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Guidelines for users of imported bumblebee colonies

All-Ireland Pollinator Plan

www.pollinators.ie

Implementation coordinated by the National Biodiversity Data Centre

National Biodiversity Data Centre
Documenting Ireland's Wildlife

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How-to-guide 7

What is the All-Ireland Pollinator Plan?

Pollinators are in trouble, both in Ireland and around the world.[1,2] Here in Ireland, we have many pollinating insects including bees (wild and managed), hoverflies and many more. One-third of our 99 Irish bee species are currently threatened with extinction. If nothing is done, we will lose our precious pollinators on which we depend for food security and ecosystem functioning. The All-Ireland Pollinator Plan is a shared plan of action that aims to target the causes of pollinator decline and reverse the worrying decline of these vital organisms.[3]

Who is this guide for?

This guide is designed to inform and advise users of imported bumblebee colonies in animal-pollinated crop systems on best practice regarding the use of managed pollinators. This is a specific target (Target 3.4) of the All-Ireland Pollinator Plan.[3] The recommendations outlined in this guide will provide users of imported colonies with an opportunity to help protect native, wild Irish pollinators through responsible, best-practice management of imported colonies.

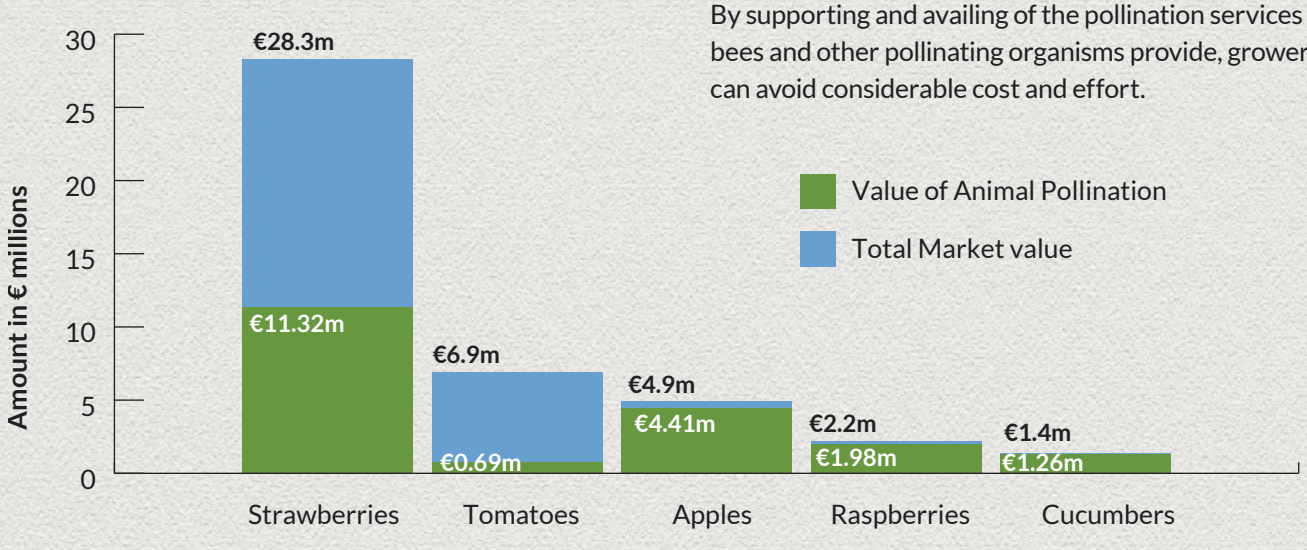
Economic importance of pollinators

The decline in pollinator populations is extremely concerning, especially considering the economic importance of the services which they provide.

It has recently been estimated that the global loss of pollinators would cost the world's economy a trade deficit of €260 billion to €1.11 trillion per year. In Ireland and the UK, pollination services have been estimated to annually contribute up to €59 million and £322 million to the respective economies.[4,5] In Ireland, this estimate increases to a loss of between €150 and €840 million per annum when imported animal-pollinated goods are considered.[4]

In terms of specific crops, pollination services provided to oilseed rape in Ireland are valued at €3.9 million per year.[6] In Northern Ireland, the value of pollination services for apple trees is estimated to be around £7 million annually.[7] In fact, if we didn't have insect pollinators at all, the cost of manually pollinating tomato crops by humans could reach €10,000 per hectare.[8] Further estimates of the value of bee pollination for crops, such as strawberries and tomatoes, are summarised in the accompanying bar chart.[4]

By supporting and availing of the pollination services bees and other pollinating organisms provide, growers can avoid considerable cost and effort.



Five actions for commercial bumblebee users

1 Order native colonies in good time (Pages 12 - 13)

This ensures the native buff-tailed bumblebee subspecies will be ready and arrive in time to pollinate your crops. Seek advice on amount of colonies to order from your suppliers.

2 Place colonies to optimise pollination services (Page 14)

Placing colonies evenly around field site, in cool, dry, shaded areas soon after delivery keeps pollinators comfortable and ensures they visit the entirety of your crop.

3 Monitoring colony health and life-cycle (Pages 15-16)

Understanding the stages of development of your colony and signs of trouble allows informed decision making in the day-to-day management of colonies during the crop flowering period.

4 Dispose of colonies correctly after 8 weeks (Pages 18-19)

Appropriate disposal of colonies after use for pollination lowers the levels of escape of reproductive bumblebees into the environment and mitigates risks that commercial bumblebees may pose to wild pollinators.

5 Be an All-Ireland Pollinator Plan business supporter (Page 22)

Take on actions to help threatened, wild Irish pollinators that also contribute to crop pollination.

Benefits of commercial bumblebee colonies to horticulture

To produce good quality fruit, effective pollination is crucial. Wild bees (including bumblebees and solitary bees) play a huge role in the pollination of Irish crops. Additionally, growers may source managed or imported pollinators to boost the pollination services in their field crops or in greenhouse settings.

In general, honeybees (*Apis mellifera*) are the most widely used and well-known managed pollinator for crop production. Now, it is becoming more widely appreciated that other pollinator species may be more beneficial in certain crop-growing scenarios.[9] For example, glasshouses (particularly heated glasshouses) are unsuitable for other managed pollinators such as honeybees. Using alternatives to honeybees also mitigates the risks associated with depending on a single species for pollination services.

Bumblebees have several traits that facilitate the successful pollination of many crops. Bumblebees possess the ability to buzz-pollinate, i.e. buzzing at a particular frequency to release pollen from certain plant flowers, which is vital for successful pollination of crops such as tomatoes, blueberries, cranberries and peppers.[10] Some bumblebees have longer tongues than honeybees, allowing them to interact more effectively with certain flowers, such as red clover.[11] For certain crops like strawberries, bumblebees are 2.5 times more efficient pollinators than honeybees.[12]

In Ireland, changeable and poor weather conditions are quite common. Growers producing fruit at cooler, wetter times of year, such as apple growers, require pollinators that continue to forage and pollinate even when it might be cold and raining. Honeybees tend not to forage during these weather conditions.[10] Bumblebees, however, do forage during the harsher weather conditions to collect the pollen and nectar they need. Their larger bodies and hair allow them to regulate their temperature while doing this.[10]

“Bumblebees, unlike other types of bee, have the ability to “buzz-pollinate” certain crops such as tomatoes!

Irish bumblebee-pollinated crops

In 2006, more than 95% of commercial bumblebee colony sales were for tomato crop pollination.[8] Increasingly, commercial bumblebees are used as pollinators for soft fruits.[10,13,14] Surveys conducted amongst growers by Teagasc and the Department of Agriculture, Food and the Marine (DAFM), across the island and Republic of Ireland (ROI), respectively, shed light on the main crops for which growers imported commercial bumblebee pollinators.

In 2013, nearly 60% of growers importing commercial bumblebees into the ROI were using them for strawberry pollination, 25% for apple pollination and 20% for tomato pollination. [13]

Note:
As growers often grow more than one crop, percentages in below figure do not add up to 100%.

Target crops in Ireland for which bumblebees are imported to pollinate.

*Teagasc survey of growers on island of Ireland (2007, 2009)

**DAFM survey of growers in Republic of Ireland (2013)

Bumblebee pollination in horticulture

Most fruit growers in Ireland know that bumblebee pollinators are extremely beneficial in producing both high yields and high-quality products. For this reason, many people in Ireland import commercially-reared colonies of buff-tailed bumblebee (*Bombus terrestris*) to provide pollination services to their crops.[10,11] While this species is technically native to Ireland, commercial colonies are reared in artificial conditions by a number of companies based in Europe.[10]

Did you know?

Over 1 million bumblebee colonies are exported around the world every year, and this trade is worth over €55 million per year.[10,12]

Commercial bumblebee use in Ireland

Between 1,500 and 2000 colonies of commercially reared bumblebees are imported into the island of Ireland on average every year.[13,14] The mean number of commercial bumblebee colonies imported has risen from ~17 to ~33 per grower colonies between the years 2007 and 2013. This suggests that commercial bumblebee use by horticultural growers over the last two decades is gaining traction, perhaps due to a widening appreciation of bumblebees as pollinators for Irish-grown crops and increasing acreage in response to market demand.[13, 14]

Importation of bumblebee colonies appears to be concentrated along the East of Ireland.[15] There are several major suppliers of artificially reared bumblebees to Ireland and these rearing facilities are based in Europe.

Irish buff-tailed bumblebees in Ireland and Britain have been found to be genetically distinct from one another.[16] It is thought that the current imports of commercial bumblebees into Ireland are of the same variety that are native to Ireland. However, it is not clear whether commercial bumblebee producers sourced Irish buff-tailed bumblebee queens when beginning the production of colonies of this sub species (*Bombus terrestris audax*) in 2010 and 2011.

As a result of this uncertainty, growers are advised to proceed with caution in relation to how they manage their commercial bumblebee colonies, as the colonies imported may not be of the exact same genetic make-up as those we have wild in Ireland.

Kingdom	Animalia
Phylum	Arthropoda
Class	Insecta
Order	Hymenoptera
Family	Apidae
Genus	Bombus
Species	*B. terrestris*
Sub-species	*B. t. audax*

Why don't we just rear Irish bumblebee colonies?

As yet, the market for Irish bred *B. terrestris audax* in Ireland is limited and there is no national producer.

Bombus terrestris sub-species

The buff-tailed bumblebee population spans across mainland Europe, Northern Africa, and is also found on Mediterranean islands. Across this distribution, buff-tailed bumblebee populations have evolved into a number of distinct groups called sub-species. These groups can differ from one another in colouration, size, genetics and sometimes behaviour. [17,18]

Up until 2010 and 2011, mainland European subspecies of buff-tailed bumblebees (*B. terrestris dalmatinus* and *B. t. terrestris)* were the breeding stock used to supply the UK and Ireland with commercial bumblebee colonies.[19] After growing concerns, these companies began to produce colonies of the native sub-species of Britain and Ireland, called *B. t. audax*.[19, 20]

Legislation regarding bumblebee importation

The island of Ireland has two different jurisdictions which oversee beekeeping and bee imports. In the North, the relevant authority is the Department of Agriculture, Environment and Rural Affairs (DAERA) and, in the Republic of Ireland, it is the Department of Agriculture, Food and Marine (DAFM).

As a member state of the EU, the Republic of Ireland must follow EU regulations as defined in the "Balai" Directive (Council Directive 92/65/EEC). Under this Directive, bumblebees must be certified by the competent authority in the origin member state that they meet certain requirements and show no sign of disease prior to dispatch.[21]

Bumblebee colonies must be accompanied by a health certificate to their final destination.

Honeybee diseases and parasites are the only species-specific pathogens that are specified in legislation. If bees carry or if their area of origin is not free of these honeybee-specific parasites, they cannot be certified and are prohibited from being exported to the Republic of Ireland.[21] The parasites directly addressed in the legislation include American foulbrood, the small hive beetle (*Aethina tumida*), the Tropilaelaps mite and Fireblight (*Erwinia amylovora*). [21]

The importation of colonies containing bumblebee-specific parasites (usually invisible to the naked eye) such as *Crithidia bombi*, *Nosema bombi* and *Apicystis bombi* are not specified in either Irish or EU legislation.

Only honeybee-specific parasites are directly addressed in EU legislation.

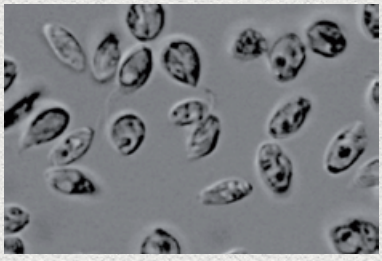
In Ireland, under the European Communities (Birds and Natural Habitats) Regulations 2011 (Regulation 49), it is an offence to release or allow the escape of any animal, both vertebrate and invertebrate, that is of a species, subspecies or variety that is not 'ordinarily resident' in the country. In this context, only commercial colonies of the native Irish subspecies of bumblebees, *B. t. audax*, should be imported.[22]

Prior to arrival, growers importing bumblebee colonies must notify the Horticulture and Plant Health Division of DAFM at least one full day in advance of the arrival of a bumblebee order. This is the same in the North, where importers must inform DAERA of incoming bumblebee colonies.

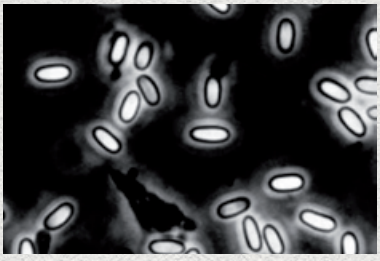
It is an offence to release or allow the escape of any animal that is not 'ordinarily resident' in the country.

In order to comply with this legislation, growers must source their commercial bumblebees from reputable suppliers and distributors.

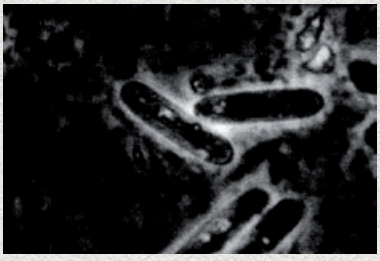
Images of bumblebee specific parasites as viewed under microscopes.



A *Crithidia bombi*, a common parasite which infects the gut of adult bumblebees and causes reduced fitness, foraging rates and learning efficiency.[23]



B *Nosema bombi*, less common than *C. bombi*, can reduce worker survival and worker size.[24]



C *Apicystis bombi* has been linked to rapid Queen death and deteriorated bumblebee fat resources.[25]

Risks of commercial bumblebee importation

Although there are many benefits associated with supplemental pollination services from imported bumblebee colonies, there are also a number of risks involved…

① Competition with native pollinators

The importation of bumblebee colonies may cause competition between imported buff-tailed bumblebees and wild, indigenous buff-tailed bumblebees as well as with the many other native Irish bee species, often foraging on the same crops. [26,27,28,29]

It has been widely documented that commercial bumblebees can escape from their colonies and the greenhouses in which they are housed and can spread up to 10km from their original site.

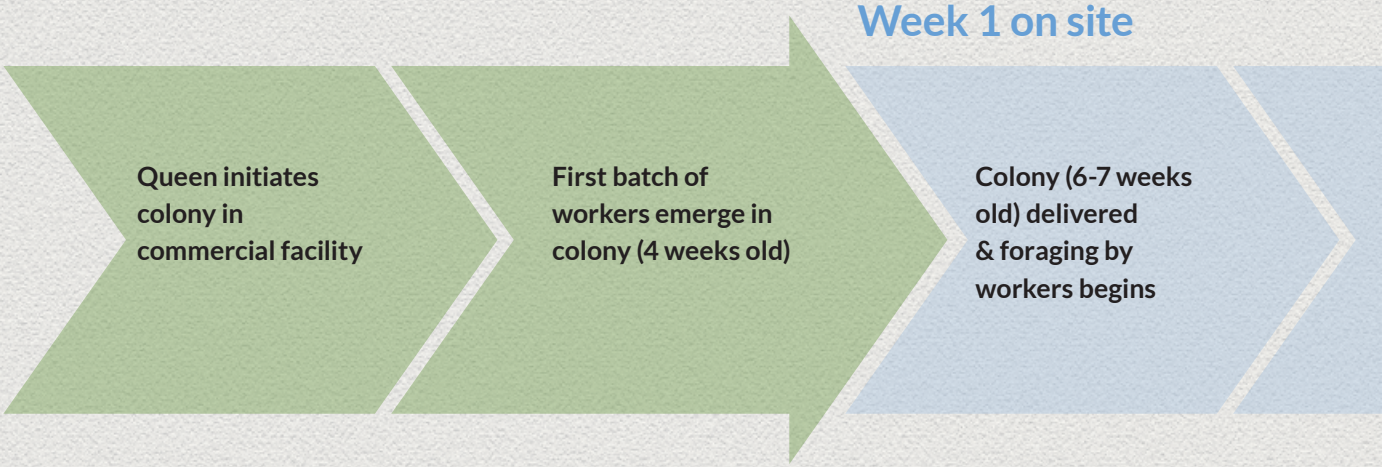
Furthermore, they have been known to establish themselves in the wild and produce colonies. As pollinator nest and food supplies are limited, increased numbers of commercial buff-tailed bumblebee may result in competition between native and commercial bees.

② Spread of disease

Instances of parasites such as *Crithidia bombi* and *Nosema bombi* have been found in imported bumblebee colonies in both Ireland and the UK.[12, 28, 30] Importation of commercial bumblebee colonies has also been shown to have the potential to spread both honeybee and bumblebee pathogens and parasites. [30,31]

Imported bumblebees carrying any of these parasites can pass these pathogens on to wild bee populations and, indeed, studies have found that incidences of some parasites among wild bee populations increase proportionally with proximity to sites with commercial colonies. [12,32] This is very worrying considering the massive role wild pollinators play in both crop and wild plant pollination.

Timeline of commercial colony lifespan[33]



> *"Incidences of parasites among wild bee populations increase proportionally with proximity to sites with commercial colonies. This is very worrying considering the massive role wild pollinators play in both crop and wild plant pollination.*

③ Hybridisation

It has been shown that Irish and British buff-tailed bumblebee populations are genetically distinct.[16] Native Irish populations may have certain genes or traits that they have evolved to deal specifically with Irish flora, crops, landscape and climate. [16]

Non-native sub-species or genetically-distinct bumblebee colonies (generated through unrepresentative starter stocks of bumblebee queens, inbreeding or artificial selection) that are imported may produce individuals that can mate with wild Irish populations and create hybrid offspring.

Mating between commercial bumblebees and the potentially genetically-distinct Irish populations may cause reduced specialisation in Irish populations. [16,28]

Week 8 on site

Queen switches from laying female eggs to male eggs (8-9 weeks old)

Males and new queens emerge (10-12 weeks old)

Time to dispose of colony (14-15 weeks old)

Recommendations for commercial bumblebee users

Before ordering...

A number of studies have found evidence that attracting a diverse array of wild pollinators, such as planting flower strips, to crop fields, such as orchards, can be linked with improved fruit and seed sets in certain crop systems.[34]

Wild pollinators have already been shown to heavily contribute to the pollination of certain crops in Ireland so supporting wild populations may reduce the pressure to import or increase the numbers of imported colonies on your crop site.

See more about what you can do to support wild pollinator populations on Page 20-21.

How to order colonies and how many should you order?

Colonies can be ordered through distributers. It is essential that the native subspecies, *B. t. audax*, is the commercial species that is imported. The number of colonies that should be ordered should be based on floral density of the target crop and the area of the crop site. Most standard soft fruit hives available are suited to crops with between 25 and 35 blossoming flowers / m^2 per week and its recommended to place one colony per 1000 m^2.[35] In the case of blueberry and cranberry pollination, 3 hives per 4000m^2 is recommended.[36]

Consult with your supplier to receive advice on suitable bumblebee colony products and the recommended density of colonies for your target crop.

When will you need commercial colonies?

It is recommended that growers order colonies well in advance of required delivery. The time at which you need bumblebee colonies delivered will depend on the target crops and when they flower, require or are receptive to pollination services. It is recommended to place boxes when your crop is in 5 to 10% bloom.[36] Commercial bumblebee colonies are only fit to be used for approximately 8 weeks after their delivery, as around this time they will begin to produce reproductive individuals (males and new queens) and numbers of workers will decrease.[37]

NOTE:
Under the "Balai" Directive (Council Directive 92/65/EEC), certificates of health must accompany each colony exported.[21]

© Sarah Larragy

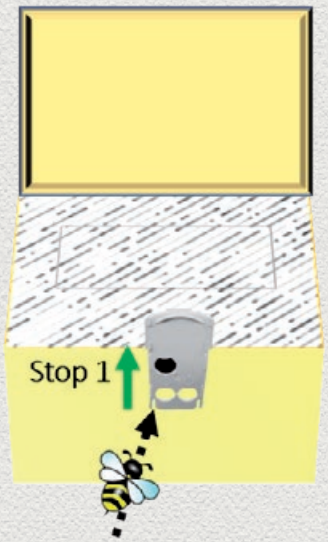
When your colonies arrive...

Once you have received your colonies, place them in the final location immediately, keeping the box upright at all times. It is recommended that imported bumblebee products, including single, double or triple colony products, be spaced out evenly in the field on arrival. Advice should be sought from your supplier as to what type of pollinator product (e.g. single or triple colonies) and colony density is best suited to your particular target crop(s).

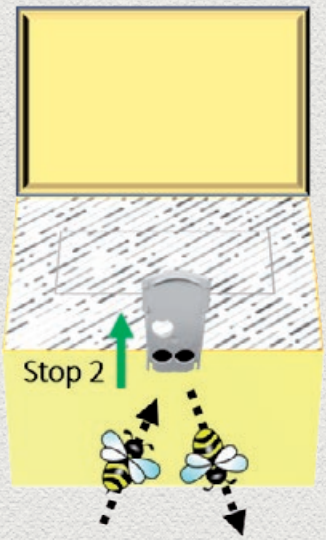
When placing bumblebee colony products, ensure that:

- Whether you are using single or triple bumblebee colony boxes, do not place multiple products close together. In the case of single colonies, place the flight holes in different directions to other colonies already placed and ensure nothing is obstructing the flight holes.[38]
- Colonies are placed low (20 – 60cm from ground) and in the shade. There should be no direct sunlight shining into the flight hole as this can dramatically increase temperatures inside the colony and affect pollination.[38]
- Colony bee locks are opened between 2 – 18 hours after arrival, when the sun is low in the sky such as early morning or late afternoon. [39]
- Colony is not moved again once the bee lock has been opened. Bees are excellent navigators but moving the colony once its inhabitants have gotten used to their surroundings will likely disorientate them.[39]
- If it is absolutely necessary to move the bumblebee colony box, ensure that all bees have returned to colony by pushing down the white sliding door (or bee lock) of the colony down to the first stop (see below figure). After two hours, the bee lock can be fully closed. Now the colony can be safely moved.
- If a bee box in a row is removed after other colonies nearby have been set down, it should be replaced with a similar looking box to prevent confusion among bees from other colonies, as bees use landmarks to find and return to their colony after foraging trips.[39]
- Honeybee and bumblebee hives are separated by a minimum of 90 meters and preferably placed at opposite ends of the crop to prevent honeybees robbing bumblebee resources.[40]

When bee lock is all the way down, no bees can leave or enter colony



When bee lock is at 'Stop 1' position, bees can enter colony.



When bee lock is at 'Stop 2' position, bees can both leave & return to colony.

Understanding your colony

Bumblebee colony life cycle

In order to produce bumblebee colonies, commercial facilities stimulate bumblebee queens to lay eggs. She incubates her first batch of eggs, usually numbering around 8. These eggs take about four to five weeks to fully develop, from egg to larva to pupa until finally, they are fully grown workers.

Once the workers emerge, the queen no longer forages and this responsibility is assumed by her daughters. These are the main pollinating force of the colony as they collect pollen and nectar to feed their queen and developing larva. [41]

The worker numbers grow quickly after this point, as does the 'bubbly' structure of the colony. After a while, the queen starts laying eggs that will develop into reproductive individuals: Gynes (future queen bees) and drones (male bees). This marks the colony coming to the end of its life cycle.[42]

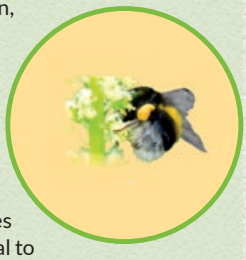
Bumblebee workers are the main pollinating force of the colony.

The bumblebee castes

Queen

The queen of the colony is about 2cm in length. She is the mother of all the workers, gynes and most males that are produced in the colony. Once her first batch of workers has developed, she will remain inside the colony, looking after developing brood.

Workers



Workers, daughters of the queen, are ~1.3cm in length. They have pointed abdomens. Their role in the colony is to forage (often seen with pollen baskets), look after developing brood, and to defend and maintain the colony. Foraging worker bees carry more pollen on their bodies than male bees, so their potential to pollinate while foraging is higher.[41] Their numbers can reach 350 individuals in a single colony.

Males

Male bees are sting-less. The main role of males in the colony is reproduction. Males usually leave the colony they were born in and go in search of virgin queens from other colonies. They have rounded abdomens and do not collect pollen baskets. While male bumblebees are capable of some pollination, they usually don't remain in the vicinity of the colony.[41]

Gynes

Towards the end of the colony life cycle, the colony produces gynes. These are new queens that can potentially mate and hibernate through the winter, while all members of the old colony die off. The following Spring, new bumblebee Queens emerge from hibernation and begin forming their own colonies. It is not advised that imported colonies be allowed to produce and release gynes to the wild.

Looking after your colony

All bumblebee colonies require two sources of food: Nectar and pollen.

Supplemental pollen:
Required when bumblebees are unable to forage on crop e.g. while being reared in commercial facilities & prior to release on target crop.

Supplemental sugar syrup:
Required when target crops do not produce adequate nectar resources, primarily **tomatoes**.

All commercial colonies come with a source of artificial nectar (a sucrose solution) underneath the box containing the bees.

This placement means it is inaccessible to any opportunistic foragers like honeybees, wasps and flies. Depending on the supplier, you may need to open this source of sucrose so the bees can access it through a wick but often this is not necessary as it has already been made accessible to the bees.

This is useful in maintaining energy levels of bees while they forage on crops that may have low amounts of nectar available, such as tomatoes. Pollen may be supplied with your colonies in order to feed them prior to releasing them to the crop. In most cases, it is only necessary to feed pollen to your bumblebees when your crops are not yet in flower. Discuss with your supplier whether supplemental pollen or sucrose solution is required for commercial bumblebees pollinating your particular crop species. Some suppliers have methods of cleaning pollen shipped alongside commercial colonies to reduce disease and parasite transmission e.g. through irradiation. Check with your supplier to see if the pollen supplied with your colony has been treated to remove potential pathogens or parasites.

Signs of trouble

Imported bumblebee colonies may face external stressors either during transit or on site that may affect their health and functioning. For this reason, it may be beneficial to monitor colonies periodically for any signs of disease or stress. Signs of a colonies facing stressors such as disease or poor nutrition may include:

- Inactive, lethargic or unresponsive bumblebees both in the box or foraging;
- In times of stress, bumblebee workers may remove larva from the brood cells and deposit them in the corners of their boxes;

- Viruses such as Deformed Wing Virus may affect the development of essential anatomical structures such as wings etc.;

- The queen of the colony may die and this means that no new workers will be laid.

Colony boxes should only be examined after all bees have returned to their colonies in the evening and the bee lock is closed. If you suspect disease in your colony, be sure to close and seal up colony to prevent spread of pathogens.

Any concerns regarding the health of the bumblebee colony should be reported back to your distributer and/or supplier.

Safety

Of course, the main danger of having commercial bumblebee colonies is the risk of being stung. However, with proper precautions, the risk of bee stings can be reduced significantly. Bumblebees tend to be more docile than honeybees, particularly while foraging.[10] Unlike honeybees, however, bumblebees have a smooth stinger that can pierce human skin more than once while having no negative effect on the bumblebee.[10]

How to avoid being stung:

- Ensure all those working on crop site are aware of where the colonies are placed.
- Refrain from wearing strong smelling products such as perfumes or aftershaves.[43]
- Watches and jewellery can also be aggravating to bees due to the smell of oxidised metal.[43]
- If bumblebee colonies have to be moved, fed pollen or inspected, ensure that all bees are inside the colony by waiting until evening and closing the bee lock to prevent bees from exiting prior to these interactions.[43]
- Don't swat or touch bees, and do not disturb colonies unnecessarily.

If you are stung:

- Stay calm. Most people usually experience short-term pain and some minor swelling at the site of the sting. An antihistamine is usually enough to lessen the worst of the symptoms within an hour or so. [44]
- Monitor for any unusual symptoms such as digestive problems, breathing difficulties, irregular heartbeats, heart palpitations or loss of consciousness. If any of these symptoms are noticed, you may be having an allergic reaction and you must get to a doctor or call an ambulance ASAP.

Disposal of colonies

When is the colony no longer operational?

As a rule of thumb, colonies are no longer a productive, operational unit after 8 weeks of colony use. This is because, by this time, the queen has usually died or been overthrown by her workers and workers are no longer being produced.

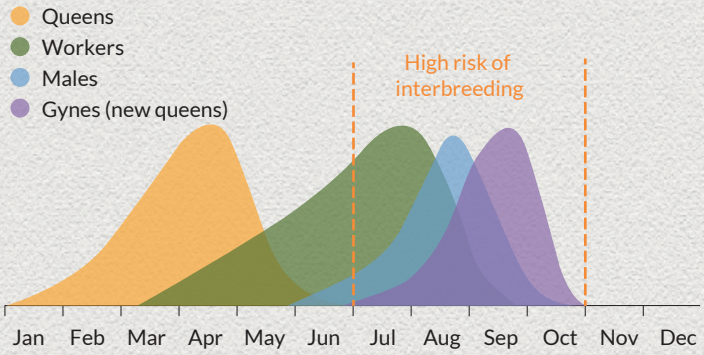
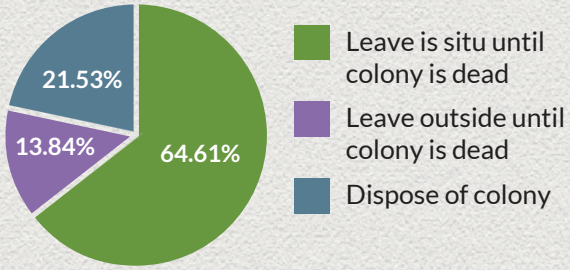


Figure adapted from "Bee Aware", Murray *et al.* [37]

Releasing imported *B. terrestris* bumblebees to the wild will not help Irish pollinators.

Why should colonies be disposed of ?

Colonies must be removed from the crop site and disposed of in a contained manner in order to prevent escape of reproductive bees which could lead to interbreeding with native pollinators. It also prevents any individuals potentially carrying parasites or disease to native populations. Allowing colonies to run their cycle in situ or outside may pose risks to wild pollinators on which natural and agricultural ecosystems alike depend. It is also safer to remove colonies and prevent unnecessary stings or accidents at this point, especially as they are likely not providing significant pollination services. In 2013, less than one quarter of growers were disposing of their colonies at the end of the cycle.



Survey data collected by the Dept. of Agriculture in 2013 showing % of growers in ROI and their choice of colony disposal method.[13]

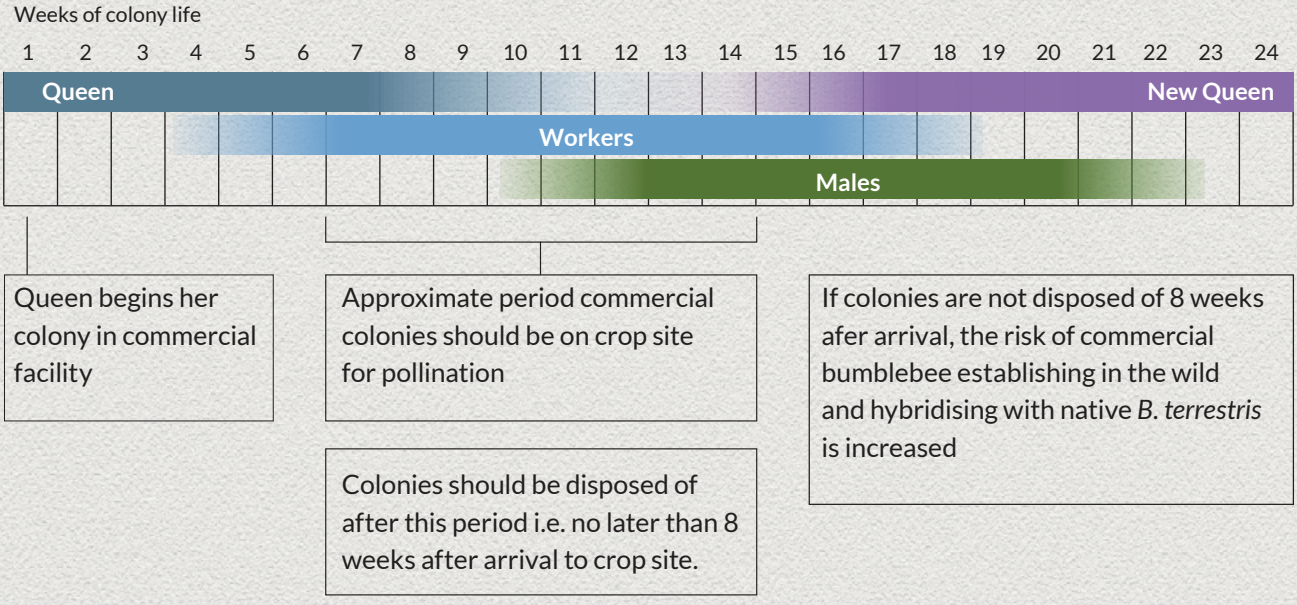
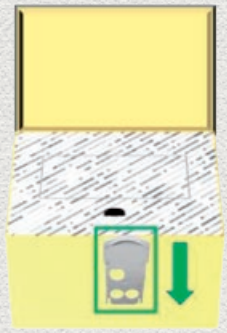


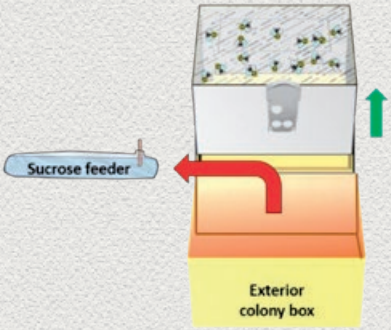
Figure adapted from "Bee Aware", Murray *et al.* [37]

Colony disposal

- After 8 weeks of imported colony use, it is time for disposal.
- Wait until late in the evening when bumblebee workers have ceased foraging and are back in the colony. Close the bee lock of the colony.
- Food stores (sugar solution) should be removed from underneath the colony and disposed of.
- Colonies should then be closed completely, placed into a bin bag and completely sealed with tape such as duct tape.
- Colonies should then be put into a cold room or freezer to accelerate colony death. Equipment for the freezing of colonies to facilitate the proper disposal of these colonies is eligible for grant aid under the Scheme of Investment Aid for the Development of the Commercial Horticulture Sector. For more information, go to: https://www.agriculture.gov.ie/farmingsectors/horticulture/horticultureschemes/ .
- After one week, colonies can be disposed alongside or in the same manner as other agricultural waste.

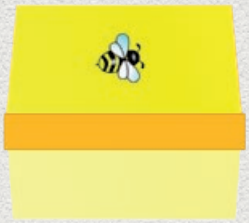


1. Close bee lock



2. Remove interior colony box and dispose of sucrose

3. Reinsert interior colony box into exterior covering.



4. Close lid of exerior covering.

5. Put colony into plastic bin bag, seal and place into cold room or freezer.

6. Leave colony for a week in cold and then dispose of alongside agricultural waste.

In order to protect our important wild pollinator species, it is imperative that colonies be disposed of properly & NOT be left outdoors after 8 weeks of use on site.

How you can help wild pollinators

Although the use of managed pollinators such as honeybees and commercial bumblebees is an accepted reality, the aim of the All-Ireland Pollinator Plan is to reverse the decline of wild pollinators in Ireland. Research has shown that wild pollinators contribute hugely to crop pollination in Ireland.[6] There are a number of additional actions those in horticulture can take in addition to the responsible management of imported bumblebee colonies to help tackle the worrying decrease in wild pollinator populations that are crucial for the pollination of a wide variety of crops in Ireland.

Many of these actions can not only benefit wild pollinators, but also the growers themselves such as reinforcing the green image of Irish products, increasing pollination services provided by wild pollinators and increasing benefits such as natural pest control.

Will hedgerows and wildflowers draw pollinators away from crops?

There is very little evidence that suggests pollinators are drawn away from crops by alternative floral resources. Instead, providing flowers that bloom throughout the season ensures the stability of resources on which pollinators depend.

Five BEE FRIENDLY actions for horticultural growers

1 Maintain native flowering hedgerows

Hedgerows are intrinsically linked with our green image in Ireland. They are essential sources of food (e.g. Hawthorn), shelter and transport corridors for pollinators in the wild and also benefit organisms that provide natural pest control.

2 Allow wildflowers to grow around the farm & reduce mowing

Applicable for both outdoor and covered crops, the management of wildflower resources (e.g. dandelions, clover, Phacelia, bramble and ivy etc.) will allow pollinator numbers to build up before the target crop comes into flower and after your crop has bloomed. In addition, strawberry flowers need to be visited up to 5 times by a bumblebee to achieve 100% pollination, so increasing the numbers of potential visitors may have a significantly positive effect on fruit quality and yield.

3 Provide nesting places for wild bees

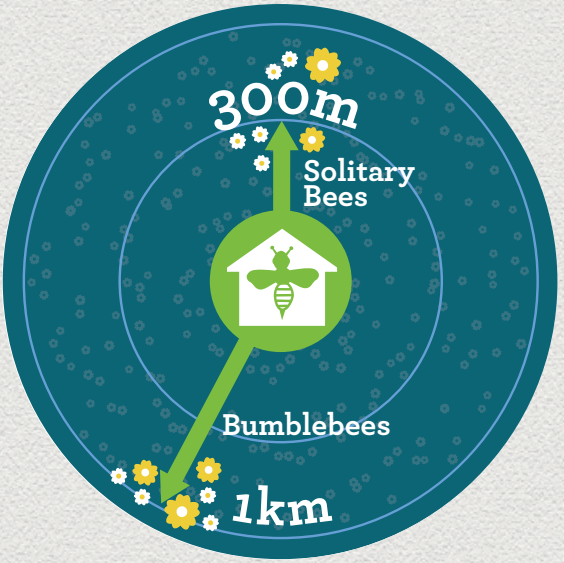
In order to survive, bees need safe places to hibernate and nest. If planning to develop nesting sites, ensure these areas are near to flowering plant resources and away from any places where pesticides may be sprayed. For more information on creating nesting habitats for bees, visit www.pollinators.ie/resources/how-to-guide-nesting/

4 Minimise artificial fertiliser use

As wildflowers are more likely to thrive in lower fertility soils, reducing the amount of fertiliser use can help boost wildflower populations and provide food for pollinators. An alternative to using artificial fertiliser is to plant legumes such as clover, which help naturally fix nitrogen in the soil. Herbal leys are another alternative which can improve soil structure, mineral and protein content, nitrogen-fixing ability drought-resisting ability and season-round yield.

5 Reduce pesticide inputs

Insecticides cannot distinguish between pest insects and beneficial ones such as pollinators. They can have both lethal and sub-lethal effects on pollinators. Fungicides sometimes increase the toxicity of certain insecticides and can have a negative impact bee numbers and diversity. Only spray when necessary and if possible, spray at night during dry, calm conditions, or not at all, during flowering so as to not allow pesticides to come into contact with pollinators. Always seek advice from a qualified plant protection advisor when making decisions on the application of pesticides and please remember all growers are required to grow adhering to the principals of Integrated Pest Management as mandate by The Sustainable Use of Pesticides Directive.



How to sign your business up to the All-Ireland Pollinator Plan

Businesses across Ireland have an opportunity to get involved with the All-Ireland Pollinator Plan and help encourage pollinator populations to recover from their current decline. To sign up as a business supporter, follow these simple steps:

Go to pollinators.ie/businesses/ to download the 'Businesses: Actions to help pollinators' guide. Send a signed copy of the 'Framework for Businesses' form to ufitzpatrick@biodiversityireland.ie

On pages 4 – 6 of the 'Businesses: Actions to help pollinators' guide, you can select pollinator-friendly actions that are suitable for your company. Many of the 'bee-friendly actions for horticultural growers' (Page 21) are listed among these Business Actions.

Sign up to 'Actions for Pollinators', an online mapping system that can be used to register your site and have your participation as a Business Supporter recognised. Actions for Pollinators can be accessed at https://pollinators.biodiversityireland.ie/

By becoming a Business Supporter of the All-Ireland Pollinator Plan, you can demonstrate your sustainability credentials to your customers. Additionally, you help ensure the stability of supply chains that depend on animal-pollinated crops.

Bibliography

1. Biodiversity Data Centre. Summary note on Ireland's bees [online]. Biodiversity Data Centre. Available at: https://bit.ly/2MUKMMo (Accessed 3rd December 2019)
2. Goulson, D., Nicholls, E., Botías, C., & Rotheray, E. L. (2015) Bee declines driven by combined stress from parasites, pesticides, and lack of flowers. Science, 347(6229), pp. 1255957.
3. All-Ireland Pollinator Plan 2015-2020. National Biodiversity Data Centre Series No. 3, Waterford.
4. Stout, J.C., Murphy, J.T. and Kavanagh, S. (2019) Assessing Market and Non-market Values of Pollination Services in Ireland (Pollival). Environmental Protection Agency, Report 209.
5. Hanley, N., Breeze, T.D., Ellis, C. and Goulson, D. (2015) Measuring the economic value of pollination services: Principles, evidence and knowledge gaps. Ecosystem Services, 14, pp.124-132.
6. Stanley, D., Gunning, D. & Stout, J. (2013) Pollinators and pollination of oilseed rape crops (Brassica napus L.) in Ireland: ecological and economic incentives for pollinator conservation. Journal of Insect Conservation, 17(6), pp. 1181-1189.
7. Christie, S.J. (2011) UK National Ecosystem Assessment: Northern Ireland summary [online]. Northern Ireland Environmental Agency. Available at: https://bit.ly/2oqIDi4 (Accessed 3rd December 2019)
8. Velthuis, H. H. W. & Van Doorn, A. (2006) A century of advances in bumblebee domestication and the economic and environmental aspects of its commercialization for pollination. Apidologie, 37(4), pp. 421-451.
9. Goulson, D. (2003) Conserving wild bees for crop pollination. Journal of Food Agriculture and Environment, 1(1), pp. 142-144.
10. Goulson, D. (2010) Bumblebees: behaviour, ecology, and conservation. Oxford: Oxford University Press.
11. Sladen, F. W. L. (1912) The humble-bee: Its life-history and how to domesticate it, with descriptions of all the British species of Bombus and Psithyrus, Cambridge: Cambridge University Press.
12. Teagasc (2012) Managing bumblebee imports to maintain pollinator diversity [online]. Available at: https://goo.gl/3GbhUq (Accessed 3rd December 2019).
13. DAFM (unpublished). Survey of commercial pollinator use by growers conducted in 2013.
14. Teagasc (unpublished) Survey of commercial pollinator use by growers conducted in 2007 and 2009.
15. Murray T., Kehoe, E., Horgan, F. (2008) Trends in Commercially Reared Bumblebee Importation for Pollination in Ireland (Conference poster) [online]. Environ. Dundalk Institute of Technology, January 2008. Available at: https://goo.gl/ijYmgx (Accessed 3rd December 2019)
16. Moreira, A. S., Horgan, F. G., Murray, T. E. & Kakouli-Duarte, T. (2015) Population genetic structure of Bombus terrestris in Europe: Isolation and genetic differentiation of Irish and British populations. Molecular Ecology, 24(13), pp. 3257-3268.
17. Lecocq, T., Rasmont, P., Harpke, A. & Schweiger, O. (2016) Improving International Trade Regulation by Considering Intraspecific Variation for Invasion Risk Assessment of Commercially Traded Species: The Bombus terrestris Case. Conservation Letters, 9(4), pp. 281-289.
18. Rasmont, P., Coppée, A., Michez, D. & De Meulemeester, T. (2008) An overview of the Bombus terrestris (L. 1758) subspecies (Hymenoptera: Apidae). Annales de la Société entomologique de France, 44(2), pp. 243-250.
19. Biobest (n.d.) Success of Biobest's native UK bumblebee recently proven by science [online]. Available at: https://goo.gl/opfZ2K (Accessed 3rd December 2019).
20. Koppert Biological Systems (2011) Native bumblebee available for growers in UK and Ireland: Koppert Biological Systems [online]. Available at: https://bit.ly/2rcMVuK (Accessed 3rd December 2019).
21. Council Directive (1992) Council Directive 92/65/EEC, 1992 Laying down animal health requirements governing trade in and imports into the Community of animals, semen, ova and embryos not subject to animal health requirements laid down in specific Community rules referred to in Annex A (I) to Directive 90/425/EEC. Official Journal of the European committees, 268, pp. 54–72.
22. Government of Ireland, S.I. No. 477/2011. European Communities (Birds and Natural Habitats) Regulations 2011. Dublin: The Stationary Office.
23. Schmid Hempel, R. and Tognazzo, M. (2010) Molecular divergence defines two distinct lineages of Crithidia bombi (Trypanosomatidae), parasites of bumblebees. Journal of Eukaryotic Microbiology, 57(4), pp.337-345.
24. Plischuk, S., Antúnez, K., Haramboure, M., Minardi, G.M. and Lange, C.E. (2017) Longterm prevalence of the protists Crithidia bombi and Apicystis bombi and detection of the microsporidium Nosema bombi in invasive bumble bees. Environmental microbiology reports, 9(2), pp.169-173.
25. Lipa, J.J. and Triggiani, O. (1996) Apicystis gen nov and Apicystis bombi (Liu, Macfarlane & Pengelly) comb nov (Protozoa: Neogregarinida), a cosmopolitan parasite of Bombus and Apis (Hymenoptera: Apidae). Apidologie, 27(1), pp.29-34.
26. Ings, T., Ward, N. & Chittka, L. (2006) Can commercially imported bumble bees out compete their native conspecifics? Journal of Applied Ecology, 43(5), pp. 940-948.
27. Goulson, D. (2010) Impacts of non-native bumblebees in Western Europe and North America. Applied Entomology and Zoology, 45(1), pp. 7-12.
28. Murray, T. E., Coffey, M. F., Kehoe, E. & Horgan, F. G. (2013) Pathogen prevalence in commercially reared bumble bees and evidence of spillover in conspecific populations. Biological Conservation, 159, pp. 269-276.
29. Dafni, A., & Shmida, A. (1996) The possible ecological implications of the invasion of Bombus terrestris (L.) (Apidae) at Mt Carmel, Israel, 183-200. The Conservation of Bees (eds A. Matheson, S.L. Buchmann, C. O'Toole, P. Westrich & I.H. Williams), pp. 183–200. Academic Press, London, UK.
30. Graystock, P., Yates, K., Evison, S. E. F., Darvill, B., Goulson, D. & Hughes, W.O.H. (2013) The Trojan hives: pollinator pathogens, imported and distributed in bumblebee colonies. Journal of Applied Ecology, 50(5), pp. 1207-1215.
31. Arbetman, M. P., Meeus, I., Morales, C. L., Aizen, M. A., & Smagghe, G. (2013). Alien parasite hitchhikes to Patagonia on invasive bumblebee. Biological invasions, 15(3), 489-494.
32. Colla, S. R., Otterstatter, M. C., Gegear, R. J. & Thomson, J. D. (2006) Plight of the bumble bee: pathogen spillover from commercial to wild populations. Biological conservation, 129(4), pp. 461-467.
33. Duchateau, M.J. and Velthuis, H.H.W. (1988) Development and reproductive strategies in Bombus terrestris colonies. Behaviour, 107(3-4), pp.186-207.
34. Blaauw, B. R., & Isaacs, R. (2014) Flower plantings increase wild bee abundance and the pollination services provided to a pollination dependent crop. Journal of Applied Ecology, 51(4), pp. 890-898.
35. Foster, D. (2004) Advances in Biological control and pollination of soft fruit [online]. In National Soft Fruit Conference Proceedings April 2004. Available at: https://bit.ly/2Wm21cL (Accessed 29th October 2019).
36. Abrol, D. P. (2011) Pollination biology: Biodiversity conservation and agricultural production. Dordrecht: Springer Science & Business Media.
37. Murray T., Kehoe, E., Horgan, F. (2007) Bee aware. Today's Farm, 18(6), pp. 10-11.
38. Koppert Biological Systems (2017) Natupol [online]. Koppert Biological Systems. Available at: https://www.koppert.com/natupol/ (Accessed 3rd December 2019)
39. Bioline Agro Sciences (2016) Beeline. Bioline Agro Sciences [online]. https://www.biolineagrosciences.com/products/beeline/ (Accessed 3rd December 2019)
40. Ullmann, K., Isaacs, R., Vaughan, M., May, E., Ellis, J., Williams, N., Pitts-Singer, T., Boyle, N., Cane, J., Ward, K., Gibbs, J., Joshi, N. & Biddinger, D. (2017) Guide to Integrated Crop Pollination. Portland, OR. Integrated Crop Pollination Project.
41. Wolf, S. and Moritz, R.F. (2014) The pollination potential of free-foraging bumblebee (Bombus spp.) males (Hymenoptera: Apidae). Apidologie, 45(4), pp.440-450.
42. Alford, D.V. (1978) The life of the bumblebee. Davis-Poynter.
43. Koppert Biological Systems (2013) Treatment of bumblebee stings and allergies [online]. Available at: https://bit.ly/2owvXq6 (Accessed 29th October 2019)
44. Bucher, C., Korner, P., & Wüthrich, B. (2001) Allergy to bumblebee venom. Current opinion in allergy and clinical immunology, 1(4), 361-365.

This booklet is one of a series of Guidelines produced to help different sectors take actions under the All-Ireland Pollinator Plan. For more information and other useful resources, please see **www.pollinators.ie**

National Biodiversity Data Centre
Documenting Ireland's Wildlife

About the National Biodiversity Data Centre

The National Biodiversity Data Centre is a national organisation that collects and manages data to document Ireland's wildlife resource, and to track how it is changing. Find out what biodiversity has already been recorded in your local area: **maps.biodiversityireland.ie**

Help us to build up the knowledge of biodiversity in your local area by submitting sightings to **records.biodiversityireland.ie**

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IRISH RESEARCH COUNCIL
An Chomhairle um Thaighde in Éirinn

Maynooth University
National University of Ireland Maynooth

teagasc
Agriculture and Food Development Authority

Trinity College Dublin
The University of Dublin