

Hylobius Industry Research Programme (HIRP) Conference



7th April

Birnam Arts Centre, Birnam,
Dunkeld, PH8 0DS

SBRI (Small Business Research Initiative (SBRI) competition): finding a solution to *Hylobius abietis* in Scottish forestry

- Aim to achieve cost effective establishment of young forest trees in Scotland by reducing mortality from damage caused by large pine weevil *Hylobius abietis*.
- Technical and Commercial Consortium formed to participate in the CAN DO Innovation Challenge Fund Initiative

Forest Research (FR)



- FR is the Research Agency of the Forestry Commission
- UK's principal organisation for forestry and tree-related research.
- Internationally renowned for provision of science, research, evidence, data and services in support of sustainable forestry.
- Senior Entomologist Roger Moore's research has led to the development of two key strategies to help the forest industry combat *Hylobius*: the fallow strategy (2001) and the *Hylobius* Management Support System HMSS (2009)

The Natural Resources Institute of the University of Greenwich (NRI)



- NRI is a specialist research, development and education organisation of the University of Greenwich, UK.
- Prof David Hall has over 45 years' experience in the isolation, identification, synthesis, formulation and field application of insect semiochemicals and other natural products for monitoring and controlling pests and diseases of crops, livestock and humans.

Sentomol



- Sentomol is a UK-based SME specialising in the supply of pheromone monitoring and trapping solutions in horticulture and pest control for over 10 years
- Owner David Loughlin has a 30-year heritage in pest management from agrochemicals to semiochemicals
- Sentomol has established a position as a supplier of novel solutions in niche markets such as traps for horseflies to protect horses and biological control solutions to protect heritage properties and museums from clothes moths.



Hylopod™ System:

Hylobius Monitoring & Control

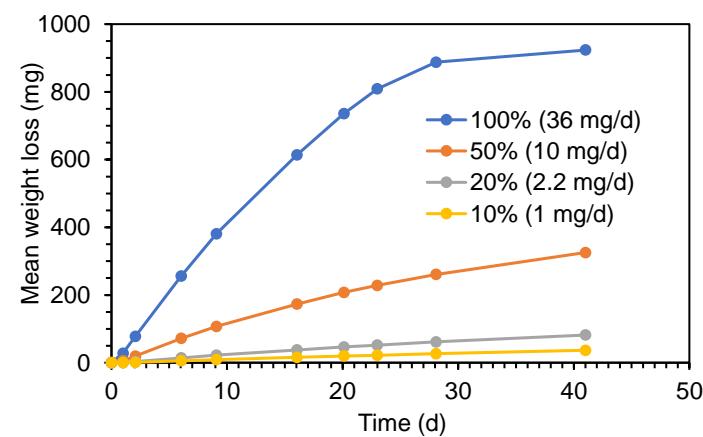
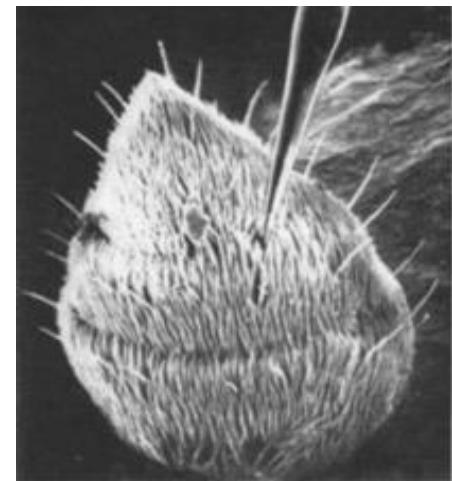
Introducing the Hylopod approach

- The Hylopod system offers an entirely new approach to the integrated **monitoring** and **control** of *Hylobius abietis*, Large Pine Weevil.
- It is a complete **population management system** offering flexible site-specific monitoring of *Hylobius* risk, site management decision support, site outbreak control for local and forest-wide population reduction.
- It links with the existing HMSS
- It is a system of component parts that offers a range of continually evolving solutions and tools and provides a platform for emerging biocontrol agents



The Hylopod Lure

- The Hylopod Lure is a unique blend of chemicals identified from host plants that is highly attractive to *Hylobius*
- Laboratory analysis involved collection of volatiles, gas chromatography linked to mass spectrometry and electro-physiology using probes placed in weevil antennae to detect responses
- Dispensers have been developed to deliver the required period of attraction in the field at the optimum release rate



The Hylopod Monitoring Trap

Hylopod M

- Robust monitoring tool to replace billets which are heavy, costly, and their attractiveness is short-lived
- The Hylopod M attracts and retains weevils for manual counting and verification

Hylopod RS:

- Remote sensing trap sends images of captured weevils to central facility for analysis and verification
- Developed with Censis - Scotland's Innovation Centre for sensing, imaging and Internet of Things (IoT) technologies



Remote Sensing Monitoring

Not new, and evolving rapidly.

There are many systems now being developed for remote monitoring of insect pests.

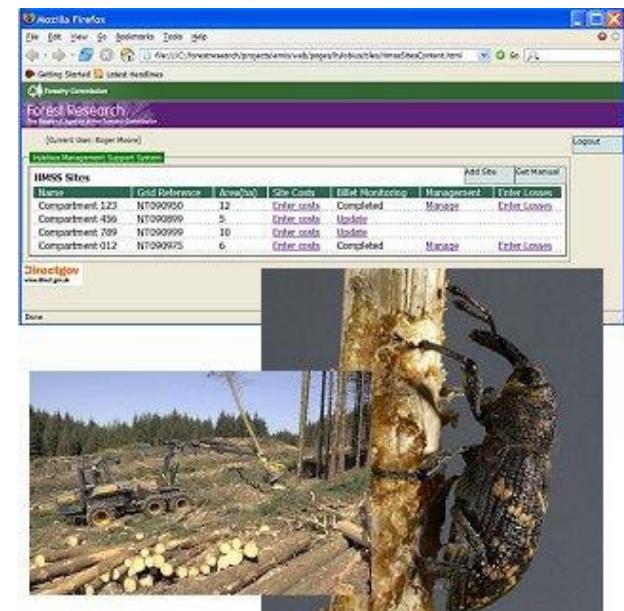


Not all have become established in the market.

Some are now available globally.

Integrating with the HMSS

- Established decision support system to help foresters predict and reduce damage and costs due to *Hylobius*
- Helps foresters plan future clearfell restocking strategies to minimise transplant damage by *Hylobius*
- Avoids unnecessary insecticide use and initial restock failure
- Reduces top-up insecticide applications and beating up of destroyed transplants
- Satisfies requirements of Forest Stewardship Council (FSC) & UK Woodland Assurance Standard (UKWAS)
- HMSS updates will be available shortly to increase functionality



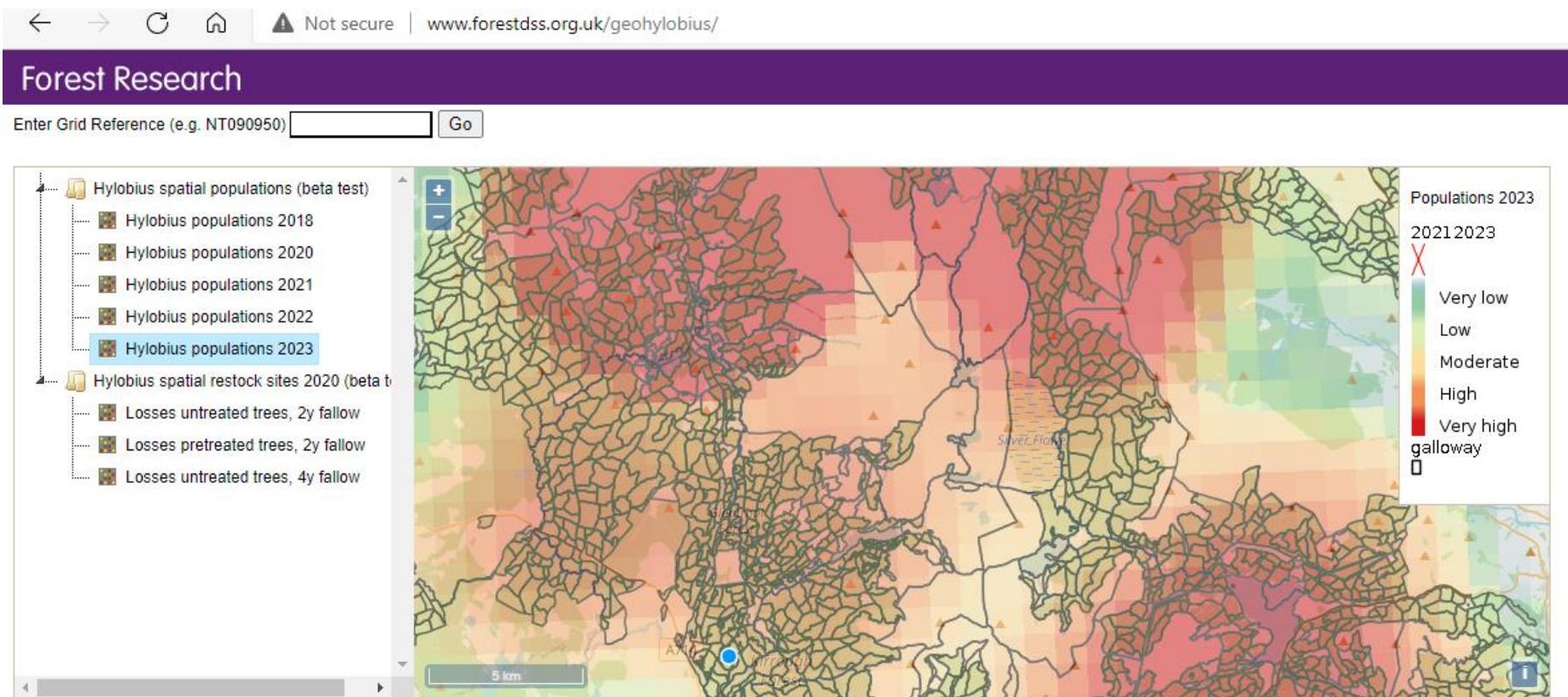
Data Interpretation - **Hylobius Management Support System (HMSS)**

- Hylopod M and RS traps both provide *Hylobius* count and site data that integrates directly with the HMSS.
- The HMSS predicts damage to transplants on clearfells in pre- and post- restocking (5 week monitoring period).
- The Hylopod RS can provide a longer period of weevil trapping and detection if required.
- Regular monitoring enables ‘reactive’ short-term management but is of limited use for planning long-term site management without HMSS



Data Interpretation - *Hylobius* Management Support System (HMSS)

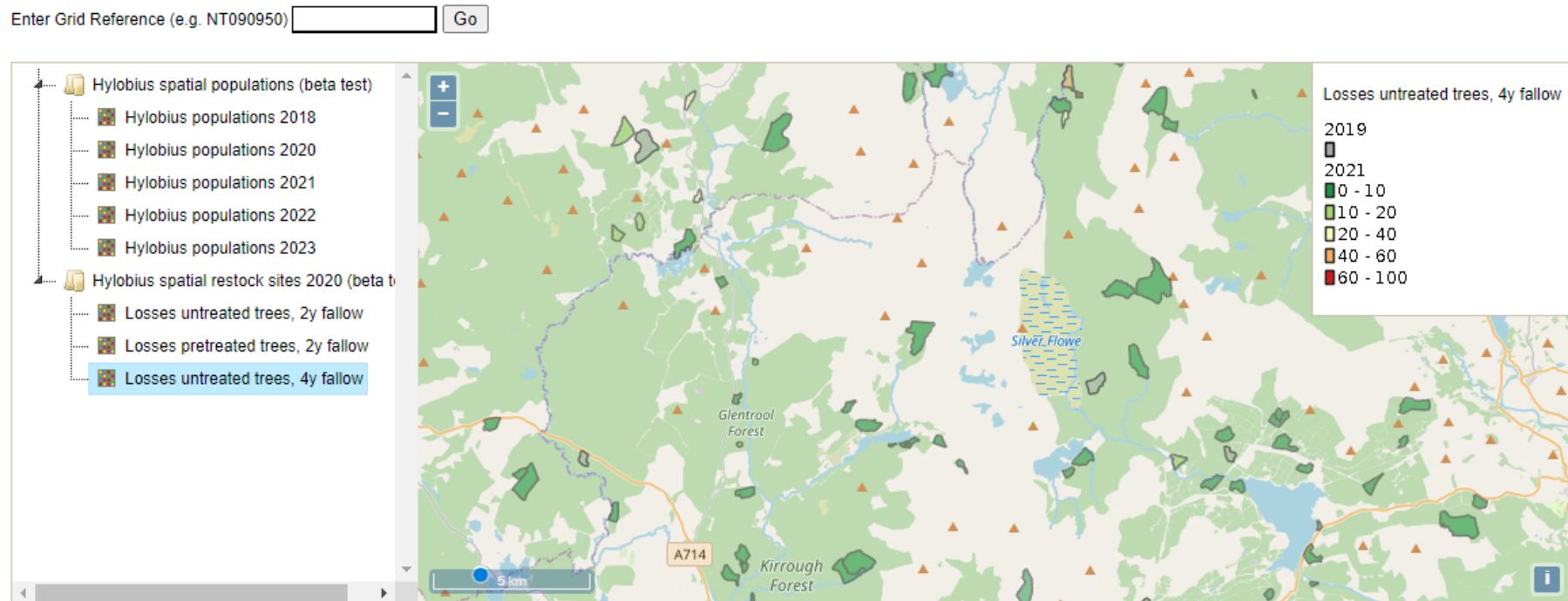
- Hylopod™ data (manual or remotely sensed) uploaded to HMSS via storage/mobile/API
- Counts converted to population density, predicted into the future using pre-existing HMSS models and mapped (Scale: site or forest-wide)



Data Interpretation - *Hylobius* Management Support System (HMSS)

- *Hylobius* population density auto- converted to predicted future restock losses
- Interactively investigate the site-specific '*Hylobius* risk' associated with different future restock strategy
- Key outputs from HMSS can be exported to planning tools

Forest Research





Hylobius Biocontrol in Forestry: Evolution

Traditional Application of Nematodes

- Entomopathogenic nematodes are commercially-available biocontrol agents
- Targeted at larval population of *Hylobius* found around stumps
- Many problems and limitations
- Steep slopes, soft ground, old brash mats do not support the rig
- Large volume of water, block size
- Less effective on sites in north



Hylopod™ System: Lure and Kill with Biocontrol

- Adult *Hylobius* weevils are attracted to discrete mini-pods where they are infected by nematodes
- Infected weevils are free to leave the mini-pods to infect other weevils on site before dying
- Reduced weevil mating, lower egg and larvae numbers then drive down the next generation
- Current studies using commercially-available nematodes which do not require registration
- Demonstrated entomopathogenic nematodes and fungi can kill *Hylobius* and can be distributed with the Hylopod system
- Fungi will require registration



Hylopod™ System: Lure and Kill with Biocontrol

- Mini-pod delivery units containing the biological agent are distributed throughout a clearfell site
- Combined with a small number of Hylopod RS units as dual-function biocontrol delivery and monitoring devices, providing a measure of insect visits to treatment stations.



Achievements

- Compounds from Scots pine and Sitka spruce that are attractive to *Hylobius* have been identified and an artificial blend produced
- Controlled release dispensers for the blend have been developed that are more attractive than twigs, last for > 2 months in the field, and can catch as many *Hylobius* as the standard billet trap
- Catches in **Hylopod™ system** traps give good *Hylobius* captures when used in **monitoring mode** and even better in **lure-and-kill mode**
- **Hylopod system** catches very low numbers of non-target invertebrates
- *Hylobius* counts can be integrated with HMSS for site-specific advice from time of monitoring to 5 years post monitoring
- Formulations of entomopathogenic nematodes and fungi gave high weevil mortality in laboratory
- Ability of **both** to infect adult weevils in the field demonstrated
- Nematode field infections of adults have been delivered via the **Hylopod™ system**.

The Project Team



Steven Harte (NRI), Daniel Bray (NRI), David Loughlin (Sentomol), Roger Moore (FR), David Hall (NRI),
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