# Population Genetics of Farmland Sawflies


Cook, N.[1,2]; Karley, A.J.[1]; Russell, J.R.[1]; Parish, D.[3]; Hubbard, S.F.[1,2]

[1]Environment Plant Interactions, Scottish Crop Research Institute, Invergowrie, Dundee, DD2 5DA

[2]Division of Plant Sciences, University of Dundee at SCRI, Invergowrie, Dundee, DD2 5DA

[3]Game and Wildlife Conservation Trust, 2 East Adamston Farm Cottages, Muirhead, By Dundee, DD2 5QX


**Figure 1**: A Grey Partridge (*Perdix perdix*) male. A UK Biodiversity Action Plan (BAP) "priority species".

**Figure 2**: The Yellowhammer (*Emberiza citrinella*). Also a BAP priority species.

**Figure 3**: A common farmland sawfly larva. Unknown species. Symphytan larvae are similar in appearance to the larvae of lepidopterans but distinguished by the presence of 6 or more pairs of abdominal pro-legs.

Over the last 50 years or so populations of certain farmland bird species have undergone severe declines. Among the key indicator species are Grey Partridges (Fig. 1), Yellowhammers (Fig. 2) and Corn Buntings. The population declines of these species are generally attributed to "farming intensification". One of the possible effects of intensive farming prescriptions could be that they affect the supply of insect food to bird populations at critical points in their breeding cycle[1].

It has been suggested that a key component of the fledgling diet may be the larvae of grassland sawflies *(Hymenoptera, Symphyta)* (Fig. 3), and that intensification has reduced the numbers of these insects to the extent that they limit the population size of bird species that depend on them[2].

Sawfly populations may be more than usually susceptible to disturbance by farming practices for a number of reasons. Firstly their adult stages are poor dispersers and secondly some species are known to possess single locus Complementary Sex Determination (sl-CSD)[3]. In combination these characteristics might produce an abundance of sterile males as a result of inbreeding and therefore play an important part in the population decline.

**sl-CSD:**

In addition to the haplodiploid sex-determining mechanism characteristic of all hymenopteran insects, some species also possess single-locus Complementary Sex Determination (sl-CSD). When sl-CSD is also present the sex of an individual is not only dependant upon ploidy (haploid male, diploid female) but on the allelic composition at a single sex determining gene locus. Hemizygotes (haploid individuals) develop as normal males. Heterozygotes at the locus develop as normal diploid females but homozygotes at the locus develop as sterile diploid males.

## Materials & Methods

If poor dispersal rates and sl-CSD are present in farmland sawfly populations it should be possible to detect their presence through patterns of genetic variation within and between sawfly populations at a range of spatial scales, and from both intensive and non-intensive farms.

Sawflies are only present in the winged (adult) form from April to August in Scotland therefore all insects for study must be obtained during this period. Sawflies are being collected in grass margin/set-aside land at 3 contrasting farm sites via the use of malaise traps (Fig. 4). Traps are collected from on a weekly basis and the trap is then moved to a new random position within its sampling area for the following week.

**Figure 4**: A standard malaise trap. The trap is of a neutral colour and is open-sided. Insects are directed upwards by the shape of the structure into the ethanol-filled collection bottle.

Genetic variation will be quantified by the development of microsatellite markers, and the presence/absence of sl-CSD will be determined by flowcytometric analysis of neuronal cell DNA content.

## Results

Microsatellite markers for the common British farmland sawfly species *Tenthredopsis nassata* (Fig. 5) and *Tenthredopsis excisa* are in development. Once the markers are fully developed we will be able to compare genetic diversity between sampling sites and relate this to the environmental factors prevailing at each site. We should also be able to determine the extent to which sawflies are moving around in the farmland habitat.

The first indicator that sl-CSD is present in a field population is a male-biased sex ratio. For all sampling sites in 2009 the ratio of males to females was significantly higher for both *T. nassata* (Fig. 6) and *T.excisa* (Fig. 7). Flow Cytometry will be used to definitively confirm or deny the presence of sl-CSD in these populations.

**Figure 5** : *Tenthredopsis nassata*. A common British farmland sawfly.

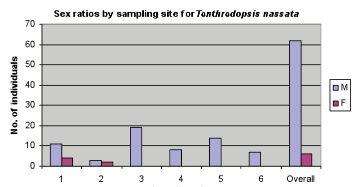


**Figure 6**: Chart showing the sex ratios at all six collection sites (2009) for *T. nassata* and the overall sex ratio.

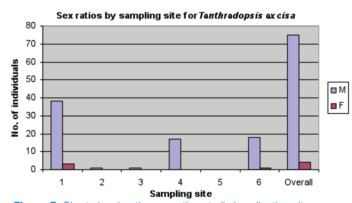


**Figure 7**: Chart showing the sex ratios at all six collection sites (2009) for *T. excisa* and the overall sex ratio.

## References


1 Chamberlain, *et al*. (2000). "Changes in the abundance of farmland birds in relation to the timing of agricultural intensification in England and Wales." Journal of Applied Ecology **37**: 771-788.

2 Potts, G. R. (1986). The Partridge. Pesticides, predation and conservation. Collins; London; UK.

3 van Wilgenburg, *et al*. (2006). "Single locus complementary sex determination in Hymenoptera: an "unintelligent" design?" Frontiers in Zoology **3**(1).