

MONITORING OF THE CHOUGH OPTION IN THE ANTRIM COAST, GLENS AND RATHLIN ENVIRONMENTALLY SENSITIVE AREA

1998 - 2002

Report to the Department of Agriculture and Rural Development by Agri-environment Monitoring Unit *Queen's University Belfast* March 2004

Agri-environment Monitoring Unit

The agri-environment scheme monitoring programme in Northern Ireland is funded by the Department of Agriculture and Rural Development (DARD) through its Science Service and carried out by Queen's University, Belfast (QUB).

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Acknowledgements

Thanks are extended to Giles Knight (RSPB) for contributing to this report and providing information on RSPB monitoring. Thanks also to Jenny Campbell (National Trust) for information and for assisting with survey work. We are also grateful to the farmers and landowners for their co-operation in allowing access to their land.

CONTENTS

SUM	MARY	, 	1
1.	INTR		
	1.1.	Background	3
	1.2.	The DARD Chough Option	4
	1.3.	Research and monitoring	5
2.	MON	IITORING THE EFFECTS OF THE CHOUGH OPTION	6
	2.1.	Methods	6
	2.2.	Results	9
3.	MON	IITORING OF THE CHOUGH POPULATION	
	3.1. I	Methods	
	3.2. I	Results	19
4.	DISC		21
5.	REF	ERENCES	24

SUMMARY

The decline of the chough population in Northern Ireland has been attributed to the loss of their habitat due to changing farming practices. The Department of Agriculture and Rural Development (DARD) introduced the Chough Option into specific areas within the Antrim Coast, Glens and Rathlin Environmentally Sensitive Area (ESA) in 1997 with the aim of maintaining and restoring suitable chough feeding habitat.

Monitoring by QUB to determine the effects of the option commenced in 1998 with a baseline survey of vegetation and surface-active invertebrates on a range of fields used by the chough. A resurvey was carried out in 2002 and data compared between years. Results indicate that suitable chough habitat is being maintained with some areas of short sward and the presence of known invertebrate prey items. Current literature recommends very short swards close to chough nesting sites although maintaining these may be at the expense of other species.

Monitoring of the remnant chough population by the RSPB since 1998 has shown that they utilise land under Chough Option management almost exclusively. Many other factors have been implicated in the decline of chough populations. In the absence of a viable population these factors may prove difficult to determine. However, it would appear that agri-environment scheme farmland management on the north Antrim coast is providing the best hope for survival of the chough in Northern Ireland and is also benefiting other farmland birds.

1. INTRODUCTION

1.1. Background

The chough, *Pyrrhocorax pyrrhocorax,* is a member of the crow family and is confined mainly to western coastal areas in Britain and Ireland. They nest in cliff crevices and feed mainly on unimproved grassland and coastal heathland on cliff tops and slopes. Their diet consists primarily of invertebrates, especially those found in soil or dung.

The decline of the chough in the UK and Ireland has been well documented (Cabot, 1965; Bullock *et al.*, 1983; Whilde, 1988) and several theories proposed to explain this trend. These include increased competition, increased predation, climatic factors, habitat change and the genetic structure of populations due to the sedentary nature of the species (Monaghan, 1988). More recent work (e.g. McCracken and Bignal, 1998) attributes this decline to a lack of suitable feeding areas as a result of the loss and deterioration of unimproved grasslands and coastal heath.

In Northern Ireland the chough population has continued to fall, with only 9 or 10 breeding pairs observed in 1982. The decline is thought to be related to a lack of suitable feeding habitat mainly due to agricultural improvement and changes in livestock farming practise. By 1992 there were only two breeding pairs remaining, confined to the mainland north Antrim coast. The population has remained more or less stable since then, although breeding success has been poor. However since 1998 there has only been one breeding pair observed.

The chough is a protected species in Europe and listed in the Irish Red Data Book as internationally important (Whilde, 1993). Therefore it requires conservation action in Northern Ireland and as such is a priority species in the Biodiversity Action Plan. A specific action plan has been produced (EHS, 2000) with the lead agencies involved being Environment and Heritage Service (EHS) and Department of Agriculture and Rural Development (DARD). The RSPB chair the BAP Steering

Group for chough and are closely involved in management and monitoring. A farmer's representative and the National Trust also sit on this group. The objective of the Species Action Plan is to maintain chough as a breeding species in Northern Ireland. Restoration of the breeding population to at least 1982 levels, i.e. 10 pairs, by 2010 is the main target.

1.2. The DARD Chough Option

Research carried out by the RSPB in 1996 identified the remaining important chough feeding areas in north Antrim (Colhoun & Donaghy, 1996). Following this DARD introduced the Chough Option into the Antrim Coast, Glens and Rathlin Environmentally Sensitive Area (ESA) scheme in 1997. The initial aim was to maintain and restore suitable chough feeding habitat on the north Antrim coast. Landowners at Fair Head and the Causeway Coast were targeted and encouraged to enter into Chough Option agreements. In return for following a specific management plan (initially for 5 years) the landowner receives an additional payment on top of the ESA payment. By 1998, seven farmers and landowners, including the National Trust, had signed Chough Option agreements on 265 ha of farmland. This includes 154ha at Fair head and 111ha at the Causeway. Over the two land blocks, 219ha is unimproved grassland or rough grazing, 26ha is improved grassland and 20ha is arable.

Management prescriptions for the Chough Option were developed jointly by DARD and RSPB. The priority is to provide the best habitat for feeding chough by maintaining grasslands with a short sward (i.e. 2-3cm) for at least part of the year. Management plans also require all year round grazing on certain fields. Supplementary feeding must be sited in agreement with DARD. Other prescriptions include gorse or bracken control, topping of grass tussocks, and fertiliser and pesticide restrictions. Cereal fields must have stubble retained over winter to provide grain as an additional food source for chough as well as other farmland birds.

1.3. Research and monitoring

Research on chough feeding behaviour at the Causeway and Fair Head in 1996 indicated that the birds utilised a range of habitats during the breeding season, mostly within a 1km radius of the nest-site (Colhoun & Donaghy, 1996). However they showed a distinct preference for a small number of areas, most of which were unimproved or semi-improved grassland. Where improved grassland was used foraging was concentrated on particular features such as rocky outcrops or short vegetation beside paths. Further studies found that field characteristics that influenced selection by chough included little or no inputs of fertilisers, well-drained soils and a short sward (Hart, 1996).

Monitoring the effects of the Chough Option commenced in 1998 with a baseline survey of vegetation and surface-active invertebrates on a range of fields by Queen's University of Belfast (QUB). A resurvey was carried out in 2002. The aim of this study was to evaluate the effectiveness of management prescriptions in delivering habitat suitable for choughs on designated areas.

Regular monitoring of the remnant chough population has been carried out by the RSPB since 1998, along with records from others such as the National Trust. In 1999 an Agri-environment Project Officer was appointed jointly by DARD and RSPB and had responsibility for promoting appropriate habitat management and monitoring chough activity. This responsibility has since been taken up by RSPB. Breeding success is assessed each year and possible causes of failure investigated, such as predation of chicks by peregrine falcons.

Land at the Causeway is under ASSI and SAC designation and as such will have a condition and compliance monitoring programme established by EHS to prevent further damage to habitats. The National Trust also carry out biological surveys of their land including fields under Chough Option and ESA agreement.

2. MONITORING THE EFFECTS OF THE CHOUGH OPTION

2.1. Methods

Site selection

Monitoring sites on the Causeway Coast and at Fair Head were chosen from different habitat categories under the Chough Option (Figures 1a & 1b). The sites were within fields or compartments identified by the RSPB as having high or low usage (i.e. percentage frequency of visits) by feeding choughs in May and June of 1996 (Coulhoun & Donaghy, 1996).

Figure 1a. Map of Causeway Coast showing land under Chough Option agreement and positions of sites monitored in 1998 and 2002.



Figure 1b. Map of Fair Head showing land under Chough Option agreement and positions of sites monitored in 1998 and 2002.



Field methods

Plants and invertebrates were sampled at these sites in 1998 and 2002, based on methods used in biological monitoring of ESAs (Hegarty *et al.* 1994). Plant monitoring was carried out in mid-July along permanent marked transects. Plant species (excluding bryophytes) were recorded from four 2m x 2m quadrats along one or two 40m transects at each site. Percentage cover was estimated for all higher plant species within a nested 1m x 1m quadrat, together with bare ground cover. Sward height was measured at each quadrat. Invertebrates were sampled using five pitfall traps at each site. The invertebrates were collected during three, four-week periods in April, June and August. Ground beetles (Carabidae) and spiders (Araneae) were identified to species level in each year. Other invertebrates of known chough prey species (McCracken *et al.*1992) were identified to group level in 2002.

Data analysis

Mean and total numbers of plant and invertebrate species were calculated for each site. Species richness, the number of species found on a habitat, is the most widely adopted measure of diversity (Magurran, 1983). Changes in species richness over time were determined by comparing (using paired t-test) the mean number of higher plant species, i.e. excluding mosses, liverworts and lichens, for each site in 1998 with the mean number on the same site in 2002.

Similarity indices were calculated for ground beetle and spider populations between years. The Sørensen similarity index gives a measure of the level of change in the species composition of a sample and can be used to determine the level of change in species between baseline and re-survey (Coulson & Butterfield, 1985).

2.2. Results

Species diversity

There were no significant changes between years in the mean number of higher plant species recorded at each monitoring site (Table 1). This suggests that plant diversity has been maintained in these grassland habitats under Chough Option agreement.

Site	Mean no. species (s.e.)				
	1998	2002			
1A	19.75 (1.1)	21.5 (1.2)			
1B	21.25 (2.5)	25.5 (0.7)			
2	8.0 (1.1)	8.75 (1.0)			
4A	26.25 (1.4)	25.0 (2.8)			
4B	13.0 (2.2)	17.5 (4.0)			
5	15.25 (0.9)	17.5 (0.7)			
6	15.75 (1.7)	17.0 (1.1)			
7	25.75 (1.0)	26.0 (0.4)			

Table 1. Mean number of higher plant species recorded per $2m \times 2m$ quadrat at each site in 1998 and 2002 (n = 4).

There were no significant changes in the numbers of species of ground beetles and spiders between 1998 and 2000 (Tables 2 and 3). However similarity indices for species between years show that there were some changes in species composition. The numbers of individuals captured also fluctuated which may be due to climatic or other factors. The numbers of individuals of other invertebrate groups captured on each site was recorded in 2002 (Table 4.)

Site	No. species		No. ind	ividuals	Similarity	
	1998	2002	1998	2002	index (%)	
1A	3	9	66	151	50	
2	12	13	76	163	72	
3	6	13	55	186	53	
4B	14	19	307	224	60	
5	14	14	196	72	57	
6	19	14	158	225	61	
7	19	15	320	338	65	

Table 2. Number of ground beetle species and individuals recorded at each site in1998 and 2002.

Table 3. Number of spider species and individuals recorded at each site in 1998 and 2002.

Site	No. species		No. ind	ividuals	Similarity	
	1998	2002	1998	2002	index (%)	
1A	8	10	34	140	67	
2	13	11	131	115	58	
3	7	8	86	131	67	
4B	19	18	201	101	76	
5	27	18	467	381	67	
6	25	15	267	347	50	
7	15	22	262	279	70	

Group	No. individuals per site						
Gloup	1 A	2	3	4B	5	6	7
Larval Coleoptera	29	16	91	15	28	97	139
Tipulidae	8	0	0	13	15	3	3
Larval Tipulidae	2	0	0	1	1	0	0
Diptera	65	6	26	23	4	17	182
Scarabaeidae	1	2	11	0	32	6	17
Opiliones	0	12	0	25	19	7	30
Staphylinidae	2	4	1	9	12	8	44
TOTAL	107	40	129	86	111	138	415

Table 4. Total abundance of other invertebrate groups captured in 2002 at each site.

Site descriptions and species composition

Sites 1A and 1B

These sites are located in an area adjacent to cliffs (and near to nesting site) that was recorded as having the highest chough usage in 1996 (i.e. 51-100% of visits). Transects are located in an area of unimproved grassland with patches of comparatively species—rich vegetation. Site 1A is on flat ground in a rushy depression. Site 1B is on an adjacent steep slope with very short turf. The sward is sedge dominated (*Carex* spp.) with frequent herb species including daisy (*Bellis perennis*), ribwort plantain (*Plantago lanceolata*), selfheal (*Prunella vulgaris*) and white clover (*Trifolium repens*).

The vegetation is short and heavily cattle-grazed. There has been no change in sward height on the sampling date between years (Fig. 2). However, there has been a fairly large increase in the mean cover of bare ground in the quadrats from 2.5% to 15%. This is likely to be due to poaching by cattle that are grazed on this field all year round, as per management agreement.

Numbers of species and individuals of both ground beetles and spiders increased on site 1A between the two years surveyed. Increases in ground beetles were due mainly to increases in the numbers and variety of *Pterostichus* species trapped at this site (Table 2). Spider species composition varied with a notable increase in abundance of *Erigone* and *Oedothorax* species, both of which have a strong preference for more open, highly managed sites. Abundance of *Pardosa palustris,* which is usually found in damp heathery places declined. This is indicative of a change in the sward architecture towards a more open habitat. Other known chough prey items trapped on this site consisted mainly of Diptera (true flies) and larval Coleoptera (beetles) (Table 4).



Figure 2. Mean vegetation height per quadrat at each site in 1998 and 2002.

Site 2

This vegetation transect is located on unimproved grassland on cliff edge close to the footpath. The area was not recorded as being utilised by chough in 1996, although it is fairly near to a traditional nest site. Plant and invertebrate data cannot be correlated at this site as pitfall traps were placed inside the boundary of the adjacent improved field. This was due to the high possibility of disturbance of the traps by the public. The vegetation is species-poor rank grassland, dominated by coarse grasses such as false oat-grass (*Arrhenatherum elatius*) and yorkshire fog (*Holcus lanatus*). There was a slight increase in vegetation height between 1998 and 2002 (Fig. 2). The sward in this area on the cliff edge was too tall when viewed in terms of the Chough Option. Practical problems in grazing the cliff areas are recognised and maintenance of short swards on adjacent areas may be a viable alternative. There has been grazing and trampling of the cliff slopes by up to 35 sheep in 2002 and 2003, with associated access issues and some stock losses. The trampled area along the cliff path itself may be suitable for chough, as birds have been observed foraging here in the past (Hart, 1996)

Numbers of ground beetle and spider species showed little change at this site. There was comparatively high similarity in ground beetle species composition between years (Table 2) although there was a 46% increase in the numbers of individuals captured. This was due mainly to increases in the abundance of medium sized ground beetles *Nebria brevicollis, Pterostichus melanarius* and *P. strenuus.* These should be viable prey items in the chough diet.

Spider species composition varied between years with a notable increase in abundance of *Oedothorax fuscus*, which has a strong preference for more open, highly managed sites. Abundance of *Lepthyphantes tenuis*, which has been shown to prefer tall vegetation, decreased as did *Pardosa pullata* whose abundance is dependent on vegetation cover providing a critical level of humidity. This indicates a lower, more open vegetation structure. This site had the lowest number of other known prey items (Table 4).

Site 3

Site 3 is located within an unimproved grassland field grazed by cattle. The field was not recorded as being visited by chough in 1996. The sward overall was uneven and was likely to be too high on average to be optimal for feeding chough.

Numbers of ground beetle species and numbers of individuals increased on this site between years and numbers of spider individuals also increased (Tables 2 & 3). Increases in ground beetle numbers were due mainly to increases in the medium sized ground beetles *Nebria brevicollis* and *Pterostichus strenuus*.

Spider species composition varied with notable increases in the abundance of *Oedothorax fuscus*, and decreases in the abundance of *Pardosa palustris* indicative of more open managed habitats. Larval Coleoptera were the most abundant other prey items at this site although Diptera and Scarabaeidae (dung beetles) were also available in comparatively high numbers (Table 4).

Sites 4A and 4B

This area is not in the Chough Option but is managed under ESA agreement by National Trust and within an ASSI. Therefore management objectives are primarily to maintain the important habitat of species-rich grassland, heath and scrub mosaic. The land has been broadly classified by DARD as species-rich dry grassland. The area had no chough usage recorded in May/June 1996 but foraging chough were observed here in 1998 and subsequently.

Site 4A is species-rich heathy grassland, dominated by sedges (*Carex* spp.) with frequent devil's bit scabious (*Succisa pratensis*), meadow thistle (*Cirsium dissectum*) and tormentil (*Potentilla erecta*). Site 4B is in an adjacent damper rushy hollow and less species-rich, with frequent yorkshire fog (*Holcus lanatus*) and meadow buttercup (*Ranunculus acris*). Vegetation is cattle and sheep grazed with variable sward height, ranging between 5cm and 50cm in 2002. Both sites have shown some increase in mean sward height since 1998, as recorded in mid-July (Fig 2). Therefore this area, particularly 4B, was possibly undergrazed in places in terms of chough suitability at time of survey. However the management prescription for this area is for grazing in late summer and therefore sward would be expected to be relatively tall. Choughs will select shorter patches within preferred fields so this may not be a problem as long as patches of short turf are maintained on the drier slopes. Undergrazing of grassland may lead to an increase

of gorse, coarse grasses, bracken or rushes and therefore result in loss of feeding habitat. There are no indications of this occurring at present.

Numbers of ground beetle species increased at this site whereas numbers of spider species showed comparatively little change (Tables 2 & 3). Numbers of ground beetle and spider individuals however both declined by 27% and 49% respectively which may be more important in terms of suitable chough habitat.

Spider species composition varied with decreases in abundance of four spider species which preferred open, managed sites. Abundance of spiders that preferred a wet habitat increased as did *Bathyphantes gracilis,* which has been shown to prefer tall vegetation. This further supports the vegetation results from this site. A range of other known prey items including larval Coleoptera, Tipulidae (crane–flies), Diptera, Opiliones (harvestmen) and Staphylinidae (rove beetles) were available at this site (Table 4).

Site 5

This transect is located in an area recorded as of generally low chough usage in 1996 (2-4% of visits over season). The area had been classified by DARD as unimproved or rough grazing. Vegetation recorded in 1998 included heather (*Calluna vulgaris*) and other heath/acidic grassland species. The sward now includes more agricultural species such as rough meadow-grass (*Poa trivialis*), perennial rye-grass (*Lolium perenne*), white clover (*Trifolium repens*), and weeds including spear thistle (*Cirsium vulgare*) and chickweed (*Stellaria media*). These vegetation changes may have occurred as a result of heavy grazing and consequent enrichment. The management plan for this area includes all year grazing by cattle and sheep. Vegetation height recorded in mid-July was approximately the same in 2002 as 1998 and was above the optimal for chough feeding (Fig. 2).

Numbers of both spider and beetle individuals trapped decreased on this site between years and the number of spider species also showed a decrease (Table 3).

Spider species composition varied with increases in abundance of *Erigone dentipalpis* and *Oedothotax fuscus* both of which have a strong preference for more open, highly managed sites, however *Pachygnatha degeeri* which is typically associated with dry, open localities decreased. Abundance of *Pardosa palustris* which is usually found in damp heathery places notably decreased, as did *Pardosa pullata* whose abundance is dependant on vegetation cover providing a critical level of humidity. Overall these changes suggest more open, less dense vegetation architecture. An extensive range of other known prey items from seven categories (Table 4) was trapped at this site in 2002.

Site 6

Chough usage was recorded as moderate in this area in 1996 (5-10% of visits). The area is unimproved grassland, grazed by sheep. The vegetation is species-poor and dominated by common bent-grass (*Agrostis capillaris*) and yorkshire fog (*Holcus lanatus*). There was comparatively little change in vegetation height between 1998 and 2002. The sward was fairly short although probably slightly above optimal when recorded in mid-July.

Both numbers of ground beetle individuals and species decreased at this site between years although numbers of spider individuals increased mainly due to increases in abundance of *Erigone* and *Oedothorax* species, both of which have a strong preference for more open, highly managed sites. Abundance of *Pardosa pullata*, which depends on vegetation cover providing a critical level of humidity, also decreased. These indicate a change in the sward architecture towards a more open habitat. Other known prey items at this site comprised mainly of larval Coleoptera although other prey items were also available (Table 4).

Site 7

This area had the highest usage by feeding choughs in 1996 (51-75% of visits). Vegetation is unimproved grassland with short, sheep-grazed turf dominated by common bent (*Agrostis capillaris*) and crested dog's-tail (*Cynosurus* cristatus).

There was a slight increase in vegetation height between 1998 and 2002 (Fig. 2) due to increase in taller tussocks of unpalatable grasses, mat grass *Nardus stricta* and tufted hair-grass (*Deschampsia cespitosa*). Presence of these grasses in a quadrat results in a greater mean vegetation height although much of the sward was still short, 5cm or less, at time of remonitoring. Topping of these grass tussocks is recommended if cover appears to be increasing.

Both numbers of ground beetle species and individuals increased at this site between years. Spider species composition did not change significantly although there were small increases in abundance of hydrophilic spider species and small decreases in xerophilous species, probably due to 2002 being a wetter than average year.

This site had the highest numbers of ground beetles and spiders (Tables 2 and 3). Abundance of other prey items was almost three times that of the most abundant other site surveyed. Scarabaeidae, Opiliones, Staphylinidae and Tipulidae were all represented although it was the abundance of larval Coleoptera and Diptera that boosted numbers in this category (Table 4).

3. MONITORING OF THE CHOUGH POPULATION

3.1. Methods

Regular transect monitoring of the chough population by the RSPB commenced in 1999, using recording forms developed following the 1996 research. The Agrienvironment Officer (AEO) walked set transects at the Causeway Coast and Fair Head at intervals of 2 weeks during the breeding season and 3 or 4 weeks for the rest of the year. Details pertaining to birds seen, their behaviour, and in particular, their location were recorded, using site maps with numbered compartments. Feeding and other behaviour, prey species, and condition of ground at the feeding location were all recorded. Additional information included interaction with other birds (especially corvids and raptors), weather conditions and other species present

As well as RSPB, other local agencies, including volunteers, the National Trust, and farmers, have taken records of bird sightings and other details. Building on records taken since 1998, a database of information on the choughs has been gradually established, and includes both transect monitoring and casual observations.

In addition to the bird monitoring, there was an opportunity to ensure that all landholders were adhering to the prescriptions set out in the Chough Option (CO). While individual field condition was not recorded on all bird monitoring visits, periodic checks were made, using individual farm files. Whenever possible, all fields in the CO were walked by the AEO, with sward heights and stocking details recorded. Actual field condition was then matched against the prescription. Through discussions with both farmers and DARD, any habitat enhancements that could be made were addressed. Monitoring is now undertaken by RSPB, although this work may require DARD input in the future, in order to ensure comprehensive compliance.

3.2. Results

Causeway Coast

Casual observations of the pair of adult non-breeding choughs at the Causeway in 1998 showed that they were mostly using unimproved/semi-improved grassland for foraging. Birds were seen feeding on invertebrates associated with cow dung (53% of occasions), on bare/eroded soils (22%), on coastal grassland around 30cm (9%) and on closely-grazed grass of 5-10cm (9%) and once on a newly-cut silage field.

Transects carried out at the Causeway in May and June of 2002 observed the adult pair of choughs mainly feeding on cliff slopes near the nest site, on coastal grassland of variable height. The time spent foraging accounted 70-80% of the total time observed. The birds were also seen in an adjacent unimproved grassland field that was closely grazed. The pair produced three chicks in late June, the first successfully fledged in Northern Ireland since 1996. The five birds were seen feeding on the Causeway cliffs and CO fields until mid-July. In September and October the two adult birds were seen foraging in a harvested barley field adjacent to CO land. There were no further sightings of the young birds. In 2003 the Causeway pair produced two young in mid-June and the family were present until mid-July. By late summer there was only one adult and one young bird sighted.

Fair Head

At Fair Head in 1998 two adult non-breeding birds were seen on the headland but most often (i.e. 64% of observations) were recorded as foraging on semi-improved grassland 2-5cm in height. In 1999 only one bird was observed at Fair Head, and remained for nearly two years without a mate. This is an indication of the site loyalty that choughs display to their 'home patch', even to exclusion of actively searching for a mate. There have been no choughs sighted at Fair Head since 2000.

Other bird species

Other farmland birds listed as species under threat in Northern Ireland also appear to have benefited from positive habitat management. Wintering birds such as snipe, curlew and golden plover have regularly been sighted, along with snow buntings and meadow pipit. In spring, pipits and skylarks have nested in notable numbers and flocks of up to 40 linnets have been present.

The National Trust have recorded twite, snow buntings and whooper swans feeding on their winter stubble field under the Chough Option.

4. DISCUSSION

Much of the recent relevant literature agrees that traditional livestock farming is important for the maintenance of chough populations. The implementation of the DARD Chough Option on the north Antrim coast appears to be providing a range of vegetation suitable for chough foraging. Plant and invertebrate diversity has been maintained at monitoring sites, although there have been some changes in species composition. In some instances vegetation height was significantly above the 2-3cm recommended by the option although this should not be of great concern within the context of the whole area. It should be noted that due to the limited resources available vegetation monitoring was only carried out on randomly selected transects at each site. As such the results can only give an indication of changes between 1998 and 2002 as measured in mid-July. Vegetation height over each field should therefore be measured regularly over the season as part of compliance monitoring. In the most recent literature, Johnstone et al. (2002) suggest a target sward height of 2cm for chough foraging areas. However this may present problems for livestock grazing and also for the maintenance of certain habitats, for example coastal heathland.

Choughs have been found to have differing feeding preferences at different times of the year (McCracken & Bignal, 1992). The present study has found that a wide range of invertebrates that commonly occur in the known diet of choughs is present in areas under the DARD chough option, during the summer months. Ground beetles and larval Coleoptera as well as Scarabaeidae (dung beetles), Staphylinidae and Tipulid larvae (leatherjackets) have all been trapped in pitfall traps. The results show that the known prey species such as dung beetle and leatherjackets were more abundant at some sites than others. Pitfall trapping gives an indication of abundance and diversity of surface-active invertebrates. More investigation of invertebrate food sources using soil cores and examination of cow dung is recommended. The effect of livestock anti-parasitic drugs such as 'Ivermectin' on chough food resources has yet to be further investigated. Studies elsewhere have shown that this chemical kills the invertebrates in cow dung, which are an important food item (McCracken & Foster, 1993).

Stubble fields have been used by foraging chough during the winter months. Therefore other farmers in agri-environment schemes with land near to areas under Chough Option should be encouraged to retain winter stubble as part of their management agreements. Cereal fields provide spilt grain, an important food source for chough. Due to pesticide restrictions after harvesting these fields should also provide weed seeds and invertebrates for a range of wintering farmland birds. Therefore this management will benefit other declining birds in the area such as linnet and twite.

During RSPB monitoring visits, choughs were found to be utilising Chough Option land almost exclusively, and considerable behavioural information was noted. Although difficult to identify significant trends, with such a small population size, this data amounts to a sizeable picture, and could prove crucial in years to come, especially if there is an expansion in numbers. Much valuable information was gathered during the first successful breeding attempts in Northern Ireland for six years in 2002 and 2003. In the intervening years, a number of breeding attempts had been made and future research may yet identify key differences between behaviour during successful and unsuccessful breeding seasons.

In Northern Ireland, the target for the Biodiversity Action Plan is 10 breeding pairs of chough by 2010. It is hoped that this will be achieved through natural recolonisation, but there is also the possibility of re-introductions from elsewhere in the UK or Ireland. There have also been discussions by the RSPB on the potential for colour ringing of young birds, in order to see where the adults take them, when they move away from the area after breeding. More information is required about the movements and requirements outside the breeding season if the chough is to be maintained as a breeding species in Northern Ireland.

As is evident from the literature on the chough it is a highly complex species with complex requirements many of which are not fully understood. Without a viable population in the area of study it is difficult to draw further conclusions from the monitoring. However, given the current knowledge of the species' habitat and dietary requirements it would appear that the agri-environment scheme on the

north Antrim coast is providing the best hope for survival of the chough in Northern Ireland. A close partnership between all relevant parties, particularly DARD, EHS, RSPB, National Trust and local landowners is essential in order to bring about the recovery of this key species of priority concern.

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