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European crane fly

(also known as leatherjackets)
Tipula paludosa Meigen and *Tipula oleracea* L.

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Introduction

Two species of European crane flies were detected in New York State in 2004, the first report of these exotic species in the eastern United States. While there are many similarities between the two species, certain differences in their biology are relevant enough that management practices need to be tailored to the particular species.

Native to northwestern Europe, *T. paludosa* (the "European crane fly") has established in three separate geographic regions of North America, which includes the Canadian provinces of Nova Scotia (1955), British Columbia (1965) and Ontario (1996). Native to central and southern Europe, *T. oleracea* (the "common crane fly") has established in South America (Ecuador, 1999) and British Columbia (1998). In the U.S., they range from Washington to northern California, mostly west of the Cascades and coastal areas. In NY, they are most widespread in the western half of the Erie Canal corridor. *T. paludosa* has been detected in Erie, Monroe and Niagara counties, while *T. oleracea* has been detected in Monroe, Niagara, Ontario, Onondaga, Oswego, Seneca and Wayne counties. In spring 2006, *T. oleracea* was also detected in Nassau and Suffolk counties on Long Island; it is unclear whether this represents a separate introduction, or whether it is one end of a wide range that crosses the entire state. Local observers date their likely presence in western NY back to 2002. The arrival of *T. paludosa* was probably inevitable, given that the this species is widespread and firmly established in southern Ontario. While *T. oleracea* has not yet been reported from Ontario, it was detected in Michigan in 2005. Both insects were probably introduced to North America via infested soil media. Unless we build awareness and establish safeguards to curtail their range expansion, movement of sod, container stock and other materials could occasion spread of these exotic species locally and regionally, across NY and into New England.

The larvae, known as leatherjackets, can be problematic in any grass-based system, from low- and high maintenance turf, like home lawns and golf courses, to production-based systems like sod farms and grass seed fields. West of the Cascades, they are regarded as the most serious insect pests in lawns, pastures and hay fields. All turfgrass and forage species appear to be susceptible. Incidence of this pest is influenced less by host plant than by biological or physical habitat factors. Overall, they are dependent on moist soil conditions, and survival is favored by mild winters and wet, cool summers. In turfgrass, leatherjackets are favored in areas with thatch buildup and poor drainage.

In addition to grasses, leatherjackets have the potential to affect cereal and other crops in North America. In British Columbia they are serious pests in seedling nurseries, affecting not only transplant bare-root stock, but also container stock, where they girdle the stem at the soil line. Elsewhere, they affect flowers and several types of vegetable and small fruits. In their native range, they are injurious pests of spring and winter cereals and can become troublesome in a variety of minor crops ranging from sugar beets and turnips to brassicas, berries and carrots.

Description and life cycle

There are several species of native and non-injurious crane flies in NY that inhabit grassy habitats and can be found emerging from turfgrass. Like many of them, *T. paludosa* and *T. oleracea* adults resemble oversized mosquitoes, but they do not feed and are weak (*T. paludosa*) to modest (*T. oleracea*) fliers. One

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Figure 1a. European crane fly larvae *(T. paludosa)*.

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Figure 1b. Damage due to severe leatherjacket infestation in home lawns *(T. paludosa)*.

diagnostic character of European crane fly adults is a narrow dark-colored band along the leading edge of the wing adjacent to a light-colored band. Unlike some native species, there are no pigmented areas or patterns on the veins, cross-veins or rest of the wing. Adults of the two species can be differentiated in terms of relative length of wing to abdomen (in females), number of antennal segments and spacing between the eyes. A definitive identification, however, will depend on a specialist.

Adults are 2.5-3.0 cm long, pupae 3.0-3.5 cm, mature larvae 3-4 cm and eggs 1.0 x 0.5 mm. They complete one (*T. paludosa*) or two (*T. oleracea*) generations a year, with the emergence of adults occurring over a period of a few to several weeks at any one site, over the period of early spring (*T. oleracea*) and late July to September (both species). Adult females will emerge, mate and lay most of their eggs all within the first day (*T. paludosa*) or 3-4 days (*T. oleracea*) of their brief reproductive lives, either in a single batch because gravid females are unable to fly any distance (*T. paludosa*) or in several batches because gravid females are more capable fliers (*T. oleracea*). Each will deposit up to 200-300 black eggs at or near the soil surface. Eggs are sensitive to drought and require wet conditions to survive, hatching in 1 (*T. oleracea*) or 1.5-2 (*T. paludosa*) weeks.

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Figure 2. Late winter damage due to leatherjacket infestation in a golf course green (*T. oleracea*).

Larvae develop through four instars before they pupate. Like eggs, development and survival is favored under moist conditions. Active larvae mostly inhabit the top 3 cm of the soil where they feed on root hairs, roots and crowns of grass hosts. Larger larvae may emerge to forage on stems and grass blades on the soil surface. Larvae usually achieve third (*T. paludosa*) or fourth (*T. oleracea*) instar by the time cold temperatures force them to overwinter. For *T. paludosa*, most damage is attributed to the rapidly growing fourth instars in the spring. By mid-June, they have achieved their maximum size and move 3-5 cm deep in the soil where they remain in a non-feeding and inactive stage until pupation, which ends when pupae wriggle to the surface so the adult fly can emerge. In contrast, *T. oleracea* does not have a long aestivation stage, leading to an adult emergence in spring, and the emergence of a second generation in the fall. The empty pupal cases (exuviae, or the "jackets" of the leatherjackets) look like small grey-black twigs protruding from the sward where they can be spotted on low-mown turf such as fairways, putting greens and tee boxes.

Damage

Impact reported in NY has taken the form of scalping damage to golf course greens, root-feeding injury to home lawns, turf disruption due to the activities of skunks searching for larvae, and swarms of adults reported as nuisance problems by home owners in suburban settings. Direct injury to turf is expressed as yellowing spots and bare patches. In the worse case scenario, this can impact entire home lawns as experienced in some areas of Ontario. This injury is caused by disruption of the rooting zone, similar to white grub damage, and by foliar feeding on crowns and leaf blades, similar to black cutworm damage. Early to mid-May is when injury is most likely to be expressed by *T. paludosa* because large larvae are feeding rapidly as they approach the end of development. The season of most likely injury due to *T. oleracea* has not yet been established, but in early 2006 damage on greens was linked to the presence of *T. oleracea* larvae that had taken refuge in aeration holes over the winter or in early spring. An area the size of a quarter was scalped around entry holes. Injury is most easily confirmed by searching for larvae. Birds are major predators, and the peck-holes from foraging crows and other species are easily detected, and by themselves can be troublesome in high maintenance turf areas such as golf course greens.

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Figure 3. European crane fly eggs, fourth instar larva, pupa, pupal exuvia and adult *(T. paludosa).*

Monitoring

To detect the presence of invasive crane flies, the pupal cases can be monitored on tees and greens where they protrude from the low-mown turf. At peak emergence times in the spring (*T. oleracea*) or fall (both species), adults may become very abundant and noticeable as they flit about low in the grass. They may also congregate during the day on the sides of buildings, sliding doors, window screens and fences. Because adults lay eggs so soon after emergence, at least for *T. paludosa*, they do not move far. Therefore, sites with abundant adults, larvae or pupal cases should be monitored as an indication of sites where eggs of the next generation are likely to be laid. If a European crane fly infestation is suspected, send adults, larvae or pupal cases to a specialist for proper identification. While it is not yet possible to reliably distinguish larvae and pupae of the two invasive species, they can be differentiated from native crane fly species, and observations on the abundance of those life stages could also help diagnose the problem if adults cannot be collected. Up to now, there are no accounts of native crane flies causing injury to turfgrass.

If signs of insect activity and turfgrass injury suggest leatherjackets, core sampling is the best way to detect and sample larvae. Take samples with a cup cutter and rip apart the core to look for larvae. Depending on the insect's life cycle and field

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Figure 4. Empty pupal case protruding from low-mown turf after emergence of the adult *(T. paludosa)*.

conditions, the larvae are best sought in a core by both searching from the soil up to the base of the roots and thatch layer, and by searching down from the grass where larvae can be concealed in the upper layer of the thatch. This is the best way to make accurate population counts. Although disclosing solutions (such as dish soap or dilute pyrethroid solutions) have been suggested as an alternative, they may not work well; when these irritants are poured onto the turf, larvae are supposed to be driven to the surface where they can be seen. Even if this method were to expose leatherjackets, it would greatly underestimate population densities. Adults are best captured with a sweep net, but they can also be seen flitting about in grassy areas or perching on nearby vegetation.

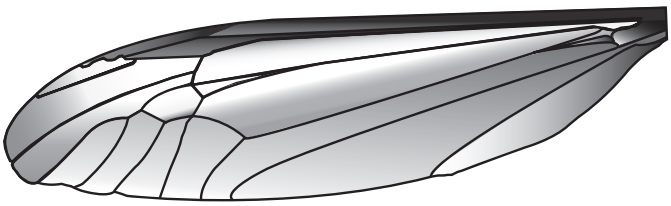

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Figure 5. Diagnostic color pattern on the wing.

Management

Control tactics should be directed against the larvae because adults are hard to target and short-lived. Suggested thresholds range from 15 to 50 larvae per sq.ft., depending on overall turf health. In Ontario, Canada, lawns have been reported with as many as 75-125 larvae/sq.ft. Even if thresholds are surpassed, it is important to keep in mind that leatherjackets can suffer very high mortality due to predation by birds and other vertebrates. Vigorous home lawns and golf courses can therefore support relatively high populations.

Because of their sensitivity to dry conditions, careful management of soil moisture levels may be a key cultural control tactic to reduce populations. Some strategies are to carefully manipulate the timing and frequency of irrigation, particularly during the oviposition period, to better drain chronically infested areas, and to allow the sward to dry (i.e. avoiding irrigation) in the fall. Other recommendations to alleviate problems are to maintain a vigorous stand that is more tolerant to infestation, and to rake up larvae at night when they emerge to feed at the soil surface. Another possibility is to soak the green, cover with a tarpaulin, and dispose of larvae trapped underneath after they moved to the surface to escape the excess moisture.

If necessary, preventive applications of insecticides are best made in the late fall (September to October) at the time of egg laying or when larvae are smaller and still active at the soil surface. Otherwise curative applications can be made in spring (May) once high populations or feeding damage of *T. paludosa* are detected. If populations of *T. oleracea* are present, a late fall treatment would be superior, as it would target both species; *T. oleracea* completes two generations a year and susceptible larval populations are hard to target in the spring. There are many control products registered for leatherjacket control in turfgrass of NY (LINK: Cornell Pest Management Guidelines for Commercial Turfgrass). Results from efficacy trials in NY state against *T. paludosa* indicate that imidacloprid and trichlorfon offer 73-87% control in either the spring or fall window. Carbaryl, chlorpyrifos and one biological control option (Beauveria bassiana, an entomopathogenic fungus) are other alternatives labeled for leatherjackets in NYS that have shown more variable, but positive, results. The entomopathogenic nematode, Steinernema carpocapsae, is a biological alternative that has been promoted in the Northwest.

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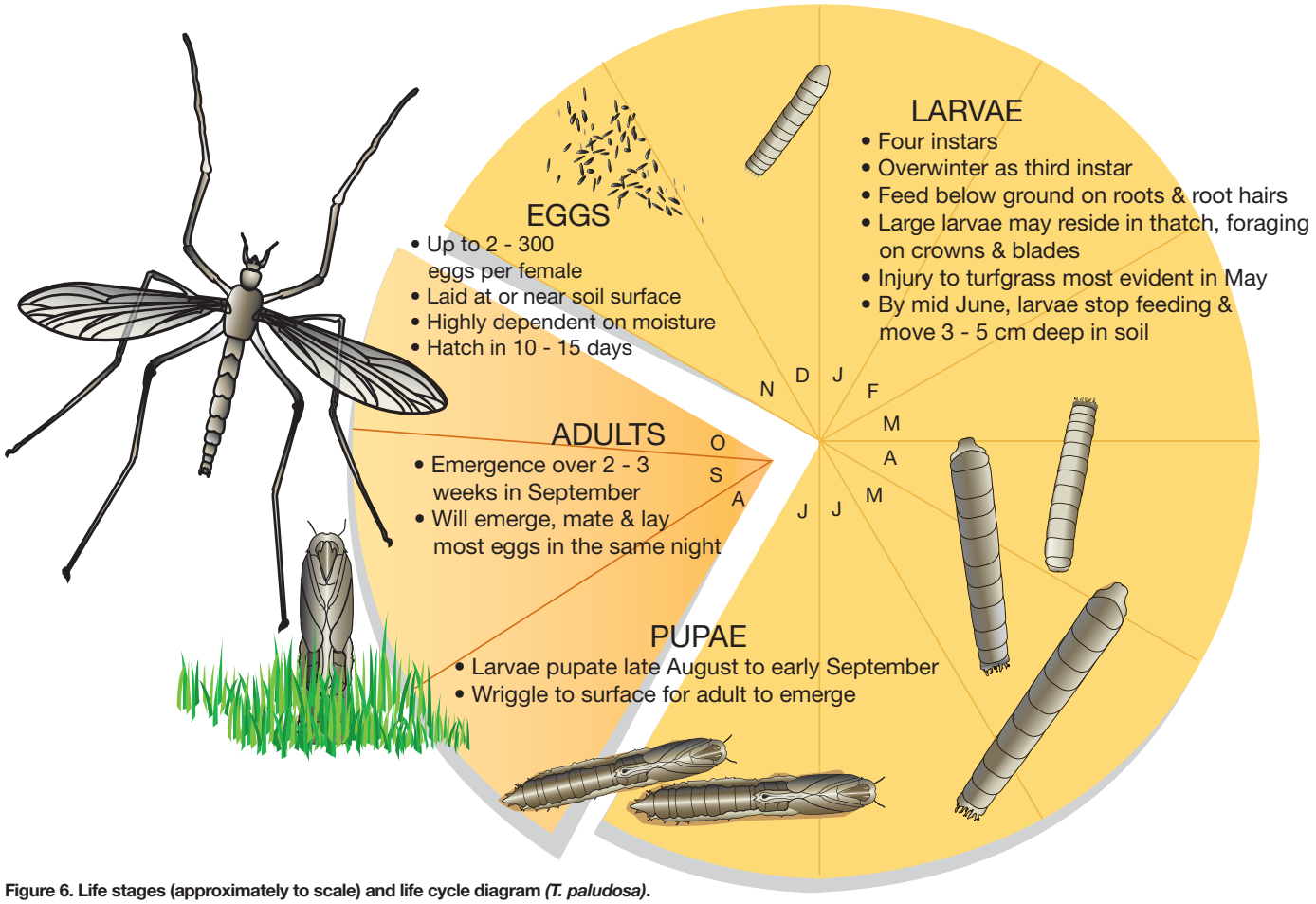

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Figure 6. Life stages (approximately to scale) and life cycle diagram *(T. paludosa)*.

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