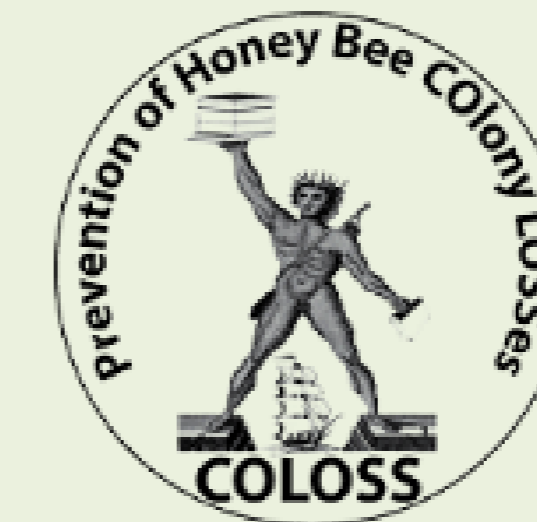


# Investigating Honey Bee Colony Losses from Surveys of Beekeepers



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## 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 beehive: 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.



Figure 1: A healthy honey bee colony

## 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<sup>1,2</sup> (Fig. 2)
- termed Colony Collapse Disorder (CCD)<sup>2</sup> 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



Figure 2: A lost colony at spring inspection ([www.coloss.org](http://www.coloss.org))

- CCD has occurred elsewhere to a more limited extent<sup>3</sup>, 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.

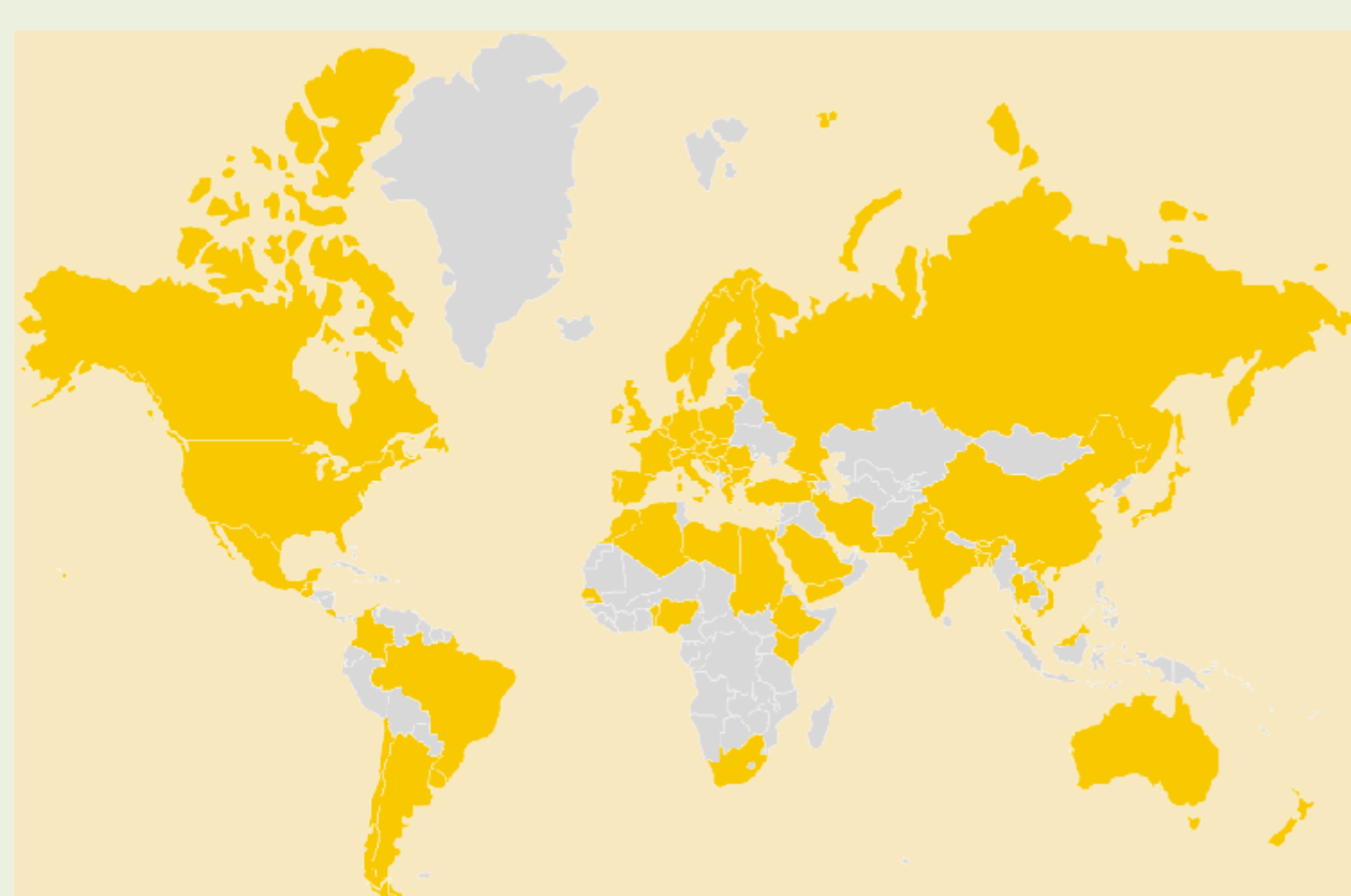


Figure 3: Global reach of COLOSS ([www.coloss.org](http://www.coloss.org))

## Surveys in Scotland 2006-2017

- We began surveys of beekeepers in 2006<sup>4,5</sup>, to study beekeeping experience as a result of the *Varroa* mite moving north (Fig. 4):



Figure 4: *Varroa* mite, and on a honey bee ([http://entnemdept.ufl.edu/creatures/misc/bees/varroa\\_mite.htm](http://entnemdept.ufl.edu/creatures/misc/bees/varroa_mite.htm))

- Sampling design: initially a quota-type survey in 2006, subsequently geographically stratified random sampling of the membership of the Scottish Beekeepers Association (SBA)
- Survey mode: postal surveys 2008-2012, then mixed online/postal survey till 2016
- 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
- Response rates: 77% in 2006, about 45% postal only, 60-65% online/postal, 42% in 2017.

## Beekeeper profile in Scotland

- A typical beekeeper is male, aged 60+, has 1 apiary, 3 colonies of local hybrid bees and 5 years experience (Fig. 5)

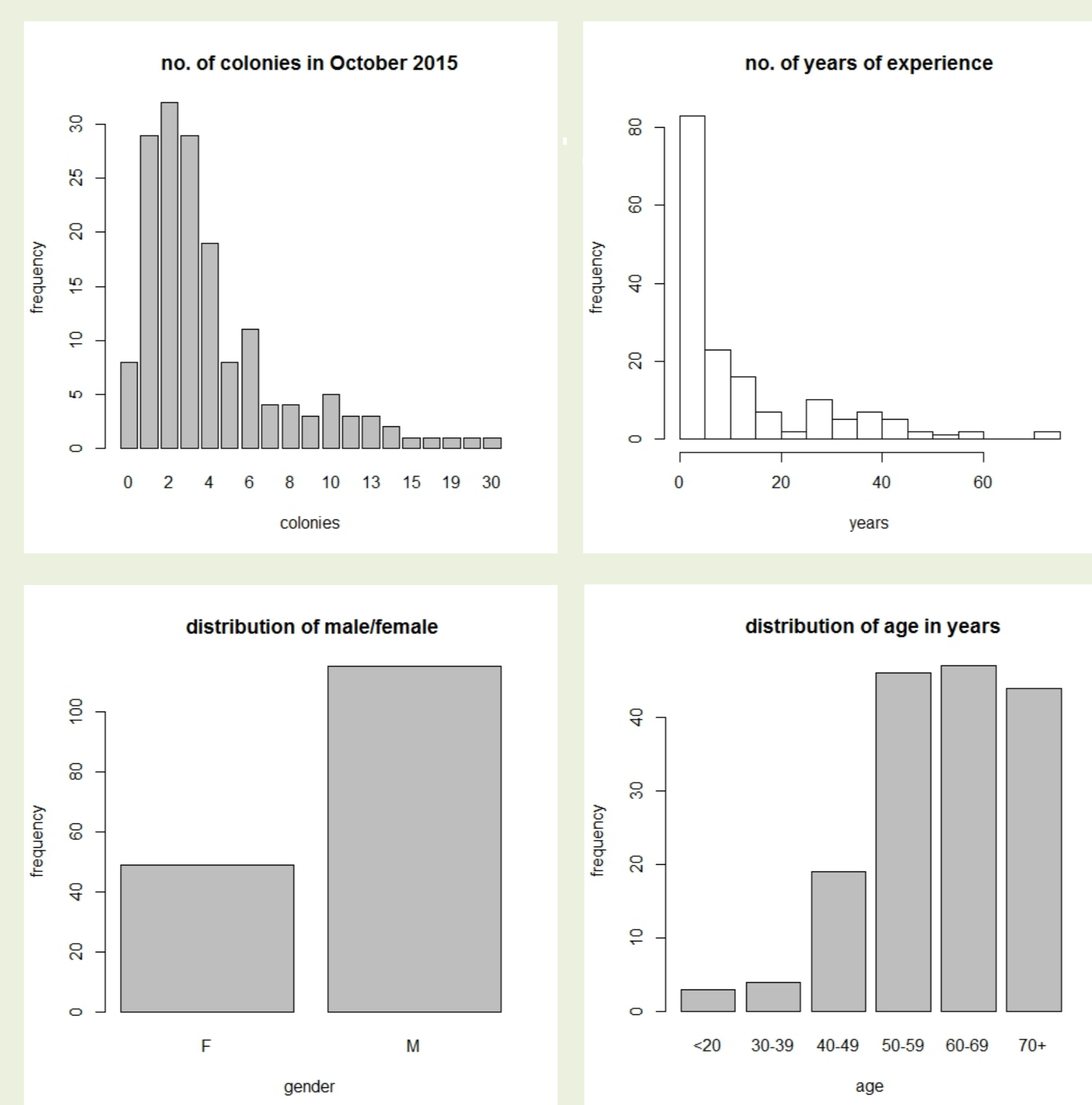


Figure 5: Some results from the 2016 survey (165 beekeepers)

## Winter losses in Scotland

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

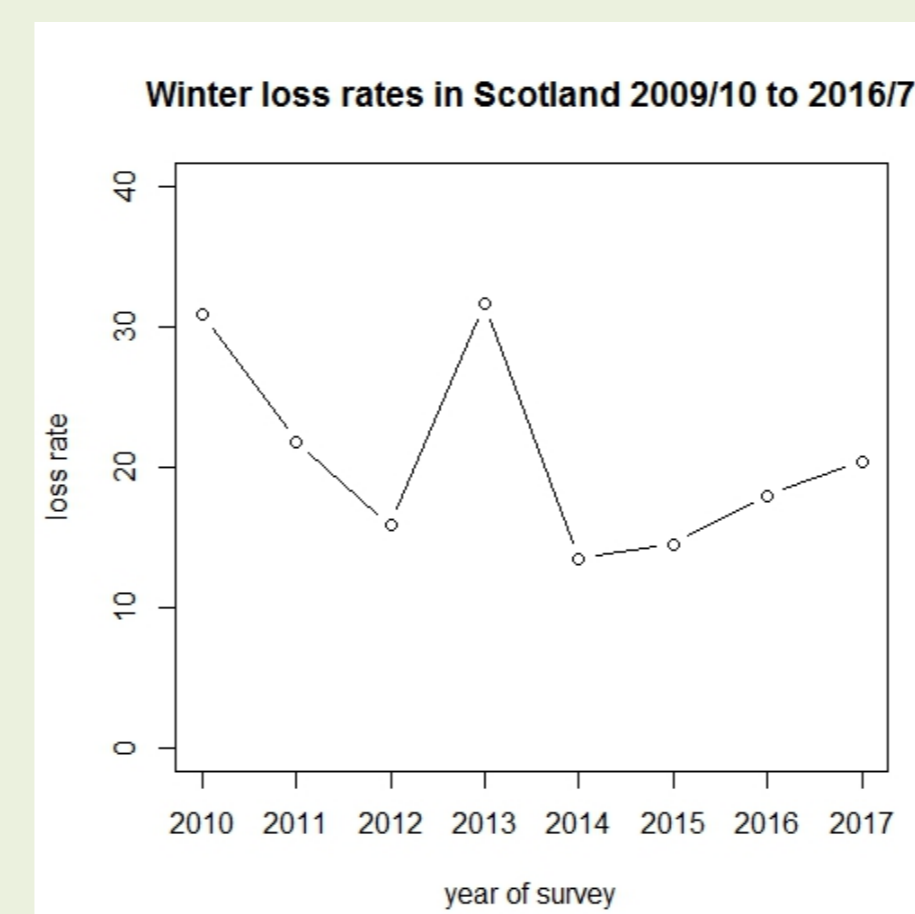


Figure 6: Winter loss rates in Scotland

## Winter loss rates internationally

- Varying patterns of loss rates between countries and regions from year to year (Fig. 7)<sup>6,7,8</sup>

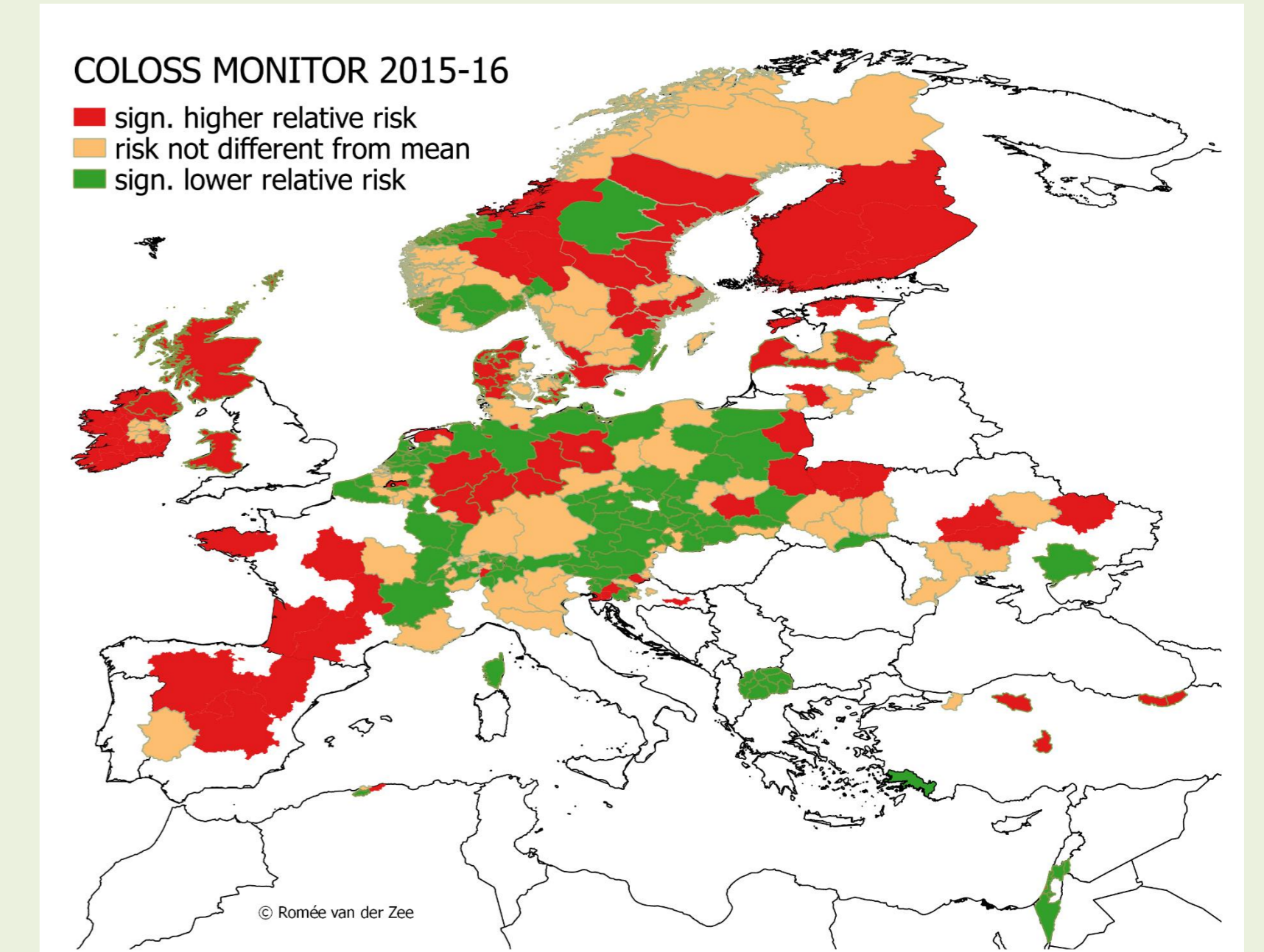
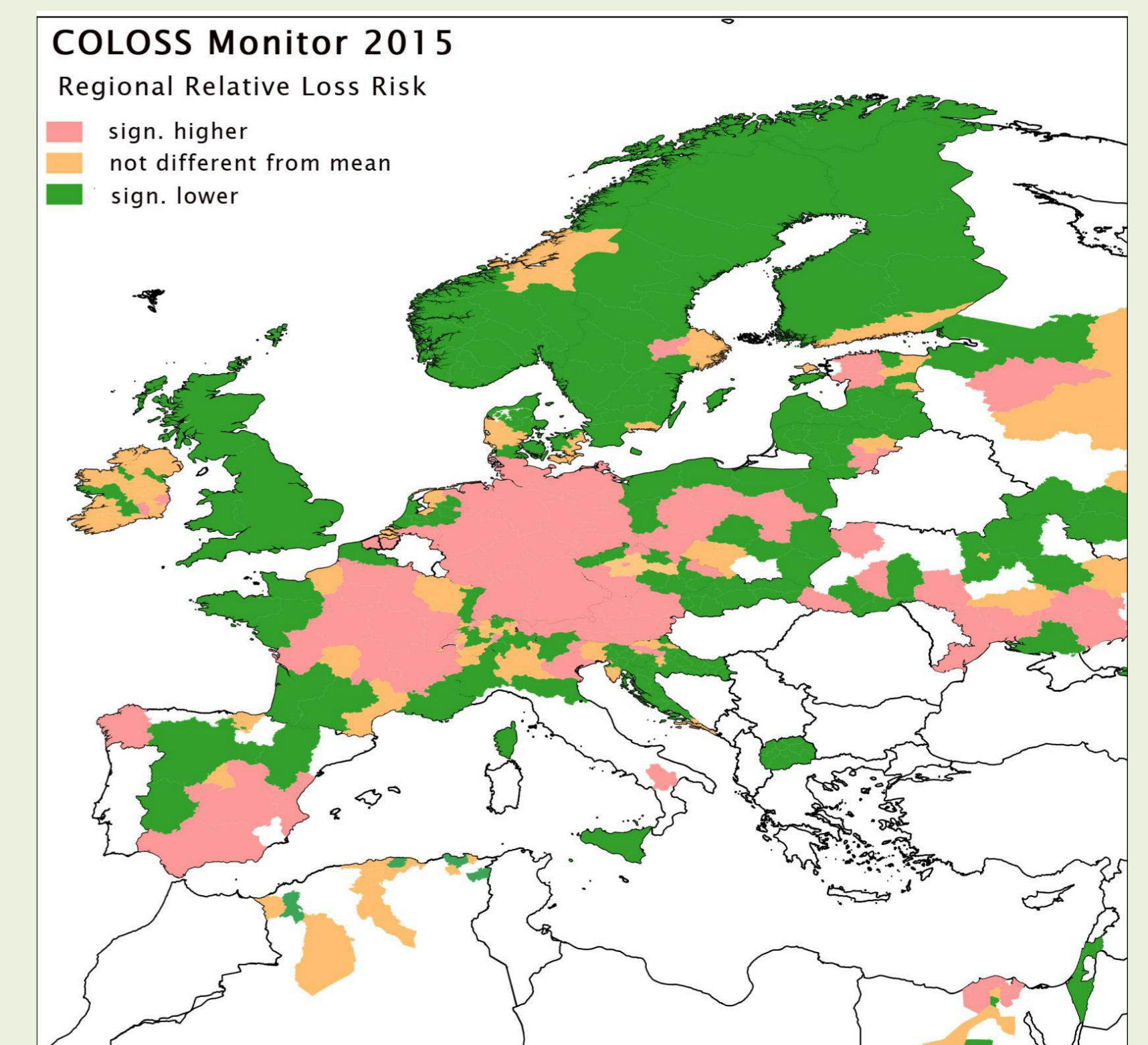
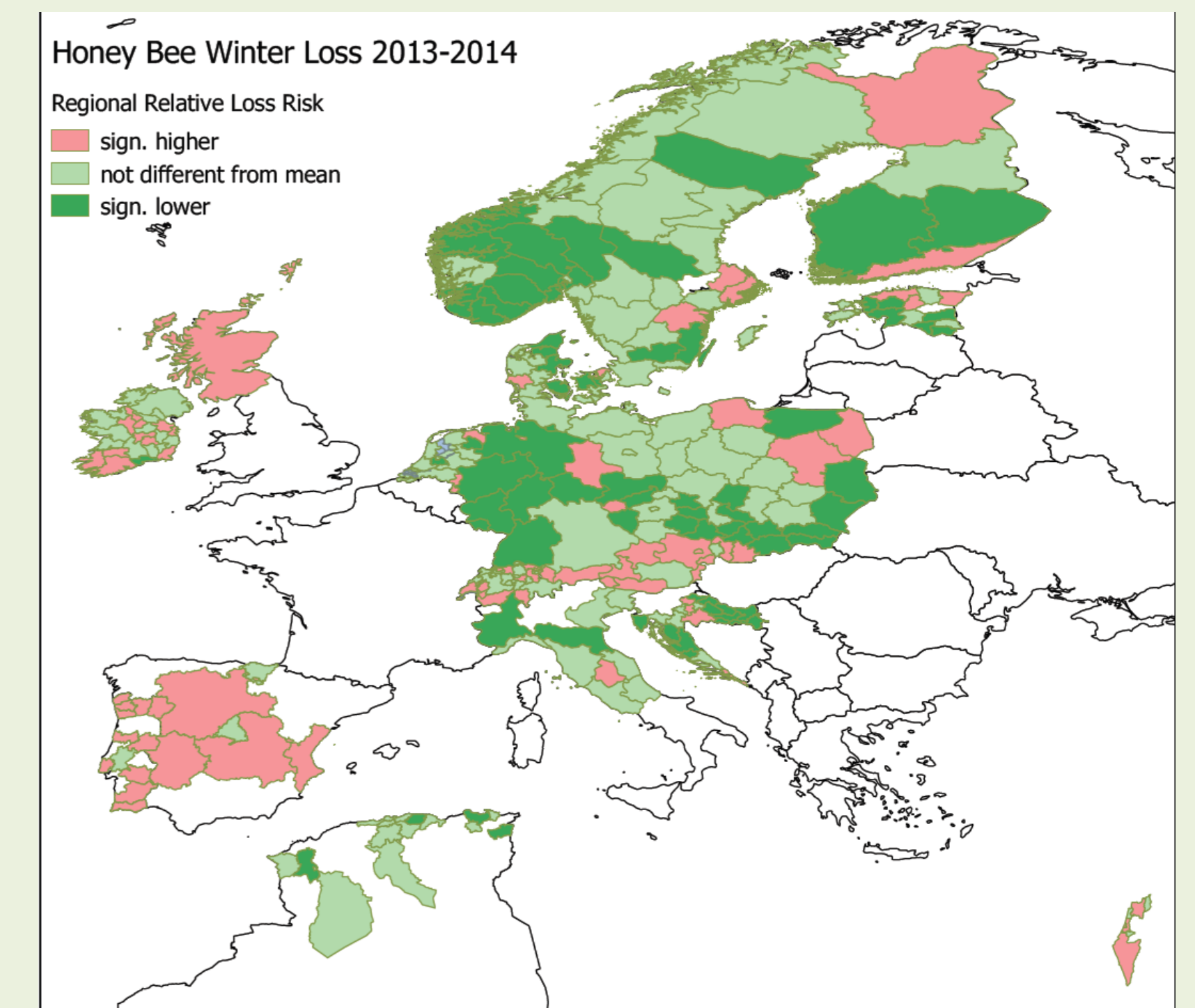


Figure 7: Some results from the COLOSS monitoring group

## Ongoing work

- Monitoring patterns and trends in loss rates
- Risk factors include queen problems, *Varroa* treatment strategy, forage availability and pesticides<sup>7,9</sup>
- Current work is identifying the role of temperature and rainfall levels at critical times of year using generalised linear mixed models (GLMMs) for the risk of colony loss.

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