

ALLERTON PROJECT PAPER SUMMARIES

CROP MANAGEMENT:

ECONOMICS OF CEREAL CROP FIELD MARGINS

Jones, N.H., Chaney, K., Wilcox, A. & Boatman, N.D. (1995). *The implications of improving the conservation value of field margins on crop production.* In: *Integrated Crop Protection: Towards Sustainability?*, 63: 131-139. BCPC Symposium Proceedings No. 63, British Crop Protection Council, Farnham.: This study quantified the implications of field margin management on cereal crop yield. Field studies were conducted in Shropshire and Leicestershire between 1993-1994. The Shropshire study found that growing the crop up to the field margin gave the highest yield, followed by growing crops adjacent to a wildflower or grass strip. The poorest yield was obtained from a conservation headland adjacent to a sterile strip. The Leicestershire study surveyed winter wheat headlands, and found that grain yields were significantly less at the crop edge compared to 12m into the crop. Weed biomass was significantly greater at the field margin and decreased further into the field centre. - No full text available.

Chaney, K., Wilcox, A., Perry, N.H. & Boatman, N.D. (1999). *The economics of establishing field margins and buffer zones of different widths in cereal fields.* *Aspects of Applied Biology*, 54: 79-84.: This paper assessed the economics of cereal field margin widths. The relationship between winter wheat yield and distance from the crop edge was studied in 16 fields in Shropshire in 1994, and 24 fields in Leicestershire and Hampshire in 1995. Results found that average crop yield was 44% lower at the crop edge than in the field centre. Gross margins for wheat crop were then calculated using prices of £50, £70 and £90 per tonne, and compared with the payments offered for grass margins under the Countryside Stewardship and Pilot Arable Stewardship Schemes. If wheat was priced below £70/t, the payments offered for grass margins between 2-12m in width exceeded income lost from reduced wheat production area on a 10ha field. Overall income was positive. Income was lost if grass margins were 20m in width. The study concluded that the use of grass margins should be considered strategically due to their potential wildlife benefits, despite the loss of income from margins at certain widths.

COVER CROPS/BREAK CROPS EFFECTS

Stoate, C., Szczur, J. & Partridge, J. (2012). *The ecology of hemp production relative to alternative break crops.* In: McCracken, K. (ed.) *Valuing Ecosystems: Policy Economic and Management Interactions*: 264-269. Scottish Agricultural College & Scottish Environment Protection Agency, Edinburgh.: This study examined the ecological conditions associated with growing hemp as a break crop. Soil moisture content, worm count, percentage light below crop, weed diversity and percentage cover were measured within the crop, along with bird and invertebrate interactions. Results found that hemp has a superior ability to suppress weeds due to its light shading foliage and interaction with soil ecology. Its wildlife benefits were comparable to other crop types. The study concluded that hemp has very desirable attributes as a break crop.

Crotty, F.V. & Stoate, C. (2017). *Understanding cover crops at the farm-scale - a method of sustainable intensification?* *Aspects of Applied Biology*, 136: 79-86.: This paper describes a three-year experimental study which investigated how various cover crops affect soil quality. The study found that weed biomass was significantly lower in some cover crops compared to controls. This finding persisted in following spring oat crop, suggesting a continued weed suppressive effect of cover crops. Spring crop strength and health were also improved, reflecting further improvements in soil conditions. The study concluded that cover crops have significant effects on soil structure, weed biomass and crop yields, and could potentially provide productivity and environmental benefits, a win-win for sustainable intensification.

Reynolds, S.H., Ritz, K., Crotty, F.V., Stoate, C., West, H. & Neal, A.L. (2017). *Effects of cover crops on phosphatase activity in a clay arable soil in the UK.* *Aspects of Applied Biology*, 136: 215-220.: This study assessed how different cover crops affect the activity and persistence of soil enzymes (acid and alkaline phosphatase). The effects were compared to an un-cropped control. Results found no initial effect of cover crops on alkaline phosphatase activity. Significant effects were detected at the point of maturation in the following cash crop, with greatest activity seen with an oat cover crop. Acid phosphatase activity showed species-specific differences at both the point of incorporation and maturation, with the greatest effect seen in oat and phacelia cover

crop. The study concluded that cover crops can affect soil phosphatase enzymes and this effect is species-dependant. Cover crops could be a potential means to enhance soil phosphorous cycling.

Crotty, F.V. (2017). Slug invasions: cover crops, establishment methods or environmental conditions? Aspects of Applied Biology, 136: 299-306.: This study examined different cover crops and their legacy effects (carried over ecological impacts) using slug populations. Slug populations in different cover crops were monitored over a two year period (three trials). Results found that slug populations varied greatly, and populations were associated more with cultivation method than cover crop species. The study concluded that economically damaging slug populations likely occur when a perfect combination of environment conditions and cropping systems align. Better understanding of these interactions is required to aid the implementation of integrated farm management.

Crotty, F.V. & Stoate, C. (2019). The legacy of cover crops on the soil habitat and ecosystem services in a heavy clay, minimum tillage rotation. Food and Energy Security, 8(e00169): 1-16.: This study assessed how different cover crop mixtures affect soil properties and ecosystem services. In a field-scale study, three commonly-sold cover crop mixtures and a control were studied in a min-till system on heavy clay soil. Soil properties, soil fauna, weed abundance and subsequent spring oat crop performance were measured. Results found the following: Soil properties varied little across treatments, however, lower magnesium and higher nitrate levels were seen in legume cover crop mixtures. The abundance of soil surface earthworms was higher in radish cover crop mixtures, whilst other fauna did not differ. Significant weed suppression was seen in cover crops during the growing period and the subsequent crop, resulting in yield increases and economic gains. The study concluded that cover crops could provide benefits on heavy clay soil, including improved nutrient leaching, weed suppression, crop yield and ecosystem benefits. Cover crops could have role in the sustainable management of arable rotations.

INTEGRATED CROP MANAGEMENT

Aspects of Applied Biology 62, 2000 : Farming Systems for the New Millennium “Crop protection strategies for Integrated Farming Systems.” S E Ogilvy, V W L Jordan, A R Leake, S Higginbotham: This article describes research into integrated crop management (ICM), in which crops are grown to minimise need for agrochemical inputs. Nine UK sites within the Integrated Arable Crop Production Alliance (IACPA) were studied. Results found that within the ICM study sites, on average 54% less fungicide, 41% less herbicide and 39% less insecticide was required by weight of active ingredient, and costs were reduced by 41% for fungicides, 31% for herbicides, and 27% for insecticides. The study concluded that crop protection inputs could be substantially reduced across a range of crops using ICM.

Aspects of Applied Biology 62, 2000 : Farming Systems for the New Millennium “Bird species as indicators to assess the impact of Integrated Crop Management on the environment: a comparative study.” H J Saunders, A R Leake: This study compared farmland bird densities on arable plots managed via conventional, organic and Integrated Crop Management (ICM) methods. Five common and representative bird species were studied; skylark, grey partridge, yellowhammer, robin and blue tit. Results found that ICM was not as important in determining bird densities as crop production method or rotation cycles. At the organic site, the nearby presence of hedgerows or farmland was a significant predictor of bird density. The study concluded that organic farming was the most environmentally beneficial system for birds overall, followed by ICM and then conventional.

Aspects of Applied Biology 62, 2000: Farming Systems for the New Millennium. “Environmental and Ecological aspects of Integrated, Organic and Conventional farming systems.” S Higginbotham, A R Leake, V W L Jordan and S E Ogilvy: This paper describes two long-term studies into the use of Integrated Crop Management (ICM) in the UK. The studies concluded that ICM could play an important role in the conservation and enhancement of farmland habitats that are beneficial to birds, mammals, earthworms, arthropods and soil invertebrates. It suggests that the habitat improvements observed in the study were a result of sympathetic field margin management and minimal cultivation to reduce soil disturbance.

Pesticide Outlook Vol 11, Issue 4, August 2000. “The future of Integrated Crop Management.” A R Leake: This article discusses integrated farm management (IFM) and its role relative to the increasing pressure on farming systems. It states that IFM has great potential to meet societies multifunctional demands for high quality, low-impact food that is traceable and profitable. However, it is underdeveloped and under-researched. The article concludes that to achieve full potential, IFM must adopt clear objectives at the crop and farm level, and these must be agreed across the entire food chain. It must address production technique and environmental aspirations, and

provide options to suit different farm types. Research to identify interactions between agricultural production and the environment is needed, which will provide opportunity to improve farmland habitat and biodiversity.

Journal of Pest Management Science 56 : 950-953 (2000) “The development of Integrated Crop Management in agricultural crops: comparisons with conventional methods.” A R Leake: This paper describes research trials on Integrated Crop Management (ICM) within the UK and Europe. The trials found that, compared to conventional methods, an ICM approach could be economically viable and environmentally beneficial – No Full Text available.

WAYS WE GROW CROPS (general)

Leake, A.R. (2010). Different Soil Cultivation Systems and Their Implications for Nutrient Planning and Energy Use. *International Fertiliser Society Proceedings*, 676: 1-16.: This paper examined the impact of various soil and crop establishment techniques on a range of practical, economic, agronomic and environmental factors. Results suggested that a reduction in soil cultivation intensity was beneficial for soil structure, erosion and nutrient loss. This also provided advantageous habitat for soil organisms and farmland birds, and reduced energy usage. The paper concluded that farmers must increasingly rely on their ability to balance multiple objectives as conflicts between crop yield, nutrient conservation and wildlife intensify.

Knox, O.G.G., Leake, A.R., Walker, R.L., Edwards, A.C. & Watson, C.A. (2011). Revisiting the multiple benefits of historical crop rotations within contemporary UK agricultural systems. *Journal of Sustainable Agriculture*, 35: 163-179.: This article presents an overview of past and present cropping systems in the UK and provides support for the reconsideration of crop rotation. It describes regional differences in rotations and how current cultivation practises bear little resemblance to those historically due to adaptations in cropping systems, machinery and inputs. The paper argues there is a need for alternatives to high input farming due to volatile fertiliser prices, changing climatic conditions and stricter environmental legislation. The paper concludes that knowledge gained from past crop rotation techniques should be utilised and where appropriate used to support modern cropping systems.

Crotty, F.V. & Stoate, C. (2018). How can soil-improving cropping systems reduce compaction? Assessing mechanical methods in comparison to increasing root uptake and growth through biological amendments. *Aspects of Applied Biology*, 140: 63-70.: This study investigated how the effects of soil compaction on crop yield could be reduced. An arable field was purposely compacted and four treatments to alleviate soil compaction were tested: a plough, a low disturbance subsoiler (mechanical), an arbuscular mycorrhizal fungal inoculant (biological) and a control. The change in compaction over one harvest year was measured, as well as soil physics, weed abundance and barley crop yield. Results found significant differences in soil health, weed abundance and crop yield between treatments. Further consideration is needed to determine which treatments could be considered ‘soil-improving’. - No Full Text available

Stockdale, E.A., Griffiths, B.S., Hargreaves, P.R., Bhogal, A., Crotty, F.V. & Watson, C.A. (2019). Conceptual framework underpinning management of soil health - supporting site-specific delivery of sustainable agro-ecosystems. *Food and Energy Security*, 8: 1-18.: This study developed a predictive framework to demonstrate the effects of common management choices on soil and crop yield. Conceptual framework from a landscape ecology approach was utilised, using knowledge on the effects of fixed site factors, cropping systems and management practises on soil parameters in UK lowland agricultural systems. The framework demonstrated how the integrated consideration of structural, dynamic and functional aspects of the soil system, as well as local details, could allow detailed, site-specific predictions to be made about the effects of management on soil health.

Villamizar, M.L., Stoate, C., Biggs, J., Morris, C., Szczur, J. & Brown, C.D. (2020). Comparison of technical and systems-based approaches to managing pesticide contamination in surface water catchments. *Journal of Environmental Management*, 260(110027): 1-10.: This study compared the ability of different cropping approaches to manage pesticide contamination in surface water. A technical, a field-scale, and a systems-based cropping approach were studied in a 900ha headwater catchment on heavy clay soil. Land management options were assessed via SWAT analysis and semi-structured discussions with farmers. Results found that vegetated buffers 20m wide around watercourses were the most effective intervention to manage pesticide contamination. Differentiated application timings were rendered ineffective by farmers due to the collaboration and precise forecasting required. Downstream pesticide limits were also deemed unacceptable as they could only be achieved

by restricting the area treated with herbicide, forcing farmers to switch away from oilseed rape. Farmers reported a need for pesticide targets that were specific to headwater catchments.

Stoate, C., Bussell, J. & Fox, G. (2021). Potential of deep-rooting agricultural grass cultivars for increasing water infiltration and soil organic carbon. *Aspects of Applied Biology*, 146: 1-6. This study tested the potential of Festololium and agricultural cocksfoot cultivars to improve water infiltration and carbon sequestration rates. Replicated plot experiments were conducted over 3 years and tested against a standard ryegrass/clover mixture. Results found no difference in soil organic carbon between the cultivar treatments and control, however, Festololium plots had a higher root volume when no cutting took place. Infiltration rates were higher in the Festololium and cocksfoot plots in year 1, but not in year 2 or 3 (harvesting compacted the soil/constrained root growth). The study concluded that Festololium cultivars may provide flood risk and water quality benefits through improved infiltration, however, these benefits may only be realised if harvesting intensity is reduced. The potential for carbon sequestration needs further study.

Brighton Crop Protection Conference (Weeds) 1999. Food quality, supply and storage. “Weed control and crop quality; the conflicting demands in organic and conventional farming systems.” A R Leake: This article discusses the conflicts faced by conventional and organic farming sectors. Specifically, how providing produce with zero contamination is conflicted by minimising weed control and reducing environmental impact. The article describes how weed control level is determined by the ultimate product destination and the system used to grow it. It concludes that better consumer tolerance of low contamination could reduce the weed control measures required, and for some crops, increase the percentage harvested and sold, and lower prices. Increases in demand for organic produce could lead to better tolerance in the future. Until growers fully develop ICM, the demand for cosmetically clean produce will still exist.

HERBICIDE USE IN CROPS

Sotherton, N.W., Leake, A.R., Leaper, D. & Edwards, R.V. (2005). The use of sulfosulfuron in Conservation Headlands to support farmland biodiversity. *The British Crop Protection Council International Congress - Crop Science & Technology 2005*: 1103-1108. This paper describes sulfosulfuron trials in Leicestershire between 2003-2004. Aims were to assess sulfosulfuron use in Conservation Headlands, a management option in the Environmental Stewardship Scheme that allows weeds to be removed from cereal crop edges whilst leaving species of wildlife value. Trial results showed that the spectrum of activity of sulfosulfuron gave it appropriate properties for use in Conservation Headlands. It was concluded that, if applied at the correct time, sulfosulfuron gives good levels of control of cleavers and rough-stalked meadow grass; species of little conservation value but detrimental to farming.

Stoate, C., Brown, C., Velez, M.V., Jarratt, S., Morris, C., Biggs, J., Szczur, J. & Crotty, F. (2017). The use of a herbicide to investigate catchment management approaches to meeting Sustainable Intensification (SI) objectives. *Aspects of Applied Biology*, 136: 115-120. This study used the grassweed herbicide propyzamide, to assess, as part of an inter-disciplinary approach, if catchment management practises could meet Sustainable Intensification (SI) objectives. A Leicestershire catchment growing oilseed rape was studied through data collection, modelling and farmer discussion. Results identified that a better understanding of the variations in soil moisture and soil compaction is needed. Farmers deemed methods such as split herbicide application and reduction in oilseed rape area to be unviable due to the level of between-farm collaboration and catchment-scale coordination required. The study concluded that existing economic and agronomic pressures may contribute to SI, but longer-term planning and government support is required to deliver multiple public benefits.

SOIL MANAGEMENT:

CONSERVATION AGRICULTURE:

Jones, C.A., Basch, G., Baylis, A.D., Bazzoni, D., Biggs, J., Bradbury, R.B., Chaney, K., Deeks, L.K., Field, R., Gómez, J.A., Jones, R.J.A., Jordan, V.W.L., Lane, M.C.G., Leake, A.R., Livermore, M., Owens, P.N., Ritz, K., Sturny, W.G. & Thomas, F. (2006). Conservation Agriculture in Europe: An Approach to Sustainable Crop Production by Protecting Soil and Water? SOWAP (SOil and WATER Protection), Bracknell. This review presents knowledge and experience of Conservation Agriculture (CA), to assess, in the context of evolving EU legislative framework, whether CA should be encouraged. Part one presents CA worldwide

and context for its wider implementation in Europe. Part two discusses its practical introduction across the range of European cropping systems and the implications for biodiversity. The article concludes that CA, if applied correctly, could bring significant benefits to farmers, the environment and society across a range of farm types and regions in Europe. However, the methods used must match individual situations. Further knowledge must be gained through European, regional and local initiatives. Effective dissemination is required to allow wider adoption

Leake, A.R. (2007). Conservation Agriculture. In: Liniger, H. & Critchley, W. (eds) Where the Land is Greener - Case Studies and Analysis of Soil and Water Conservation Initiatives Worldwide: 77-80. World Overview of Conservation Approaches and Technologies (WOCAT), Bern.: This article describes a case-study at the Allerton Project, which in 2000, replaced conventional mouldboard ploughing by state-of-the-art Conservation Agriculture (CA). CA led to a range of benefits on the farm: Run-off, soil erosion, nutrient leaching, soil tillage costs and labour were reduced, whilst soil structure, properties, buffering capacity, soil biota, biodiversity and overall farm yield were improved. Negative effects included increased grass weed growth and herbicide costs, excessive crop residues, slug problems, unsuitability in certain soil types and surface compaction at conversion. The article concluded that CA should be maintained to maximise its benefits, and could be improved by additional measures such as organic matter or cover crops. The negative effects could be addressed by using techniques such as crop rotation, spraying, or soil loosening.

Leake, A.R. (2007). Soil Management Initiative. In: Liniger, H. & Critchley, W. (eds) Where the Land is Greener - Case Studies and Analysis of Soil and Water Conservation Initiatives Worldwide: 81-84. World Overview of Conservation Approaches and Technologies (WOCAT), Bern.: This article provides an overview of the Soil Management Initiative (SMI). SMI was established in 1999 to promote the adoption of appropriate soil management practices in England, especially conservation agriculture (CA). It aims to refine and spread technologies through land-users by gathering organisations with varied expertise and share results and advice to farmers. The article reports that SMI has successfully stimulated CA, which should result in environmentally sustainable land management. It has effectively channelled research into results readily available to farmers and documented improvements in management techniques in an accessible way. The article concludes that SMI still has ongoing issues with lack of funding and should continue to attract funds and voluntary contributions.

Leake, A.R. & Lane, M.C.G. (2009). Soil and Water Protection Project (SOWAP) - so what? In: Zlatic, M., Kostadinov, S. & Bruk, S. (eds) Global Change - Challenges for Soil Management from Degradation through Soil and Water Conservation to Sustainable Soil Management. Conference Abstracts: 213. University of Belgrade, Faculty of Forestry, Belgrade, Serbia.: As part of the Soil and Water Protection Project (SOWAP), this study assessed the economic, ecological and crop yield outcomes of 'Conservation Agriculture' (CA), against traditional mouldboard plough-based systems in the UK, Belgium and Hungary. The three main principles of CA were followed (reduced tillage, permanent soil cover and crop rotations). Results found the following: Reduced tillage was beneficial for those soils vulnerable to erosion, as soil and nitrogen loss was reduced. Earthworm and microbial populations were enhanced, and birds preferred when their winter feed was not buried by ploughing. Labour and fuel input costs were reduced, but 'taken in the round' crop yields subsequently declined. Overall profits were not severely impacted as yield reductions were offset by reduced input costs. The study concluded that CA has an important role in modern agriculture, particularly in areas at high risk of soil erosion. It cannot however be taken as a one solution for all.

SOIL MANAGEMENT (OTHER)

Jordan, V.W.L. & Leake, A.R. (2004). Contributions and interactions of cultivations and rotations to soil quality, protection and profitable production. In: Jellis, G. (ed.) Proceedings of 2004 Home Grown Cereals Authority Conference: Managing Soil and Roots for Sustainable Production: 4.1-4.10. Home-Grown Cereals Authority, London.: This article summarises how soil rotation and cultivation can contribute to soil quality, soil protection and profitable production. It describes the importance of crop rotations in wheat-dominated arable crop production, and how the integration of crop rotations in reduced cultivation systems can lead to multiple soil improvements. **The article concludes that reduced cultivation tillage systems in conjunction with appropriate agronomic practises can improve production efficiency and profitability, as well as soil degradation, soil health and environmental protection.**

Chambers, B., Goulding, K. & Leake, A.R. (2011). Simply Sustainable Soils. Six Simple Steps for Your Soil to Help Improve the Performance, Health and Long-term Sustainability of Your Land. Asda and LEAF

(Linking Environment and Farming), Stoneleigh Park, Warwickshire: This is a brochure produced in association with ASDA and LEAF (Linking Environment And Farming). It aims to help farmers and growers get the best out of their soil, create awareness of the importance of soil quality and help land owners track changes in soil quality over time. It is focused on Six Simple Steps to improve the performance, health and long-term sustainability of land: Soil structure, Drainage, Compaction, Soil Organic Matter Status, Soil pH and Nutrients, and Biological Health.

ECOSYSTEM SERVICES ASSOCIATED WITH AGRI-ENVIRONMENT SCHEMES

Stoate, C. (2010). Where do we go from here? Combining biodiversity with ecosystem services through agri-environment schemes. *Aspects of Applied Biology*, 100: 219-224.: This paper describes research at the Allerton Project, which explored how biodiversity conservation and ecosystem service objectives could be integrated through Agri-Environment Schemes. Research found that some individual management options within the schemes met multiple objectives, whilst further benefits arose from their integration into broader land-use systems. The paper concluded that these complementarities could add value for the tax payer and improve the compatibility of schemes with farmer's legal, economic and cultural objectives.

Stoate, C. & Szczur, J. (2013). An ecosystem services approach to productive land management in a farm-scale catchment. *Aspects of Applied Biology*, 121, *Rethinking Agricultural Systems in the UK*: 35-42.: This project examined how multi-objective farm management could reduce the trade-offs associated with production and conservation, and enhance ecosystem services. On Loddington's demonstration farm, practises to highlight the interactions between ecosystem services and management were adopted. These included non-crop habitats with multiple objectives, such as the encouragement of pollinators and crop pest predators, the provision of recreation opportunities, and the adoption of soil management within the 'productive area'. The project demonstrated how targeted multi-objective management could optimise a range of ecosystem services on farmland, instead of choosing between land sparing and land sharing.

Stoate, C. (2014). Wildlife has its uses. Managing farmland for ecosystem services. *British Wildlife*, 25: 154-160.: This article outlines the complex relationship between food production and environmental objectives in the UK. It describes the implementation of Agri-Environment Schemes and how they have effectively diverted some productive land to the creation and management of wildlife habitat. It states that despite this, conflict between production and wildlife will intensify as the population and their consumption increase. The article talks about the recent concept of 'ecosystem services' (benefits we derive from the environment) and how this is an unfamiliar and poorly understood concept by most. It concludes that a practical setting is needed to bring these issues to life and make specialist concepts clearer.

Stoate, C. (2014). Delivering integrated farm management in practice: understanding ecosystem services. In: McCracken, K. (ed.) *Agriculture and the Environment X. Delivering Multiple Benefits from our Land: Sustainable Development in Practice*: 46-52. *Scotland's Rural College and Scottish Environment Protection Agency, Edinburgh and Stirling.*: This study explored interactions between food production and ecosystem services within a Leicestershire farm catchment. Ultimate aims were to inform policy and practise associated with Sustainable Intensification. Results found the following: Agricultural headwaters had a role in buffering the impacts of non-agricultural pollution on main rivers. Functional groups of organisms acted as indicators of long-term productive land management and provided immediate ecosystem services. The paper concluded that an integrated management approach is likely the most cost-effective way to meet agricultural and environmental objectives.

.Lampkin, N.H., Pearce, B.D., Leake, A.R., Creissen, H., Gerrard, C.L., Girling, R., Lloyd, S., Padel, S., Smith, J., Smith, L.G., Vieweger, A. & Wolfe, M.S. (2015). *The Role of Agroecology in Sustainable Intensification*. Report for the Land Use Policy Group: Organic Research Centre, Elm Farm, and Game & Wildlife Conservation Trust, Newbury and Fordingbridge.: This report explored how agro-ecological approaches could contribute to Sustainable Intensification (SI) in the UK and Europe. It took well-known approaches (integrated crop management, organic farming and agroforestry), and assessed to what extent they could contribute to SI outcomes, and the policy drivers and constraints affecting their adoption. Results suggested that agro-ecological approaches could maintain or improve the following: productivity, biodiversity, ecosystem services, soil and water natural capita, farming system profitability, and non-renewable energy consumption. The

article concluded that agro-ecological approaches could make a substantial contribution to SI, but need to be supported by improved knowledge (and active farmer engagement) and policy drivers. A mosaic of approaches to address specific needs will deliver best results and provide insurance against the failure of any single strategy.

Dicks, L.V., Rose, D.C., Ang, F., Aston, S., Birch, A.N.E., Boatman, N.D., Bowles, E.L., Chadwick, D., Dinsdale, A., Durham, S., Elliott, J., Firbank, L., Humphreys, S., Jarvis, P., Jones, D., Kindred, D., Knight, S.M., Lee, M.R.F., Leifert, C., Lobley, M., Matthews, K., Midmer, A., Moore, M., Morris, C., Mortimer, S., Murray, T.C., Norman, K., Ramsden, S., Roberts, D., Smith, L.G., Soffe, R., Stoate, C., Taylor, B., Tinker, D., Topliff, M., Wallace, J., Williams, P., Wilson, P., Winter, M. & Sutherland, W.J. (2018). What agricultural practices are most likely to deliver "sustainable intensification" in the UK? *Food and Energy Security*, 2018;e00148: 1-15.: This study explored which farm management practises were most likely to deliver Sustainable Intensification (SI), from practises not widely adopted by UK farms. Stepwise methodology and group decision-making with agricultural experts was used to identify 18 priority practises. These reflected a more technological, production-focused view of SI (as opposed to social or environmental), yet reflected an integrated approach. The paper concluded that the identified practises provide a focal point to achieve SI as the UK develops post-Brexit agricultural policy and pursues the second Sustainable Development Goal for sustainable agriculture. //For a subset of priority practises, data was gathered on the levels of existing uptake through a stratified survey of seven focal regions in England and Wales. It found there was substantial uptake of most practises, suggesting UK farming is innovative. Two practises (prediction of pest and disease outbreak and staff training on environmental issues) were identified for which uptake was low, but that farmers found appealing and would consider adopting.

ECONOMICS & FARMER PARTICIPATION IN AGRI-ENVIRONMENT SCHEMES

Stoate, C. (2004). Preparing for a new agri-environment scheme in England: influences on farmer participation. In: Cristóvão, A. (ed.) Proceedings of the 6th European International Farming Systems Association Conference: 459-465. International Farming Systems Association, Vile Real, Portugal.: This paper describes the preliminary results of research on farmer participation in agri-environment schemes. Research focused on the proposed Entry Level Scheme (ELS) and the adoption of individual management options within it. Results found an association between farm size and participation in the existing Countryside Stewardship Scheme, but not in the proposed ELS. Farmer age and environmental values influenced their participation in the ELS, with a strong preference for options that were independent of commercial crops. The study concluded that the design of the ELS should be adapted to accommodate farmer's needs, interests and concerns to ensure their participation and commitment.

Stoate, C. & Jarvis, P.E. (2006). A practical appraisal of on-farm costs of Environmental Stewardship and other influences on farmers' adoption of it. *Aspects of Applied Biology*, 80: 3-9.: This study assessed the costs of implementing Environmental Stewardship (ES) habitats in a farm business and surveyed farmer attitudes toward participation in the East Midlands. Results found that the annual payments for Countryside Stewardship exceeded the costs for all habitats except 'recreating grassland'. Payments for capital works were lower than the incurred costs, which had overall positive implications for acceptability of Entry Level Stewardship ELS, and less so for Higher Level Stewardship HLS. ELS was overall more acceptable to farmers than HLS. 'Payment rates' and 'wildlife' ranked highly as influencers of participation in ELS, but only 'landscape' was important in HLS. The study concluded that better communication of economically viable habitat management options is essential, and farmer's landscape, cultural and economic objectives must be considered.

Stoate, C. & Bird, D.P. (2007). Does farmers' knowledge of birds influence their conservation of them? *Aspects of Applied Biology*, 81: 227-230.: This study explored farmer's knowledge of bird species for which Environmental Stewardship (ES) is designed, and assessed if this influenced their adoption of it. Data was gathered from 64 farmers as part of an ES training scheme in Leicestershire. Results found that older farmers had significantly more knowledge of bird species on their farms than younger farmers, but this had no significant influence on their interest in ES. Knowledge of some Biodiversity Action Plan (BAP) species such as reed bunting was low, while knowledge of species such as lapwing and barn owl was high. The study concluded that information provision and habitat management for familiar bird species could be important for the conservation of less familiar BAP species.

Jarratt, S., Morris, C. & Stoate, C. (2013). The role of Environmental Stewardship in the development of farmers' 'environmental learning careers'. *Aspects of Applied Biology*, 121, Rethinking Agricultural Systems in the UK: 149-156. This paper analysed interviews from 43 farmers in the East of England, to identify environmentally friendly careers associated with agri-environment schemes. Aims were to understand how career pathways differed in the extent of farmer ownership and career 'stages' (changes made in response to internal or external contingencies). The study concluded that the scheme should recognise the different careers and career 'stages' at which farmers enter the scheme. It should promote cooperation between complementary activities on participating farms and accommodate roles for landscape-scale leaders from advanced career pathways.

THE EYE-BROOK CATCHMENT COMMUNITY PROJECT

Stoate, C. (2005). Land use and aquatic ecosystem protection within an English lowland catchment: The Eye brook. In: *Sharing a Common Vision for our Water Resources. Proceedings of the 6th International Conference of the European Water Resources Association, Athens. On CD-ROM.* This paper describes a catchment-based project in The Eye Brook, which combined practical farming, scientific research and local knowledge to address the issues surrounding soil and nutrient run-off from arable land. The paper describes the following project activities: Research into the influence of cultivation methods on soil erosion and the aquatic ecosystem, brown trout surveys and their findings of low recruitment due to the sedimentation of spawning substrate, research that combined ecological science with Participatory Learning to investigate if 'Paired Ponds' in arable ditches could mitigate soil and nutrient run-off, and a stakeholder workshop to understand local catchment issues, values and concerns of local people. The paper concluded that catchment-based projects could provide focus and better understanding of catchment issues.

Stoate, C. (2008). Combining science and community involvement for public and private benefits from catchment management in lowland England. In: *8th European International Farming Systems Association (IFSA) Symposium, Clermont-Ferrand, France: 187-188. International Farming Systems Association (IFSA), Clermont-Ferrand, France.* This paper describes a community heritage project in the Eye Brook catchment in Leicestershire. A combination of multi-disciplinary science and social learning was used to explore a range of environmental issues with a view to achieving public and private benefits. - No Full Text available

Stoate, C., Amos, M. & King, P. (2009). Land use history as a foundation for catchment management planning in the Eye Brook, England. In: *Breuste, J., Kozová, M. & Finka, M. (eds) European Landscapes in Transformation: Challenges for Landscape Ecology and Management: 336-339. International Association for Landscape Ecology.* As part of a catchment community project, this study assessed the use of future land-use scenario maps (as opposed to historical maps) to engage local residents. Aims were to improve awareness of past and present processes to better inform future land management and resource use. - No Full Text available

Stoate, C. (2010). Exploring a Productive Landscape. From a Long History to a Sustainable Future in the Eye Brook Catchment. *Game & Wildlife Conservation Trust on Behalf of the Eye Brook Community Project, Fordingbridge.* This booklet describes a catchment community project in the Eye Brook between 2006-2010. Aims were to stimulate discussion about environmental issues in the catchment based on understanding from a local people and historical and scientific knowledge. The main concerns raised included a cultural gap between the rural and urban community (visitors valued countryside but not those manage it), the low economic returns on local products, and the lack of local identity. The project demonstrated how a social learning approach could achieve a shared understanding of environmental issues and be used to inform policy that is locally relevant.

Stoate, C. (2011). A social learning approach to raising environmental awareness at the catchment scale: the Eye Brook England. In: *Ban, M., Duic, N. & Guzovic, Z. (eds) 6th Dubrovnik Conference on Sustainable Development of Energy, Water and Environment Systems: 1-9. International Centre for Sustainable Development of Energy, Water and Environment Systems, Zagreb.* This article describes a social learning project in the Eye Brook catchment between 2006-2010. Aims were to raise awareness of environmental issues in the catchment that could be translated into widespread behavioural change. The project valued and utilised scientific, local and historical knowledge through inter-disciplinary research, public events, a newsletter, a teaching pack and a book. The article concluded that the project principles are widely applicable to other sites and circumstances – No Full Text available

Stoate, C. (2012). Building a common understanding of natural resource management and use within a catchment community - the Eye Brook, England. *International Journal of Sustainable Water and Environmental Systems*, 4: 35-41.: This paper describes a social learning project in the Eye Brook catchment between 2006-2010. Aims were to recognise and utilise knowledge from scientific, local and historical cultures to improve natural resource management, especially of water, to benefit local people and regulators. The project comprised of inter-disciplinary research, public events, a newsletter, research, a teaching pack and a book. Overall, the project improved farmers engagement with environmental issues and increased public awareness of water-related agri-environmental processes. Locally, the work was extended to practical management, and nationally it influenced the development of new community-led projects.

LIVESTOCK MANAGEMENT (feeding)

Kendall, N.R., Smith, J., Whistance, L.K., Stergiadis, S., Stoate, C., Chesshire, H. & Smith, A.R. (2021). Trace element composition of tree fodder and potential nutritional use for livestock. *Livestock Sciences*, 250(104560): 1-11.: This study assessed the nutritional composition of tree leaves and their potential use as supplementary fodder for ruminant livestock. Leaves from goat willow, oak and alder were collected from three UK sites during spring and autumn, and their nutritional content was assessed relative to the requirements of grazing sheep. Results found that all leaf species exceeded the dietary crude protein (CP) and metabolisable energy (ME) requirement for growing lambs. There was no significant effect of season on these concentrations. Leaf zinc and cobalt concentrations were species-dependant, with sheep requirements being met by willow and alder but not by oak. The study concluded that tree leaves, if fed alone, contained adequate ME and CP concentrations to support lamb growth. Zinc and cobalt concentrations were sufficient that willow could be used as a bio-supplement within a conventional grazing system.

Stoate, C., Fox, G., Bussell, J. & Kendall, N.R. (2021). A role of agroforestry in reducing ammonia and greenhouse gas emissions from ruminant livestock systems. *Aspects of Applied Biology*, 146: 1-6.: This study tested whether willow leaves could modify protein digestion and nitrogen breakdown in ruminant livestock. Using urine patches, greenhouse gas emissions and ammonia produced by weaned lambs fed willow leaves for two weeks was compared with weaned lambs that were not. Results showed that ammonia and greenhouse gas emissions were lower in urine patches produced by willow fed lambs, however, only the reduction in nitrous oxide was statistically significant. The study concluded that using willow as fodder in silvopastoral systems could reduce greenhouse gas and ammonia emissions from ruminant livestock and warrants further investigation.

ALLERTON RESEARCH ANNIVERSARY PAPERS

Stoate, C. (2004). The Allerton Project: Research and Demonstration of Practical Environmental Management on Farmland. In: Dallemand, J.F. & Mottram, L.C. (eds) *Ecosites, Ecocentres and the Implementation of European Union Environment and Sustainable Development Policies: 19-23. Proceedings of the Final Ecolink Workshop. European Commission Directorate-General Joint Research Centre, Brussels.*: This paper presents the initial achievements of the Allerton project between 1994-2004. It discusses the outcomes of the sixty plus scientific papers published on research and work on the farm – No Full Text available

Stoate, C., Leake, A.R., Jarvis, P.E., Szczer, J. & Moreby, S.J. (2015). The Allerton Project: twenty-three years of agricultural and environmental data collection on a commercial farm. *Aspects of Applied Biology*, 128: 27-33.: This paper summarises 23 years of research at the Allerton Project. Using long-term data sets from a baseline year in 1992, it presents findings in relation to changes in farm management practises, including the manipulation of game management, soil management intensity and crop rotations. The main findings are that game and songbird numbers were heavily influenced by game management and weather, and the economic performance of the business was constrained by volatile crop prices and higher input costs (especially fertiliser and herbicides associated with black grass). The paper concludes that the optimisation of cropped and non-cropped areas may contribute to economic, social and environmental objectives simultaneously. It highlights the importance of long-term data in guiding this.

Stoate, C. (2017). The Allerton Project's first 25 years: part 2. British Wildlife, 29: 38-43.: This article summarises the first 25 years of research at the Allerton Project, which explored the relationships between productive land, wildlife conservation and environmental benefits. It describes how wildlife has responded to management changes e.g. the doubling of songbird numbers, and how food production has become less profitable. It describes changes in crop rotations, and the finding that spring-sown crops are increasingly important for the control of blackgrass, the autumn-germinating grass weed.

.Stoate, C. (2017). The Allerton Project's first 25 years: a rich seam of evidence to support farmland conservation. British Wildlife, 28: 392-397: This article summarises the first 25 years of research at the Allerton Project, in which the relationships between productive land, wildlife conservation and environmental benefits were investigated. The findings provide evidence to inform the development of new land-use policy in England, including agricultural and agri-environment schemes.- No Full Text available.

MULTI-FUNCTIONAL FARM MANAGEMENT AND FARMLAND BIRDS

Boatman, N.D. & Brockless, M.H. (1998). The Allerton Project: farmland management for partridges (*Perdix perdix*, *Alectoris rufa*) and pheasants (*Phasianus colchicus*). Gibier Faune Sauvage, 15: 563-574.: This project assessed the influence of habitat management and predation control on wild game populations. On an arable estate in the Midlands, management implemented in 1993 involved predator control and the provision of nesting and brood rearing cover (via Conservation Headlands and Wild Bird Cover). Bird population trends and breeding performance were studied via counts in 1998, and a radio-tracking study of hen pheasants in 1995. Results found that game bird breeding success and species population size had increased since management began. The choice of hen nesting habitat was proportionate to habitat availability, with 56% of tracked hens located in cereal fields (30% left site). Hen pheasant home ranges contained more arable crops than expected, and field edges were utilised less in the study area than in overall home ranges.

Boatman, N.D., Stoate, C. & Watts, P.N. (2000). Practical management solutions for birds on lowland arable farmland. In: Aebischer, N.J., Evans, A.D., Grice, P.V. & Vickery, J.A. (eds) Ecology and Conservation of Lowland Farmland Birds: 105-114. British Ornithologists' Union, Tring.: This paper evaluated conservation management techniques for farmland birds. Management techniques that provided nesting habitat and food during the breeding season and winter were assessed on two farms in the Midlands. Results found the following: Overall game bird numbers increased between 1992 -1998 (*this is after management was adopted?*). Yellowhammer and skylark numbers were maintained or increased despite national declines at the time. The study concluded that the techniques could help sustain or increase breeding bird densities on farmland, however, the exact mechanisms behind this are not fully understood. As these techniques are expensive and most farmers will invest only limited time and money, grant aid from Agri-environment schemes will become increasingly important to stimulate conservation management of this type.- No Full Text available

Boatman, N.D. & Bence, S.L. (2000). Management of set-aside to enhance biodiversity: the wild bird cover option. Aspects of Applied Biology, 62: 73-78.: The study assessed the biodiversity and habitat value of the Wild Bird Cover option of set-aside, relative to other types of set-aside. A farm in Leicestershire was used for study. Results found that set-aside sown with Wild Bird Cover was a preferred habitat for nesting and foraging wild game birds such as pheasant and skylark. It was a favoured habitat by butterflies, an insect group of high conservation interest.

Stoate, C. & Thomson, D.L. (2000). Predation and songbird populations. In: Aebischer, N.J., Evans, A.D., Grice, P.V. & Vickery, J.A. (eds) Ecology and Conservation of Lowland Farmland Birds: 134-139. British Ornithologists' Union, Tring.: This paper describes two studies that investigated whether British songbird declines are linked to their avian predators. Study one manipulated the abundance of magpies and carrion crows on three Leicestershire farms, and measured the breeding success and abundance of songbirds. It found that corvid control had a positive impact on songbird breeding success and abundance, however, this may have been due to habitat changes. Study two used historical data from the Common Bird Census to assess whether the presence of magpie or sparrowhawk at a site affected the rate of songbird population change. It found no significant effect. The study concluded that whilst songbirds suffer from predation, the national populations are resilient. It highlighted the benefits of combining insights from local field studies and the modelling of extensive national data.

Boatman, N.D. & Stoate, C. (2000). Integrating biodiversity conservation into arable agriculture. *Aspects of Applied Biology*, 62: 21-30.: This paper describes a habitat management programme at the Allerton Project, in which cropped and non-cropped areas were adopted at field and landscapes scales between 1992 -1998. Aims were develop methods to integrate biodiversity conservation into commercial agriculture using wild game as an incentive to farmers. The study found that the adoption of the programme led to a 42% increase in farmland bird populations, with substantial increases in game birds and hares. The paper discusses the costs of implementing the conservation techniques and wider application – No Full Text available

Stoate, C. & Szczur, J. (2001). Could game management have a role in the conservation of farmland passerines? A case study from a Leicestershire farm. *Bird Study*, 48: 279-292.: This paper assessed whether game management could aid the conservation of farmland passerines. Passerine numbers were monitored over six years on Leicestershire farmland managed for game. Management included habitat management, winter feeding and nest predator control. Results found that the abundance of breeding passerines increased during the period of game management, with nationally declining species displaying greatest increases. The study concluded that the integration of wild game management into farm systems may deliver conservation benefits for nationally declining farmland birds. The precise mechanisms by which management leads to improved bird numbers are not fully understood and may differ between species.

Stoate, C. (2001). Reversing the declines of farmland birds: a practical demonstration. *British Birds*, 94: 302-309.: This study investigated the implications of game management for declining songbirds on Leicestershire farmland. Game management implemented in 1993 included the provision of nesting and insect-rich foraging habitats, food, cover and nest predator control. Following management adoption, results showed that abundances of nationally declining songbird species increased by 102%. The study concluded that game management may have a role in farmland bird conservation and songbird populations may be restored if it is applied appropriately. Partnerships that combine farmer incentives with state-funded Agri-Environment Schemes could help farmers apply this management more widely and reverse farmland bird declines.

Stoate, C. (2002). Multifunctional use of a natural resource on farmland: wild pheasant (*Phasianus colchicus*) management and the conservation of farmland passerines. *Biodiversity and Conservation*, 11: 561-573.: This study assessed how wild game management on farmland could contribute to the conservation of passerines. Bird numbers were monitored over a 7-year period on farmland in Leicestershire following the introduction of game management for shooting. Results found that following management adoption, numbers of nationally declining passerine species had increased significantly. The study concluded that game management could contribute to the conservation of nationally declining farmland birds and associated recreational activities such as bird watching.

Stoate, C. (2002). Increasing the Government's Farmland Bird Index through conservation management at the farm scale: a ten year demonstration. In: *Proceedings of the Brighton Crop Protection Conference - Pests and Diseases 2002*: 971-976. *British Crop Protection Council*.: This paper describes a ten-year bird monitoring project on a Leicestershire farm. Aims were to assess conservation management techniques within Agri-Environment Schemes, implemented to reverse declines in a Farmland Bird Index (FBI). Results found that the overall abundance of FBI species increased rapidly in response to conservation management, however, there was considerable variation between species. The paper concludes that in addition to the FBI, Government Biodiversity Action Plans (BAP) for birds of conservation concern are important indicators of successful management, as they encompass species the FBI does not.

Stoate, C. & Murray, K.A. (2002). A new design for the arable landscape and its use by farmland passerines. In: *Chamberlain, D.E. & Wilson, A. (eds) Avian Landscape Ecology: Pure and Applied Issues in the Large-Scale Ecology of Birds*: 342-345. *International Association for Landscape Ecology (UK)*.: This study assessed the use of foraging habitat by skylark and yellowhammer on farmland managed for wild game. Management adopted in 1993 included crop mixtures for wildlife and habitat diversity development. Results found subtle and substantial differences in the way each species utilised habitat. The study concluded that the habitat diversity associated with game management is likely to benefit passerines. Current agri-environment schemes should encourage such diversity to meet conservation objectives. - No Full Text available

Stoate, C. (2002). Farmers' Management Strategies and the Conservation of Farmland Passerines. Unpublished Ph.D.;thesis. Open University, Milton Keynes.: This study assessed the implications of multi-

functional farm management for farmland birds. On a Leicestershire farm, changes in wild bird numbers and nesting success were monitored following the adoption of multi-functional farm management. Results found that bird abundances increased following management adoption, with nationally declining species displaying greatest increases. Herbaceous vegetation had a positive influence on nest survival of yellowhammer and whitethroat, whilst hedge height had a negative influence. The study concluded that multi-functional farm management could deliver conservation benefits for farmland birds.\\Vegetation management incentives among farmers in Wiltshire were also investigated. Only farmers with both game and conservation interests claimed to adopt field boundary management beneficial to whitethroats. An improved understanding of farmer's cultural and economic incentives may lead to wider adoption of conservation management.

Stoate, C., Brockless, M.H. & Boatman, N.D. (2002). A multifunctional approach to bird conservation on farmland: a ten-year appraisal. *Aspects of Applied Biology*, 67: 191-196.: This paper describes a ten-year monitoring project at Loddington, in which the integration of game management into a farm business has resulted in substantial increases in numbers of nationally declining bird species (including BAP species). The paper also discusses the implications for the recreational use of wildlife on farmland – No Full Text available.

Stoate, C. (2004). Water and wildlife on a commercial farm: multifunctional management of set-aside and other natural resources in lowland England. In: Cristóvão, A. (ed.) *Proceedings of the 6th European International Farming Systems Association Symposium: 303-310. International Farming Systems Association, Vila Real, Portugal.*: This paper describes a multi-functional farm management project at Loddington, in which commercial farming, set-aside, game management and environmental objectives have been integrated. The set-aside area needed to qualify for Arable Area Payments has been managed to provide environmental benefits, such as crop planting for wildlife and riparian buffer strips for wetland habitat. Results show that wild birds exploit these habitats, and numbers of nationally declining songbirds have increased. The project has demonstrated how environmental objectives can be integrated into a farm business and satisfy Rural Development objectives for multi-functional management and resource use. This could be applied more widely in Europe, but the exact objectives and implementation may vary requiring farmer collaboration.

Stoate, C. & Szczer, J. (2005). Predator control as part of a land management system: Impacts on breeding success and abundance of passerines. *Wildlife Biology in Practice*, 1: 53-59.: This study assessed the effects of predator control cessation on passerines within a game management system. Results found the following: Passerine breeding abundance declined within two years of predator control cessation. Blackbird nest survival rate declined within one year of predator control cessation, but returned to pre-cessation rates after two years. This was put down to landowner behaviour towards magpies, the main nest predator of passerines. In the surrounding area, over 40% of landowners had increased their magpie control since 1992. The population available for recruitment was reduced and subsequent magpie numbers were not restored following predator control cessation. The study concluded that many factors interact to influence farmland bird abundance and highlighted the importance of human behavioural influences.

Stoate, C. & Moorcroft, D. (2007). Research-based conservation at the farm scale: Development and assessment of agri-environment scheme options. *Aspects of Applied Biology*, 81: 161-168: This study investigated the potential benefits of integrated farm management for birds of conservation concern using skylark plots and beetle banks as case studies. Skylark plots provide invertebrate prey and lengthen the skylark breeding season, and beetle banks provide overwintering habitat for beneficial aphid predators. Results showed that skylark young numbers were 49% higher in crops with skylark plots than in crops without. In beetle banks, cocksfoot, false oat grass, Yorkshire fog and meadow fox tail were deemed the most beneficial species for beetle and grasshopper predators. The study concluded that the use of skylark plots and beetle banks could help meet government biodiversity targets within commercial farms, and deliver agri-environment options that benefit wildlife and the taxpayer.

White, P.J.C., Stoate, C., Szczer, J. & Norris, K.J. (2008). Investigating the effects of predator removal and habitat management on nest success and breeding population size of a farmland passerine: a case study. *Ibis (Suppl.1)*, 150: 178-190.: This study assessed the influence of habitat management and predator control on blackbird population size and nest success. A blackbird population was observed on a farm that had previously undergone various agri-environment and game management options including nest predator control. The study found the following: Predator control had a positive influence on blackbird breeding population size, however, this was not due to improved nest success alone. Habitat within the nest vicinity influenced blackbird survival at the

egg stage, and nest placement characteristics influenced survival at the nestling stage. The study concluded that agri-environment schemes and game management likely influence the nest predation of farmland passerines, and this must be considered in management. As observational data has a limited ability to detect and explain such effects, the precise mechanisms are not yet fully understood – No Full Text available.

White, P.J.C., Stoate, C., Szczur, J. & Norris, K.J. (2014). Predator reduction with habitat management can improve songbird nest success. *Journal of Wildlife Management*, 78: 402-412.: This study assessed whether systematic predator control and sporadic corvid reduction could improve the nest success of farmland songbirds. Songbird data spanning 11 years was analysed from 3 lowland farms subject to different game management regimes. Results found a positive effect of predator control on the nest survival of blackbird, chaffinch, dunnoek, song thrush and yellowhammer. This effect occurred at the egg stage for blackbird and across stages for the others. Sporadic corvid reduction had a positive effect on blackbird survival at the nest stage, and a negative effect on yellowhammer survival at the egg and nest stage. The study concluded that systemic predator control could improve songbird nesting success on farms, if there is suitable habitat management. The extent to which predator reduction influences populations may depend on other mechanisms such as overwinter mortality.

Aebischer, N.J., Bailey, C.M., Gibbons, D.W., Morris, A.J., Peach, W.J. & Stoate, C. (2016). Twenty years of local farmland bird conservation: the effects of management on avian abundance at two UK demonstration sites. *Bird Study*, 63: 10-30. This study assessed the relative influence of habitat management and predator control on farmland breeding bird abundance. Bird abundances were studied on two contrasting farms compared to regional trends. At Loddington Farm in Leicestershire, management adopted in 1993 included predator control, which ceased in 2002. At Hope Farm in Cambridgeshire, management adopted in 2002 included annual provision of nesting cover and food for farmland birds. Initially, *following management implementation?* faster increases in bird abundance were observed on the study farms compared to the surrounding regions. This increase was not sustained at Loddington after predator control ceased, but was at Hope farm where predator densities were naturally lower. The study concluded that at low predator densities, farmland bird recovery could be achieved by habitat management alone. At higher predator densities, species recovery may require additional predator control – No Full Text available.

Dunn, J.C., Gruar, D., Stoate, C., Szczur, J. & Peach, W.J. (2016). Can hedgerow management mitigate the impacts of predation on songbird nest survival? *Journal of Environmental Management*, 184: 535-544.: This study assessed whether sympathetic hedgerow management could reduce songbird nest predation on farmland. Songbird nest selection preferences were assessed based on hedgerow features, and these features tested to see if they influenced nest predation risk/survival. Results found that songbirds preferred nests with high above-vegetation cover, high visibility on the nest-side and low visibility on the hedge far-side. Hedgerow structure was the only feature to influence nestling survival. Vegetation that restricted access to corvid predators and nests near vantage points were associated with higher chick survival. Mechanically cut hedgerows with low visibility and corvid accessibility were associated with higher survival post-chick stage. The study concluded that reductions in hedgerow management may expose nesting songbirds to increased predation. Regular rotational cutting could maintain a dense woody structure and reduce nest predation.

FARMLAND BIRD ECOLOGY:

HABITAT USE BY FARMLAND BIRDS

Stoate, C. & Szczur, J. (1997). Seasonal changes in habitat use by yellowhammers (*Emberiza citrinella*). In: 1997 Brighton Crop Protection Conference – Weeds: 1167-1172. British Crop Protection Council, Farnham.: This paper studied farmland habitat use by yellowhammers across different seasons. Results showed the following: In summer, yellowhammers foraged on broad-leaved crops, then switched to newly ripened cereal crops such as barley and wheat. They foraged on cropped and adjacent un-cropped habitats including the set-aside managed for Wild Bird Cover. In winter, yellowhammers used cereal-based Wild Bird Cover the most (relative to availability). The study concluded that the management of Wild Bird Cover on set-aside could aid the conservation of farmland buntings, through the provision of invertebrate food in summer and seed food in winter.

Bradbury, R.B. & Stoate, C. (2000). The Ecology of Yellowhammers *Emberiza citrinella* on lowland farmland. In: Aebischer, N.J., Evans, A.D., Grice, P.V. & Vickery, J.A. (eds) *Ecology and Conservation of Lowland Farmland Birds: 165-172. British Ornithologists' Union, Tring.*: This paper synthesised findings from the literature and field studies to infer possible causes of yellowhammer declines on lowland farmland. It suggests that the loss and degradation of hedgerows, field margins and stubbles, and the intensification of grassland management has reduced the availability of food and nest-sites for farmland yellowhammers. The paper concludes that the Arable Stewardship Pilot Scheme could benefit yellowhammers in arable areas. Further research is needed in pastoral areas.

Murray, K.A., Wilcox, A. & Stoate, C. (2002). A simultaneous assessment of farmland habitat use by breeding skylarks and yellowhammers. *Aspects of Applied Biology*, 67: 121-127: This study assessed farmland habitat use by breeding skylarks and yellowhammers. Foraging birds and their nests were observed during the breeding season on an arable farm in Leicestershire. Managed set-aside was identified as an important habitat for both species. Skylarks made best use of kale-based crop mixtures, and yellowhammers of cereal-based crop (relative to availability). The study concluded that flexible crop compositions within agri-environment schemes may yield the widest conservation benefits for farmland birds.

Stoate, C. (1997). Abundance of Whitethroats *Sylvia communis* and potential invertebrate prey, in two Sahelian sylvi-agricultural habitats. *Malimbus*, 19: 7-11.: This study compared bird and invertebrate abundances between Tudu habitat (dry farmland with indigenous trees/shrubs) and recently coppiced Neem plantations in Northern Nigeria in 1996. 80 point bird counts and 110 beating tray samples of insects were conducted. The results found that whitethroats, subalpine warblers and tawny-flanked prinias were present in Tudu habitat but absent in Neem plantations. Invertebrates were scarcer in Neem plantations than Tudu habitat – No Full Text available.

FACTORS AFFECTING TERRITORY ESTABLISHMENT/NEST SUCCESS/SURVIVAL

Stoate, C. (1999). The influence of field boundary structure on breeding territory establishment of whitethroat *Sylvia communis* and yellowhammer *Emberiza citrinella*. *Aspects of Applied Biology*, 54: 125-130.: This study assessed the influence of field boundary structure on the territory establishment of breeding whitethroat and yellowhammer. Results found the following: Territory establishment was positively influenced by the amount of herbaceous vegetation, with both species using it considerably as nest site. Territory establishment was negatively influenced by hedge height. The study concluded that, as herbaceous vegetation has been lost from the field boundaries of many farms, arable and active management of this habitat is needed for the conservation of whitethroats, yellowhammers and associated farmland wildlife.

Stoate, C. & Szczur, J. (2001). Whitethroat *Sylvia communis* and Yellowhammer *Emberiza citrinella* nesting success and breeding distribution in relation to field boundary vegetation. *Bird Study*, 48: 229-235.: This study assessed the influence of field boundary characteristics on the territory establishment and nesting success of whitethroat and yellowhammer. A field study was conducted in Leicestershire. Results showed the following: The abundance of herbaceous vegetation had a positive effect on both species. Whitethroats nested almost exclusively in herbaceous vegetation, and yellowhammer nests were less susceptible to predation in this habitat. Hedge height had a negative influence on the presence of breeding whitethroats. The study concluded that the maintenance of low hedges and uncut herbaceous vegetation strips in field boundaries could aid the conservation of farmland whitethroat and yellowhammer.

Stoate, C. & Szczur, J. (2006). Potential influence of habitat and predation on local breeding success and population in Spotted Flycatchers *Muscicapa striata*. *Bird Study*, 53: 328-330.: This study assessed the relative influence of predator abundance and habitat type on the breeding success of spotted flycatchers. On a mixed arable livestock farm in Loddington, predators were controlled between 1993–2001 in a manipulation experiment. Flycatcher data was collected between 1992-2004. Results showed the following: Predator control had a positive influence on flycatcher breeding abundance and survival. In the absence of predator control, habitat type significantly affected nest survival, with higher survival associated with habitats at greater height and in gardens. Survival was lower in woodland habitats, likely due to the presence of predatory species e.g. squirrels. The study concluded that predator abundance is important for determining the breeding success of spotted flycatchers, especially in woodland habitats. This must be considered in the conservation management to meet BAP targets.

Stoate, C. (2012). Filling the hungry gap - late-winter supplementary feeding of farmland birds.

Conservation Land Management, 10: 4-7: This study assessed the benefits of providing late-winter seed food for farmland birds (a period known as the 'hungry gap'). Research was conducted at the Allerton Project farm. Bird numbers in years when late-winter seed food was provided were compared with years when food was not provided. Results showed the following: The use of supplementary feeders by birds increased in late-winter in response to the depletion of natural food supply. In years when late-winter seed food was provided, bird numbers almost doubled and breeding numbers in the following summer were 30% higher for species using the feeders. The study concluded that late-winter seed food is important for the survival and subsequent breeding numbers of farmland birds. Further research should assess how best to provide this food and which species may benefit most.

BIRD CROP PREFERENCES

Boatman, N.D., Stoate, C., Henderson, I.G., Vickery, J.A., Thompson, P.G.L. & Bence, S.L. (2003). Designing Crop/Plant Mixtures to Provide Food for Seed-Eating Farmland Birds in Winter. BTO Research Report No.339. British Trust for Ornithology, Thetford.: This study assessed seed preferences of farmland birds. Bird use of game crop, Wild Bird Cover and wildlife seed mixtures within the pilot Arable Stewardship Scheme was assessed via experimental and large scale surveys across arable and mixed farming regions. Results found the following: The same crops were favoured by passerines and game birds (kale, turnip, cereals, and oil seed rape). Overall bird densities were higher in winter bird food crop than conventional crops, and lower on Arable Stewardship plots as they contained mostly low-ranking crops (buckwheat and phacelia). Overall winter bird densities were higher in crops greater than one hectare in area. Some species were more abundant in crops near field boundaries/hedgerows. The study concluded that kale was the most widely used crop, and, for it to provide the most benefit for birds it must be sown in separate strip areas or mixed with cereals /quinoa (kale is biennial). Areas of one hectare or more are needed to provide seed through the winter, and crops near hedgerows may provide the most benefit for most species.

Boatman, N.D. & Stoate, C. (2002). Growing crops to provide food for seed-eating birds in winter. Aspects of Applied Biology, 67: 229-235.: This paper describes a series of experimental studies that assessed the preferences of seed-eating birds for different annual and biennial crops. Results found that bird species differed in the crops they selected and most species used a variety of crops. Some species were restricted to certain crop types e.g. yellowhammers to cereals and greenfinches to borage, sunflowers and mustard. The most commonly used crops were kale, quinoa, fat hen and linseed, whilst buckwheat, borage and sunflower were used little. The study concluded that the provision of seed-resources by growing crops on set-aside or within Agri-Environment Schemes could help maintain bird populations when natural supplies are low.

PASSERINE NESTLING DIET

Moreby, S.J. & Stoate, C. (2000). A quantitative comparison of neck-collar and faecal analysis to determine passerine nestling diet. Bird Study, 47: 320-331.: This study compared two methods of nestling diet determination; neck collars and faecal analysis. Results from both methods were compared when studying the diets of dunnock, yellowhammer and whitethroat chicks. Significant differences between the methods were found with regard to the relative abundance of invertebrates recorded in dunnock and whitethroat diet. No differences were detected between methods for yellowhammer diet. The study concluded that both methods were able to identify important food groups, however, they differed in the proportion of groups they could identify. Calculating correction factors for soft-bodied insect groups may remove any underestimation in faecal analysis due to differential digestion rates.

Moreby, S.J. & Stoate, C. (2001). Relative abundance of invertebrate taxa in the nestling diet of three farmland passerine species, Dunnock *Prunella modularis*, Whitethroat *Sylvia communis* and Yellowhammer *Emberiza citrinella* in Leicestershire, England. Agriculture, Ecosystems and Environment, 86: 125-134.: This study assessed invertebrate dietary components of farmland passerines. Faecal samples of dunnock, whitethroat and yellowhammer were studied from arable farmland between 1996 -1997. The relative abundances of invertebrate dietary components were measured at the order and species level to determine the taxa most important for nestling diet. Results found that the same invertebrates were present in the diet of all three species, but there were significant differences in the relative abundances. The paper concludes by stressing the importance of identifying insect dietary components to all levels, and states that the finer details may be crucial to the understand dietary requirements of farmland birds. - *They found different abundances in results identified to different levels?* - No Full Text available

FARM MANAGEMENT IN TERRESTRIAL HABITATS:

GRASS STRIP/MARGIN MANAGEMENT AND BIODIVERSITY

Stoate, C. & Boatman, N.D. (2002). Ecological and agricultural benefits of linear grassland features within arable systems. In: Conservation Pays? Reconciling Environmental Benefits with Profitable Grassland Systems, s: 191-194. Proceedings of the joint British Grassland Society/BES Conference 2002, Occasional Symposium No. 36, British Ecological Society, London.: This study assessed the ecological and agricultural benefits of perennial grass strips on arable farmland. Grass strips were established as field-edge and mid-field habitats at Loddington farm. Results showed that strips were used by a range of bird, mammal and invertebrate species, and contributed to the suppression of crop pests and arable weeds in the field boundaries. The study concluded that perennial grass strips could provide ecological and agricultural benefits to arable farmland.

Margin/Field Interfaces and Small Mammals. Brown, R.A. Aspects of Applied Biology 54, 1999. Field Margins and Buffer Zones. Ecology, management and policy: This paper studied small mammals in the field margins of organic and conventional fields. A replicated site comparison study was conducted on an Essex and Leicestershire farm between 1992–1998. Four each of conventional margin, conventional crop, organic margin and organic crop sites were sampled using live traps. 10 mark-recapture samples were taken per site per season. Results showed the following: Small mammal number and activity was greater in uncultivated margins than in crop fields for both organic and conventional systems. Increases in mammal activity were greatest in winter – *do they mean differences between margin and crop?* Seeded margins displayed the most rapid increase in mammal activity over the study period for wood mouse, bank vole and common shrew. The study concluded that whilst the results were not analysed for statistical significance, they provide support for the creation of uncultivated margins and the planting of grass buffer strips around arable or pasture fields.

Stoate, C. (2019). Bird and Invertebrate Ecology in Field Margins. In: Dover, J.W. (ed.) The Ecology of Hedgerows and Field Margins: 250-262. Routledge, Abingdon.: This paper summarises field margin management at the Allerton Project farm over a 25 year period. It describes how management has changed in response to wildlife-orientated research findings (from routine spraying, to hedgerow and vegetation creation, to recent traditional and blackthorn hedges, perennial grass strips within agri-environment schemes, to seed-bearing crops to provide winter food for birds). The paper states how research focus has been on birds due to their cultural value, and on invertebrates that benefit crop production through their roles in bird food provision, pollination and crop pest predation.

INTEGRATED FARM MANAGEMENT AND BIODIVERSITY

BCPC Brighton Conference 2002: The biodiversity benefits of different farming systems. A R Leake: This article considers the effects of various conventional, integrated (IFM) and organic farming practises on birds, invertebrates and soil flora and fauna. It argues that it is not the farming system itself that exerts the impact on biodiversity, but the aspects associated with that system (e.g. IFM with non-inversion tillage can benefit soil fauna and birds; organic farming with diverse crop rotations, livestock or incomplete weed control is beneficial; and conventional farming with sensitively managed field margins and set-aside can maintain biodiversity). The article concludes that increasing the farm area converted to organic or IFM practises, coupled with stewardship schemes on conventional farms could increase biodiversity on a national level. Further studies on the mechanisms within each system are needed, particularly for IFM, instead of studies or comparisons of the systems themselves.

Proceedings of the IFA Agro-economics Committee Conference 1997: “Integrated plant nutrition – results of recent trials.” A R Leake: This paper describes organic farming and Integrated Farm Management (IFM) trials in the UK. IFM adopts a holistic approach to the farm operation, ensuring productivity is maintained whilst minimising environmental impacts. - No Full Text available.

OTHER

Stoate, C. & Wilson, P.J. (2020). Historical and Ecological Background to the Arable Habitats of Europe. In: Hurford, C., Wilson, P.J. & Storkey, J. (eds) *The Changing Status of Arable Habitats in Europe - a Nature*

Conservation Review: 3-13. Springer, London.: This paper provides an overview of changes in arable farm practises since the 1940s and the associated impacts on wildlife. It describes changes in herbicide and fertiliser use, farm machinery size, irrigation and ploughing, and how this has led to the homogenisation of arable land in Europe. The paper concludes that the pressures on arable land could be reduced by slowing population growth and increasing agricultural efficiency. Better understanding of environmental impacts associated with agricultural intensification coupled with payments could provide incentive for farmers to reduce their inputs and mitigate impacts.

Boatman, N.D., Stoate, C., Rio Carvalho, C. & de Snoo, C. (2001). Environmental impacts of European agriculture: Issues and policy options in the cereals sector. In: Petersen, J.-E. & Shaw, K. (eds) Environmental Standards in Agriculture, Proceedings of a Pan-European Conference 5-7 October 2000, Madrid: 15-34. Institute for European Environmental Policy, London.: This paper describes the environmental impacts of cereals-based arable systems under the headings of soil, water, biodiversity, landscape and air, drawing on the more detailed treatment given by Boatman et al. (1999) – No Full Text available.

Leake, A.R. (2002). Biodiversity in different farming systems. In: Proceedings of the Brighton Crop Protection Conference - Pests and Diseases 2002: 949-956.: This paper considers the impacts of various practises within arable, conventional, integrated and organic farming systems on birds, invertebrates, soil fauna and flora. - No Full Text available.

FARM MANAGEMENT IN RIPARIAN HABITATS

BUFFER STRIP POOLS AND BIODIVERSITY

Stoate, C., Whitfield, M., Williams, P. & Driver, K. (2006). Wetland habitat creation and mitigation of water pollution from field drains: use of buffer strip pools within an arable landscape. In: Water and the Landscape: The Landscape Ecology of Freshwater Ecosystems: 331-334. International Association for Landscape Ecology (UK), Oxford.: This study examined the potential wildlife and nutrient management benefits of buffer strip pools. Arable land in a Leicestershire clay catchment was studied. Results found that Phosphorus concentrations were lower in buffer strip pools than their supplying ditch or drain, where concentrations often exceeded that required for eutrophication. The pools supported macrophyte and aquatic invertebrates including nationally scarce Coleoptera species. The study concluded that buffer strip ponds could reduce the transport of phosphorous to watercourses in arable catchments and benefit a range of freshwater plants and invertebrates.

Stoate, C., Whitfield, M., Williams, P., Szczur, J. & Driver, K. (2007). Multifunctional benefits of an agri-environment scheme option: Riparian buffer strip pools within 'Arable Reversion'. Aspects of Applied Biology, 81: 221-226.: This study examined the potential biodiversity and water quality benefits of riparian buffer strip pools on arable land. Results found that phosphorus concentrations were 40-50% lower in pools than their supplying ditch, suggesting that pools reduce the sediment load and nitrate and phosphate concentrations entering watercourses. The pools supported amphibians and invertebrates, and provided insect food and breeding habitat for birds. White throat and reed bunting displayed increased numbers and nest survival in pools compared to field boundaries. Lapwing, yellow wagtail, mallard and snipe also used the pools. The study concluded that riparian buffer strip pools could provide water quality and biodiversity benefits.

SMALL FIELD WETLANDS

Stoate, C., Bradbury, R.B., Williams, P., Szczur, J., Kirby, W. & Aquilina, R. (2012). Biodiversity and water resource protection benefits of small-scale constructed wetlands on farmland. In: Constructed Wetlands - Water Management, Treatment and Reuse. Proceedings of Constructed Wetlands Association Annual Conference. Aqua Enviro, London.: This study assessed the potential of small-scale field edge and corner wetlands to meet biodiversity conservation and water resource objectives. Wetland potential was measured by its delivery of open water, bare earth and invertebrate food sources for farmland birds. The use of wetlands by foraging birds and their acceptability to farmers was also measured. - No Full Text available.

Ockenden, M.C., Deasy, C., Quinton, J.N., Surridge, B. & Stoate, C. (2014). Keeping agricultural soil out of rivers: Evidence of sediment and nutrient accumulation within field wetlands in the UK. *Journal of Environmental Management*, 135: 54-62.: This study assessed the ability of small field wetlands to slow down and store agricultural run-off in the UK landscape. Ten field wetlands were built across sandy, silty and clay sites, and surveyed annually for sediment and nutrient retention. Results found that the nutrient element ratios in sediment collected from the wetlands were consistent between sites, despite their different soil characteristics. The nutrient value of sediment was similar to the soil in surrounding fields, suggesting it could be useful as a soil replacement but not as a fertiliser. The study concluded that even small wetlands were successful in mitigating soil and nutrient loss, and could be important for keeping soil out of rivers.

STREAM ECOLOGY

Jarvie, H.P., Sutton, E.J., Withers, P.J.A., Harper, D.M., Stoate, C., Foy, R., Mortimer, R.J.G. & St Quinton, K. (2007). Impacts of agricultural land use on streamwater and sediment phosphorus concentrations: implications for phosphorus-cycling in lowland rivers. In: Heckrath, G., Rubaek, G.H. & Kronvang, B. (eds) *Diffuse Phosphorus Loss: Risk Assessment, Mitigation Options and Ecological Effects in River Basins; Danmarks Jordbrugs Forskning Plant Science*, 130: 83-86. University of Aarhus, Denmark.: This study tested how different agricultural land-uses affect phosphate P concentrations in stream water and bed sediment. The ability of bed sediment to act a P sources/sinks was also tested. Three catchment systems, characteristic of farming systems with variable P loss, were monitored in Wye, Avon and Loddington. Each contained a control, **a stream draining very low intensity agriculture and a stream draining high-risk agriculture? P and iron concentrations in the stream water and surface bed sediments were analysed over two years.** - No Full Text available.

Stoate, C., Harper, D.M., Jarvie, H.P., Wasiak, P.H., Wasiak, K.A., Williams, P. & Szczur, J. (2009). Benefits of grassland livestock production to aquatic ecosystems. *Aspects of Applied Biology*, 95: 33-38.: This study compared the impacts of arable systems and grassland-livestock systems on stream ecology. Streams in the Eye Brook catchment in Leicestershire were studied as part of DEFRA-funded research projects. Results found that suspended sediment and phosphorous concentrations were significantly lower in grassland sub-catchment streams than in arable streams. Aquatic macro-invertebrate and diatom diversity was higher in grassland streams. The study concluded that, relative to arable systems, pasture managed for livestock has higher chemical and ecological watercourse status and provides ecosystem services such as flood control and nutrient cycling. Grassland likely buffers the stream from diffuse pollution and its ditches flow more continuously to support higher invertebrate diversity.

Williams, P., Biggs, J., Stoate, C., Szczur, J., Brown, C. & Bonney, S. (2020). Nature based measures increase freshwater biodiversity in agricultural catchments. *Biological Conservation*, 244(1108515): 1-14.: This study compared the effects of biodiversity-only mitigation measures and multi-functional ecosystem service mitigation measures in agricultural water bodies, with regard to freshwater plant biodiversity. Over a nine-year period, plant species richness was monitored annually in water bodies of three lowland catchments. Results showed the following: In the absence of any mitigation measures, all catchments experienced declines in macrophyte richness. The addition of clean-water ponds as a biodiversity-only measure increased total catchment richness, as well as the number of rare plant species and populations of spatially restricted species. The study concluded whilst multi-functional ecosystem service measures could bring biodiversity benefits, the creation of clean-water ponds for biodiversity could improve ongoing declines in freshwater plant biodiversity in farm landscapes. *They subjected each of the study catchments to different management types?* - No Full Text available.

OTHER

Stoate, C., Jones, S., Crotty, F., Morris, C. & Seymour, S. (2019). Participatory research approaches to integrating scientific and farmer knowledge of soil to meet multiple objectives in the English East Midlands. *Soil Use and Management*, 35: 150-159.: This paper explored how participatory research could combine scientific and farmer knowledge of soils to meet multiple objectives. Various knowledge exchange approaches between

farmers and researchers were studied across five projects in East Midlands between 2014-2018. Approaches ranged from communication, consultation, co-production and combination. Their objectives, methods and outcomes were compared and assessed against specified success criteria for participatory research. The study concluded that multiple approaches to participatory research could be complementary, depending on context and scale. Participatory research may strengthen engagement and trust within a farming community, and improve understanding of how to address soil management objectives.

Leake, A.R. (2001). Integrated Pest Management for Conservation Agriculture. In: Proceedings of the First World Congress on Conservation Agriculture: A Worldwide Challenge, Madrid, October 1st-5th, 2001: 245-253.: This article explored integrated pest management and possible solutions to pest control under agricultural intensification. It concluded that the best pest control options rely on the integration of alternative methods including cultural, biological, mechanical and chemical means. If multiple mechanisms are used, the differential interactions between tillage and pests will unlikely to lead to yield losses of economic consequence.

Aspects of Applied Biology 62, 2000 : Farming Systems for the New Millennium “Climate change, farming systems and soils.” A R Leake: This study compared energy balances within conventional, integrated and organic farming systems in the UK. Results found that an organic system required 3x as much draft energy to produce a ton of grain than an integrated system (as required additional weed control). Yields from the organic system were typically 50% less than conventional systems. Organic systems used less external energy, but low yield meant the overall C conversion was less efficient. Integrated systems achieved the best overall performance balancing the advantages of the other systems.

Sotherton, N.W., Leake, A.R. & Stoate, C. (2009). Existing and future environmental marketing schemes: lessons from the past and plans for the future. Aspects of Applied Biology, 95: 15-20.: This study examined the Conservation Grade Standard, a type of Environmental Marketing Scheme (EMS). Aims were to address the lack of evidence surrounding the Scheme’s delivery of environmental benefits in order to support its credibility. The paper discusses how an EMS could be evaluated and how this could be designed and costed. Ways in which farmers could monitor wildlife to provide evidence and credibility for their scheme are suggested – No Full Text available.

The Biologist (2001) 48, 4. Integration: farm and environment. A R Leake: This article examines European agricultural systems and discusses whether the abandonment of these practises could allow more productive agricultural systems such as GM – No Full Text available

Leake, A.R. (2002). Farming systems, subsidies and sustainability. In: Proceedings Crop Protection in Northern Britain 2002: 1-8.: This paper identifies areas that could deliver both support to farmers and improved environmental performance. It focuses on the subsidy payments associated with organic systems – No Full Text available.
