MOVEMENT OF *ANOPLOPHORA GLABRIPENNIS* AND *ANOPLOPHORA NOBILIS*: STUDIES OF FLIGHT, ORIENTATION AND DISPERSAL POTENTIAL

Michael T. Smith[1], Ruitong Gao[2], Guohong,Li[2], and Stephen Teale[3]

[1]USDA Agricultural Research Service, Beneficial Insects Introduction Research Lab, 501 S. Chapel St., Newark, DE 19713

[2] Institute of Forest Protection, Chinese Academy of Forestry, Beijing, China 100091

[3]SUNY, Department of Environmental & Forest Biology, Syracuse, NY 13210

ABSTRACT

The Asian longhorned beetle (ALB), *Anoplophora glabripennis* Motsch., is native to China and Korea. *A. glabripennis* was first discovered in North America in New York in 1996, followed by its discovery in Chicago, Illinois in 1998. ALB is believed to have colonized North America as a stowaway in solid wooden packing materials (i.e. crating, palettes, dunnage) originating from China. Larvae of this species feed in the cambium and xylem of a large variety of hardwood tree species, including maple, first killing branches and eventually the entire tree.

USDA-APHIS-PPQ has mounted a campaign to eradicate this pest from North America by establishing domestic quarantines that prohibit local transportation of potentially infested wood, aggressively scouting for infested trees and eliminating them, and imposing a new and more stringent shipping rule that requires wooden packing materials from China be treated to kill wood borers (18 September 1998 Federal Register 63 FR 50100-50111, Docket No. 98-087-1). However, in spite of these efforts, which have resulted in the removal of over 3,900 trees in New York and over 1,200 trees in Chicago, ALB-infested trees were discovered during 1999 in three areas outside quarantine zones in New York (including ca. 1,000 trees) and Chicago (including ca. 315 trees) (USDA-Forest Service 1999).

Research directed at ALB includes efforts focused on the eradication of ALB, as well as on the management of ALB should eradication fail. In regard to eradication, where the aim is to eliminate all reproductively viable individuals from the infested areas, establishment of quarantine boundaries inside of which intensive search and destroy operations are conducted, is essential. Delineation of such boundaries are based in large part upon the dispersal potential of ALB. Furthermore, central to the development and implementation of management strategies for ALB, is an in-depth understanding of its population dispersal potential, as well as other key biological and behavioral characteristics. Such an understanding of the process of invasion is a cornerstone to the development of a proactive program for the prevention and early detection of

new introductions. Therefore, investigations of ALB (*A. glabripennis* and *A. nobilis*) movement were initiated in Gansu Province in north-central China during 1999. These investigations included studies of both the individual ALB flight and orientation behavior, as well as its population dispersal potential.

Individual Flight Behavior. The first year of a two-year study of the flight distance, direction, orientation and host selection behaviors of individual adult beetles of *A. glabripennis* and *A. nobilis* was conducted under natural field conditions in Gansu, China. In addition, evaluation of how this behavior is affected by key environmental parameters (i.e. wind direction and speed, temperature, cloud cover, angle and aspect of sun, time of day) and biotic factors were also determined. During these studies a total of 450 adult ALB were evaluated. To date, analysis of these data has shown that an individual ALB can fly an average distance of ca. 25- 46 m in a single flight, which ranged from 3 - 420 m. These data also indicated that flight propensity and flight distance are strongly influenced by the time of day. Most importantly however, this data suggest that the size (linear distance) of host-free space is a key factor governing dispersal distance. Furthermore, the data also indicate a strong directionality to flight, as well as a strong landing orientation to standing trees.

Population Dispersal. The first year of a multi-year study of the season-long population dispersal potential of *Anoplophora glabripennis* was conducted under natural field conditions in Gansu, China. The Mass-Mark Recapture (MMR) method was employed, in which over 16,000 adult ALB were marked and released. These included both newly emerged (0-24 hr old) ALB (obtained from caged infested logs), which were released daily, as well as free living field collected ALB (of unknown age), which were released weekly. ALB were recaptured weekly for a total of 14 weeks by sampling groups of trees at 50, 100, 150, 200, 250, 300, 400, 500, and 600 m from the release points in each of the primary compass directions (N, NE, E, SE, S, SW, W, NW). In addition, ALB were also randomly sampled around the outer periphery of the study area. During this 3.5 month study, dispersal distance, direction, and rate, as well as body size and egg load of recaptured ALB were determined. In addition, daily environmental data (temperature, wind direction and speed, rain fall), weekly ALB population density (n=769 trees; calculated based upon meters of linear tree canopy), and landscape heterogeneity (spatial aspects) were also determined. Field experimentation was completed in early October 1999. To date, analysis of the data has shown that the mean dispersal distance for male and female *A. glabripennis* and *A. nobilis* ranged from approximately 220 - 300 m. More notably, this study showed that ALB can disperse over 1,400 meters in a single season, carrying eggs, well over the previously reported distance of 100-200 meters. In addition, these studies showed a noticeable directional effect as well. Analysis of recapture data relative to ALB population density (temporal and spatial) and landscape heterogeneity are in progress. Molecular techniques are also being employed in an effort to predict the potential dispersal distance of ALB. To this end, ALB larvae (20 larvae) were collected from 5 trees beyond the outer recapture distances (740 - 1,350 m) from the center release site in each of the 8 primary compass directions. Molecular analysis are only now being initiated.

The second year of the individual flight behavior and population dispersal studies will be conducted in China during 2000. The implications and practical application of the new information developed in the individual flight and orientation behavioral studies will also be explored (i.e. trap development and host tree selection). In addition, data from these studies, together with investigations of ALB colonization behavior, will be utilized for the development of prediction models of ALB dispersal and establishment under different landscapes at risk to ALB invasion in the U.S.