Honey bees are a major pollinator group providing essential pollination of crops to maintain yield and variety of food crops. Products of the bee hive: honey, wax, propolis, royal jelly, pollen. Honey bees face many threats, including: lack of forage and reduced diversity of forage owing to intensive agriculture, pests, parasites and diseases, effects of pesticides used on crops, and adverse weather.

Honey bees are a major pollinator group providing essential pollination of crops to maintain yield and variety of food crops. Products of the bee hive: honey, wax, propolis, royal jelly, pollen. Honey bees face many threats, including: lack of forage and reduced diversity of forage owing to intensive agriculture, pests, parasites and diseases, effects of pesticides used on crops, and adverse weather.

**Importance of honey bees**

- Honey bees are a major pollinator group providing essential pollination of crops to maintain yield and variety of food crops.
- Products of the bee hive: honey, wax, propolis, royal jelly, pollen.
- Honey bees face many threats, including: lack of forage and reduced diversity of forage owing to intensive agriculture, pests, parasites and diseases, effects of pesticides used on crops, and adverse weather.

**Surveys in Scotland 2006–2017**

- We began surveys of beekeepers in 2006\(^{1}\)–\(^{2}\), to study beekeeping experience as a result of the Varroa mite moving north (Fig. 4):
  - Sampling design: initially a quota-type survey in 2006, subsequently geographically stratified random sampling of the membership of the Scottish Beekeepers Association (SBA).
  - In 2017 an online only survey of 1201 SBA members with a valid email address.
  - Survey sample sizes: 100 in 2006 rising to 400 in 2016.

**Winter loss rates internationally**

- Varying patterns of loss rates between countries and regions from year to year (Fig. 7)\(^{6,7,8}\).

**Monitoring colony losses**

- A huge amount of research worldwide was sparked by sudden unexplained large-scale colony losses in the USA in the winters 2006/7 and 2007/8, termed Colony Collapse Disorder (CCD)\(^{2}\) owing to rapid disappearance of most adult worker bees, leaving brood, queen and food stores.
- Lack of dead worker bees inside and near the hive, and with delayed invasion of hive pests and robbing of honey by nearby colonies.
- CCD has occurred elsewhere to a more limited extent\(^{2}\), and is now less common.
- Large losses in the past presented differently and were more readily explained.
- Honey bee colony losses routinely occur over winter particularly, but at a lower level.

**Ongoing work**

- Monitoring patterns and trends in loss rates.
- Risk factors include queen problems, CCD has occurred elsewhere.
- A huge amount of research worldwide was sparked by sudden unexplained large-scale colony losses in the USA in the winters 2006/7 and 2007/8, termed Colony Collapse Disorder (CCD)\(^{2}\) owing to rapid disappearance of most adult worker bees, leaving brood, queen and food stores.
- Lack of dead worker bees inside and near the hive, and with delayed invasion of hive pests and robbing of honey by nearby colonies.
- CCD has occurred elsewhere to a more limited extent\(^{2}\), and is now less common.
- Large losses in the past presented differently and were more readily explained.
- Honey bee colony losses routinely occur over winter particularly, but at a lower level.

**Monitoring colony losses**

- National monitoring of beekeeping experience and colony losses began in many countries.
- The COLOSS (Prevention of honey bee COlony LOSSes) honey bee research association was formed in 2008.
  - now involves 942 members from 97 countries (Fig. 3).
  - a core activity is monitoring colony losses and understanding risk factors.

**Winter losses in Scotland**

- Overall proportion of colonies lost varies (Fig. 6).

**References**