally on Dunnet beach people were dispersed over a large area or were moving in opposite directions therefore it was not possible for the survey team to reach all of the people on the beach. The headcounts for Dunnet beach were taken at vantage points that provided a clear view over extensive areas of the beach.

Dunnet beach was the most popular area in Dunnet Bay due to the easy access and parking. No one was observed on Murkle beach and Peedie beach during the fieldwork; however, people were interviewed at Dunnet beach that spent time on these beaches. Commercial fishermen, hobby fishermen and anglers were observed at Dwarwick Pier and Castletown Harbour.

The observed weather conditions were also recorded during the fieldwork and are presented in Appendix 1. The weather was very changeable, often throughout the day, and this had a bearing on the number of people on the beach and the activities that were being undertaken. There were some warm sunny periods when numerous activities were taking place but temperatures were often kept cool by strong winds and intermittent rain. People undertaking activities such as dog walking, walking and angling were not deterred from using the beaches by poor weather conditions.

3.2 Activities occurring in Dunnet Bay

Dunnet beach was the largest of the beaches in Dunnet Bay and it was divided into zones during the data analysis in order to indicate the variation in occupancy on different parts of the beach. The zones are shown in Figure 11. The length of the beach was divided into eight zones and the demarcations were selected based on changes in occupancy or natural splits in the geography, such as streams or paths. The breadth of the beach was divided into three sections, termed upper, mid and lower. It should be noted that the delineation of the upper and lower sections is not the same as the Mean Low Water Springs mark and the Mean High Water Springs marks for Dunnet beach shown in Figure 2.

Figure 11. Map of Dunnet beach showing major features and survey zone demarcations

Specific activities were identified where possible, but in the situations where people were undertaking a wide range of activities, each for a short duration, and were not able to provide a breakdown of the time spent undertaking each activity, a general term 'playing' has been used. This included, for example, ball games, paddling, sunbathing, collecting stones and shells, playing with sand, kite flying, reading and eating.

The most popular area of Dunnet beach was Zone 2, which was the area in front of the car park at the Seadrift Visitors Centre. This area was popular with tourists and local people that were undertaking numerous activities such as sitting on the beach, playing, building sandcastles, sunbathing, paddling and swimming (see Figure 12). Many people were in family groups.

Figure 12. People undertaking activities on Dunnet beach in Zone 2

People who were walking, dog walking, bird watching and angling tended to use the length of the beach from Zone 1 to Zone 6 or Zone 2 to Zone 6 (see Figure 13). An annual two day beach clean of Dunnet beach was organised by the rangers at the Seadrift Visitors Centre and was undertaken by contractors. Zone 7 was infrequently used as it was a shingle area but it was reported to be a popular area for fossil collection. Zone 8 was a small area of sand that was very popular with bait diggers, and although there were numerous worm casts in Zone 1, bait diggers had a preference for Zone 8. People were walking and dog walking on the many paths over the sand dunes, and footprints and quad bike tracks were observed in the dune area on numerous occasions during the fieldwork.

Figure 13. People undertaking activities along the whole length of Dunnet beach

Within the zones, there were particular activities that were undertaken on the upper, mid or lower sections of the shore. Some people preferred to walk along the upper section of the beach on the dry sand and on windy days family groups tended to sit in this area as the nearby sand dunes provided some shelter from the breeze. In Zone 2, there was a preference for sitting on the beach in the mid section on calm days and, depending on the state of the tide, many people walked from the visitors centre car park straight down to the waters edge. Many walkers and dog walkers used the length of the beach along the mid section on the firm sand and people often walked along the water line or strand line. The lower section of the shore was predominantly used by anglers, bait diggers, people paddling and people walking along the beach at low tide.

The water off the shore of Zone 2 was popular with people paddling, swimming, surfing and body boarding since many people used the beach in Zone 2 as their base. People were also paddling in Zone 1 and Zones 3 to 6 while walking or dog walking along the length of the beach. Fishing was taking place in the waters of Dunnet Bay. One commercial creel fisherman was fishing on the western side of Dunnet Bay and one hobby creel fisherman was fishing on the eastern side of the bay. Both fishermen were catching crabs and lobsters. One commercial fisherman was using bag-nets on the western side of the bay to catch salmon and it was reported that another bag-net fisherman operated on the eastern side of Dunnet Bay.

The following activities were taking place on Dunnet beach but no quantitative data was obtained and therefore these activities have not been included in the data analysis. Nature studies, which included

rock pooling, collecting shells and walking on the beach, were organised by rangers at the Seadrift Visitors Centre for several school parties per year. The rangers also organised guided evening walks for groups of local people and tourists. It was reported that sand yachting took place on Dunnet beach.

The rangers at the Seadrift Visitors Centre reported that they had observed up to 250 people on Dunnet beach at any one time, with visitors coming and going throughout the day. This level of activity was only seen on very hot summer days, typically about ten days per year.

Very few people were identified undertaking activities on Murkle and Peedie beaches. Although no one was observed on these beaches, data were collected during interviews at other locations for people walking and dog walking on Peedie beach and for people angling, walking, dog walking and horse riding on Murkle beach.

Figures 14 and 15 illustrate the locations where particular activities were being conducted for intertidal activities and water based activities respectively. The charts show the number of people recorded undertaking each activity at each location. Note that individuals might conduct multiple activities at a single location or activities at more than one location and, for example, that an individual conducting two different activities in Zone 2 and one activity in Zone 3 is represented in the data three times.

The area where most intertidal activities were undertaken was Zone 2, although numerous activities were undertaken in Zone 1 and Zones 3 to 6. The areas where few activities were undertaken by a small number of people were Zones 7 and 8, the dunes, Peedie beach and Murkle beach. The busiest area for activities in and on water was off Zone 2.

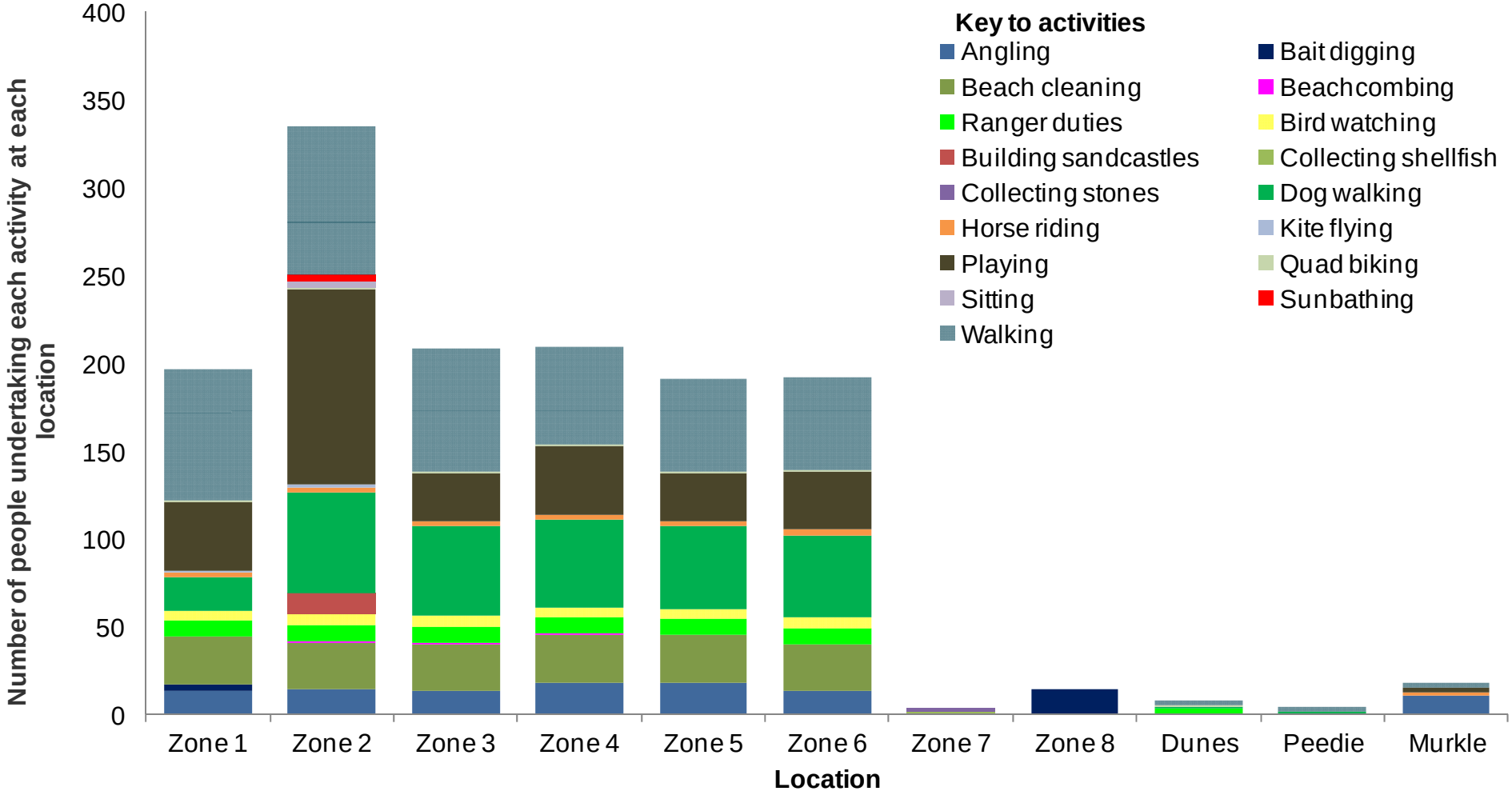

Figure 14. The number of people undertaking each intertidal activity at various locations in Dunnet Bay

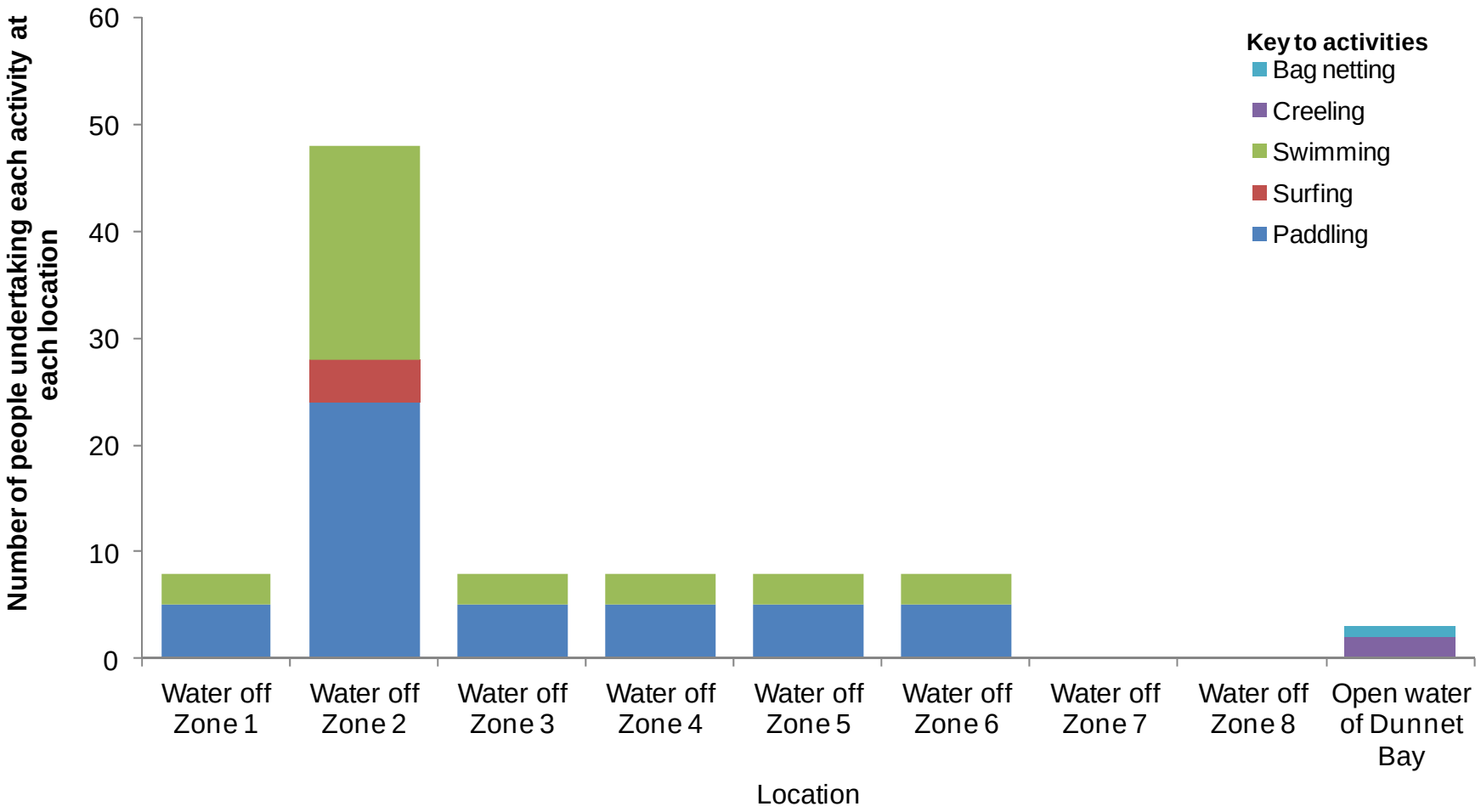

Figure 15. The number of people undertaking each activity in the water and on the water at various locations in Dunnet Bay

3.3 Novel activities

Various novel activities were identified that could lead to individuals being exposed to particles. One person collected an unidentified marine alga and a small amount of sand from Dunnet beach to use as compost on their vegetable garden. It was reported that farmers dragged ploughshares twice per year through the sand on Dunnet beach in order to clean them, although this was based on anecdotal evidence and therefore no quantitative data was obtained. An archaeological dig was taking place in the Dunnet Bay area and the archaeologists were seeking permission to extend their excavations into the dune area.

3.4 Clothing worn by people undertaking activities

Observations of the type and amount of clothing worn by individuals and the amount of exposed skin were recorded and are presented below. This information can assist in determining an individual's probability of coming into contact with a particle on the Dunnet Bay beaches.

General beach activities

Individuals undertaking general beach activities, for example, dog walking, walking, playing, rock pooling, sitting on the beach and building sandcastles, wore a wide range of clothing, dependent largely upon the weather.

In periods of warmer weather people generally wore light summer clothing, typically shorts and short sleeved shirts and approximately 30% of people undertaking leisure activities were barefoot for all or part of their time on the beach. Flip-flops, sandals and semi-enclosed plastic shoes were frequently worn and in some cases sand could enter the footwear and remain trapped next to the skin. People who were paddling in the sea were usually barefoot but a few wore semi-enclosed plastic shoes. Children generally had a greater area of skin exposed than adults undertaking the same activities, with bathing costumes and shorts being more commonly worn by children.

In periods of cooler weather the people spending time on the beach undertaking activities such as walking and beachcombing were predominantly fully clothed and were typically wearing trousers, shirts, jackets and sturdy shoes. Local people tended to be better prepared for sudden changes to the weather and usually wore more protective clothing than tourists undertaking the same activities. Dog walkers generally wore footwear such as trainers, hiking boots or Wellington boots but were occasionally bare footed.

Angling, bait digging and shellfish collection

People undertaking these activities were generally well covered, wearing trousers, waterproof jackets and sturdy footwear or Wellingtons. However, during very warm weather some people wore t-shirts and shorts. Bait diggers generally did not wear gloves nor did the only shellfish collector that was identified. Although no commercial shellfish collectors were encountered during the survey, it cannot be discounted that they operate in the area and it is known from other habits survey that commercial collectors usually wear gloves.

Water based leisure activities

Those individuals identified undertaking water based leisure activities, such as swimming and bodyboarding were predominantly wearing swimwear. However, some bodyboarders, surfers and swimmers wore wetsuits. Some very young children bathed naked.

Other observations

It was noted that sediment adhered to the skin, clothing, footwear and belongings of people on the beach and that fine or damp sediments were more likely to adhere than coarse or dry sediments. Sediment also adhered to the fur of dogs. People were often observed leaving the beach with sediments still adhering to their clothes and belongings and to their dogs. Sediments removed from the beach in this way could be transferred to people's vehicles and homes. During episodes of strong winds, sediments were blown across the beach and onto people and their belongings. It was noted that sediments were more likely to adhere to people's skin if they had applied sun cream.

3.5 Inadvertent ingestion

Individuals were noted to be consuming picnics and snacks on the beach. This could potentially lead to inadvertent ingestion of a particle adhered to foodstuffs. Approximately 22% of interviewees periodically consumed food on the beach and the majority of these were members of families eating picnics.

Also, activities such as ball games and quad biking where sediment was accidentally thrown up into people's faces and mouths increased the chance of inadvertent ingestion. Sediment was also blown into the faces of people on the beach during strong winds.

Young infants were identified spending time sitting on sand and conducting activities involving the handling of sediments such as building sandcastles and playing with handfuls of sand. This could potentially lead to the inadvertent ingestion of sediments by hand to mouth transfer.

4 DATA ANALYSIS

The data has been analysed in a variety of ways in order to facilitate the various types of calculation that may be carried out in order to determine the probability of people encountering a particle. The results of these analyses are presented in Appendices 2 to 7 and are discussed below.

4.1 Occupancy and handling rates

4.1.1 Annual and single visit occupancy and handling rates

The occupancy and handling rates are presented in Appendix 2 as hours per year and frequency and duration of single visits for each person. This information can be used in calculating the probability of encountering a particle on a single visit or on an annual basis.

People visited Dunnet beach at various frequencies. Some visited on a daily basis and these were mainly dog walkers that lived locally. Tourists based in the area and people visiting relatives often made several visits to the beach within a limited period, ranging from one to several weeks per year. Sometimes these people made more than one trip to the area within the course of a year. Anglers, both local and from further afield, usually visited the beach throughout the year. Tourists passing through the area usually visited the beach only once.

Peedie beach was used infrequently; one tourist was dog walking daily for 2 weeks, and several local people were walking on the beach once per week in the summer months.

Although no one was observed on Murkle beach during this survey, it was reported that some local people use the beach regularly. People interviewed at Dunnet beach reported that they visited Murkle beach and these included horse riders who used the beach once per month, a walker that visits once per week, and tourists that used the beach on only one occasion. During the 2008 habits survey in the Dounreay area two local people were identified that spent 45 minutes per day throughout the year walking their dogs on Murkle beach.

4.1.2 High-rate groups for occupancy and handling

High rates of intertidal occupancy and handling for adults and children were identified using two methods; the ‘cut-off’ method described by Hunt *et al.,* 1982 and the 97.5th percentile.

With the ‘cut-off’ method, the appropriate high rate was calculated by taking the arithmetic mean of the values between the maximum observed rate and one third of the maximum observed rate. The

individuals derived by the 'cut-off' method are referred to as the 'high-rate group' in this report. With small numbers of observations, as for some occupancy data, there is the possibility of a high-rate group of one person. This is allowable provided the ICRP criteria of "reasonable" and "sustainable" apply (ICRP, 2006). In such cases judgement was used, based for example, on knowledge of the individual's occupation, to ensure these criteria held good. Data analysed by the cut-off method were structured into age groups. The age groups and their relevant age ranges are based on the recommendations in ICRP 72 (ICRP, 1996), and are listed below:

Age group	**Age range in group**
3-month-old	Under 1-year-old
1-year-old	1-year-old
5-year-old	2-year-old to 6-year-old
10-year-old	7-year-old to 11-year-old
15-year-old	12-year-old to 16-year-old
Adult	17-year-old and over

The intertidal occupancy and handling rates are presented in Appendix 3 and are summarised in Tables 1 and 2 below for adults and children respectively.

Table 1. Summary of adults' intertidal occupancy and handling rates

Intertidal substrate or handling activity	Number of observations	Number of people in the high-rate group	Maximum rate of the high-rate group (h y^{-1})	Mean rate of the high-rate group (h y^{-1})	97.5th percentile rate (h y^{-1})
Rock	6	1	24	24	22
Sand	115	25	330	249	330
Sand and stones	17	12	81	34	61
Handling fishing gear	3	1	1344	1344	1299
Handling sediment	21	13	30	29	30

The only adult in the high-rate group for intertidal occupancy over rock was collecting winkles at the southern end of Dunnet beach in Zone 7. Adults in the high-rate group for intertidal occupancy over sand were undertaking the following activities: bait digging in Zone 8; angling on the lower shore from Zone 1 to Zone 6; playing in Zone 2; dog walking in Zone 1 to Zone 6; and undertaking ranger duties in Zone 1 to Zone 6 and in the dunes. People in the adult high-rate group for intertidal occupancy over sand and stones were walking and angling at Murkle beach. The only person in the adult high-rate group for handling fishing gear was a fisherman who was handling creels located in Dunnet Bay. This person's handling rate included time repairing creels and it should be noted that gloves were

worn while fishing but were not worn when repairing the creels. The activities for the adult high-rate group for handling sediment were bait digging in Zone 8 and collecting winkles in Zone 7.

Table 2. Summary of children's intertidal occupancy and handling rates

Intertidal substrate or handling activity	Number of observations	Number of people in the high-rate group	Maximum rate of the high-rate group (h y^{-1})	Mean rate of the high-rate group (h y^{-1})	97.5th percentile rate (h y^{-1})
15-year-old age group					
Rock	1	1	1	1	Not applicable
Sand	3	1	93	93	89
Handling sediment	1	1	1	1	Not applicable
10-year-old age group					
Rock	1	1	1	1	Not applicable
Sand	26	5	154	119	154
Handling sediment	5	4	14	8	14
5-year-old age group					
Rock	2	2	5	5	5
Sand	17	3	182	173	182
Sand and stones	1	1	3	3	Not applicable
Handling sediment	8	2	10	7	9
1-year-old age group					
Sand	1	1	35	35	Not applicable
3-month-old age group					
Sand	1	1	2	2	Not applicable
Sand and stones	1	1	3	3	Not applicable
Handling sediment	1	1	2	2	Not applicable

The activities undertaken by children in the high-rate group for intertidal occupancy over rock were walking and rock pooling on the rocks at the northern end of Dunnet beach. Children in the high-rate group for intertidal occupancy over sand were playing and dog walking in Zone 1 to Zone 6 and children in the high-rate group for intertidal occupancy over sand and stones were playing on Murkle

beach. Children in the high-rate group for handling sediment were playing and building sandcastles in Zone 2.

4.1.3 Water based activities

Activities were identified taking place in and on the water in Dunnet Bay. Activities where there is a high likelihood of the individual's face submerging under water have been classified as activities 'in water' as they are more likely to lead to ingestion of water and all other activities have been classified as 'on water'. Occupancy rates for activities taking place on the water and in the water for adults and children are presented in Appendix 4. High rates have not been calculated for activities in and on the water.

The activities taking place in the water in Dunnet Bay were swimming and surfing. Ten adults and 14 children were identified spending time in the water and the highest occupancy rate was 16 h y^{-1} for four adults and two children who were swimming. Other children were observed body boarding and swimming during the fieldwork. Activities taking place on the water were paddling, fishing with creels and fishing with bag-nets. Eleven adults and 14 children were identified spending time on the water and the highest occupancy rate was 900 h y^{-1} for a commercial fisherman who was creeling in Dunnet Bay.

4.2 Consumption rates

High rates of food consumption for adults and children were identified using the 'cut-off' method described by Hunt *et al.,* 1982 (see Section 4.1.2) and 97.5th percentiles.

4.2.1 High-rate groups for the consumption of aquatic foods

The results of the analysis for adults' and children's aquatic food consumption are presented in Appendix 5 and are summarised in Table 3. For the purpose of data analysis, aquatic foods were aggregated into the following four food groups: fish, crustaceans, molluscs and marine plants/algae. Adults were consuming foods from all of these groups. Children in the 10-year-old age group were consuming fish but were not identified consuming crustaceans, molluscs or marine plants. No children in the 15-year-old age group, the 5 year-old age group, the 1-year old age group or the 3-month-old age group were identified consuming seafood.

The fish consumers were: anglers and their families who consumed bass (*Dicentrarchus labrax*), mackerel (*Scomber scombrus*), pollack (*Pollachius pollachius*), cod (*Gadus morhua*) and flounder (*Platichthys flesus*) caught from Dunnet beach and Castletown Harbour; local people who consumed mackerel caught in Dunnet Bay; a fisherman who consumed salmon (*Salmo salar*) caught in Dunnet Bay; and a hobby creel fisherman/angler who consumed ling (*Molva molva*) and cod caught in the

north part of Dunnet Bay. The crustacean consumers were commercial and non-commercial creel fishermen who set creels for lobster (*Homarus gammarus*) and crabs (*Cancer pagurus*) in Dunnet Bay, and local residents who consumed lobster from Dunnet Bay. The mollusc consumer was a local resident who collected winkles (*Littorina littorea*) and mussels (*Mytilus edulis*) from the rocks in Zone 7 of Dunnet beach and collected Quahog clams (*Arctica islandica*) that had been washed up on to Dunnet beach. One person consumed green seaweed, believed to be *Enteromorpha sp*., which was collected from Peedie beach and one person consumed sea lettuce (*Ulva lactuca*) from Dunnet beach.

People in the adult high-rate group for fish were consuming all of the fish species specified above, with the exception of mackerel and salmon. People in the adult high-rate group for crustaceans were consuming crab and lobster, and the person in the adult high-rate for molluscs was consuming quahog clams, mussels and winkles. The person in the adult high-rate group for marine plants/algae was consuming green seaweed, believed to be *Enteromorpha sp*. Children in the 10 year-old age group high-rate group for fish were consuming bass and mackerel.

Table 3. Summary of adults' and children's consumption rates of aquatic foods from Dunnet Bay

Food group	Number of observations	Number of high-rate consumers	Maximum consumption rate for the high-rate group (kg y^{-1})	Minimum consumption rate for the high-rate group (kg y^{-1})	Mean consumption rate for the high-rate group (kg y^{-1})	97.5th percentile consumption rate (kg y^{-1})
Adult						
Fish	10	3	15.1	7.0	10.5	13.8
Crustaceans	4	2	8.6	4.0	6.3	8.3
Molluscs	1	1	6.5	6.5	6.5	NA
Marine plants/algae	2	1	1.1	1.1	1.1	1.1
10 year-old age group						
Fish	2	2	0.5	0.5	0.5	0.5

NA = Not applicable
NC = Not consumed

4.2.2 High-rate groups for the consumption of terrestrial wild foods

The results of the analysis for adults' terrestrial wild food consumption are presented in Appendix 6 and are summarised in Table 4. For the purpose of data analysis, the wild foods were aggregated into the following two food groups: wild fungi and freshwater plants. Two local people were identified consuming wild foods from the area; one person collected wild fungi from the sand dunes near Castletown and near the Seadrift Visitor Centre and also collected watercress from the stream at the Castletown end of Dunnet beach; and the other person collected wild fungi from the sand dunes. One of these people also consumed sorrel while walking in the area but was unable to provide a quantity. The person in the adult high-rate group for wild fungi consumed a mixture of wild fungi and the person in the high-rate group for freshwater plants consumed watercress. No children were identified consuming wild foods. It was reported that there were wild fungi and blackberries growing in the forest behind the sand dunes.

Table 4. Summary of adults' consumption rates of terrestrial wild foods from Dunnet Bay

Food group	Number of observations	Number of high-rate consumers	Maximum consumption rate for the high-rate group (kg y^{-1})	Minimum consumption rate for the high-rate group (kg y^{-1})	Mean consumption rate for the high-rate group (kg y^{-1})	97.5th percentile consumption rate (kg y^{-1})
Wild fungi	2	1	7.5	7.5	7.5	7.3
Freshwater plants	1	1	1.0	1.0	1.0	NA

NA = Not applicable

4.3 Consumption, occupancy and handling rates for each individual

The consumption, occupancy and handling rates for each individual are presented in Appendix 7. The members of the high-rate groups are identified within the tables.

5 LIMITATIONS AND ASSUMPTIONS

The results of the survey were subject to limitations relating to the fieldwork, and assumptions were made during interpretation of the data. These are outlined below for consideration when undertaking radiological assessments.

Limitations arising during the fieldwork and data collection include the following:

- Meteorological limitations; during the fieldwork the weather was variable and there were periods of rain and cold temperatures which affected the number of people observed on the beaches. Therefore, the data could be an underestimate.
- Temporal limitations; fieldwork was generally conducted during the daytime, between the hours of 9 am and 5 pm. Nevertheless, interviews that were conducted during the day covered activities undertaken in the evening. However, if there were people using the area only at night they would have not been observed during the survey and therefore the data could be an underestimate.
- Seasonal limitations; the fieldwork was conducted over one week in July so activities taking place at other times of the year may not have been accounted for. Therefore, the data could be an underestimate.
- Spatial limitations; due to the shape of the coastline and the length of the survey area it was not possible to have a complete view of the whole of the survey area from a single vantage point. Consequently, some people visiting the area may not have been observed and therefore the data may be an underestimate.
- Data provision limitations; data provided by interviewees could be an underestimate or overestimate of their actual time and it was easier for some people to provide accurate data than others.

Assumptions made during the interpretation of the data were:

- If people stated that they undertook an activity along the length of Dunnet beach, it was assumed that this covered Zone 1 to Zone 6.

6 ACKNOWLEDGEMENTS

Gratitude is expressed to members of the public, to staff at the Seadrift Visitors Centre and to representatives of local authorities who offered helpful advice and information during the survey. The survey was undertaken on behalf of SEPA and the project officer gave considerable guidance during the survey. Figures 1, 2 and 3 are Crown copyright.

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APPENDIX 1. DAILY RECORD OF THE NUMBER OF PEOPLE AND THE ACTIVITIES OBSERVED AT LOCATIONS WITHIN THE SURVEY AREA

Date and location	Temperature (°C)	Observed cloud cover (%)	Observed weather	Approximate headcount	Number of people for whom data was collected	Activities observed[a]
Thursday 23rd July 2009						
a.m.	14	90	Patchy, light rain			
Murkle beach				0	0	None
Castletown Harbour				5	5	Angling, handling bag-nets
p.m.	15	60	Patchy, light rain, cool light breeze			
Dunnet beach (zones 1 - 4)				30	17	Dog walking, playing, building sandcastles, swimming, body boarding and walking
Dwarwick Pier		100	Heavy rain	2	0	Winkle collecting
Friday 24th July 2009						
a.m.	11	100	Heavy rain, strong wind			
Dunnet beach (zones 5 - 8)		100	Misty rain, cold breeze	0	0	None
Dunnet beach (zones 1 - 4)				0	0	None
p.m.	12	80	Light rain, light wind			
Dunnet beach (zones 5 - 8)				4	0	Quad biking
Dunnet beach (zones 1 - 4)				0	0	None
Peedie beach				0	0	None
Dunnet beach (zones 1 - 4)		70	Overcast and moderate breeze	23	12	Dog walking, quad biking playing and walking
Dunnet beach (zones 5 - 8)				2	2	Bait digging
Saturday 25th July 2009						
a.m.	13	80	Dry, cold breeze			
Dwarwick Pier				5	2	Launching a boat for angling, walking and launching a creeling boat
Castletown Harbour		30	Sunny, strong wind, chilly	2	0	Launching a boat for angling
Dunnet beach (zones 4 and 5)				4	0	Dog walkers
Dunnet beach (zones 1 - 4)				10	10	Playing, swimming, walking, bird watching, playing and horse riding

APPENDIX 1. DAILY RECORD OF THE NUMBER OF PEOPLE AND THE ACTIVITIES OBSERVED AT LOCATIONS WITHIN THE SURVEY AREA

Date and location	Temperature (°C)	Observed cloud cover (%)	Observed weather	Approximate headcount	Number of people for whom data was collected	Activities observed[a]
p.m.	15	10	Dry, cool breeze			
Murkle beach		10	Sunny, chilly breeze but warm in the sun	1	0	Checking creels off-shore
Dunnet beach (zones 1 - 4)		0	Sunny and warm	40	35	Kite flying, dog walking, paddling, surfing, building sandcastles, bird watching, picnicking and sunbathing
Peedie beach		10	Sunny and warm, light breeze	0	0	None
Dunnet beach (zones 5 - 8)				2	2	Bait digging
Sunday 26th July 2009						
a.m.	13	100	Heavy rain, strong wind, cold			
Castletown Harbour				0	0	None
Dunnet beach (zones 5 - 8)				3	0	Dog walking, jogging
Dwarwick Pier				0	0	None
Dunnet beach (zones 4 and 5)			Light rain progressing to heavy rain, strong wind, cold	0	0	None
p.m.	13	100	Light rain, cold breeze			
Castletown Harbour				1	1	Commercial creel fishing
Dunnet beach (zoes 1 - 4)			Light rain progressing to heavy rain	5	1	Walking
Castletown Harbour				0	0	None
Dunnet beach (zones 5 - 8)			Rain, cold wind	0	0	None
Monday 27th July 2009						
a.m.	13	50	Sunny, warm, light breeze			
Murkle beach				0	0	None
Castletown Harbour				0	0	None
Dunnet beach (zones 1 - 4)				12	12	Sitting, playing, paddling, body boarding and digging in the sand

APPENDIX 1. DAILY RECORD OF THE NUMBER OF PEOPLE AND THE ACTIVITIES OBSERVED AT LOCATIONS WITHIN THE SURVEY AREA

Date and location	Temperature (°C)	Observed cloud cover (%)	Observed weather	Approximate headcount	Number of people for whom data was collected	Activities observed[a]
p.m.	15	90	Overcast, rain, cool breeze			
Dunnet beach (zones 1 - 4)				6	6	Walking, sitting on the beach and building sandcastles
Dwarwick Pier		90	Mild, no rain	0	0	None
Dunnet beach (zones 1 - 4)			Sunny, warm	16	16	Dog walking, angling, sitting on the beach and building sandcastles
Tuesday 28th July 2009						
a.m.	13	60	Sunny, patchy clouds, very strong cold wind			
Dunnet beach (zones 5 - 8)				4	2	Dog walking and fossil hunting
Dunnet beach (zones 4 and 5)				7	7	Walking, paddling, kite flying, playing and digging in the sand
p.m.	13	70	Sunny, patchy clouds, very strong cold wind, thunder clouds later in the afternoon			
Dwarwick Pier				1	1	Angling
Dunnet beach (zones 1 - 4)				5	5	Beachcombing, playing, paddling and sitting on the beach
Murkle beach				0	0	None

Notes

Interviews were not conducted with all the people included in the headcount for a variety of reasons. For example, people were sometimes dispersed over a large area, they may have been moving in opposite directions, or they may have been interviewed on a previous occasion.

[a]Activities were often taking place within particular areas of Dunnet beach, rather than throughout all the zones specified.

APPENDIX 2. ANNUAL AND SINGLE VISIT OCCUPANCY AND HANDLING RATES

Observation number	Sex	Age (years)	Substrate	Location	Activity	Annual rate (h y^{-1})	Category	Frequency and duration of visits
1	M	41	-	Off the shore of Zone 2	Swimming	16	Water (in)	Swimming for 1 hour per session per week for 16 weeks. Playing and sandcastling 8 hours per visit once per week for 16 weeks and 1 hour per visit per week for 26 weeks
			Sand	Zone 2 (upper)	Playing	150	Intertidal occupancy	
			Sand	Zone 2 (upper)	Building sandcastles	4		
			Sand	Zone 2 (upper)	Building sandcastles	4	Handling sediment	
2	F	32	-	Off the shore of Zone 2	Swimming	16	Water (in)	Swimming for 1 hour per session per week for 16 weeks. Playing and sandcastling 8 hours per visit once per week for 16 weeks and 1 hour per visit per week for 26 weeks
			Sand	Zone 2 (upper)	Playing	150	Intertidal occupancy	
			Sand	Zone 2 (upper)	Building sandcastles	4		
			Sand	Zone 2 (upper)	Building sandcastles	4	Handling sediment	
3	M	9	-	Off the shore of Zone 2	Swimming	16	Water (in)	Swimming for 1 hour per session per week for 16 weeks. Playing and sandcastling 8 hours per visit once per week for 16 weeks and 1 hour per visit per week for 26 weeks
			Sand	Zone 2 (upper)	Playing	150	Intertidal occupancy	
			Sand	Zone 2 (upper)	Building sandcastles	4		
			Sand	Zone 2 (upper)	Building sandcastles	4	Handling sediment	
4	M	7	-	Off the shore of Zone 2	Swimming	16	Water (in)	Swimming for 1 hour per session per week for 16 weeks. Playing and sandcastling 8 hours per visit once per week for 16 weeks and 1 hour per visit per week for 26 weeks
			Sand	Zone 2 (upper)	Playing	150	Intertidal occupancy	
			Sand	Zone 2 (upper)	Building sandcastles	4		
			Sand	Zone 2 (upper)	Building sandcastles	4	Handling sediment	

APPENDIX 2. ANNUAL AND SINGLE VISIT OCCUPANCY AND HANDLING RATES

Observation number	Sex	Age (years)	Substrate	Location	Activity	Annual rate (h y^{-1})	Category	Frequency and duration of visits
5	F	2	-	Zone 2 (lower)	Paddling	16	Water (on)	Paddling for 1 hour per session per week for 16 weeks. Playing and sandcastling 8 hours per visit once per week for 16 weeks and 1 hour per visit per week for 26 weeks
			Sand	Zone 2 (upper)	Playing	150	Intertidal occupancy	
			Sand	Zone 2 (upper)	Building sandcastles	4		
			Sand	Zone 2 (upper)	Building sandcastles	4	Handling sediment	
6	M	U	Sand	Zone 4 (lower) to Zone 5 (lower)	Angling	12	Intertidal occupancy	Angling 4 times a year at 3 hours per visit. Bait digging 4 times a year at 1 hour per visit
			Sand	Zone 8	Bait digging	4		
			Sand	Zone 8	Bait digging	4	Handling sediment	
7	M	U	Sand	Zone 4 (lower) to Zone 5 (lower)	Angling	12	Intertidal occupancy	Angling 4 times a year at 3 hours per visit. Bait digging 4 times a year at 1 hour per visit
			Sand	Zone 8	Bait digging	4		
			Sand	Zone 8	Bait digging	4	Handling sediment	
8	M	U	Sand	Zone 4 (lower) to Zone 5 (lower)	Angling	12	Intertidal occupancy	4 times a year at 3 hours per visit
9	M	U	Sand	Zone 4 (lower) to Zone 5 (lower)	Angling	12	Intertidal occupancy	4 times a year at 3 hours per visit
10	M	U	Sand	Zone 4 (lower) to Zone 5 (lower)	Angling	12	Intertidal occupancy	4 times a year at 3 hours per visit
11	F	43	Sand	Peedie beach	Dog walking	16	Intertidal occupancy	1.5 hours everyday for 3 weeks in summer, split between 2 locations
			Sand	Zone 1 to Zone 6	Dog walking	16		
12	M	65	Sand	Zone 1 to Zone 6	Walking	64	Intertidal occupancy	4 times per week for 4 months at 1 hour per visit
13	F	65	Sand	Zone 1 to Zone 6	Walking	64	Intertidal occupancy	4 times per week for 4 months at 1 hour per visit
14	F	45	Sand and stones	Murkle beach	Horse riding	15	Intertidal occupancy	1 time per week at 1 hour per visit, plus 7 other 1 hour visits per year. 25% of time at Murkle
			Sand	Zone 1 to Zone 6	Horse riding	44		

APPENDIX 2. ANNUAL AND SINGLE VISIT OCCUPANCY AND HANDLING RATES

Observation number	Sex	Age (years)	Substrate	Location	Activity	Annual rate (h y^{-1})	Category	Frequency and duration of visits
15	M	35	Sand	Zone 2 (mid)	Kite flying	1	Intertidal occupancy	Once a year at 2 hours, split between 2 activities
			Sand	Zone 2 (upper)	Sunbathing	1		
16	F	36	Sand	Zone 2 (mid)	Kite flying	1	Intertidal occupancy	Once a year at 2 hours, split between 2 activities
			Sand	Zone 2 (upper)	Sunbathing	1		
17	M	4	-	Zone 2 (lower)	Paddling	1	Water (on)	Once a year at 2 hours, 50% of time paddling
			Sand	Zone 2 (upper)	Playing and building sandcastles	1	Intertidal occupancy	
			Sand	Zone 2 (upper)	Building sandcastles	1	Handling sediment	
18	F	3	-	Zone 2 (lower)	Paddling	1	Water (on)	Once a year at 2 hours, 50% of time paddling
			Sand	Zone 2 (upper)	Playing and building sandcastles	1	Intertidal occupancy	
			Sand	Zone 2 (upper)	Building sandcastles	1	Handling sediment	
19	M	65	Sand	Zone 2 (upper)	Sitting and playing	2	Intertidal occupancy	Once a year at 2 hours
20	F	65	Sand	Zone 2 (upper)	Sitting and playing	2	Intertidal occupancy	Once a year at 2 hours
21	M	42	Sand	Zone 2 (upper)	Sitting on a chair	2	Intertidal occupancy	Visiting for the weekend, 1 hour each day
22	M	7	-	Zone 2 (lower)	Paddling	1	Water (on)	Visiting for the weekend, 1 hour each day
			Sand	Zone 2 (upper)	Playing	1	Intertidal occupancy	
23	F	9	-	Zone 2 (lower)	Paddling	1	Water (on)	Visiting for the weekend, 1 hour each day
			Sand	Zone 2 (upper)	Playing	1	Intertidal occupancy	
24	M	50	Sand	Zone 1 to Zone 6	Playing	49	Intertidal occupancy	In the area for 14 days, on the beach for 3.5 hours everyday
25	F	50	Sand	Zone 1 to Zone 6	Playing	49	Intertidal occupancy	In the area for 14 days, on the beach for 3.5 hours everyday
26	M	8	Sand	Zone 1 to Zone 6	Playing	28	Intertidal occupancy	In the area for 14 days, on the beach for 3.5 hours everyday of which 30 minutes a day paddling
			-	Zone 2 (lower)	Paddling	7	Water (on)	
			Sand	Zone 2 (upper)	Building sandcastles	14	Intertidal occupancy	
			Sand	Zone 2 (upper)	Building sandcastles	14	Handling sediment	

APPENDIX 2. ANNUAL AND SINGLE VISIT OCCUPANCY AND HANDLING RATES

Observation number	Sex	Age (years)	Substrate	Location	Activity	Annual rate (h y^{-1})	Category	Frequency and duration of visits
27	M	U	Sand and stones	Murkle beach	Angling	30	Intertidal occupancy	27.5 hours a month angling (split into approx 5 visits) and average 2.5 times a month bait digging for 1 hour
			Sand	Zone 1 (lower) to Zone 6 (lower)	Angling	300		
			Sand	Zone 8	Bait digging	30		
			Sand	Zone 8	Bait digging	30	Handling sediment	
28	M	U	-	Dunnet Bay	Handling creels	1344	Handling gear	On the boat for 30 weeks per year at 6 days a week at 5 hours per day. Handling rate includes mending time ashore.
			-	Dunnet Bay	Creeling offshore	900	Water (on)	
29	M	67	Sand and stones	Murkle beach	Walking	81	Intertidal occupancy	Walking 2 to 3 times per week at 2.5 hours per visit, all year: 50% on Dunnet and 25% each on Peedie and Murkle. Winkling 12 times per year at 2 hours per time.
			Sand	Peedie beach	Walking	81		
			Sand	Zone 1 (mid and lower) to Zone 6 (mid and lower)	Walking & collecting seaweed	163		
			Rock	Zone 7	Collecting winkles	24		
			Rock	Zone 7	Collecting winkles	24	Handling sediment	
30	F	57	Sand	Zone 1 to Zone 6	Walking	1	Intertidal occupancy	Only visit, 1 hour
31	F	41	Sand	Zone 2 (upper)	Sitting on a blanket	52	Intertidal occupancy	One hour visit per week all year
32	F	8	-	Off the shore of Zone 2	Swimming	4	Water (in)	Swimming for 15 mins per week for 16 weeks per year. Playing for 1 hour per visit per week for 48 weeks per year
			Sand	Zone 2 (upper)	Playing	48	Intertidal occupancy	
33	F	10	-	Off the shore of Zone 2	Swimming	4	Water (in)	Swimming for 15 mins per week for 16 weeks per year. Playing for 1 hour per visit per week for 48 weeks per year
			Sand	Zone 2 (upper)	Playing	48	Intertidal occupancy	

APPENDIX 2. ANNUAL AND SINGLE VISIT OCCUPANCY AND HANDLING RATES

Observation number	Sex	Age (years)	Substrate	Location	Activity	Annual rate (h y^{-1})	Category	Frequency and duration of visits
34	F	10	-	Off the shore of Zone 2	Swimming	4	Water (in)	Swimming for 15 mins per week for 16 weeks per year. Playing for 1 hour per visit per week for 48 weeks per year
			Sand	Zone 2 (upper)	Playing	48	Intertidal occupancy	
35	M	7	-	Off the shore of Zone 2	Swimming	4	Water (in)	Swimming for 15 mins per week for 16 weeks per year. Playing for 1 hour per visit per week for 48 weeks per year
			Sand	Zone 2 (upper)	Playing	48	Intertidal occupancy	
36	F	74	Sand	Zone 2 (upper)	Sitting on a blanket	1	Intertidal occupancy	Only visit, 1 hour
37	M	57	Sand and stones	Zone 7	Collecting stones	1	Intertidal occupancy	Only visit, 1 hour
38	F	57	Sand and stones	Zone 7	Collecting stones	1	Intertidal occupancy	Only visit, 1 hour
39	M	33	-	Zone 1 (lower) to Zone 6 (lower)	Paddling	1	Water (on)	Visiting for 1 week, walking on the beach everyday for 1.5 hours plus 10 mins per day paddling
			Sand	Zone 1 (mid and lower) to Zone 6 (mid and lower)	Walking	11	Intertidal occupancy	
40	F	33	-	Zone 1 (lower) to Zone 6 (lower)	Paddling	1	Water (on)	Visiting for 1 week, walking on the beach everyday for 1.5 hours plus 10 mins per day paddling
			Sand	Zone 1 (mid and lower) to Zone 6 (mid and lower)	Walking	11	Intertidal occupancy	
41	M	51	Sand	Zone 1 (upper) to Zone 6 (upper)	Walking	5	Intertidal occupancy	Visit for 2.5 weeks a year, on the beach 2 times per week at 1 hour
42	M	25	Sand	Zone 1 (upper) to Zone 6 (upper) and dunes	Walking	5	Intertidal occupancy	Visit for 2.5 weeks a year, on the beach 2 times per week at 1 hour

APPENDIX 2. ANNUAL AND SINGLE VISIT OCCUPANCY AND HANDLING RATES

Observation number	Sex	Age (years)	Substrate	Location	Activity	Annual rate (h y^{-1})	Category	Frequency and duration of visits
43	M	8	Sand	Zone 1 (upper) to Zone 6 (upper) and dunes	Walking	5	Intertidal occupancy	Visit for 2.5 weeks a year, on the beach 2 times per week at 1 hour
44	M	U	Sand	Zone 1 (mid)	Kite flying	4	Intertidal occupancy	Only visit, 4 hours
45	M	2	Sand	Zone 2 (mid)	Playing	3	Intertidal occupancy	Only visit, 4 hours
			Sand	Zone 2 (mid)	Building sandcastles	1		
			Sand	Zone 2 (mid)	Building sandcastles	1	Handling sediment	
46	F	50	Sand	Zone 2 (mid) to Zone 4 (mid)	Beach combing	91	Handling beach materials	Half an hour per day for 6 months
47	M	35	Sand	Zone 1 to Zone 6	Walking	9	Intertidal occupancy	3.5 hours a day for 14 days
			Sand	Zone 2 (upper)	Sitting and playing	40		
48	F	35	Sand	Zone 1 to Zone 6	Walking	9	Intertidal occupancy	3.5 hours a day for 14 days
			Sand	Zone 2 (upper)	Sitting and playing	40		
49	F	4	Sand	Zone 1 to Zone 6	Walking	9	Intertidal occupancy	3.5 hours a day for 14 days, including 45 mins per day paddling
			-	Zone 2 (lower)	Paddling	10	Water (on)	
			Sand	Zone 2 (upper)	Playing	20	Intertidal occupancy	
			Sand	Zone 2 (upper)	Building sandcastles	10		
			Sand	Zone 2 (upper)	Building sandcastles	10	Handling sediment	
50	M	8	Sand	Zone 1 to Zone 6	Walking	9	Intertidal occupancy	3.5 hours a day for 14 days, including 45 mins per day paddling
			-	Zone 2 (lower)	Paddling	10	Water (on)	
			Sand	Zone 2 (upper)	Playing	20	Intertidal occupancy	
			Sand	Zone 2 (upper)	Building sandcastles	10		
			Sand	Zone 2 (upper)	Building sandcastles	10	Handling sediment	
51	M	45	Sand and stones	Murkle beach	Walking	3	Intertidal occupancy	Only visit, split between 2 locations
			Sand	Zone 1 to Zone 6	Walking	2		
52	F	34	Sand and stones	Murkle beach	Walking	3	Intertidal occupancy	Only visit, split between 2 locations
			Sand	Zone 1 to Zone 6	Walking	2		
53	F	63	Sand	Murkle beach	Walking and playing	3	Intertidal occupancy	Only visit, split between 2 locations
			Sand	Zone 2 (upper)	Walking and playing	2		
54	M	3	Sand and stones	Murkle beach	Walking and playing	3	Intertidal occupancy	Only visit, split between 2 locations
			Sand	Zone 2 (upper)	Building sandcastles	2		
			Sand	Zone 2 (upper)	Building sandcastles	2	Handling sediment	

APPENDIX 2. ANNUAL AND SINGLE VISIT OCCUPANCY AND HANDLING RATES

Observation number	Sex	Age (years)	Substrate	Location	Activity	Annual rate (h y^{-1})	Category	Frequency and duration of visits
55	M	6 months	Sand and stones	Murkle beach	Playing	3	Intertidal occupancy	Only visit, split between 2 locations
			Sand	Zone 2 upper	Playing with sand	2		
			Sand	Zone 2 upper	Playing with sand	2	Handling sediment	
56	M	U	Sand and stones	Murkle beach	Angling	30	Intertidal occupancy	27.5 hours a month angling (split into approx 5 visits) and average 2.5 times a month bait digging for 1 hour
			Sand	Zone 1 (lower) to Zone 6 (lower)	Angling	300		
			Sand	Zone 8	Bait digging	30		
			Sand	Zone 8	Bait digging	30	Handling sediment	
57	M	U	Sand and stones	Murkle beach	Angling	30	Intertidal occupancy	27.5 hours a month angling (split into approx 5 visits) and average 2.5 times a month bait digging for 1 hour
			Sand	Zone 1 (lower) to Zone 6 (lower)	Angling	300		
			Sand	Zone 8	Bait digging	30		
			Sand	Zone 8	Bait digging	30	Handling sediment	
58	M	U	Sand and stones	Murkle beach	Angling	30	Intertidal occupancy	27.5 hours a month angling (split into approx 5 visits) and average 2.5 times a month bait digging for 1 hour
			Sand	Zone 1 (lower) to Zone 6 (lower)	Angling	300		
			Sand	Zone 8	Bait digging	30		
			Sand	Zone 8	Bait digging	30	Handling sediment	
59	M	U	Sand and stones	Murkle beach	Angling	30	Intertidal occupancy	27.5 hours a month angling (split into approx 5 visits) and average 2.5 times a month bait digging for 1 hour
			Sand	Zone 1 (lower) to Zone 6 (lower)	Angling	300		
			Sand	Zone 8	Bait digging	30		
			Sand	Zone 8	Bait digging	30	Handling sediment	
60	M	U	Sand and stones	Murkle beach	Angling	30	Intertidal occupancy	27.5 hours a month angling (split into approx 5 visits) and average 2.5 times a month bait digging for 1 hour
			Sand	Zone 1 (lower) to Zone 6 (lower)	Angling	300		
			Sand	Zone 8	Bait digging	30		
			Sand	Zone 8	Bait digging	30	Handling sediment	

APPENDIX 2. ANNUAL AND SINGLE VISIT OCCUPANCY AND HANDLING RATES

Observation number	Sex	Age (years)	Substrate	Location	Activity	Annual rate (h y^{-1})	Category	Frequency and duration of visits
61	M	U	Sand and stones	Murkle beach	Angling	30	Intertidal occupancy	27.5 hours a month angling (split into approx 5 visits) and average 2.5 times a month bait digging for 1 hour
			Sand	Zone 1 (lower) to Zone 6 (lower)	Angling	300		
			Sand	Zone 8	Bait digging	30		
			Sand	Zone 8	Bait digging	30	Handling sediment	
62	M	U	Sand and stones	Murkle beach	Angling	30	Intertidal occupancy	27.5 hours a month angling (split into approx 5 visits) and average 2.5 times a month bait digging for 1 hour
			Sand	Zone 1 (lower) to Zone 6 (lower)	Angling	300		
			Sand	Zone 8	Bait digging	30		
			Sand	Zone 8	Bait digging	30	Handling sediment	
63	M	U	Sand and stones	Murkle beach	Angling	30	Intertidal occupancy	27.5 hours a month angling (split into approx 5 visits) and average 2.5 times a month bait digging for 1 hour
			Sand	Zone 1 (lower) to Zone 6 (lower)	Angling	300		
			Sand	Zone 8	Bait digging	30		
			Sand	Zone 8	Bait digging	30	Handling sediment	
64	M	U	Sand and stones	Murkle beach	Angling	30	Intertidal occupancy	27.5 hours a month angling (split into approx 5 visits) and average 2.5 times a month bait digging for 1 hour
			Sand	Zone 1 (lower) to Zone 6 (lower)	Angling	300		
			Sand	Zone 8	Bait digging	30		
			Sand	Zone 8	Bait digging	30	Handling sediment	
65	M	U	Sand and stones	Murkle beach	Angling	30	Intertidal occupancy	27.5 hours a month angling (split into approx 5 visits) and average 2.5 times a month bait digging for 1 hour
			Sand	Zone 1 (lower) to Zone 6 (lower)	Angling	300		
			Sand	Zone 8	Bait digging	30		
			Sand	Zone 8	Bait digging	30	Handling sediment	

APPENDIX 2. ANNUAL AND SINGLE VISIT OCCUPANCY AND HANDLING RATES

Observation number	Sex	Age (years)	Substrate	Location	Activity	Annual rate (h y^{-1})	Category	Frequency and duration of visits
66	M	U	-	Dunnet Bay	Handling bag nets	440	Handling gear	4 hours a day at 5 days a week for 16 weeks handling nets at sea. Mending nets ashore for 1.5 hours a day for 5 days a week for 16 weeks
			-	Dunnet Bay	Servicing bag nets	320	Water (on)	
72	M	65	Sand	Zone 2 to Zone 6	Dog walking	14	Intertidal occupancy	2 hours a day for 1 week
73	F	65	Sand	Zone 2 to Zone 6	Dog walking	14	Intertidal occupancy	2 hours a day for 1 week
74	M	72	Sand	Zone 2 (upper)	Sitting on a chair	105	Intertidal occupancy	On the beach for 5 hours a day, every other day for 6 weeks
				Zone 2 (mid) to Zone 6 (mid)	Dog walking			
75	F	72	Sand	Zone 2 (upper)	Sitting on a chair	105	Intertidal occupancy	On the beach for 5 hours a day, every other day for 6 weeks
				Zone 2 (mid) to Zone 6 (mid)	Dog walking			
77	M	71	Sand	Zone 2 and Zone 3 (mid) to Zone 6 (mid)	Dog walking	10	Intertidal occupancy	1 hour a day for 10 days
78	M	77	Sand	Zone 2 and Zone 3 (mid) to Zone 6 (mid)	Dog walking	10	Intertidal occupancy	1 hour a day for 10 days
79	M	71	Sand	Zone 2 and Zone 3 (mid) to Zone 6 (mid)	Dog walking	10	Intertidal occupancy	1 hour a day for 10 days
80	M	38	-	Off the shore of Zone 2	Swimming	1	Water (in)	On holiday for 4 days, 3 hours playing, 15 mins sandcastling, 15 mins swimming and 15 mins paddling per day
			-	Zone 2 (lower)	Paddling	1	Water (on)	
			Sand	Zone 2 (mid)	Building sandcastles	1	Handling sediment	
			Sand	Zone 2 (mid)	Building sandcastles	1	Intertidal occupancy	
			Sand	Zone 2 (mid)	Playing	12		
81	F	45	-	Off the shore of Zone 2	Swimming	1	Water (in)	On holiday for 4 days, 3 hours playing, 15 mins sandcastling, 15 mins swimming and 15 mins paddling per day
			-	Zone 2 (lower)	Paddling	1	Water (on)	
			Sand	Zone 2 (mid)	Building sandcastles	1	Handling sediment	
			Sand	Zone 2 (mid)	Building sandcastles	1	Intertidal occupancy	
			Sand	Zone 2 (mid)	Playing	12		

APPENDIX 2. ANNUAL AND SINGLE VISIT OCCUPANCY AND HANDLING RATES

Observation number	Sex	Age (years)	Substrate	Location	Activity	Annual rate (h y^{-1})	Category	Frequency and duration of visits
82	F	12	-	Off the shore of Zone 2	Swimming	1	Water (in)	On holiday for 4 days, 3 hours playing, 15 mins sandcastling, 15 mins swimming and 15 mins paddling per day
			-	Zone 2 (lower)	Paddling	1	Water (on)	
			Sand	Zone 2 (mid)	Building sandcastles	1	Handling sediment	
			Sand	Zone 2 (mid)	Building sandcastles	1	Intertidal occupancy	
			Sand	Zone 2 (mid)	Playing	12		
83	M	9	-	Off the shore of Zone 2	Swimming	1	Water (in)	On holiday for 4 days, 3 hours playing, 15 mins sandcastling, 15 mins swimming and 15 mins paddling per day
			-	Zone 2 (lower)	Paddling	1	Water (on)	
			Sand	Zone 2 (mid)	Building sandcastles	1	Handling sediment	
			Sand	Zone 2 (mid)	Building sandcastles	1	Intertidal occupancy	
			Sand	Zone 2 (mid)	Playing	12		
84	F	67	Sand	Zone 1 to Zone 6 and dunes	Ranger duties	168	Intertidal occupancy	6 hours a week from April to October
85	F	19	Sand	Zone 1 to Zone 6 and dunes	Ranger duties	168	Intertidal occupancy	6 hours a week from April to October
86	M	34	Sand	Zone 1 to Zone 6 and dunes	Ranger duties	168	Intertidal occupancy	6 hours a week from April to October
87	U	U	Sand	Zone 1 to Zone 6	Beach cleaning	13	Intertidal occupancy	Collect litter 2 days a year for 6.5 hours
88	U	U	Sand	Zone 1 to Zone 6	Beach cleaning	13	Intertidal occupancy	Collect litter 2 days a year for 6.5 hours
89	U	U	Sand	Zone 1 to Zone 6	Beach cleaning	13	Intertidal occupancy	Collect litter 2 days a year for 6.5 hours
90	U	U	Sand	Zone 1 to Zone 6	Beach cleaning	13	Intertidal occupancy	Collect litter 2 days a year for 6.5 hours
91	U	U	Sand	Zone 1 to Zone 6	Beach cleaning	13	Intertidal occupancy	Collect litter 2 days a year for 6.5 hours
92	U	U	Sand	Zone 1 to Zone 6	Beach cleaning	13	Intertidal occupancy	Collect litter 2 days a year for 6.5 hours
93	U	U	Sand	Zone 1 to Zone 6	Beach cleaning	13	Intertidal occupancy	Collect litter 2 days a year for 6.5 hours
94	U	U	Sand	Zone 1 to Zone 6	Beach cleaning	13	Intertidal occupancy	Collect litter 2 days a year for 6.5 hours
95	U	U	Sand	Zone 1 to Zone 6	Beach cleaning	13	Intertidal occupancy	Collect litter 2 days a year for 6.5 hours

APPENDIX 2. ANNUAL AND SINGLE VISIT OCCUPANCY AND HANDLING RATES

Observation number	Sex	Age (years)	Substrate	Location	Activity	Annual rate (h y^{-1})	Category	Frequency and duration of visits
96	M	60	Sand	Dunes	Dog walking	171	Intertidal occupancy	Walks on the beach every day for between 30 mins and 45 mins, 75% in the dunes
			Sand	Zone 3 (upper) to Zone 4 (upper)	Dog walking	57		
97	M	45	Sand	Zone 2 (mid) to Zone 4 (mid)	Walking	2	Intertidal occupancy	Only visit, 2 hours
98	F	41	Sand	Zone 2 (mid) to Zone 4 (mid)	Walking	2	Intertidal occupancy	Only visit, 2 hours
99	M	66	Sand	Zone 2 (mid) to Zone 4 (mid)	Dog walking	1	Intertidal occupancy	Only visit, 1 hour
100	F	65	Sand	Zone 2 (mid) to Zone 4 (mid)	Dog walking	1	Intertidal occupancy	Only visit, 1 hour
101	F	U	Sand	Zone 2 (mid) to Zone 6 (mid)	Dog walking	2	Intertidal occupancy	Only visit, 2 hours
102	F	U	Sand	Zone 2 (mid) to Zone 6 (mid)	Dog walking	2	Intertidal occupancy	Only visit, 2 hours
103	F	U	Sand	Zone 2 (mid) to Zone 6 (mid)	Dog walking	2	Intertidal occupancy	Only visit, 2 hours
104	M	U	Sand	Zone 2 (mid) to Zone 6 (mid)	Dog walking	2	Intertidal occupancy	Only visit, 2 hours
105	M	U	Sand	Zone 2 (mid) to Zone 6 (mid)	Dog walking	2	Intertidal occupancy	Only visit, 2 hours
106	M	7	Sand	Zone 2 (mid) to Zone 6 (mid)	Dog walking	2	Intertidal occupancy	Only visit, 2 hours
107	M	10	Sand	Zone 2 (mid) to Zone 6 (mid)	Dog walking	2	Intertidal occupancy	Only visit, 2 hours
108	M	52	Sand	Zone 1 (upper) to Zone 6 (upper)	Quad biking	2	Intertidal occupancy	Visiting for 2 days, 2 hours each day on beach
			Sand	Dunes	Quad biking	2		
109	M	60	-	Dunnet Bay	Handling creels	90	Handling gear	At sea 6 days a week between May and September at 2 hours a time. Handles creels for 45 mins per sea trip.
			-	Dunnet Bay	Creeling offshore	240	Water (on)	
110	F	85	Sand	Zone 2 (mid) to Zone 6 (mid)	Walking	4	Intertidal occupancy	Twice a year at 2 hours a visit
111	F	59	Sand	Zone 2 (mid) to Zone 6 (mid)	Walking	4	Intertidal occupancy	Twice a year at 2 hours a visit
112	M	58	Sand	Zone 1 to Zone 6	Bird watching	8	Intertidal occupancy	On holiday for 4 days, 2 hours per day on beach
113	F	55	Sand	Zone 1 to Zone 6	Bird watching	8	Intertidal occupancy	On holiday for 4 days, 2 hours per day on beach

APPENDIX 2. ANNUAL AND SINGLE VISIT OCCUPANCY AND HANDLING RATES

Observation number	Sex	Age (years)	Substrate	Location	Activity	Annual rate (h y^{-1})	Category	Frequency and duration of visits
114	M	48	-	Off the shore between Zone 1 and Zone 6	Swimming	5	Water (in)	Playing twice a month all year round for 4 hours a time plus swimming and paddling 5 times each per year at 1 hour.
			Sand	Zone 1 to Zone 6	Playing	96	Intertidal occupancy	
			-	Zone 1 (lower) to Zone 6 (lower)	Paddling	5	Water (on)	
115	M	8	-	Off the shore between Zone 1 and Zone 6	Swimming	5	Water (in)	Playing twice a month all year round for 4 hours a time plus swimming and paddling 5 times each per year at 1 hour.
			Sand	Zone 1 to Zone 6	Playing	96	Intertidal occupancy	
			-	Zone 1 (lower) to Zone 6 (lower)	Paddling	5	Water (on)	
116	M	10	-	Off the shore between Zone 1 and Zone 6	Swimming	5	Water (in)	Playing twice a month all year round for 4 hours a time plus swimming and paddling 5 times each per year at 1 hour.
			Sand	Zone 1 to Zone 6	Playing	96	Intertidal occupancy	
			-	Zone 1 (lower) to Zone 6 (lower)	Paddling	5	Water (on)	
117	F	60	Sand	Zone 2	Playing	30	Intertidal occupancy	Visits the beach 2 hours a day, everyday for 5 months and an additional 10 times for 3 hours each in the school holidays
			Sand	Zone 2 to Zone 6	Dog walking	280		
118	F	38	Sand	Zone 2	Playing	30	Intertidal occupancy	10 visits of 3 hours in school holidays
119	F	8	Sand	Zone 2	Playing	30	Intertidal occupancy	10 visits of 3 hours in school holidays
120	F	7	Sand	Zone 2	Playing	30	Intertidal occupancy	10 visits of 3 hours in school holidays
121	M	6	Sand	Zone 2	Playing	30	Intertidal occupancy	10 visits of 3 hours in school holidays
122	M	4	Sand	Zone 2	Playing	30	Intertidal occupancy	10 visits of 3 hours in school holidays
123	F	68	Sand	Zone 1 to Zone 3	Walking	3	Intertidal occupancy	2 days at 1.5 hours
124	F	42	Sand	Zone 1 to Zone 3	Walking	3	Intertidal occupancy	2 days at 1.5 hours
125	M	9	Sand	Zone 1 to Zone 3	Walking	3	Intertidal occupancy	2 days at 1.5 hours
126	M	7	Sand	Zone 1 to Zone 3	Walking	3	Intertidal occupancy	2 days at 1.5 hours
127	M	4	Sand	Zone 1 to Zone 3	Walking	3	Intertidal occupancy	2 days at 1.5 hours

APPENDIX 2. ANNUAL AND SINGLE VISIT OCCUPANCY AND HANDLING RATES

Observation number	Sex	Age (years)	Substrate	Location	Activity	Annual rate (h y^{-1})	Category	Frequency and duration of visits
128	F	32	Sand	Zone 1 to Zone 6	Walking	70	Intertidal occupancy	Once a week for 5 months at 3.5 hours
129	M	35	Sand	Zone 1 to Zone 6	Walking	70	Intertidal occupancy	Once a week for 5 months at 3.5 hours
130	M	63	Sand	Zone 1 (mid) to Zone 6 (mid)	Dog walking	183	Intertidal occupancy	30 mins per day all year
131	M	40	-	Off the shore of Zone 2	Surfing	1	Water (in)	1 visit for 4 hours only
			Sand	Zone 2	Playing	3	Intertidal occupancy	
132	F	38	-	Zone 2 (lower)	Paddling	1	Water (in)	1 visit for 5 hours only
			Sand	Zone 2 (mid)	Sunbathing	4	Intertidal occupancy	
133	F	11	-	Off the shore of Zone 2	Surfing	1	Water (in)	1 visit for 4 hours only
			Sand	Zone 2	Playing	3	Intertidal occupancy	
134	M	8	-	Off the shore of Zone 2	Surfing	1	Water (in)	1 visit for 4 hours only
			Sand	Zone 2	Playing	3	Intertidal occupancy	
135	M	5	-	Off the shore of Zone 2	Surfing	1	Water (in)	1 visit for 4 hours only
			Sand	Zone 2	Playing	3	Intertidal occupancy	
136	M	35	Rock	Rocks at the north end of Dunnet beach	Rock pooling	5	Intertidal occupancy	On holiday for 1 week, on the beach 6 days for 4 hours each day
			Sand	Zone 1 (lower)	Bait digging	1	Intertidal occupancy	
			Sand	Zone 1 (lower)	Bait digging	1	Handling sediment	
			Sand	Zone 1, Zone 4 and Zone 6	Playing	18	Intertidal occupancy	
137	F	35	Rock	Rocks at the north end of Dunnet beach	Rock pooling	5	Intertidal occupancy	On holiday for 1 week, on the beach 6 days for 4 hours each day
			Sand	Zone 1 (lower)	Bait digging	1	Intertidal occupancy	
			Sand	Zone 1 (lower)	Bait digging	1	Handling sediment	
			Sand	Zone 1, Zone 4 and Zone 6	Playing	18	Intertidal occupancy	
138	M	5	Rock	Rocks at the north end of Dunnet beach	Rock pooling	5	Intertidal occupancy	On holiday for 1 week, on the beach 6 days for 4 hours each day
			Sand	Zone 1 (lower)	Bait digging	1	Intertidal occupancy	
			Sand	Zone 1 (lower)	Bait digging	1	Handling sediment	
			Sand	Zone 1, Zone 4 and Zone 6	Playing	18	Intertidal occupancy	
139	M	3	Rock	Rocks at the north end of Dunnet beach	Rock pooling	5	Intertidal occupancy	On holiday for 1 week, on the beach 6 days for 4 hours each day
			Sand	Zone 1 (lower)	Bait digging	1	Intertidal occupancy	
			Sand	Zone 1 (lower)	Bait digging	1	Handling sediment	
			Sand	Zone 1, Zone 4 and Zone 6	Playing	18	Intertidal occupancy	
140	M	48	Sand	Zone 1 (mid and lower) and Zone 6 (mid and lower)	Angling	195	Intertidal occupancy	Angling 2 or 3 times per week at 3 hours per time for 26 weeks (mid April to mid Oct). Digs for bait twice per week for 26 weeks at 30 mins per time.
			Sand	Zone 8	Bait digging	26		
			Sand	Zone 8	Bait digging	26	Handling sediment	

APPENDIX 2. ANNUAL AND SINGLE VISIT OCCUPANCY AND HANDLING RATES

Observation number	Sex	Age (years)	Substrate	Location	Activity	Annual rate (h y^{-1})	Category	Frequency and duration of visits
142	M	58	Sand	Zone 6 (upper)	Playing	2	Intertidal occupancy	Only visit of 2 hours
143	F	42	Sand	Zone 6 (upper)	Playing	2	Intertidal occupancy	Only visit of 2 hours
144	F	8	Sand	Zone 6 (upper)	Playing	2	Intertidal occupancy	Only visit of 2 hours
145	M	6	Sand	Zone 6 (upper)	Playing	2	Intertidal occupancy	Only visit of 2 hours
146	M	25	Sand	Zone 2	Playing	15	Intertidal occupancy	On holiday for 5 days, 3 hours a day on beach plus 10 mins per day paddling.
			-	Zone 2 (lower)	Paddling	1	Water (on)	
147	F	24	Sand	Zone 2	Playing	15	Intertidal occupancy	On holiday for 5 days, 3 hours a day on beach plus 10 mins per day paddling.
			-	Zone 2 (lower)	Paddling	1	Water (on)	
148	F	68	-	Off the shore of Zone 2	Swimming	16	Water (in)	Swimming 3 times per week for 16 weeks at 20 mins per time. Walking 2 or 3 times per week for 20 weeks at 1 hour per visit split between Dunnet and Peeedie plus 1 time per week for 28 weeks at 30 mins per time at Dunnet.
			Sand	Peedie beach	Walking	25	Intertidal occupancy	
			Sand	Zone 1 and Zone 6	Walking	39		
149	M	69	-	Off the shore of Zone 2	Swimming	16	Water (in)	Swimming 3 times per week for 16 weeks at 20 mins per time. Walking 2 or 3 times per week for 20 weeks at 1 hour per visit split between Dunnet and Peeedie plus 1 time per week for 28 weeks at 30 mins per time at Dunnet.
			Sand	Peedie beach	Walking	25	Intertidal occupancy	
			Sand	Zone 1 and Zone 6	Walking	39		

APPENDIX 2. ANNUAL AND SINGLE VISIT OCCUPANCY AND HANDLING RATES

Observation number	Sex	Age (years)	Substrate	Location	Activity	Annual rate (h y^{-1})	Category	Frequency and duration of visits
150	M	32	-	Off the shore of Zone 2	Swimming	1	Water (in)	Visits area twice a year for 5 days and spend 3.5 hours each day playing on beach plus 1 hour swimming and 2 hours paddling split over all visits
			-	Zone 2 (lower)	Paddling	2	Water (on)	
			Sand	Zone 2 (upper)	Playing	35	Intertidal occupancy	
151	F	30	-	Off the shore of Zone 2	Swimming	1	Water (in)	Visits area twice a year for 5 days and spend 3.5 hours each day playing on beach plus 1 hour swimming and 2 hours paddling split over all visits
			-	Zone 2 (lower)	Paddling	2	Water (on)	
			Sand	Zone 2 (upper)	Playing	35	Intertidal occupancy	
152	M	2	-	Off the shore of Zone 2	Swimming	1	Water (in)	Visits area twice a year for 5 days and spend 3.5 hours each day playing on beach plus 1 hour swimming and 2 hours paddling split over all visits
			-	Zone 2 (lower)	Paddling	2	Water (on)	
			Sand	Zone 2 (upper)	Playing	35	Intertidal occupancy	
153	F	1	-	Zone 2 (lower)	Paddling	3	Water (on)	Visits area twice a year for 5 days and spend 3.5 hours each day playing on beach plus 3 hours paddling split over all visits
			Sand	Zone 2 (upper)	Playing	35	Intertidal occupancy	
154	M	71	Sand	Zone 2 and Zone 6	Dog walking	112	Intertidal occupancy	0.5 hours every day for 20 weeks and 0.5 hours at 3 times per week for 28 weeks
155	F	70	Sand	Zone 2 and Zone 6	Dog walking	112	Intertidal occupancy	0.5 hours every day for 20 weeks and 0.5 hours at 3 times per week for 28 weeks

APPENDIX 2. ANNUAL AND SINGLE VISIT OCCUPANCY AND HANDLING RATES

Observation number	Sex	Age (years)	Substrate	Location	Activity	Annual rate (h y^{-1})	Category	Frequency and duration of visits
156	M	U	Sand	Zone 1 and Zone 6	Walking	13	Intertidal occupancy	Walking for 2 hours per day for 6 or 7 days. Angling for 2 times per year at 3 hours per time.
			Sand	Zone 2 (mid)	Angling	6		
157	F	38	Sand	Zone 1 and Zone 6	Playing	75	Intertidal occupancy	Playing 2 or 3 times per month for 2 or 3 hours per time. Dog walking 3 times per month at 30 mins per time.
			Sand	Zone 1 (mid) and Zone 6 (mid)	Dog walking	18		
158	M	8	Sand	Zone 1 and Zone 6	Playing	75	Intertidal occupancy	Playing 2 or 3 times per month for 2 or 3 hours per time. Dog walking 3 times per month at 30 mins per time.
			Sand	Zone 1 (mid) and Zone 6 (mid)	Dog walking	18		
159	F	13	Sand	Zone 1 and Zone 6	Playing	75	Intertidal occupancy	Playing 2 or 3 times per month for 2 or 3 hours per time. Dog walking 3 times per month at 30 mins per time.
			Sand	Zone 1 (mid) and Zone 6 (mid)	Dog walking	18		
160	M	48	Rock	Rocks at the north end of Dunnet beach	Walking	1	Intertidal occupancy	Only visit, 2 hours
			Sand	Zone 1 and Zone 2	Walking	1		
161	M	50	Rock	Rocks at the north end of Dunnet beach	Walking	1	Intertidal occupancy	Only visit, 2 hours
			Sand	Zone 1 and Zone 2	Walking	1		
162	F	47	Rock	Rocks at the north end of Dunnet beach	Walking	1	Intertidal occupancy	Only visit, 2 hours
			Sand	Zone 1 and Zone 2	Walking	1		
163	F	10	Rock	Rocks at the north end of Dunnet beach	Walking	1	Intertidal occupancy	Only visit, 2 hours
			Sand	Zone 1 and Zone 2	Walking	1		
164	F	13	Rock	Rocks at the north end of Dunnet beach	Walking	1	Intertidal occupancy	Only visit, 2 hours
			Sand	Zone 1 and Zone 2	Walking	1		
165	F	U	Sand	Zone 2	Playing	15	Intertidal occupancy	Visiting the area for 6 days, on the beach 2.5 hours each day

APPENDIX 2. ANNUAL AND SINGLE VISIT OCCUPANCY AND HANDLING RATES

Observation number	Sex	Age (years)	Substrate	Location	Activity	Annual rate (h y^{-1})	Category	Frequency and duration of visits
166	M	U	Sand	Zone 2	Playing	15	Intertidal occupancy	Visiting the area for 6 days, on the beach 2.5 hours each day
167	M	U	Sand	Zone 2	Playing	15	Intertidal occupancy	Visiting the area for 6 days, on the beach 2.5 hours each day
168	F	75	Sand	Zone 2	Playing	15	Intertidal occupancy	Visiting the area for 6 days, on the beach 2.5 hours each day
169	M	9	Sand	Zone 2	Playing	15	Intertidal occupancy	Visiting the area for 6 days, on the beach 2.5 hours each day
170	M	4	Sand	Zone 2	Playing	15	Intertidal occupancy	Visiting the area for 6 days, on the beach 2.5 hours each day
171	M	65	Sand	Zone 1 and Zone 6	Dog walking	182	Intertidal occupancy	3 or 4 times a week for 1 hour each time, all year
172	F	60	Sand	Zone 1 and Zone 6	Dog walking	182	Intertidal occupancy	3 or 4 times a week for 1 hour each time, all year
173	M	2	Sand	Zone 1 and Zone 6	Dog walking	182	Intertidal occupancy	3 or 4 times a week for 1 hour each time, all year
174	F	4	Sand	Zone 1 and Zone 6	Dog walking	182	Intertidal occupancy	3 or 4 times a week for 1 hour each time, all year

Notes

Where a wide range of activities were being undertaken, each for a short duration, these have been referred to collectively as 'playing'. The activities included, for example; ball games, paddling, sunbathing, collecting stones and shells, playing with sand, kite flying, reading and eating.

Gloves were usually worn by individuals undertaking creeling and bag netting but not when repairing creels and nets.

U = Unknown.

Unknown ages are for adults only.

APPENDIX 3. INTERTIDAL OCCUPANCY AND HANDLING RATES, WITH MEMBERS OF THE HIGH-RATE GROUPS IDENTIFIED

Table A3.1 Adults' intertidal occupancy rates in Dunnet Bay by substrate

Observation number	Location	Activity	Occupancy (h y^{-1})		
			Rock	Sand	Sand & stones
29	**Zone 7**	**Collecting winkles**	**24**	-	-
	Zone 1 (mid and lower) to Zone 6 (mid and lower) and Peedie beach	**Walking and collecting seaweed**	**-**	**244**	**-**
	Murkle beach	**Walking**	**-**	**-**	**81**
136	Rocks at the north end of Dunnet beach	Rock pooling	5	-	-
	Zone 1, Zone 4 and Zone 6/Zone 1 (lower)	Playing/Bait digging	-	19	-
137	Rocks at the north end of Dunnet beach	Rock pooling	5	-	-
	Zone 1, Zone 4 and Zone 6/Zone 1 (lower)	Playing/Bait digging	-	19	-
160	Rocks at the north end of Dunnet beach	Walking	1	-	-
	Zone 1 and 2	Walking	-	1	-
161	Rocks at the north end of Dunnet beach	Walking	1	-	-
	Zone 1 and 2	Walking	-	1	-
162	Rocks at the north end of Dunnet beach	Walking	1	-	-
	Zone 1 and 2	Walking	-	1	-
27	**Zone 1 (lower) to Zone 6 (lower)/Zone 8**	**Angling/Bait digging**	**-**	**330**	-
	Murkle beach	**Angling**	**-**	**-**	**30**
56	**Zone 1 (lower) to Zone 6 (lower)/Zone 8**	**Angling/Bait digging**	**-**	**330**	-
	Murkle beach	**Angling**	**-**	**-**	**30**
57	**Zone 1 (lower) to Zone 6 (lower)/Zone 8**	**Angling/Bait digging**	**-**	**330**	-
	Murkle beach	**Angling**	**-**	**-**	**30**
58	**Zone 1 (lower) to Zone 6 (lower)/Zone 8**	**Angling/Bait digging**	**-**	**330**	-
	Murkle beach	**Angling**	**-**	**-**	**30**
59	**Zone 1 (lower) to Zone 6 (lower)/Zone 8**	**Angling/Bait digging**	**-**	**330**	-
	Murkle beach	**Angling**	**-**	**-**	**30**
60	**Zone 1 (lower) to Zone 6 (lower)/Zone 8**	**Angling/Bait digging**	**-**	**330**	-
	Murkle beach	**Angling**	**-**	**-**	**30**
61	**Zone 1 (lower) to Zone 6 (lower)/Zone 8**	**Angling/Bait digging**	**-**	**330**	-
	Murkle beach	**Angling**	**-**	**-**	**30**
62	**Zone 1 (lower) to Zone 6 (lower)/Zone 8**	**Angling/Bait digging**	**-**	**330**	-
	Murkle beach	**Angling**	**-**	**-**	**30**

Table A3.1 Adults' intertidal occupancy rates in Dunnet Bay by substrate

Observation number	Location	Activity	Occupancy (h y^{-1})		
			Rock	Sand	Sand & stones
63	**Zone 1 (lower) to Zone 6 (lower)/Zone 8**	**Angling/Bait digging**	**-**	**330**	-
	Murkle beach	**Angling**	**-**	**-**	**30**
64	**Zone 1 (lower) to Zone 6 (lower)/Zone 8**	**Angling/Bait digging**	**-**	**330**	-
	Murkle beach	**Angling**	**-**	**-**	**30**
65	**Zone 1 (lower) to Zone 6 (lower)/Zone 8**	**Angling/Bait digging**	**-**	**330**	-
	Murkle beach	**Angling**	**-**	**-**	**30**
117	**Zone 2/Zone 2 to Zone 6**	**Playing/Dog walking**	**-**	**310**	-
96	**Zone 3 (upper) to Zone 4 (upper) and dunes**	**Dog walking**	**-**	**228**	-
140	**Zone 1 (mid and lower) to Zone 6 (mid and lower)/Zone 8**	**Angling/Bait digging**	**-**	**221**	-
130	**Zone 1 (mid) to Zone 6 (mid)**	**Dog walking**	**-**	**183**	-
171	**Zone 1 to Zone 6**	**Dog walking**	**-**	**182**	-
172	**Zone 1 to Zone 6**	**Dog walking**	**-**	**182**	-
84	**Zone 1 to Zone 6 and dunes**	**Ranger duties**	**-**	**168**	-
85	**Zone 1 to Zone 6 and dunes**	**Ranger duties**	**-**	**168**	-
86	**Zone 1 to Zone 6 and dunes**	**Ranger duties**	**-**	**168**	-
1	**Zone 2 (upper)**	**Building sandcastles and playing**	**-**	**154**	-
2	**Zone 2 (upper)**	**Building sandcastles and playing**	**-**	**154**	-
154	**Zone 2 to Zone 6**	**Dog walking**	**-**	**112**	-
155	**Zone 2 to Zone 6**	**Dog walking**	**-**	**112**	-
74	Zone 2 (mid) to Zone 6 (mid)/Zone 2 (upper)	Dog walking/Sitting on a chair	-	105	-
75	Zone 2 (mid) to Zone 6 (mid)/Zone 2 (upper)	Dog walking/Sitting on a chair	-	105	-
114	Zone 1 to Zone 6	Playing	-	96	-
157	Zone 1 (mid) to Zone 6 (mid)/Zone 1 to Zone 6	Dog walking/Playing	-	93	-
46	Zone 2 (mid) to Zone 4 (mid)	Beach combing	-	91	-
128	Zone 1 to Zone 6	Walking	-	70	-
129	Zone 1 to Zone 6	Walking	-	70	-
12	Zone 1 to Zone 6	Walking	-	64	-
13	Zone 1 to Zone 6	Walking	-	64	-
148	Zone 1 to Zone 6 and Peedie beach	Walking	-	64	-
149	Zone 1 to Zone 6 and Peedie beach	Walking	-	64	-
31	Zone 2 (upper)	Sitting on a blanket	-	52	-

Table A3.1 Adults' intertidal occupancy rates in Dunnet Bay by substrate

Observation number	Location	Activity	Occupancy (h y^{-1})		
			Rock	Sand	Sand & stones
24	Zone 1 to Zone 6	Playing	-	49	-
25	Zone 1 to Zone 6	Playing	-	49	-
47	Zone 1 to Zone 6/Zone 2 (upper)	Walking/Playing and sitting	-	49	-
48	Zone 1 to Zone 6/Zone 2 (upper)	Walking/Playing and sitting	-	49	-
14	Zone 1 to Zone 6	Horse riding	-	44	-
	Murkle beach	Horse riding	-	-	15
150	Zone 2 (upper)	Playing	-	35	-
151	Zone 2 (upper)	Playing	-	35	-
11	Zone 1 to Zone 6 and Peedie beach	Dog walking	-	32	-
118	Zone 2	Playing	-	30	-
156	Zone 2 (mid)/Zone 1 to Zone 6	Angling/Walking	-	19	-
6	Zone 8/Zone 4 (lower) and Zone 5 (lower)	Bait digging/Angling	-	16	-
7	Zone 8/Zone 4 (lower) and Zone 5 (lower)	Bait digging/Angling	-	16	-
146	Zone 2	Playing	-	15	-
147	Zone 2	Playing	-	15	-
165	Zone 2	Playing	-	15	-
166	Zone 2	Playing	-	15	-
167	Zone 2	Playing	-	15	-
168	Zone 2	Playing	-	15	-
72	Zone 2 to Zone 6	Dog walking	-	14	-
73	Zone 2 to Zone 6	Dog walking	-	14	-
80	Zone 2 (mid)	Playing and building sandcastles	-	13	-
81	Zone 2 (mid)	Playing and building sandcastles	-	13	-
87	Zone 1 to Zone 6	Beach cleaning	-	13	-
88	Zone 1 to Zone 6	Beach cleaning	-	13	-
89	Zone 1 to Zone 6	Beach cleaning	-	13	-
90	Zone 1 to Zone 6	Beach cleaning	-	13	-
91	Zone 1 to Zone 6	Beach cleaning	-	13	-
92	Zone 1 to Zone 6	Beach cleaning	-	13	-
93	Zone 1 to Zone 6	Beach cleaning	-	13	-
94	Zone 1 to Zone 6	Beach cleaning	-	13	-

Table A3.1 Adults' intertidal occupancy rates in Dunnet Bay by substrate

Observation number	Location	Activity	Occupancy (h y^{-1})		
			Rock	Sand	Sand & stones
95	Zone 1 to Zone 6	Beach cleaning	-	13	-
8	Zone 4 (lower) and Zone 5 (lower)	Angling	-	12	-
9	Zone 4 (lower) and Zone 5 (lower)	Angling	-	12	-
10	Zone 4 (lower) and Zone 5 (lower)	Angling	-	12	-
39	Zone 1 (mid and lower) to Zone 6 (mid and lower)	Walking	-	11	-
40	Zone 1 (mid and lower) to Zone 6 (mid and lower)	Walking	-	11	-
76	Zone 2 and Zone 3 (mid) to Zone 6 (mid)	Dog walking	-	10	-
77	Zone 2 and Zone 3 (mid) to Zone 6 (mid)	Dog walking	-	10	-
78	Zone 2 and Zone 3 (mid) to Zone 6 (mid)	Dog walking	-	10	-
79	Zone 2 and Zone 3 (mid) to Zone 6 (mid)	Dog walking	-	10	-
112	Zone 1 to Zone 6	Bird watching	-	8	-
113	Zone 1 to Zone 6	Bird watching	-	8	-
41	Zone 1 (upper) to Zone 6 (upper)	Walking	-	5	-
42	Zone 1 (upper) to Zone 6 (upper) and dunes	Walking	-	5	-
53	Zone 2 (upper) and Murkle beach	Walking and playing	-	5	-
108	Zone 1 (upper) to Zone 6 (upper) and dunes	Quad biking	-	4	-
110	Zone 2 (mid) to Zone 6 (mid)	Walking	-	4	-
111	Zone 2 (mid) to Zone 6 (mid)	Walking	-	4	-
44	Zone 1 (mid)	Kite flying	-	4	-
132	Zone 2 (mid)	Sunbathing	-	4	-
123	Zone 1 to Zone 3	Walking	-	3	-
124	Zone 1 to Zone 3	Walking	-	3	-
131	Zone 2	Playing	-	3	-
51	Zone 1 to Zone 6	Walking	-	2	-
	Murkle beach	Walking	-	-	3
52	Zone 1 to Zone 6	Walking	-	2	-
	Murkle beach	Walking	-	-	3
21	Zone 2 (upper)	Sitting on a chair	-	2	-
97	Zone 2 (mid) to Zone 4 (mid)	Walking	-	2	-
98	Zone 2 (mid) to Zone 4 (mid)	Walking	-	2	-
101	Zone 2 (mid) to Zone 6 (mid)	Dog walking	-	2	-

Table A3.1 Adults' intertidal occupancy rates in Dunnet Bay by substrate

Observation number	Location	Activity	Occupancy (h y^{-1})		
			Rock	Sand	Sand & stones
102	Zone 2 (mid) to Zone 6 (mid)	Dog walking	-	2	-
103	Zone 2 (mid) to Zone 6 (mid)	Dog walking	-	2	-
104	Zone 2 (mid) to Zone 6 (mid)	Dog walking	-	2	-
105	Zone 2 (mid) to Zone 6 (mid)	Dog walking	-	2	-
142	Zone 6 (upper)	Playing	-	2	-
143	Zone 6 (upper)	Playing	-	2	-
15	Zone 2 (upper)/Zone 2 (mid)	Sunbathing/Kite flying	-	2	-
16	Zone 2 (upper)/Zone 2 (mid)	Sunbathing/Kite flying	-	2	-
19	Zone 2 (upper)	Playing and sitting	-	2	-
20	Zone 2 (upper)	Playing and sitting	-	2	-
30	Zone 1 to Zone 6	Walking	-	1	-
36	Zone 2 (upper)	Sitting on a blanket	-	1	-
99	Zone 2 (mid) to Zone 4 (mid)	Dog walking	-	1	-
100	Zone 2 (mid) to Zone 4 (mid)	Dog walking	-	1	-
37	Zone 7	Collecting stones	-	-	1
38	Zone 7	Collecting stones	-	-	1

Notes

Emboldened observations are the high rate individuals

The mean intertidal occupancy rate over rock based on the only high-rate observation is 24 h y^{-1}

The observed 97.5th percentile rate based on 6 observations for rock is 22 h y^{-1}

The mean intertidal occupancy rate over sand based on 25 high-rate observations is 249 h y^{-1}

The observed 97.5th percentile rate based on 115 observations for sand is 330 h y^{-1}

The mean intertidal occupancy rate over sand and stones based on 12 high-rate observations is 34 h y^{-1}

The observed 97.5th percentile rate based on 17 observations for sand and stones is 61 h y^{-1}

Where a wide range of activities were being undertaken, each for a short duration, these have been referred to collectively as 'playing'. The activities included, for example; ball games, paddling, sunbathing, collecting stones and shells, playing with sand, kite flying, reading and eating.

Table A3.2 Children's intertidal occupancy rates in Dunnet Bay by substrate

Observation number	Sex	Age	Location	Activity	Occupancy (h y^{-1})		
					Rock	Sand	Sand & stones
15-year-old age group							
164	**F**	**13**	**Rocks at the north end of Dunnet beach**	**Walking**	**1**	-	-
			Zone 1 and Zone 2	Walking	**-**	1	-
159	**F**	**13**	**Zone 1 to Zone 6/Zone 1 (mid) to Zone 6 (mid)**	**Playing/Dog walking**	**-**	**93**	-
82	F	12	Zone 2 (mid)	Playing and building sandcastles	-	13	-
10-year-old age group							
163	**F**	**10**	**Rocks at the north end of Dunnet beach**	**Walking**	**1**	-	-
			Zone 1 and Zone 2	Walking	**-**	1	-
3	**M**	**9**	**Zone 2 (upper)**	**Playing and building sandcastles**	-	**154**	-
4	**M**	**7**	**Zone 2 (upper)**	**Playing and building sandcastles**	-	**154**	-
115	**M**	**8**	**Zone 1 to Zone 6**	**Playing**	-	**96**	-
116	**M**	**10**	**Zone 1 to Zone 6**	**Playing**	-	**96**	-
158	**M**	**8**	**Zone 1 to Zone 6/Zone 1 (mid) to Zone 6 (mid)**	**Playing/Dog walking**	-	**93**	-
32	F	8	Zone 2 (upper)	Playing	-	48	-
33	F	10	Zone 2 (upper)	Playing	-	48	-
34	F	10	Zone 2 (upper)	Playing	-	48	-
35	M	7	Zone 2 (upper)	Playing	-	48	-
26	M	8	Zone 1 to Zone 6/Zone 2 (upper)	Playing/Building sandcastles	-	42	-
50	M	8	Zone 1 to Zone 6/Zone 2 (upper)	Walking/Playing and building sandcastles	-	39	-
119	F	8	Zone 2	Playing	-	30	-
120	F	7	Zone 2	Playing	-	30	-
169	M	9	Zone 2	Playing	-	15	-
83	M	9	Zone 2 (mid)	Building sandcastles and playing	-	13	-
43	F	8	Zone 1 (upper) to Zone 6 (upper) and dunes	Walking	-	5	-
125	M	9	Zone 1 to Zone 3	Walking	-	3	-
126	M	7	Zone 1 to Zone 3	Walking	-	3	-
133	F	11	Zone 2	Playing	-	3	-
134	M	8	Zone 2	Playing	-	3	-
106	M	7	Zone 2 (mid) to Zone 6 (mid)	Dog walking	-	2	-
107	M	10	Zone 2 (mid) to Zone 6 (mid)	Dog walking	-	2	-
144	F	8	Zone 6 (upper)	Playing	-	2	-
22	M	7	Zone 2 (upper)	Playing	-	1	-
23	F	9	Zone 2 (upper)	Playing	-	1	-

Table A3.2 Children's intertidal occupancy rates in Dunnet Bay by substrate

Observation number	Sex	Age	Location	Activity	Occupancy (h y^{-1})		
					Rock	Sand	Sand & stones
5-year-old age group							
138	**M**	**5**	**Rocks at the north end of Dunnet beach**	**Rock pooling**	**5**	-	-
			Zone 1, Zone 4 and Zone 6/Zone 1 (lower)	Playing/Bait digging (with parents)	**-**	19	-
139	**M**	**3**	**Rocks at the north end of Dunnet beach**	**Rock pooling**	**5**	-	-
			Zone 1, Zone 4 and Zone 6/Zone 1 (lower)	Playing/Bait digging (with parents)	**-**	19	-
173	**M**	**2**	**Zone 1 to Zone 6**	**Dog walking**	-	**182**	-
174	**F**	**4**	**Zone 1 to Zone 6**	**Dog walking**	-	**182**	-
5	**F**	**2**	**Zone 2 (upper)**	**Playing and building sandcastles**	-	**154**	-
49	F	4	Zone 1 to Zone 6/Zone 2 (upper)	Walking/Playing and building sandcastles	-	39	-
152	M	2	Zone 2 (upper)	Playing	-	35	-
121	M	6	Zone 2	Playing	-	30	-
122	M	4	Zone 2	Playing	-	30	-
170	M	4	Zone 2	Playing	-	15	-
45	M	2	Zone 2 (mid)	Playing and building sandcastles	-	4	-
127	M	4	Zone 1 to Zone 3	Walking	-	3	-
135	M	5	Zone 2	Playing	-	3	-
54	**M**	**3**	Zone 2 (upper)	Building sandcastles	-	2	-
			Murkle beach	**Walking and playing**	-	-	**3**
145	M	6	Zone 6 (upper)	Playing	-	2	-
17	M	4	Zone 2 (upper)	Playing and building sandcastles	-	1	-
18	F	3	Zone 2 (upper)	Playing and building sandcastles	-	1	-
1-year-old age group							
153	**F**	**1**	**Zone 2 (upper)**	**Playing**	**-**	**35**	**-**
3-month-old age group							
55	**M**	**6 months**	**Zone 2 (upper)**	**Playing with sand**	**-**	**2**	-
			Murkle beach	**Playing**	**-**	**-**	**3**

(notes on the next page)

Table A3.2 Children's intertidal occupancy rates in Dunnet Bay by substrate

Notes
Emboldened observations are the high-rate individuals

15-year-old age group
The mean intertidal occupancy rate over rock based on the only high-rate observation is 1 h y^{-1}
The observed 97.5th percentile rate is not applicable for 1 observation
The mean intertidal occupancy rate over sand based on the only high-rate observation is 93 h y^{-1}
The observed 97.5th percentile rate based on 3 observations for sand is 89 h y^{-1}

10-year-old age group
The mean intertidal occupancy rate over rock based on the only high-rate observation is 1 h y^{-1}
The observed 97.5th percentile rate is not applicable for 1 observation
The mean intertidal occupancy rate over sand based on 5 high rate observations is 119 h y^{-1}
The observed 97.5th percentile rate based on 26 observations for sand is 154 h y^{-1}

5-year-old age group
The mean intertidal occupancy rate over rock based on 2 high-rate observations is 5 h y^{-1}
The observed 97.5th percentile rate based on 2 observations for rock is 5 h y^{-1}
The mean intertidal occupancy rate over sand based on 3 high-rate observations is 173 h y^{-1}
The observed 97.5th percentile rate based on 17 observations for sand is 182 h y^{-1}
The mean intertidal occupancy rate over sand and stones based on the only high-rate observation is 3 h y^{-1}
The observed 97.5th percentile rate is not applicable for 1 observation

1-year-old age group
The mean intertidal occupancy rate over sand based on the only high-rate observation is 35 h y^{-1}
The observed 97.5th percentile rate is not applicable for 1 observation

3-month-old age group
The mean intertidal occupancy rate over sand based on the only high-rate observation is 2 h y^{-1}
The observed 97.5th percentile rate is not applicable for 1 observation
The mean intertidal occupancy rate over sand and stones based on the only high-rate observation is 3 h y^{-1}
The observed 97.5th percentile rate is not applicable for 1 observation

Where a wide range of activities were being undertaken, each for a short duration, these have been referred to collectively as 'playing'. The activities included, for example; ball games, paddling, sunbathing, collecting stones and shells, playing with sand, kite flying, reading and eating.

Table A3.3 Adults' handling rates of fishing gear and sediment in Dunnet Bay

Observation number	Location	Activity	Handling fishing gear (h y^{-1})	Handling sediment (h y^{-1})
28	**Dunnet Bay**	**Handling creels**	**1344**	-
66	Dunnet Bay	Handling bag-nets	440	-
109	Dunnet Bay	Handling creels	90	-
27	**Zone 8**	**Bait digging**	**-**	**30**
56	**Zone 8**	**Bait digging**	**-**	**30**
57	**Zone 8**	**Bait digging**	**-**	**30**
58	**Zone 8**	**Bait digging**	**-**	**30**
59	**Zone 8**	**Bait digging**	**-**	**30**
60	**Zone 8**	**Bait digging**	**-**	**30**
61	**Zone 8**	**Bait digging**	**-**	**30**
62	**Zone 8**	**Bait digging**	**-**	**30**
63	**Zone 8**	**Bait digging**	**-**	**30**
64	**Zone 8**	**Bait digging**	**-**	**30**
65	**Zone 8**	**Bait digging**	**-**	**30**
140	**Zone 8**	**Bait digging**	**-**	**26**
29	**Zone 7**	**Collecting winkles**	**-**	**24**
1	Zone 2 (upper)	Building sandcastles	-	4
2	Zone 2 (upper)	Building sandcastles	-	4
6	Zone 8	Bait digging	-	4
7	Zone 8	Bait digging	-	4
80	Zone 2 (mid)	Building sandcastles	-	1
81	Zone 2 (mid)	Building sandcastles	-	1
136	Zone 1 (lower)	Bait digging	-	1
137	Zone 1 (lower)	Bait digging	-	1

Notes

Emboldened observations are the high-rate individuals

The mean fishing gear handling rate based on 1 high-rate observation is 1344 h y^{-1}

The observed 97.5th percentile rate based on 3 observations for fishing gear is 1299 h y^{-1}

The mean sediment handling rate based on 13 high-rate observations is 29 h y^{-1}

The observed 97.5th percentile rate based on 21 observations for sediment is 30 h y^{-1}

Gloves were usually worn by individuals undertaking creeling and bag netting but not when repairing creels and nets.

Table A3.4 Children's handling rates of sediment in Dunnet Bay

Observation number	Sex	Age	Location	Activity	Handling sediment (h y^{-1})
15-year-old age group					
82	**F**	**12**	**Zone 2 (mid)**	**Building sandcastles**	**1**
10-year-old age group					
26	**M**	**8**	**Zone 2 (upper)**	**Building sandcastles**	**14**
50	**M**	**8**	**Zone 2 (upper)**	**Building sandcastles**	**10**
3	**M**	**9**	**Zone 2 (upper)**	**Building sandcastles**	**4**
4	**M**	**7**	**Zone 2 (upper)**	**Building sandcastles**	**4**
83	M	9	Zone 2 (mid)	Building sandcastles	1
5-year-old age group					
49	**F**	**4**	**Zone 2 (upper)**	**Building sandcastles**	**10**
5	**F**	**2**	**Zone 2 (upper)**	**Building sandcastles**	**4**
54	M	3	Zone 2 (upper)	Building sandcastles	2
17	M	4	Zone 2 (upper)	Building sandcastles	1
18	F	3	Zone 2 (upper)	Building sandcastles	1
45	M	2	Zone 2 (mid)	Building sandcastles	1
138	M	5	Zone 1 (lower)	Bait digging (with parents)	1
139	M	3	Zone 1 (lower)	Bait digging (with parents)	1
3-month-old age group					
55	**M**	**6 months**	**Zone 2 (upper)**	**Playing with sand**	**2**

Notes

Emboldened observations are the high-rate individuals

15-year-old age group

The mean sediment handling rate based on the only high-rate observation is 1 h y^{-1}

The observed 97.5th percentile rate is not applicable for 1 observation

10-year-old age group

The mean sediment handling rate based on 4 high-rate observations is 8 h y^{-1}

The observed 97.5th percentile rate based on 5 observations for sediment is 14 h y^{-1}

5-year-old age group

The mean sediment handling rate based on 2 high-rate observations is 7 h y^{-1}

The observed 97.5th percentile rate based on 8 observations for sediment is 9 h y^{-1}

3-month-old age group

The mean sediment handling rate based on the only high-rate observation is 2 h y^{-1}

The observed 97.5th percentile rate is not applicable for 1 observation

APPENDIX 4. OCCUPANCY RATES FOR ACTIVITIES IN AND ON THE WATER

Table A4.1 Adults' occupancy rates in and on the water in Dunnet Bay

Observation number	Location	Activity	Occupancy in water (h y^{-1})	Occupancy on water (h y^{-1})
1	Off the shore of Zone 2	Swimming	16	-
2	Off the shore of Zone 2	Swimming	16	-
148	Off the shore of Zone 2	Swimming	16	-
149	Off the shore of Zone 2	Swimming	16	-
114	Off the shore between Zone 1 and Zone 6	Swimming	5	-
	Zone 1 (lower) to Zone 6 (lower)	Paddling	-	5
150	Off the shore of Zone 2	Swimming	1	-
	Zone 2 (lower)	Paddling	-	2
151	Off the shore of Zone 2	Swimming	1	-
	Zone 2 (lower)	Paddling	-	2
80	Off the shore of Zone 2	Swimming	1	-
	Zone 2 (lower)	Paddling	-	1
81	Off the shore of Zone 2	Swimming	1	-
	Zone 2 (lower)	Paddling	-	1
131	Off the shore of Zone 2	Surfing	1	-
28	Dunnet Bay	Creeling offshore	-	900
66	Dunnet Bay	Servicing bag-nets	-	320
109	Dunnet Bay	Creeling offshore	-	240
39	Zone 1 (lower) to Zone 6 (lower)	Paddling	-	1
40	Zone 1 (lower) to Zone 6 (lower)	Paddling	-	1
132	Zone 2 (lower)	Paddling	-	1
146	Zone 2 (lower)	Paddling	-	1
147	Zone 2 (lower)	Paddling	-	1

Table A4.2 Children's occupancy rates in and on the water in Dunnet Bay

Observation number	Sex	Age	Location	Activity	Occupancy in water (h y^{-1})	Occupancy on water (h y^{-1})
15-year-old age group						
82	F	12	Off the shore of Zone 2	Swimming	1	-
			Zone 2 (lower)	Paddling	-	1
10-year-old age group						
3	M	9	Off the shore of Zone 2	Swimming	16	-
4	M	7	Off the shore of Zone 2	Swimming	16	-
115	M	8	Off the shore between Zone 1 and Zone 6	Swimming	5	-
			Zone 1 (lower) to Zone 6 (lower)	Paddling	-	5
116	M	10	Off the shore between Zone 1 and Zone 6	Swimming	5	-
			Zone 1 (lower) to Zone 6 (lower)	Paddling	-	5
32	F	8	Off the shore of Zone 2	Swimming	4	-
33	F	10	Off the shore of Zone 2	Swimming	4	-
34	F	10	Off the shore of Zone 2	Swimming	4	-
35	M	7	Off the shore of Zone 2	Swimming	4	-
83	M	9	Off the shore of Zone 2	Swimming	1	-
			Zone 2 (lower)	Paddling	-	1
133	F	11	Off the shore of Zone 2	Surfing	1	-
134	M	8	Off the shore of Zone 2	Surfing	1	-
50	M	8	Zone 2 (lower)	Paddling	-	10
26	M	8	Zone 2 (lower)	Paddling	-	7
22	M	7	Zone 2 (lower)	Paddling	-	1
23	F	9	Zone 2 (lower)	Paddling	-	1
5-year-old age group						
152	M	2	Off the shore of Zone 2	Swimming	1	-
			Zone 2 (lower)	Paddling	-	2
135	M	5	Off the shore of Zone 2	Surfing	1	-
5	F	2	Zone 2 (lower)	Paddling	-	16
49	F	4	Zone 2 (lower)	Paddling	-	10
17	M	4	Zone 2 (lower)	Paddling	-	1
18	F	3	Zone 2 (lower)	Paddling	-	1
1-year-old age group						
153	F	1	Zone 2 (lower)	Paddling	-	3

APPENDIX 5. AQUATIC FOOD CONSUMPTION RATES, WITH MEMBERS OF THE HIGH-RATE GROUPS IDENTIFIED

Table A5.1 Adults' consumption rates of fish from Dunnet Bay (kg y^{-1})

Observation number	Bass	Cod	Common ling	Flounder	Mackerel	Pollack	Salmon	Total
109	**-**	**7.9**	**7.2**	**-**	**-**	**-**	**-**	**15.1**
141	**2.2**	**3.5**	**-**	**0.8**	**-**	**2.8**	**-**	**9.3**
140	**-**	**3.5**	**-**	**0.8**	**-**	**2.8**	**-**	**7.0**
66	-	-	-	-	-	-	2.8	2.8
67	-	-	-	-	-	-	2.8	2.8
31	-	-	-	-	1.7	-	-	1.7
68	0.1	-	-	-	0.5	-	-	0.7
11	-	-	-	-	0.6	-	-	0.6
69	0.1	-	-	-	0.4	-	-	0.5
27	0.4	-	-	-	-	-	-	0.4

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of fish based on the 3 high-rate adult consumers is 10.5 kg y^{-1}

The observed 97.5th percentile rate based on 10 observations is 13.8 kg y^{-1}

Table A5.2 Adults' consumption rates of crustaceans from Dunnet Bay (kg y^{-1})

Observation number	Crab	Lobster	Total
109	**-**	**8.6**	**8.6**
28	**2.0**	**2.0**	**4.0**
12	-	0.2	0.2
13	-	0.2	0.2

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of crustaceans based on the 2 high-rate adult consumers is 6.3 kg y^{-1}

The observed 97.5th percentile rate based on 4 observations is 8.3 kg y^{-1}

Table A5.3 Adults' consumption rates of molluscs from Dunnet Bay (kg y^{-1})

Observation number	Quahog clam	Mussel	Winkle	Total
29	**1.2**	**0.4**	**4.9**	**6.5**

Notes

The emboldened observation is the high-rate consumer

The mean consumption rate of molluscs based on the only adult consumer is 6.5 kg y^{-1}

The observed 97.5th percentile rate is not applicable for 1 observation

Table A5.4 Adults' consumption rates of marine plants/algae from Dunnet Bay (kg y^{-1})

Observation number	*Enteromorpha sp.*	*Ulva lactuca* (sea lettuce)	Total
11	**1.1**	**-**	**1.1**
29	-	0.2	0.2

Notes

The emboldened observation is the high-rate consumer

The mean consumption rate of marine plants/algae based on the only high-rate adult consumer is 1.1 kg y^{-1}

The observed 97.5th percentile rate based on 2 observations is 1.1 kg y^{-1}

Table A5.5 Children's consumption rates of fish from Dunnet Bay (kg y^{-1})

10-year-old age group				
Observation number	**Age (years)**	**Bass**	**Mackerel**	**Total**
71	**10**	**0.1**	**0.4**	**0.5**
70	**7**	**0.1**	**0.4**	**0.5**

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of fish based on the 2 high-rate 10-year-old age group consumers is 0.5 kg y^{-1}

The observed 97.5th percentile rate based on 2 observations is 0.5 kg y^{-1}

APPENDIX 6. TERRESTRIAL WILD FOOD CONSUMPTION RATES, WITH MEMBERS OF THE HIGH-RATE GROUPS IDENTIFIED

Table A6.1 Adults' consumption rates of wild fungi from the Dunnet Bay area (kg y^{-1})

Observation number	Mixed fungi
29	**7.5**
84	0.1

Notes

The emboldened observation is the high-rate consumer

The mean consumption rate of wild fungi based on the only high-rate adult consumer is 7.5 kg y^{-1}

The observed 97.5th percentile rate based on 2 observations is 7.3 kg y^{-1}

Table A6.2 Adults' consumption rates of freshwater plants from the Dunnet Bay area (kg y^{-1})

Observation number	Watercress
29	**1.0**

Notes

The emboldened observation is the high-rate consumer

The mean consumption rate of freshwater plants based on the only adult consumer is 1.0 kg y^{-1}

The observed 97.5th percentile rate is not applicable for 1 observation

APPENDIX 7. CONSUMPTION, OCCUPANCY AND HANDLING RATES

Table A7.1 Adults' consumption rates (kg y^{-1}), occupancy rates (h y^{-1}) and handling rates (h y^{-1})

Observation number	Sex	Age	Fish	Crustaceans	Molluscs	Marine plants/algae	Wild fungi	Fresh water plants	Intertidal occupancy over rock	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling fishing gear	Handling sediment	Occupancy in water	Occupancy on water
1	M	41	-	-	-	-	-	-	-	**154**	-	-	4	16	-
2	F	32	-	-	-	-	-	-	-	**154**	-	-	4	16	-
6	M	U	-	-	-	-	-	-	-	16	-	-	4	-	-
7	M	U	-	-	-	-	-	-	-	16	-	-	4	-	-
8	M	U	-	-	-	-	-	-	-	12	-	-	-	-	-
9	M	U	-	-	-	-	-	-	-	12	-	-	-	-	-
10	M	U	-	-	-	-	-	-	-	12	-	-	-	-	-
11	F	43	0.6	-	-	**1.1**	-	-	-	32	-	-	-	-	-
12	M	65	-	0.2	-	-	-	-	-	64	-	-	-	-	-
13	F	65	-	0.2	-	-	-	-	-	64	-	-	-	-	-
14	F	45	-	-	-	-	-	-	-	44	15	-	-	-	-
15	M	35	-	-	-	-	-	-	-	2	-	-	-	-	-
16	F	36	-	-	-	-	-	-	-	2	-	-	-	-	-
19	M	65	-	-	-	-	-	-	-	2	-	-	-	-	-
20	F	65	-	-	-	-	-	-	-	2	-	-	-	-	-
21	M	42	-	-	-	-	-	-	-	2	-	-	-	-	-
24	M	50	-	-	-	-	-	-	-	49	-	-	-	-	-
25	F	50	-	-	-	-	-	-	-	49	-	-	-	-	-
27	M	U	0.4	-	-	-	-	-	-	**330**	**30**	-	**30**	-	-
28	M	U	-	**4.0**	-	-	-	-	-	-	-	**1344**	-	-	900
29	M	67	-	-	**6.5**	0.2	**7.5**	**1.0**	**24**	**244**	**81**	-	**24**	-	-
30	F	57	-	-	-	-	-	-	-	1	-	-	-	-	-
31	F	41	1.7	-	-	-	-	-	-	52	-	-	-	-	-
36	F	74	-	-	-	-	-	-	-	1	-	-	-	-	-
37	M	57	-	-	-	-	-	-	-	-	1	-	-	-	-
38	F	57	-	-	-	-	-	-	-	-	1	-	-	-	-
39	M	33	-	-	-	-	-	-	-	11	-	-	-	-	1
40	F	33	-	-	-	-	-	-	-	11	-	-	-	-	1
41	M	51	-	-	-	-	-	-	-	5	-	-	-	-	-
42	M	25	-	-	-	-	-	-	-	5	-	-	-	-	-
44	M	U	-	-	-	-	-	-	-	4	-	-	-	-	-
46	F	50	-	-	-	-	-	-	-	91	-	-	-	-	-
47	M	35	-	-	-	-	-	-	-	49	-	-	-	-	-
48	F	35	-	-	-	-	-	-	-	49	-	-	-	-	-
51	M	45	-	-	-	-	-	-	-	2	3	-	-	-	-

Table A7.1 Adults' consumption rates (kg y^{-1}), occupancy rates (h y^{-1}) and handling rates (h y^{-1})

Observation number	Sex	Age	Fish	Crustaceans	Molluscs	Marine plants/algae	Wild fungi	Fresh water plants	Intertidal occupancy over rock	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling fishing gear	Handling sediment	Occupancy in water	Occupancy on water
52	F	34	-	-	-	-	-	-	-	2	3	-	-	-	-
53	F	63	-	-	-	-	-	-	-	5	-	-	-	-	-
56	M	U	-	-	-	-	-	-	-	**330**	**30**	-	**30**	-	-
57	M	U	-	-	-	-	-	-	-	**330**	**30**	-	**30**	-	-
58	M	U	-	-	-	-	-	-	-	**330**	**30**	-	**30**	-	-
59	M	U	-	-	-	-	-	-	-	**330**	**30**	-	**30**	-	-
60	M	U	-	-	-	-	-	-	-	**330**	**30**	-	**30**	-	-
61	M	U	-	-	-	-	-	-	-	**330**	**30**	-	**30**	-	-
62	M	U	-	-	-	-	-	-	-	**330**	**30**	-	**30**	-	-
63	M	U	-	-	-	-	-	-	-	**330**	**30**	-	**30**	-	-
64	M	U	-	-	-	-	-	-	-	**330**	**30**	-	**30**	-	-
65	M	U	-	-	-	-	-	-	-	**330**	**30**	-	**30**	-	-
66	M	U	2.8	-	-	-	-	-	-	-	-	440	-	-	320
67	F	U	2.8	-	-	-	-	-	-	-	-	-	-	-	-
68	M	47	0.7	-	-	-	-	-	-	-	-	-	-	-	-
69	F	48	0.5	-	-	-	-	-	-	-	-	-	-	-	-
72	M	65	-	-	-	-	-	-	-	14	-	-	-	-	-
73	F	65	-	-	-	-	-	-	-	14	-	-	-	-	-
74	M	72	-	-	-	-	-	-	-	105	-	-	-	-	-
75	F	72	-	-	-	-	-	-	-	105	-	-	-	-	-
76	F	73	-	-	-	-	-	-	-	10	-	-	-	-	-
77	M	71	-	-	-	-	-	-	-	10	-	-	-	-	-
78	M	77	-	-	-	-	-	-	-	10	-	-	-	-	-
79	M	71	-	-	-	-	-	-	-	10	-	-	-	-	-
80	M	38	-	-	-	-	-	-	-	13	-	-	1	1	1
81	F	45	-	-	-	-	-	-	-	13	-	-	1	1	1
84	F	67	-	-	-	-	0.1	-	-	**168**	-	-	-	-	-
85	F	19	-	-	-	-	-	-	-	**168**	-	-	-	-	-
86	M	34	-	-	-	-	-	-	-	**168**	-	-	-	-	-
87	U	U	-	-	-	-	-	-	-	13	-	-	-	-	-
88	U	U	-	-	-	-	-	-	-	13	-	-	-	-	-
89	U	U	-	-	-	-	-	-	-	13	-	-	-	-	-
90	U	U	-	-	-	-	-	-	-	13	-	-	-	-	-
91	U	U	-	-	-	-	-	-	-	13	-	-	-	-	-
92	U	U	-	-	-	-	-	-	-	13	-	-	-	-	-
93	U	U	-	-	-	-	-	-	-	13	-	-	-	-	-
94	U	U	-	-	-	-	-	-	-	13	-	-	-	-	-

Table A7.1 Adults' consumption rates (kg y^{-1}), occupancy rates (h y^{-1}) and handling rates (h y^{-1})

Observation number	Sex	Age	Fish	Crustaceans	Molluscs	Marine plants/algae	Wild fungi	Fresh water plants	Intertidal occupancy over rock	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling fishing gear	Handling sediment	Occupancy in water	Occupancy on water
95	U	U	-	-	-	-	-	-	-	13	-	-	-	-	-
96	M	60	-	-	-	-	-	-	-	**228**	-	-	-	-	-
97	M	45	-	-	-	-	-	-	-	2	-	-	-	-	-
98	F	41	-	-	-	-	-	-	-	2	-	-	-	-	-
99	M	66	-	-	-	-	-	-	-	1	-	-	-	-	-
100	F	65	-	-	-	-	-	-	-	1	-	-	-	-	-
101	F	U	-	-	-	-	-	-	-	2	-	-	-	-	-
102	F	U	-	-	-	-	-	-	-	2	-	-	-	-	-
103	F	U	-	-	-	-	-	-	-	2	-	-	-	-	-
104	M	U	-	-	-	-	-	-	-	2	-	-	-	-	-
105	M	U	-	-	-	-	-	-	-	2	-	-	-	-	-
108	M	51	-	-	-	-	-	-	-	4	-	-	-	-	-
109	M	60	**15.1**	**8.6**	-	-	-	-	-	-	-	90	-	-	240
110	F	85	-	-	-	-	-	-	-	4	-	-	-	-	-
111	F	59	-	-	-	-	-	-	-	4	-	-	-	-	-
112	M	58	-	-	-	-	-	-	-	8	-	-	-	-	-
113	F	55	-	-	-	-	-	-	-	8	-	-	-	-	-
114	M	48	-	-	-	-	-	-	-	96	-	-	-	5	5
117	F	60	-	-	-	-	-	-	-	**310**	-	-	-	-	-
118	F	38	-	-	-	-	-	-	-	30	-	-	-	-	-
123	F	68	-	-	-	-	-	-	-	3	-	-	-	-	-
124	F	42	-	-	-	-	-	-	-	3	-	-	-	-	-
128	F	32	-	-	-	-	-	-	-	70	-	-	-	-	-
129	M	35	-	-	-	-	-	-	-	70	-	-	-	-	-
130	M	63	-	-	-	-	-	-	-	**183**	-	-	-	-	-
131	M	40	-	-	-	-	-	-	-	3	-	-	-	1	-
132	F	38	-	-	-	-	-	-	-	4	-	-	-	-	1
136	M	35	-	-	-	-	-	-	5	19	-	-	1	-	-
137	F	35	-	-	-	-	-	-	5	19	-	-	1	-	-
140	M	48	**7.0**	-	-	-	-	-	-	**221**	-	-	**26**	-	-
141	F	48	**9.3**	-	-	-	-	-	-	-	-	-	-	-	-
142	M	58	-	-	-	-	-	-	-	2	-	-	-	-	-
143	F	42	-	-	-	-	-	-	-	2	-	-	-	-	-
146	M	25	-	-	-	-	-	-	-	15	-	-	-	-	1
147	F	24	-	-	-	-	-	-	-	15	-	-	-	-	1
148	F	68	-	-	-	-	-	-	-	64	-	-	-	16	-
149	M	69	-	-	-	-	-	-	-	64	-	-	-	16	-

Table A7.1 Adults' consumption rates (kg y^{-1}), occupancy rates (h y^{-1}) and handling rates (h y^{-1})

Observation number	Sex	Age	Fish	Crustaceans	Molluscs	Marine plants/algae	Wild fungi	Fresh water plants	Intertidal occupancy over rock	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling fishing gear	Handling sediment	Occupancy in water	Occupancy on water
150	M	32	-	-	-	-	-	-	-	35	-	-	-	1	2
151	F	30	-	-	-	-	-	-	-	35	-	-	-	1	2
154	M	71	-	-	-	-	-	-	-	**112**	-	-	-	-	-
155	F	70	-	-	-	-	-	-	-	**112**	-	-	-	-	-
156	M	U	-	-	-	-	-	-	-	19	-	-	-	-	-
157	F	38	-	-	-	-	-	-	-	93	-	-	-	-	-
160	M	48	-	-	-	-	-	-	1	1	-	-	-	-	-
161	M	50	-	-	-	-	-	-	1	1	-	-	-	-	-
162	F	47	-	-	-	-	-	-	1	1	-	-	-	-	-
165	F	U	-	-	-	-	-	-	-	15	-	-	-	-	-
166	M	U	-	-	-	-	-	-	-	15	-	-	-	-	-
167	M	U	-	-	-	-	-	-	-	15	-	-	-	-	-
168	F	75	-	-	-	-	-	-	-	15	-	-	-	-	-
171	M	65	-	-	-	-	-	-	-	**182**	-	-	-	-	-
172	F	60	-	-	-	-	-	-	-	**182**	-	-	-	-	-

Notes

U = Unknown

Emboldened observations are the high-rate individuals

Table A7.2 Children's consumption rates (kg y^{-1}), occupancy rates (h y^{-1}) and handling rates (h y^{-1})

Observation number	Sex	Age	Fish	Intertidal occupancy over rock	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling sediment	Occupancy in water	Occupancy on water
15-year-old age group									
82	F	12	-	-	13	-	**1**	1	1
159	F	13	-	-	**93**	-	-	-	-
164	F	13	-	**1**	1	-	-	-	-
10-year-old age group									
3	M	9	-	-	**154**	-	**4**	16	-
4	M	7	-	-	**154**	-	**4**	16	-
22	M	7	-	-	1	-	-	-	1
23	F	9	-	-	1	-	-	-	1
26	M	8	-	-	42	-	**14**	-	7
32	F	8	-	-	48	-	-	4	-
33	F	10	-	-	48	-	-	4	-
34	F	10	-	-	48	-	-	4	-
35	M	7	-	-	48	-	-	4	-
43	F	8	-	-	5	-	-	-	-
50	M	8	-	-	39	-	**10**	-	10
70	M	7	**0.5**	-	-	-	-	-	-
71	F	10	**0.5**	-	-	-	-	-	-
83	M	9	-	-	13	-	1	1	1
106	M	7	-	-	2	-	-	-	-
107	M	10	-	-	2	-	-	-	-
115	M	8	-	-	**96**	-	-	5	5
116	M	10	-	-	**96**	-	-	5	5
119	F	8	-	-	30	-	-	-	-
120	F	7	-	-	30	-	-	-	-
125	M	9	-	-	3	-	-	-	-
126	M	7	-	-	3	-	-	-	-
133	F	11	-	-	3	-	-	1	-
134	M	8	-	-	3	-	-	1	-
144	F	8	-	-	2	-	-	-	-
158	M	8	-	-	**93**	-	-	-	-
163	F	10	-	**1**	1	-	-	-	-
169	M	9	-	-	15	-	-	-	-

Table A7.2 Children's consumption rates (kg y^{-1}), occupancy rates (h y^{-1}) and handling rates (h y^{-1})

Observation number	Sex	Age	Fish	Intertidal occupancy over rock	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Handling sediment	Occupancy in water	Occupancy on water
5-year-old age group									
5	F	2	-	-	**154**	-	**4**	-	16
17	M	4	-	-	1	-	1	-	1
18	F	3	-	-	1	-	1	-	1
45	M	2	-	-	4	-	1	-	-
49	F	4	-	-	39	-	**10**	-	10
54	M	3	-	-	2	**3**	2	-	-
121	M	6	-	-	30	-	-	-	-
122	M	4	-	-	30	-	-	-	-
127	M	4	-	-	3	-	-	-	-
135	M	5	-	-	3	-	-	1	-
138	M	5	-	**5**	19	-	1	-	-
139	M	3	-	**5**	19	-	1	-	-
145	M	6	-	-	2	-	-	-	-
152	M	2	-	-	35	-	-	1	2
170	M	4	-	-	15	-	-	-	-
173	M	2	-	-	**182**	-	-	-	-
174	F	4	-	-	**182**	-	-	-	-
1-year-old age group									
153	F	1	-	-	**35**	-	-	-	3
3-month-old age group									
55	M	6 months	-	-	**2**	**3**	**2**	-	-

Notes

Emboldened observations are the high-rate individuals