Forestry Commission
231 Corstorphine Road
Edinburgh
EH12 7AT
www.forestry.gov.uk

Managing the threat to restocking posed by the large pine weevil, *Hylobius abietis*: The importance of time of felling of spruce stands

INFORMATION NOTE

BY ROGER MOORE OF FOREST RESEARCH

AUGUST 2004

SUMMARY

This Note advises forest managers of the importance of recording the time of felling of spruce (and possibly pine) crops in order to improve the management of the large pine weevil, *Hylobius abietis*, on restocking sites. This information is important for improving the efficiency of insecticide use, identifying suitable sites for biological control operations, determining the length of fallow periods to avoid damage, and implementation of a new *Hylobius* Management Support System (*Hylobius* MSS).

BACKGROUND

Research on *Hylobius* is currently progressing rapidly towards development of an integrated management system for control of the insect and its associated damage to transplanted trees. Our understanding of *Hylobius* population dynamics over a period of six years from the time of clearfelling is now detailed enough to begin building and testing decision support systems for management of this important pest. Our studies suggest that the seasonal timing of felling is the most significant factor driving both the colonisation of sites by *Hylobius* and egg-laying in stumps by adult females. Eggs are laid from April through to mid-August (immediately following colonisation) and, depending on the time of felling, this can occur in the year of felling, the following year, or both (Table 1).

Development of immature *Hylobius* in the stumps starts immediately after eggs are laid and hence the size of larvae and developmental stage of the weevil is strongly affected by time elapsed since egg-laying. A good knowledge of felling date makes it possible to predict the growth of immature *Hylobius* in the stumps and also to forecast the timing of adult emergence and subsequent damage to young transplanted trees in the vicinity. This makes it vitally important that managers record the date of felling because weevil growth stage and timing of emergence are crucial factors in choosing an appropriate management strategy.

Table 1

The influence that time of felling has on the main period (year) of colonisation and egg-laying by adult *Hylobius*.

Felling period	Site colonisation and egg-laying in stumps
January–March	Year of felling*
April–Mid-August	Year of felling + year following felling
Mid-August–December	Year following felling

*Year of felling = calendar year

In short, time of felling and its affect on egg-laying influence the development of the insect and dictates the timing of emergence and therefore the timing of the peaks of damage.

MANAGEMENT OF *HYLOBIUS* IN TIME AND SPACE

It is possible to exploit this knowledge by mapping the chronology of felling in both time and space as a basis for predicting when and where emergence and hence damage by *Hylobius* are most likely to occur. Such mapping will improve targeting of top-up applications of insecticides. It will also enable areas to be identified where development of *Hylobius* immature stages has progressed to the point where they are most susceptible to biological control treatments using nematode worms that kill weevils in the stumps.

There also tends to be a fixed number of damaging peaks of *Hylobius* emergence on a particular site in the period after felling. Consequently, the date of felling is also important in determining the length of fallow periods where sites can be left unplanted long enough to allow the *Hylobius* population and hence damage levels to decline naturally (Heritage and Moore, 2000). Mapping the temporal and spatial sequence of felling will give the option of using fallow periods as a management strategy.

Indeed, knowing the time of felling accurately (to the nearest month) can make a year's difference in the advice given about the length of time (fallow) before a site no longer presents a high risk of generating damagingly high numbers of weevils (Figure 1).

CLEARFELL SITE MAPPING

There are three ways of mapping clearfell sites to record felling dates:

(1) 'real time' continuous monitoring of sites by installing a global positioning system (GPS) in a forest harvester;

(2) monitoring felling periodically using a hand-held GPS;

(3) monitoring felling periodically by marking the extent of felling on a 1:10 000 map.

(1) and (2) have the advantage that information can be more easily transferred to a geographical information system (GIS) such as the 'Forester' system currently used for Forestry Commission forests. (2) and (3) can be started very quickly, with little additional expenditure.

MAPPING OF FELLING PERIODS

Table 1 shows that there are three groupings of continuous felling periods that influence site colonisation and hence egg laying each year. However, as the recording of felling will be a continuous forest management process, crossing over between years, the extent of felling will only need to be recorded on two occasions each year.

- At the end of March each year (31/3)
  Map the extent of all clearfell/clearfelled sites (or parts of these sites) where felling has taken place since the mid-August mapping of the previous calendar year. Label this area with the mid-August to end of March dates and both calendar years.

- In Mid-August each year (15/8)
  Map the extent of all clearfell/clearfelled sites (or parts of these sites) where felling has taken place since the end of March mapping of the same calendar year. Label this area with the end of March to mid-August date and the calendar year when all of this felling has taken place.

WHY START MAPPING NOW?

This note is designed as a forerunner to an integrated management system that is in a late stage of development by Forest Research – the *Hylobius* Management Support System (*Hylobius* MSS). The MSS will include an option for the use of nematodes for biological control to reduce weevil populations in stumps. The MSS will take account of, and extend, many of the 'site specific' elements of risk management already outlined in Forestry Commission Information Note 38. The *Hylobius* MSS is currently under trial in selected forests and these trials have emphasised the importance of information on felling date and how difficult these data are to obtain retrospectively in many working forest management units. Beginning to map the time of felling now will enable a faster take-up of the MSS as it becomes more widely available. This is due to a time delay of $1^{1}/_{4}$ to $2\ ^{1}/_{2}$ years (the *Hylobius* development period from egg to adult) between starting to record felling dates on clearfell sites and being able to use the information for improved site management against the threat of damage by *Hylobius*.

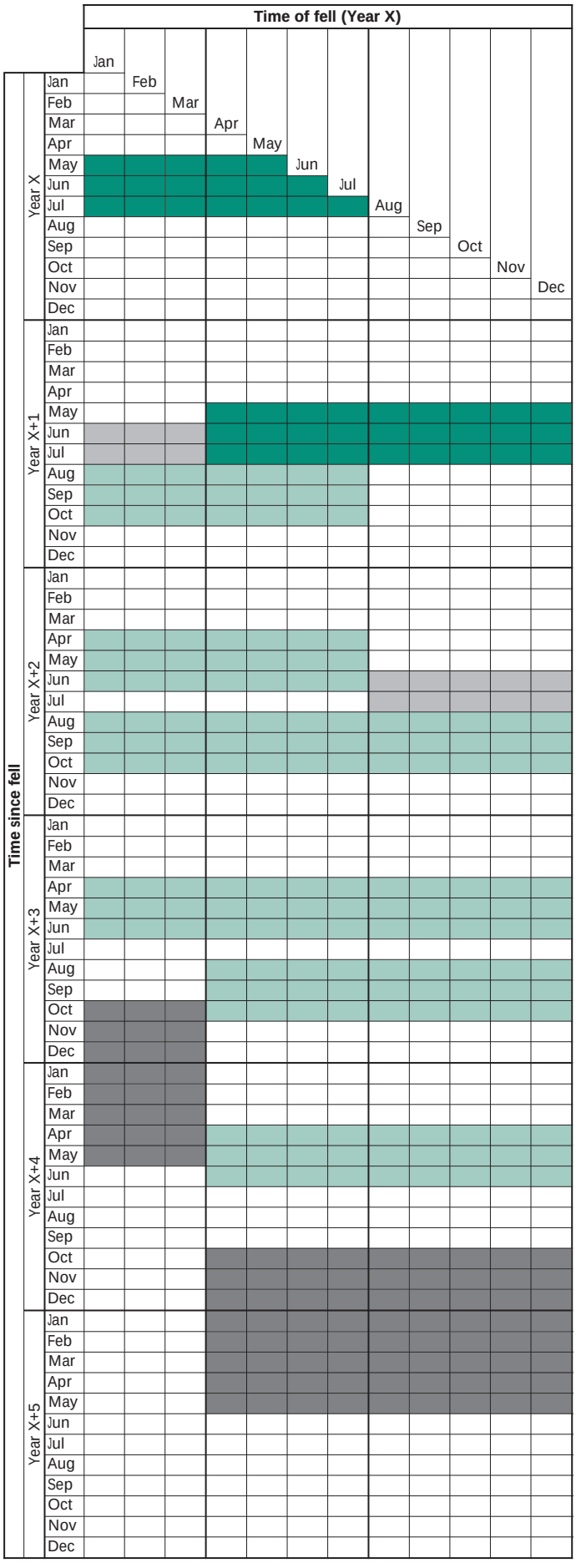
IMMEDIATE BENEFITS OF MAPPING

Forest managers who start recording felling dates now will be better placed to predict the timing of damage peaks (Figure 1: light and dark green shaded blocks) and this will allow more efficient and effective use of insecticides against *Hylobius*. In addition, they will be better able to pinpoint the optimal timing and targeting of nematode treatments (Figure 1: light grey shaded blocks), when this method of biological control becomes more widely available. There are also implications for fallow strategies when forest managers know felling times and have identified sites where a fallow period is the preferred option (Figure 1: dark grey shaded blocks).

Spring and autumn damage peaks generally start in April and August, respectively, so insecticide top-ups should be applied just before these peaks occur. Where sites are to be left fallow it is recommended that they should still be planted-up with treated trees, but no top-ups should be required. As experience of leaving sites fallow grows within a particular forest area, it may be possible to plant untreated trees after these time periods or to plant treated trees a year earlier. If nematodes are being used to reduce *Hylobius* populations/damage they should be applied during the time period highlighted in light grey (Figure 1).

Figure 1 shows the timing of the major *Hylobius abietis* population events occurring on clearfelled spruce sites (colonisation/egg-laying, emergence and damage) and recommended timings for management (top-ups to protect early plantings, nematode applications and planting without top-ups for later plantings).

Figure 1



How to use Figure 1

- Determine which of the three groups of felling dates from Table 1 (January–March, April–mid-August*, or mid-August–December**) the clearfell (or parts of clearfell) fall into.
- Read down the columns (under 'Time of Fell (Year X)') associated with these groups of felling dates to determine the year(s) and month(s) (under 'Time since Fell') when the major population events are most likely to occur and when management practices should be carried out (if required).

Key

Colonisation and egg-laying by adult 'parent' *Hylobius abietis* (and timing of damage if sites replanted, i.e. 'hot-planted')

Emergence and major damage by *Hylobius abietis* (if trees are planted, protect prior to emergence)

Optimum timing of nematode application

Proposed planting dates (plant with treated trees but no top-ups normally required). Fallow period is represented by period from 'Time of Fell (Year X)' to the time of planting (dark grey shaded area).

April to July fellings

For areas felled between April and July it is not possible to be exactly sure when colonisation and hence emergence take place. These areas can show characteristics of both January–March felled areas and/or August–December felled areas. Consequently, all 'potential' periods of colonisation and emergence are shown. The optimum timing of nematode applications on April–July felled sites must be determined by examination of development stage of *Hylobius* larvae in the stumps.

* For the purpose of this Figure: clearfells with felling dates between early and mid-August will follow the same pattern of population events and management as a clearfelling in July.

** Clearfells with felling dates from mid to end of August will follow the same pattern of population events and management as clearfells felled in August in this Figure.

RECOMMENDED ACTION

- Choose one of the three methods of monitoring time of felling outlined in the 'Clearfell Site Mapping' section.
- Map the extent of all additional areas of clearfell and clearfelled sites (since last mapping period) in your district on 31 March and 15 August each year as outlined in 'Mapping of Felling Periods' section.
- Archive the data.
- Use the fell dates and Figure 1 to plan management of felled areas to reduce damage by *Hylobius*.

CURRENT AND FUTURE DEVELOPMENTS

Trials of the new decision support system for forest managers called the *Hylobius* Management Support System (*Hylobius* MSS) started in 2003 in three Forest Districts (one in each of England, Scotland and Wales). The aim of the system is to provide 'site-specific' damage forecasts in advance of restocking and to provide advice on the need for and likely effectiveness of other *Hylobius* control techniques. These initial trials of the *Hylobius* MSS have been encouraging in terms of being able to predict levels of transplant damage into the future and have highlighted the importance of accurate recording of felling dates. Hence the need for publication of the information contained in this Note to enable forest managers to take advantage of this tool for improved management of the *Hylobius* threat in the expectation that these trials will be successful.

REFERENCE

HERITAGE, S. AND MOORE, R. (2000)
The assessment of site characteristics as part of a management strategy to reduce damage by Hylobius.
Forestry Commission Information Note 38.
Forestry Commission, Edinburgh.

Enquiries relating to this publication should be addressed to:

Dr Roger Moore
Tree Health Division
Forest Research
Northern Research Station
Roslin
Midlothian
EH25 9SY

Tel: 0131 445 2176
Fax: 0131 445 5124

Email: roger.moore@forestry.gsi.gov.uk

ISSN 1460-3802
ISBN 0-85538-636-3

FCIN061/FG(KMA)/NVSPT-1.5K/AUG04