

# **Insh Marshes – Its Hydrology, Multiple Uses and Economic Value**

**June 2002 (updated October 2007)**

**RSPB Scotland**

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## 1 Background

Insh Marshes is recognised as an internationally important wetland site with diverse habitats that support a rich variety of flora and fauna. The site covers almost 1000 hectares of the floodplain of the River Spey between Kingussie and Kincaig, at the foot of the Cairngorms. This large flat area of poorly drained land, which extends approximately 7.5 km in length and up to 1.5 km in width, is the most important floodplain mire in Britain, largely due to its unspoilt character. Historically, floodplain mire systems such as Insh Marshes were once common in Britain but most similar river valleys have now been drained, and their flow regimes controlled.

The importance of the site is reflected in its many conservation designations: SSSI, Ramsar, Special Protection Area (SPA), Candidate Special Area of Conservation (cSAC) and Proposed National Nature Reserve. Insh Marshes is additionally part of the proposed World Heritage Site, Cairngorms National Park and Cairngorm Mountain Scenic Area, and is within the Cairngorms Strath Environmentally Sensitive Area.

As an ecologically valuable wetland, a complex hydrological system and a naturally functioning floodplain, Insh Marshes is an interesting case study for considering implications of introducing the Water Framework Directive. In particular, this site highlights the complexities of identifying individual water bodies, the close links between surface water, groundwater and wetlands and the benefits of naturally functioning hydrological systems.

The major habitats on Insh Marshes are open water, scrub, basin mire, swamp, tall fen and marsh. Several rare plant species, breeding and wintering birds, invertebrates and other animals are found on the site, which contains habitats and vegetation types of international, national and local importance (Table 1).

Table 1 Key features and species on Insh Marshes Floodplain (adapted from Dickie, 2001)

	FEATURE	IMPORTANCE		
		International	National	Local
<b>Geology/ Geomorphology</b>	Geomorphological interest	<i>High</i>		
	Hydrological system	<i>High</i>		
<b>Habitat/ vegetation types</b>	Northern poor fen	<i>High</i>		
	Reed beds	<i>High</i>		
	Sedge communities	<i>High</i>		
	Open water communities	<i>Medium</i>		
<b>Plants</b>	<i>Carex chordorrhiza</i>	<i>High</i>		
	<i>Calamagrostis purpuraea</i>	<i>High</i>		
	<i>Carex aquatilis</i>	<i>Medium</i>		

	Approx 15 other nationally scarce species	<i>Medium</i>
<b>Breeding Birds</b>	Wigeon Pintail Teal Greylag Goldeneye Osprey Spotted crane Water rail Lapwing Snipe Curlew Redshank Wood sandpiper Black-headed gull Breeding waterfowl assemblage	<i>High</i> <i>High</i> <i>High</i> <i>High</i> <i>High</i> <i>High</i> <i>High</i> <i>High</i> <i>High</i> <i>High</i> <i>Medium</i> <i>Low</i> <i>Low</i> <i>High</i> <i>High</i> <i>Medium</i>
<b>Wintering birds</b>	Whooper swan Greylag goose Hen harrier Wintering wildfowl assemblage	<i>Medium</i> <i>Low</i> <i>High</i> <i>Medium</i>
<b>Mammals</b>	Otter	<i>High</i>
<b>Fish</b>	Arctic char	<i>High</i>
<b>Invertebrates</b>	Hoverfly ( <i>Hammerschmidtia ferruginea</i> ) Other Red Data Book (RDB) diptera RDB Beetles Spider <i>Wabasso</i> sp.	<i>Medium</i> <i>High</i> <i>Medium</i> <i>High</i>
<b>Historical/cultural</b>	Burial ground Cup marks	<i>Medium</i> <i>High</i>

Most of Insh Marshes is managed by the RSPB, who have done so since 1973. In the early years, a non-interventionist approach was favoured. At that time it was considered that grazing by sheep and cattle would damage the near-natural features of the marsh. Grazing on the floodplain had been in decline since the turn of the century and the vegetation had become progressively ranker and tussockier whilst the area of willow scrub had also increased significantly. It is now generally accepted that the marshes have traditionally been free from tree cover due to the presence of grazing animals. In 1991 the RSPB initiated a programme of topping, (mowing), with the aim of improving the attractiveness of the sward to graziers. This has been successful in converting the rank and tussocky vegetation into a more open and diverse sward. Today, through close liaison with the local farming community and the provision of suitable infrastructure, the restoration of grazing by sheep and cattle has been achieved over part of the site. This is the linchpin of the conservation management at Insh and in time, grazing should be the sole method of maintaining favourable conditions over the fen areas. Additionally a programme of scrub removal has been initiated, with the aim of clearing areas invaded over the last 30 years. This management should primarily benefit and enhance the nationally

important populations of breeding waders, wildfowl and spotted crane and the wintering populations of hen harrier and whooper swan.

## **2 The hydrology of Insh Marshes**

Three major tributaries, the Gynack, Tromie and Raits burns, flow directly into the River Spey, whilst several smaller burns from the surrounding hills drain directly into the marsh itself. The Spey and its major tributaries have man-made embankments on either bank, built in the late 18<sup>th</sup> and 19<sup>th</sup> centuries for flood control. When water levels are high, breaches in these floodbanks allow the water from the Spey to enter the floodplain whilst water from Loch Insh enters the marsh via the main drain at Coull culvert. In this respect, a hydrological link is maintained between the river and its floodplain.

The marshes are dissected by a series of interconnected drainage ditches constructed in the 19<sup>th</sup> century to remove excess water from the marshlands into Loch Insh and to collect water draining off the higher ground to the south (Gordon, 1993). Like the embankments many of the ditches have not been maintained and have thus choked up with vegetation and no longer drain the marsh. This has further restored the water storage capabilities of the floodplain. Current management practice is to use some of these ditches as wet fences to retain stock, these ditches are cleaned on a rotational basis whilst ensuring that they are not directly connected to the Spey and thus draining the site. Other surface water bodies on the site include lochans arising from oxbows<sup>1</sup> of the River Spey as well as kettle hole lochans.

The hydrology of the marshes is varied and complex, with the existence of different 'compartments' that vary in hydrological regime e.g. water table and ditch water levels, direction and rate of groundwater flow. Due to its large size and the complex pattern of surface water bodies present, the internal hydrology of the area is not yet fully understood but is presently being jointly investigated by the RSPB and SNH<sup>2</sup>

Water levels fluctuate naturally on Insh Marshes, as no artificial water control structures exist. Flooding occurs several times a year, mostly from autumn to spring due to a combination of:

- high flows on the River Spey due to high rainfall and snowmelt in the surrounding catchment
- rainwater/snowmelt draining down to the marshes via hill streams
- high water levels downstream of Loch Insh<sup>3</sup>, which causes the Spey to 'back-up' and overflow.

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<sup>1</sup> An oxbow lake forms when the river's course changes, abandoning a meander to leave a sickle shaped water body.

<sup>2</sup> Scottish National Heritage

<sup>3</sup> High water levels at Loch Insh are largely controlled by the damming effects of the extensive gravel and shingle deposits at the downstream confluence of the Rivers Feshie and Spey. A hydraulic dam effect also occurs when flows in the Feshie are high, holding back the waters of the Spey downstream of the Loch.

The rate at which the floods recede from the marsh depends on the depth of the floodwaters and the duration and intensity of the flood event. Floodwaters may remain for days or weeks before draining out through the breaches and drainage culverts once river levels lower. Insh Marshes remains wet throughout the year, with the water table rarely below 20cm beneath the soil surface. Water levels on the marsh are typically high from October to March, and lowest in June. Comparison of water table depths to NVC<sup>4</sup> vegetation type shows that the vegetation found on the marsh depends on the depth of the water table (Gilvear, 1994).

There is evidence of upwellings of groundwater on the Insh/Coull and Balavil sections of the marsh (Gilvear, 1994), indicating that some wetland areas are groundwater fed in summer.

During times of low flow in the River Spey and low water levels in Loch Insh, the marshes are still connected to the river and the loch via the network of surface drainage ditches (Gilvear, 1994). The height of the water table and direction of water flow on the marshes is controlled by the water levels in the River Spey and Loch Insh and water inputs to the marsh from rainfall, groundwater and surface runoff from adjacent hill slopes. Depending on the hydraulic gradient<sup>5</sup> between the drainage ditches and the marshland, the drainage ditch network can act as a water source or sink to surrounding areas. Similarly, the difference between the marsh water level and the River Spey water level determines whether the marshes act as an inflow or outflow zone for the river. The location of these zones will vary along the river and will alter with time.

Insh Marshes functions hydrologically as an almost entirely intact floodplain, with no artificially controlled water levels. The close and complex hydrological relationship between the river and marsh illustrates the difficulty of defining individual water bodies for the purposes of the WFD and clearly shows that wetlands must be considered when assessing ecological status of rivers and lochs.

### **3 Multiple Functions and economic value of the Insh Marshes floodplain**

The Insh Marshes floodplain performs multiple functions that have economic value that benefit the local economy (Table 2).

Although sometimes difficult to quantify, the economic value of these uses are undoubtedly significant in a rural economy such as this. Many of the floodplain uses rely heavily on the natural functioning of the hydrological system and the high ecological quality of the floodplain.

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<sup>4</sup> National Vegetation Classification

<sup>5</sup> The hydraulic gradient determines the direction of groundwater flow. If the marsh water table is higher than the ditch water levels, water from the marsh will drain into the ditch. Conversely, if the water table on the marsh is lower than the ditch water levels, water from the ditch will seep from the ditch into the marsh.

Table 1: Economic benefits of Insh marshes

Use	Details	Economic value
Flood defence	<p>Insh Marshes holds water after heavy rainfall and snowmelt, protecting downstream properties and farmland from extensive flooding.</p> <p>Flood risk is reduced to settlements such as parts of Aviemore, a significant base for the local tourist economy. The equivalent engineered flood control measures would be very expensive and result in the loss of important wildlife habitat.</p>	<p>In the absence of the floodplain, a rough examination of maps suggests that 7km of flood defence banks might be required to protect Aviemore. Generic costs for the replacement and maintenance of defences in England and Wales are £10,600 per km per yr (£11,872 in 2007 prices) (MAFF, 2000, <i>National Appraisal of Assets at Risk from Flooding and Coastal Defence</i>. Halcrow Maritime, HR Wallingford, Flood Hazard Research Centre). This has a present value of £213,428 per kilometre (£248,217 in 2008 prices).<sup>6</sup> Therefore, the avoided cost of 7km of defences is £1.7 million.</p>
Visitors	<p>Tourism is vital to the Highlands economy, with over a quarter of the Highlands and Islands employment being accounted for by hotels and restaurants.</p> <p>The floodplain plays an important part in the scenery and supports visitor attractions such as Insh Marshes RSPB Nature Reserve and Loch Insh Watersports Centre.</p>	<p>There were about 12,000 visitors to Insh Marshes RSPB Reserve in 2006/07, contributing approximately £132,000 to the local economy.</p>
Farming	<p>Livestock grazing at appropriate densities maintains the floodplain's high biodiversity value.</p> <p>ESA scheme and agri-environment schemes providing valuable incomes to the reserve, its agricultural partners and local graziers.</p>	<p>The rate of agri-environmental payments are currently difficult to quantify</p>
Fishing	<p>The wetland system on the Insh Marshes floodplain helps to maintain the natural conditions, particularly water quality, that are vital to the Spey's valuable fish stocks.</p>	<p>Landowners lease fishing rights on the Insh Marshes floodplain to the Badenoch Angling Association producing revenue of over £3,500 p.a.</p>

<sup>6</sup> Costs and benefits are best assessed over a long time frame, so that the relevant maintenance and replacement costs can be taken into account. The best way to do this is to use present value, which is the total value of the future benefit and cost stream in present day terms - this allows costs and benefits to be compared more easily. The present values used in this calculation use the Treasury's Green Book's declining discount rate over 100 years.

Conservation management	The majority of RSPB's reserve management expenditure is spent within the local economy. Two permanent staff are employed on the RSPB reserve. In addition, in 2006/07, 3,540 hours of work are contributed annually from volunteers, including those from the local community or on long term placements.	Of the £83,504 spent on reserve management during 2006/07, over two-thirds was spent with local businesses. This included the employment of contractors on the reserve for over 45 man-days.
Water Quality	The floodplain can improve water quality by storing nutrients and pollutants in the sediments and in vegetation.	Contributes towards the aims of WFD and benefits the river's salmonid populations, for example, so representing economic value.
Education and training	Insh Marshes provides a valuable recreational and education resource	(Unquantified)
Enterprises linked to the floodplain	Loch Insh Watersports centre forms a major part of the local tourism economy, benefiting from the high water and scenic qualities of the floodplain. Several Bed and Breakfast establishments attract custom by advertising their proximity to the Insh Marshes Floodplain and the RSPB Reserve.	(Unquantified)
Biodiversity and Conservation	The Insh Marshes floodplain contains important wetland habitats and is renowned for its biodiversity, including the number and variety of breeding waders, wintering populations of whooper swans and hen harriers and rich diversity of plants and invertebrates.	(Unquantified)

#### 4. Conclusions

Insh Marshes illustrates the hydrological complexities of a naturally functioning river system and the close links between rivers, lochs and associated wetlands. When identifying water bodies under the Water Framework Directive, it will be extremely important to take account of these links.

The floodplain provides several social, economic and environmental benefits to the Spey catchment. Natural floodplain systems such as this can have multiple uses, such as flood defence, enhancing biodiversity, and helping to maintain good water quality. Cumulatively, these contribute significantly to the local economy. Similar benefits could be accrued elsewhere by using natural or semi-natural wetlands for flood prevention. Restoring degraded river systems and reinstating the links between rivers and their floodplains should also be an important factor in achieving good ecological status under the European Water Framework Directive. Associated benefits for habitats and species will also make an important contribution towards complying with the Habitats and Birds Directives.

Runoff and snowmelt from hill slopes in the surrounding catchments reach the marshes via the River Spey and its tributaries or via the small streams that drain into the marsh itself. Changes in land use in the surrounding catchments will therefore have a direct effect on water quality and quantity on Insh Marshes and downstream. This highlights the need to look at land use and water bodies as part of a wider catchment, rather than in isolation. For such integrated catchment management to be successful, there will need to be far wider integration of land use policy and funding.

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