

Proposal: Development of an Identification Guide to Crane Fly (Insecta: Diptera: Tipulidae) Pests of Turfgrass in the Eastern U.S.

Need for project: An ease of use identification guide is needed at this time by extension agents, turf grass care specialists and homeowners to separate the species of crane flies likely to be found associated with turf grasses, and focusing on the species implicated in causing turf grass damage.

Background: The subgenus *Tipula* (*Tipula*) is an Old World group with two very similar introduced species in North America, the European Crane Fly, *Tipula* (*T.*) *paludosa* Meigen and the species *T.* (*T.*) *oleracea* Linnaeus, sometimes called the Common Crane Fly (Oosterbroek, 2005). *Tipula paludosa* is better known in North America, long established in the Pacific Northwest (Jackson and Campbell, 1975) and Canadian Maritimes provinces (Alexander, 1962), more recently in California (Umble and Rao, 2004; S. Gaimari, CDFA, pers. comm.) and is a leading insect pest of turf grass and pastures in these area. More recently, *T. oleracea*, has been discovered in the Pacific Northwest and California at a wide variety of localities and is considered established (Umble and Rao, 2004; S. Gaimari, CDFA, pers. comm.); it may have resided in these areas undetected for years and been mistaken for *paludosa*. It attacks a broad range of crops and is considered a major pest in Europe (Anonymous, 1967; Pesho et al. 1981).

Tipula paludosa was discovered in Ontario in the late 1990's at a wide variety of localities in southern Ontario, including Niagara Falls, and associated with turf damage (Pam Charbonneau, pers. comm.; specimen first confirmed by Gelhaus). Gelhaus (2001) predicted that these two species would spread soon into the Northeast U.S., if not already existing there undetected, with this spread probably through movement of eggs, larvae or pupae in turf and nursery soil or through the simple dispersal of adults. Subsequently, both species were found associated with turf damage at a variety of golf courses in southern Quebec (Simard et al., 2006; specimens identified by Gelhaus) and in western New York (Peck et al 2006, specimens confirmed by Gelhaus) and *oleracea* alone was found in Michigan (Gelhaus, 2006) adjacent to a golf course, marking the first records for eastern US. Both species are likely to rapidly spread throughout the northeast US as they have in the Pacific States. In addition, another crane fly species of European origin, *Nephrotoma cornicina*, has been found in association with golf courses in Quebec, and has the potential to cause turf damage (Gelhaus, submitted).

There are no keys available to identify all the species of crane flies found in turf environments, although Peck et al (2006) offers characters to separate these two European species of *Tipula* from each other. Turf grass environments can host a diversity of crane fly species, particularly in proximity to woodland patches or water (Tascherau et al, in press; Gelhaus identified all specimens). The adult stages of the two European-origin *Tipula* species are very similar in overall appearance to at least 3 species of native crane flies, some of which cause economic damage (Held and Gelhaus, 2006; Gelhaus, in preparation), and can be common, even abundant, in similar habitats (golf course turf, lawns, wet pastures, wet lands). Larvae of the Old World subgenus *Tipula* (*T.*), which includes *paludosa* and *oleracea*, are distinctive from larvae of all native species of crane flies (Gelhaus, 1986) but cannot be reliably distinguished from each other.

What will be done: This project will involve developing taxonomic characters for distinguishing the adult, pupal and larval stages of pest and non-pest crane flies in turf situations, and developing these characters into an on-line interactive identification aid (key). Through field experience, interactions and identifications of samples from extensions agents and homeowners, and a search of the literature, I have selected the 20 species most likely to be found in association with turf, including both introduced and native pest species. Specimens for all these species, and their associated larval stages, have been assembled for study in the collections of The Academy of Natural Sciences. This researcher has nearly 30 years experience in the taxonomy and systematics of crane flies, both adult and immature stages.

The species will be compared for nearly 50 morphological distinctions between them, in both adult and larval stage (not all are known as larvae), which are useful in terms of an identification guide. These distinctive features will be photographed using a state of the art digital imaging system at the Academy of Natural Sciences, using Automontage™ software developed by Syncroscopy, Inc., designed for producing perfectly focused images. The character set, and the images documenting the set, will be input into 20q software developed by DiscoverLife for developing on-line, interactive identification keys (see <http://www.discoverlife.org/> for main site; see <http://pick4.pick.uga.edu/mp/20q?> for variety of keys available now). The on-line keys are ideal for a variety of users of differing skills, as they can focus on easily observed features, such as body color or wing patterning, as well as details of genitalia. The user can start with any character system, with the keys automatically reformatting based on character selection and subsequent elimination of taxa. In addition, by being on-line, they are available at all times.

Timing of Project: This research will take place starting in June 2007. Researcher Gelhaus will be assisted in the project by an undergraduate student through the Academy of Natural Sciences' Research Experiences for Undergraduates summer program. Work will proceed in examining specimens, developing morphological character distinctions, and assembling the digital images. The guide will be developed in the 20q software, and a prototype will be the goal for presentation at the end of the summer student program in August 2007. Gelhaus will continue to refine the guide, and develop the background information on each species. Gelhaus will also have the guide tested by a variety of users, including extension agents, other crane fly experts, and non-traditional students of an entomology evening course to be taught by Gelhaus in Sept-Nov., 2007. A final version of the key will be completed by Dec. 2007.

Impact of Project: Crane flies will be a common problem in turf in the eastern US as they continue to spread from south-central Canada and adjoining US areas; in addition, several native species are also implicated in damage. Already on-going efforts for surveying and detection are underway in several states. This guide should prove to be an important tool for the identification of these turf grass pests. In addition, this guide will allow researchers to easily track these invasive species as they spread throughout the northeast, and native species with implications in turf damage can be documented and studied. Turf managers and homeowners can also be encouraged to use the guide, and assess when an abundant crane fly is merely a nuisance, or a damaging species which should be evaluated for control. I expect that a clarification of pest versus non-pest species will prevent needless application of treatments, particularly by homeowners. This guide will be effective throughout central and eastern North America, including a multitude of states and provinces.