

The BEESPOKE project: increasing wild pollinators and crop pollination

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Abstract: The Interreg North Sea Region of Europe is one of the most productive agricultural areas, but has been identified as having low pollination potential. The BEESPOKE project aims to encourage land managers to conserve wild insect pollinators through demonstrating their value for crop production and by providing tools to create more pollinator resilient landscapes. The tools include improved knowledge about the best pollinators for crops, seed mixes tailored to their support, protocols for estimating pollination, training materials, how agri-environment can be improved and a novel landscape model to identify where resources are best placed.

Key words: pollination, pollinators, bees, agri-environment, field margins, agro-ecology

Introduction

Insect pollination is worth €15 Billion in the EU, however, wild pollinators are declining because of loss in flower-rich habitats. The Interreg North Sea Region (NSR) of Europe is one of the most productive agricultural areas, but was identified as having low pollination potential (Zulian et al., 2013). Pollination is essential to ensure optimum yields and quality of some crops. The abundance of wild bees shows strong linear correlations with the amount of floral resources, yet despite this knowledge and the opportunity in NSR countries to increase areas of flower-rich habitat through agri-environment measures (AEMs), land managers are not widely adopting conservation practices. In 2019, the BEESPOKE project (Benefitting Ecosystems through Evaluation of food Supplies for Pollination to Open up Knowledge for End users) started with the main aim of increasing levels of pollinators and crop pollination at local and landscape scales by providing land managers and policy makers with new expertise, tools and financial knowledge to create more sustainable and resilient agroecosystems through improved conservation of insect pollinators. The project includes partners from all of the NSR countries and investigates arable and horticultural crops, along with florally diverse grassland.

Approaches

At present the focus of actions is on increasing pollinators for their conservation with less effort on increasing their contribution to crop production (Fountain, 2022). The main remit of the project is to therefore improve our understanding of the benefits of supporting pollinators for a wide range of crops and to impart this knowledge to farmers so that they may have an extra incentive to implement pollinator conservation practices.

Enhancement of floral resources

There is good evidence that the establishment of new wildflower habitat can increase wild bees (Fountain, 2022) and such an approach is supported, to varying extents, through agri-environment schemes in NSR countries. However, because crops differ in the type of pollinators needed because of differences in their flower structures, more targeted wildflower seed mixes are needed to support the most appropriate pollinators. One of the key aims of the BEESPOKE project is to support pollinators for a range of crops across the NSR. We are testing the effectiveness of the new mixes by planting flower-rich areas in close proximity to a range of crops (apples, plums, sweet cherries, strawberries in polytunnels and outdoors, raspberries and in arable areas) using a network of pilot farms in each participating country. To date we have established new wildflower areas at 76 locations.

Measuring levels of pollinators and pollination

There are still knowledge gaps regarding the extent to which flowering crops benefit from insect pollination and evidence that there are deficiencies for some crops resulting in substantial economic consequences. Another key aim of the project is to fill knowledge gaps and develop farmer friendly methods for assessing levels of pollinators and pollination, so that this can become routine practice. Investigations have been conducted in apples, pears, plums, sweet cherries, strawberries, raspberries and field beans. A protocol for measuring pollinators and pollination in apple and pears has been produced. Measuring pollinators and other beneficial insects can be time consuming and biases occur depending on the method, therefore a range of methods are being tested.

For field beans *Vicia fabae* a range of protocols have been tested (exclusion, hand and trigger pollination) to evaluate the impact of pollination on bean yields, however, results have been highly variable and variety dependent. Flower strips may only have a very local impact on levels of pollinators and pollination, therefore the distance over which effects can be detected are being investigated in apples, strawberries and arable crops. To date, there was only limited evidence that levels of some pollinators declined with distance from the flower strips, in apples, but not berry crops.

Most flowering wild plants also rely on insect pollination, yet whether this is adequate is poorly understood. Studies will be conducted in 2022 to measure levels of pollination in hawthorn.

A protocol for identifying the main groups of pollinators and measuring their numbers has been produced. Two more detailed guides to identifying the common species of bumblebee and solitary bees are also now also freely available on the project website.

Management of flower-rich habitats

For those that have tried establishing wild-flower habitats this can sometimes be a frustrating business, with poor results. The species that germinate will often depend on local conditions and so we are working closely with seed producers to increase the chances that our bespoke seed mixes will deliver what is expected. To improve the success and quality of such habitats

the project is providing training and advice to ensure optimal habitats are created. A simple guide on how to establish wildflower areas has been produced and includes common mistakes. Besides sown mixes, other habitats typically found on farmland can also support pollinators, such as hedgerows, woodland and low input grassland, and a booklet has been produced on how to manage these.

Forage crops such as alfalfa and grassland can also provide huge floral resource if allowed to flower. A phased mowing regime for alfalfa has been developed. In grassland, four floristically diverse seed mixes are being evaluated.

Table 1. Partner involvement in the project

Partner	Activities
GWCT, UK	Lead partner, field bean & hawthorn pollination, seed mixes for alongside ditches, bumblebee & solitary bee guides
Carl von Ossietzky Univ. Oldenburg, Institute for Biology and Environmental Sciences, D	Development of herb-rich grassland mixes
Cruydt-Hoeck, NL	Wildflower seed producer, advice on seed mixes, establishment & management
NIAB East Malling, UK	WP lead, testing new seed mixes, fruit and berry crop pollination, protocols, demonstration sites, training
Univ Kent, School of Economics, UK	Economics and barriers to farmers
Grünlandzentrum Niedersachsen, D	Farmer training grassland mixes
Kiviks Musteri, SE	Commercial orchard, demonstration and knowledge exchange
Sveriges Lantbruksuniversitet, Department of People and Society, SE	WP lead for monitoring and evaluation
Agrarisch Collectief Waadrâne, NL	Demonstration sites
Freelance/Provincie Fryslân	WP lead communications
HortiAdvice Scandinavia, DK	Demonstration sites and knowledge exchange
Ghent Univ., Dept. of Plant Protection, BE	Development of models, testing new seed mixes, fruit crop pollination
Univ. Copenhagen, Dept. Plant and Environmental Sciences, DK	WP lead, testing new seed mixes, fruit and berry crop pollination
Van Hall Larenstein univ. of applied sciences, NL	Testing new seed mixes, arable crop pollination, novel crops, monitoring methods
Vlaamse Landmaatschappij, BE	WP lead for policy, AEMs and SWOT analysis
Inagro VZW, BE	Testing new seed mixes, arable crop pollination, novel crops, alfalfa
NORSOK, NO	Testing new seed mixes and raspberries pollination

Landscape management

Some pollinators are very mobile capable of flying several to many kilometres and the provision of floral resources across the landscape needs consideration. To aid in this process new models have been developed to predict levels of pollination for incorporation into a farmer-friendly online tool. The model uses existing land use data and from this estimates the forage and nesting

suitability for a range of bee species and whether a nest can be established. The foraging range of the bee species is also considered. These values are then used to predict the likely pollination service for different crops. The tool will also be valuable for government agencies to facilitate landscape planning to support pollinators. A further tool to aid the design of seed mixes tailored to local conditions and target pollinators is also planned.

Improving agri-environment policy

If pollinators are to be better conserved it is essential that AEMs provide the right support. The AEMs in each partner country have been reviewed and a draft report completed. In addition, SWOT analyses are underway working with key relevant parties to identify how to improve existing AEMs.

If farmers are to implement measures to support pollinators they will want to know the financial implications. Indeed, costs may already be a barrier for many. A survey has therefore been conducted to better understand why farmers are not implementing activities to support pollinators and to understand the cost implications of such actions.

Knowledge exchange

To ensure project findings are widely implemented, a comprehensive range of knowledge exchange activities are underway. We know that farmers respond best to in-field training events therefore these are being conducted or are planned at the demonstration sites to help in their understanding of pollinators crop pollination and management of flower-rich habitats. These are supported by provision of training materials and online videos. We are using traditional and social media to generate additional interest and produce our own newsletter as well as contributing to others. Findings relating to policy will be prompted to relevant national agencies.

Project evaluation

The project combines many different elements as we are conducting novel research and providing an extensive knowledge exchange process. To aid this a comprehensive monitoring and evaluation, activities are being conducted to measure the success of the various elements and provide guidelines for future projects.

Discussion

Insects are declining globally and include many species and groups of pollinators. Given their importance for food security it is essential that we communicate the importance of this to land managers that can have a direct influence, whilst also providing them with the tools and knowledge to achieve change. The project is attempting to identify the economic importance of pollination and to provide practical solutions for farmers. Demonstration activities and provision of practical advice is an important part of this process yet is often lacking in research projects. The Interreg programme is proving value as there is a strong emphasis on communication and instigating change and provides the support to link research and knowledge exchange.

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