BEES AND THE POLLINATION OF CROPS AND WILD FLOWERS IN THE EUROPEAN COMMUNITY

Sarah A. CORBET, Ingrid H. WILLIMAS, Juliet L. OSBORNE

UNITED KINGDOM

Both domesticated and wild bees are probably declining. A steep decrease in honeybee numbers in the EC is widely feared (COPA/COGECA, 1989), but alarmingly poorly documented, and there have been serious regional losses of bumblebee species (RASMONT, 1988; WILLIAMS, 1986). An essential pollination service is performed by domesticated honeybees (*Apis mellifera*) and by wild bees (feral honeybees, 58 species of bumblebees, and hundreds of species of solitary bees).

Because of the way climatic constrains limit foraging, bumblebees are relatively more important in the north and honeybees in the south of Europe. If climatic change alters distributional ranges, some crops and wild plants may be left with inadequate pollinator populations. Monitoring is needed.

Plants that require bee pollination to set seed typically have large, colorful, nectar-rich flowers and several seeds per fruit. They include many crops grown for food, horticulture and industry, and wild plants important in semi-natural vegetation.

Deduction from floral structure indicates that the flowers of many crops and wild plants are adapted for bee pollination. Further experimental studies of pollination are much needed, to see whether inadequate pollination limits seed set, and which insect species are potential or actual pollinators. The adequacy of pollination of a given plant species will vary regionally with climate, habitat, and the nature and density of the local pollinator community. A coordinated system of experiments throughout the EC is required to provide information needed for management of crop pollination and for conservation of threatened wild plant species.

Introduction of honeybees to pollinate a crop often increases yield. The economic value of the increase in yield is hard to assess but has been estimated as 4,250 million ECUs in the EC. Unmanaged wild bee populations make a contribution that is often ignored and probably underestimated. Their predicted decline may affect yield markedly. Although some crops are better suited to wild bees, which outperform honeybees on them (red clover, field bean and alfalfa), pollination management usually involves introducing colonies of honeybees, because these are often the only bees available for moving to crops in sufficient numbers. For the other species, management techniques are available for a few (e.g. *Megaclile rotundata*, *Osmia* species) but they remain to be developed for most.

The number of honeybee colonies required per hectare for adequate pollination of a crop will vary with circumstances, and is expected to increase as wild bee populations decline. The demand for and cost of pollination contracts (hire of honeybee colonies for crop pollination) are expected to rise, and demand may exceed supply if honeybee numbers are decreasing because of economic factors, land use changes, mite infestation or agrochemical kills. Statistics on pollination contracts are needed to monitor the situation. If current trends continue, a pollination crisis is anticipated in the EC, as it is in USA (TORCHIO, 1990). Three complementary objectives should be urgently pursued in an integrated programme: to promote a thriving beekeeping industry and thereby ensure an adequate and appropriately distributed source of honeybees for pollination; to develop techniques for managing other, non-honeybee bee species as pollinators; and to enhance wild bee populations by habitat management (TORCHIO, 1990).

Fragmentation and destruction of semi-natural habitats is cause of the decline of wild bee populations, and conservation and management of these habitats, co-ordinated on a regional scale, is a potentially cost-effective component of an integrated response to the anticipated crisis in pollination. Habitats that sustain wild bee populations must provide nest sites and a seasonal succession of forage. They are generally open areas (where shrub and tree growth is prevented by poor drainage, poor soil, grazing, burning or cutting), and in which turf is undisturbed for several years. They include garigue, Atlantic heats, unimproved grassland (especially ancient hay meadows), undisturbed areas on farmland (hedges, field boundaries, tracks roadside verges) and woodland edges. The decline of such habitats is incompletely documented; it threatens bee populations.

Woodland is unevenly distributed in the EC. The best areas for bees are edges, rides and clearings, and the open woods of the Mediterranean are especially good. The suitability of woodland for bees declines as coniferous plantations replace broadleaved woodland over large areas of Europe.

The progressive loss of permanent grassland to arable cultivation between 1900 and 1970 reduced habitat suitability for bees; documented regional losses of certain bumblebee species in United Kingdom, France and Belgium are attributed to ploughing of undisturbed habitats and reduction in the areas of legume-rich forage crops and semi-natural vegetation.

Some crops dependent on bee pollination provide transient local concentrations of nectar and pollen for wild and domesticated bees during their flowering period, but they do not provide the continuity of forage necessary to sustain long-lived social or solitary bees. Cereal crops, which provide neither forage nor nest

sites for bees, have increased in the EC until very recently. Oilseed crops, notably oilseed rape in the north and sunflower in the south, which provide bee forage and require bee pollination, have increased fast since 1970, but the hectarage of fruit trees and forage legumes has fallen.

Bees in some EC countries suffer directly from pesticides (poisoning incidents are documented for honeybess in some EC countries, unmonitored for wild bees), herbicides (causing loss of forage and habitat loss) and fertilizers (use of which grassland decreases floristic diversity and hence bee forage).

As wild bee populations are reduced by these changes in land use and agricultural practice, pollination of wild flowers and crops must depend increasingly on domesticated honeybees. Honeybee hive density is higher in the EC than elsewhere (average 2.73 hives km^{-1}), but hives are unevenly distributed, with 18,000 large-scale beekeepers (with more 150 hives each) and 450,000 small-scale beekeepers. Changes in colony numbers and honey production are poorly documented, especially for the critical years since 1985, when the spread of *Varroa* mites throughout continental EC countries, with low honey prices and declining natural forage are thought to have caused a sharp decline in honeybee colony numbers and a redistribution from small-scale to large-scale apiaries. In places these are associated with migratory beekeeping; colonies are transported long distances to exploit transient nectar sources or to pollinate particular crops. The impact of this episodic flooding with honeybees on semi-natural vegetation and wild bee populations requires study.

Pollination of crops and wild plants may be at risk if honeybee numbers are falling sharply at a time when changes in land use and agriculture have reduced the population of wild bees which previously provided an unacknowledged pollination service to crops and wild plants. If bee pollinated flowers do not seed, the integrity of Europe's remaining seminatural vegetation will be destroyed and the colourful flowers of the countryside will be lost. This in turn will deprive many other herbivorous or seed-eating insects, birds and small mammals of their host plants and/or food, with consequent further loss of species diversity. Certain crops dependent on pollination (notably fruit, oilseed crops and seed crops of vegetables and forage legumes) will suffer a major decrease in yield, and many no longer be grown. Their loss will cause further depletion of nectar resources for the remaining bees. Bees need food (nectar, pollen) provided by insect-pollinated plants in order to reproduce and produce more bees. Insect-pollinated plants need bees to pollinate them if they are to reproduce and produce more plants (or a commercially viable seed yield, in the case of crops). Because of this mutual interdependence, if a shortfall in the pollinating bee population causes growers to abandon some insect-pollinated crops, the resulting decrease in bee forage available from these crops will further reduce bee numbers, exacerbating pollination problems. If the suspected current decline in beekeeping is real and sustained, there may not be enough honeybee pollination units to meet the expected increased demand for crop pollination.

This survey reveals a serious shortage of essential information. There is a need for monitoring of populations of selected species of bees and wild plants, closer investigation of pollination requirements of wild flowers and crops and the efficacy of different pollinators, prompt collation of apicultural statistics, and development and improvement of methods to enhance wild bee populations and to manage honeybees and other bee species for pollination. TORCHIO (1990) points out that when the anticipated pollination crisis hits the USA, the solution favoured by each research expert will depend on his perspective. Those working on honeybees will recommended increasing honeybee numbers, those involved in management of other bee species will recommend development of managed alternative pollinators, and those concerned with wild bee populations will recommend habitat conservation and management. In reality, all three approaches will be required if the problems are to be solved. TORCHIO therefore recommends for the USA a coordinated pollination programme in which these elements are integrated and are seen as complementary, rather than competing, options. We strongly support that recommendation for the EC.