

Report on New Zealand Flatworm study conducted at Slopefield Allotments in 2016

Summary of Findings

Brought into the UK in the 1960s, the New Zealand Flatworm exclusively eats earthworms. Earthworms are essential for good soil quality and the food chain. New Zealand Flatworms are between 5-15cm long, flat with a dark brown topside and a creamy pale underside and edge, and are often found curled up like a Swiss roll. They are pointed at both ends and covered in sticky mucus, trails of which are left wherever they have been.

In the spring of 2016, with the generous help of allotment holders at Slopefield, a study was made of the presence and abundance of New Zealand Flatworms and earthworms and the factors influencing these.



Key findings

- New Zealand Flatworms were widespread across Slopefield allotment – present in 90% of plots sampled.
- The greatest numbers of New Zealand Flatworms were found where plots were ‘cluttered’. Plots with areas of soil covered in plastic, carpet and weed control fabric had the highest numbers of New Zealand Flatworms underneath them. These coverings act as refuge (daytime shelters for the flatworm as they are prone to drying out).
- Earthworm numbers sampled were low across Slopefield, with the exception of a few plots, in line with questionnaire responses. Furthermore, 41% of respondents said that earthworm numbers had decreased since they had taken on their plots and 41% said they had stayed the same.

Recommendations

- Awareness raising is extremely important. New plot holders should be provided with information on New Zealand Flatworm in their joining packs, including what they look like, so they can keep an eye out for them. This will help control efforts and minimise numbers at the allotment, but most importantly reduce the risk of transfer of the New Zealand Flatworm (adults, juveniles or eggs) from allotments to home gardens or elsewhere via plant material or soil.
- Removal of clutter from plots can help minimise areas of shelters for the New Zealand Flatworms to hide under.
- Temporary traps using weighted plastic can, however, be useful if one wishes to carry out control. In that case, systematic checking of the traps and control needs to be carried out regularly (otherwise the traps would help the flatworms rather than hinder). Control needs to be carried out over an extended period.
- Any conditions which make the soil more suitable for earthworms will help tip the balance in their favour, e.g. incorporating organic matter into soil will benefit earthworm populations.
- Further information about New Zealand Flatworm and advice for gardeners on minimising the impact of New Zealand Flatworms can be found on the OPAL website: www.opalexplornature.org/nzflatworm. This website can also be used to leave observations, such as observed changes in abundance of flatworms or earthworms in one’s plot, or changes related to action taken.

For comments or further information please contact:

Annie Robinson annierobinson@abdn.ac.uk or René van der Wal r.vanderwal@abdn.ac.uk

Full report on New Zealand Flatworm study conducted at Slopefield Allotments in 2016

Visits were made by members of Aberdeen University to Slopefield allotments in the spring of 2016 and questionnaires were distributed. Sampling took place in 26 full-sized plots and 5 half-sized plots, and 25 people responded to the questionnaire; unfortunately not every sampled plot had a corresponding questionnaire.

The following sections summarise the principal findings arising from the study.

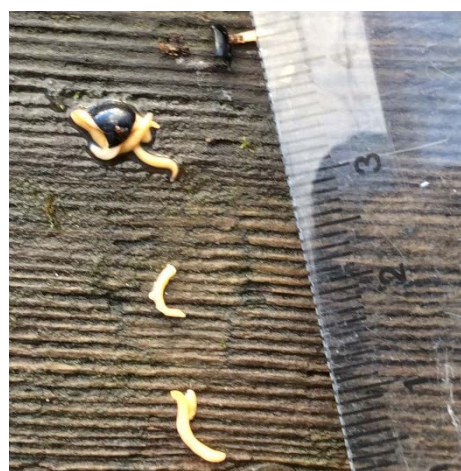
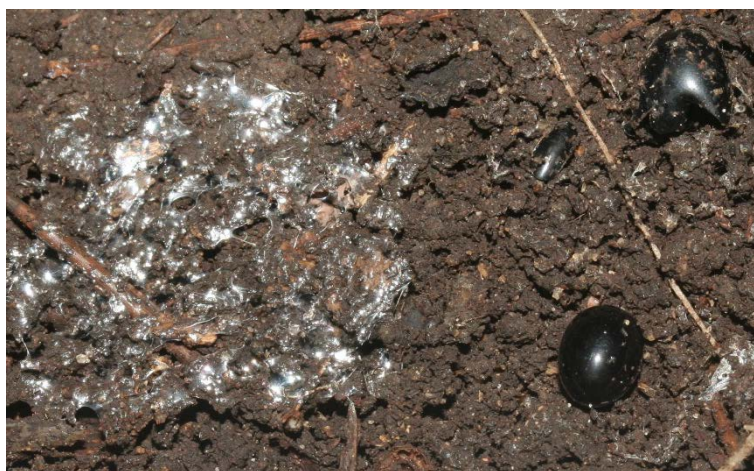
Occurrence of New Zealand Flatworms

At Slopefield, 90% of all plots sampled had New Zealand Flatworm present (average 7.2 present per plot, maximum 39 in one plot). A total of 201 New Zealand Flatworms were found.

The questionnaires indicated 60% of Slopefield plot holders believed they had New Zealand Flatworm, while 32% thought they didn't and 8% did not know whether they did have New Zealand Flatworm or not (see table below for actual numbers). Of the 8 plot holders that didn't know they had New Zealand Flatworms we found them in 6 of the plots and this discrepancy between our sampling and the questionnaire responses indicates that flatworms can go unnoticed despite the fact that most allotment holders know their plot well. Generally awareness of New Zealand Flatworm seemed to be high across plot holders and several mentioned reading about the New Zealand Flatworm in a newsletter showing the importance of communication whether between plot holders or by electronic or written communication.

Questionnaire response	Sampling	
	New Zealand Flatworm	
	Present	Absent
New Zealand Flatworm Present (in 15 plots)	in 13 plots	in 2 plots
Don't know (in 2 plots)	in 2 plots	in 0 plots
New Zealand Flatworm Absent (in 8 plots)	in 6 plots	in 2 plots

Very few plots holders (7%) reported ever having seen an egg capsule in their allotment plot, and we did not detect any during sampling.

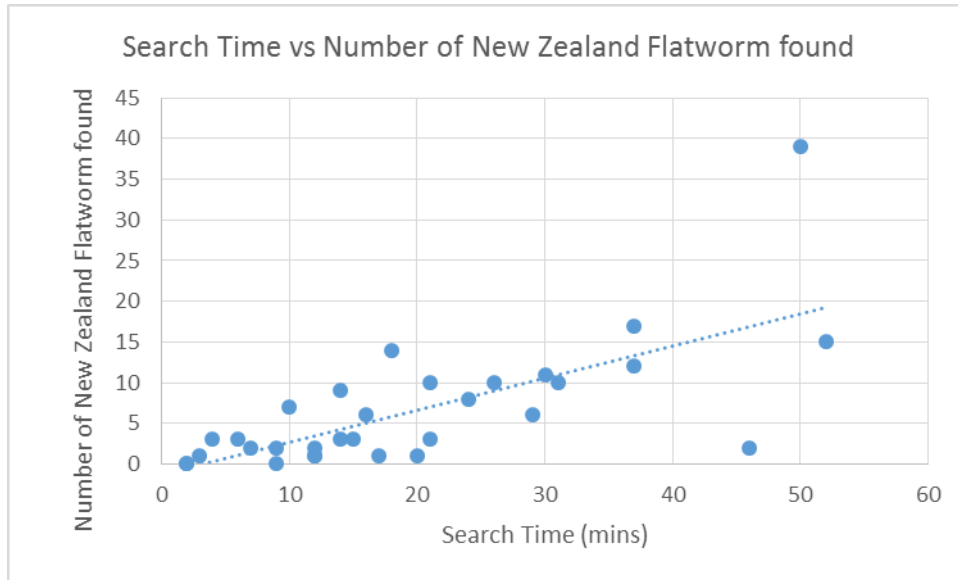


Egg capsules resemble shiny blackcurrants and are commonly found in early summer and later autumn. They vary in size between 4-11 mm long and 3-8 mm wide. Juvenile flatworms, as seen in picture on the right, emerge from the egg and are initially cream or yellow in colour. The characteristic shiny slime of New Zealand Flatworms can also be seen in the picture on the left.

Refuges of New Zealand Flatworm (daytime shelters)

The presence of refuges, i.e. places that New Zealand Flatworms shelter under, has in previous studies been highlighted as an important issue, so we studied this in detail. Refuges could be formed by stones, wood, plastic, weed control fabric or anything the New Zealand Flatworm could hide under during the day.

The abundance of refuges on a plot was categorised as either none, small, medium or lots. Two plots had no refuges of any sort, 5 plots had small amounts, 11 plots had a medium amount and 13 plots had lots. There was a clear relationship between the time it took to search possible hide-outs and the numbers of New Zealand Flatworm found. Therefore, the more cluttered a plot was, the longer it took us to inspect them all and more New Zealand Flatworms were present.



Relationship between amount of refugia and the number of New Zealand Flatworms found on a plot

Amount of refugia	Number of plots	Mean number of New Zealand Flatworms per plot
None	2	1
Small	5	1.2
Medium	11	5.6
Lots	13	10.2



The more hide-outs present, such as plastic and carpet (photo right), the more New Zealand Flatworms tended to be present.

Refuge Results

The proportion of New Zealand Flatworms found under each type of refuge was: plastic (34%), weed control fabric (27%), wood (14%), carpet (12%), large stones (11%), and cardboard (1%). These percentages partially reflect where the flatworms like to hide under (plastic, weed control fabric, carpet and wood). The refuges keep the ground nicely smooth and damp, and flatworms prefer these areas because they are prone to dehydration. The different percentages against the various refuge types also reflect how common certain materials are in the allotment. The highest number of New Zealand Flatworms found on any plot was 39, two-thirds of which were found under carpet and the remainder under plastic and wood.

History of invasion at Slopefield

It appears that New Zealand Flatworms have been present at Slopefield since at least 1996. The majority of respondents first spotted New Zealand Flatworm immediately or within a year of taking on their plot.

Information on New Zealand Flatworms included in joining packs or in newsletters as happens at Slopefield, is extremely useful to help raise awareness. An understanding of the issue can help prevent the spread and transfer of New Zealand Flatworms. Most respondents (83%) reported that they did not have New Zealand Flatworm in their home gardens, and many reported they were now very careful with bringing plant material and soil from the allotment into their home garden.

The majority of questionnaire respondents (82%) said that they did not know how New Zealand Flatworms first arrived in their plot at Slopefield. A further 9% said that New Zealand Flatworm was present when they

took over the plot, and 9% thought it came from neighbouring plots. No-one suggested that New Zealand Flatworm may have arrived with top soil or peat-based compost, or from plant material from friends. Two-thirds of plot holders knew that neighbouring plots had New Zealand Flatworms and one-third said they didn't know if neighbouring plots had New Zealand Flatworms or not.

There was no clear picture of how numbers of New Zealand Flatworms have changed at Slopefield. Just under a half of plot holders who completed a questionnaire responded to the question, and of those, 9% thought New Zealand Flatworm numbers had increased, 18% decreased, 9% fluctuated, 27% stayed the same, and 36% of people did not know. It is likely that the answer given is in part determined by how long people have had their plots for.

Impact of New Zealand Flatworms on earthworms

Of the 25 people that responded, 15 people said they had earthworms, although these were often Compost worms and Brandling worms usually found in compost bins but both can also occur in wet, decaying leaf litter, organic-rich soils and manure heaps or in the soil after compost has been dug in.



Compost worm - The whole body is stripy on its upper surface when moving. Saddle usually paler than the rest of the body.



Brandling worm - stripy on its upper surface with dark red bands and a pale pink or yellowish band in between

Since the arrival of New Zealand Flatworms, 41% of plot-holders reported that the number of earthworms had decreased, 41% stayed the same, 12% of people did not know and 6% thought that the number of earthworms fluctuated. No-one thought that the number of earthworms had increased. Several very useful insights were given:

- “Rubber-type matting on my pathways was a haven (and a good trap) for flatworms. I could collect 2 dozen every few days. I got rid of these mats last year. Flatworms are now not so obvious but still come across them fairly regularly, usually underneath something. I have virtually no earthworms in my allotment.”
- “Used to get earthworms. Not seen any for a long time.”
- “Very careful with bought and transferred plants in soil and compost. I open compost and manure on a plastic sheet to check before using.”
- “No earthworms found on plot but have found plenty in compost bins. Never seen worms in soil since I came to allotment in 2008. No change in New Zealand Flatworm numbers have been able to find them most times of year.”
- “Noticeable decline in earthworms over the 20yrs”
- “Worms decreased since had plot but do find worms in the grassy areas neighbouring the plots.”
- “Earthworm pops decreased since c. 10yrs ago only find odd one now. Birds decreased, don't see many blackbirds now for years used to be nesting in trees. New Zealand Flatworm fluctuates don't find as many anymore, increased then decreased found one this year.”

When plots were searched, no earthworms were found in 66% of plots, in 16% of plots between 1 and 5 earthworms were found, in 3% of plots between 6 and 10, and in 13% of plots more than 10. The earthworms were often found in grassy patches, suggesting that grassy paths and grassy patches may be important for the survival of earthworms where New Zealand Flatworm is present. This was also the case during more detailed sampling using 0.5 m x 0.5 m quadrats and extraction of earthworms using a combination of mustard water and hand sorting. Plots sampled in grassy patches or grassy paths had six times more earthworms than non-grassy plots. There was no difference in earthworm numbers between whether the sampling plots were near to refuges or not. During sampling two-thirds of worms found were immature worms that could not be identified to species, a third were Grey worms and an individual Blue-grey worm was found.

Plot characteristics

The type of boundary (hard e.g. corrugated metal, wall etc, or soft e.g. wire mesh fence) did not seem to affect New Zealand Flatworm numbers, although in most cases there was a mix of boundaries in a plot. One might imagine that hard boundaries would minimise movement of New Zealand flatworms between plots, however as with raised beds, we could not find evidence for such 'obstacle' effects.

Other plot characteristics were also investigated, and revealed that:

- The majority of plots had compost bin(s) and the presence of compost bin(s) did not affect the number of New Zealand Flatworms.
- The majority of plots had very little grassy patches or paths and the amount of grass found in a plot did not significantly determine the number of New Zealand Flatworms.
- The amount of grass present however, *did* influence the number of *earthworms* found. The more grass present, generally the higher the numbers of earthworms and during sampling a large proportion of the earthworms found were in grassy patches rather than in cultivated ground.

Gardening practice

Of plot holders, 95% added compost to plots, usually on an annual basis; 72% added manure either annually or biannually, and 40% added lime. There was no apparent relationship between the various additions and the number of New Zealand Flatworms or earthworms. Some plot holders from other allotments, reported that they felt that the addition of lime helped keep numbers of New Zealand Flatworm down.

Three-quarters of plots had woodchip. There did not seem to be any relationship between the presence of New Zealand Flatworms and the presence of wood chips. A potential issue with wood chip, however, may be the introduction of New Zealand Flatworm from these products.

More than half of plot holders exchanged plant material, less exchanged soil (20%).

Various methods are employed by people to control New Zealand Flatworms, including salt, lemon juice and squashing them (note: squashing is not a recommended method unless extreme caution is exercised due to potential for accidentally transporting them, or their eggs).

A quarter of respondents said they had changed gardening practices as a result of having New Zealand Flatworms, including being more vigilant about transferring New Zealand Flatworms from the allotment to gardens at home via plants and compost. One person mentioned that they had removed rubber type matting in an attempt to reduced New Zealand Flatworm numbers.

Relationship with other fauna

At Slopefield 59% of plot holders reported seeing beetles. Large predatory beetles such as Drove and Ground beetles are known to be New Zealand Flatworm predators, so any measures to promote their numbers may be helpful. Only one beetle was recorded during plot sampling.

The majority of plot holders thought that bird populations had not changed since they first noticed New Zealand Flatworms although two thought there had been a decrease, and no-one reported changes to mammal populations.

So, although an impact to earthworms from New Zealand Flatworm has been confirmed at the allotment plot level, this has not led to large observable effects on local birds and mammal populations.