COMPARING MOSQUITO COMMUNITIES OF VARIOUS PATCH-MATRIX LANDSCAPE COMBINATIONS IN CENTRAL MISSOURI, WITH IMPLICATIONS FOR DEVELOPING MODELS TO FORECAST ABUNDANCES OF IMPORTANT MOSQUITO TAXA

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INTRODUCTION

It is well understood that mosquitoes represent one of the most consequential arthropod vectors of disease in humans and animals. The importance of the pathogens that can be transmitted by these insects is difficult to overstate. Even in the absence of vector status, their presence and abundance in a wide variety of landscapes utilized by man can lead to annoyance, apprehension, and abandonment of planned activities (Harwood and James, 1979). It is for these reasons that surveys of the numbers and types of mosquitoes present in given areas at a given time are undertaken.

Disease vector population densities, combined with their relationship to landscape characters, will clearly affect the proliferation of arboviruses to humans present in these landscapes. Modeling produced from mosquito abundance and environmental factor data has been used to create disease outbreak "early warning systems" (Wegbreit and Reisen, 2000; Meide *et al.*, 2008).

Advanced mapping techniques (*e.g.,* GPS, land cover surveys) allow for the characterization of specific locations with regard to landscape, ecological matrix, and the presence of patches of different land cover types within matrices. These techniques have already been used to facilitate the development of spatial distribution maps for mosquitoes (Gleiser and Gorla, 2007). Thus, coupling biological sampling for mosquito vectors of disease with certain environmental conditions within different landscape configurations may help approximate a model for predicting the risk of encountering these disease vectors. Indeed, the ultimate aim of research on disease vectors is to characterize parameters that may forecast high-risk areas for vector interaction with humans or livestock, and to tailor control efforts for these areas (Achee *et al.,* 2006).

Distribution maps of arthropod-borne disease vectors aid in predicting the threat of disease at a landscape level (Brownstein *et al.*, 2002; Kolivras, 2006). Understanding the dynamics of vector spatial and temporal occurrence and abundance is a key to accurate forecasting of disease risk (Ryan *et al.*, 2004), and the efficient implementation of control measures (DeGroote *et al.*, 2007).

Numerous abiotic factors (*e.g.,* rainfall, temperature, wind) can also be incorporated into this forecasting. The synthesis of temporal occurrences of mosquito taxa, patch-matrix landscape organization, and variation in abiotic factors can augment understanding of potential risk for mosquito-borne diseases (Reisen *et al.*, 2008).

Therefore, the goals of the research described in this dissertation were 1) to describe the mosquito fauna of the various patch-matrix landscape combinations common in five central Missouri counties; 2) to evaluate the temporal occurrence of these mosquito taxa; 3) to assess relationships between regional weather factors and the occurrence and abundance of the mosquito fauna; and 4) to categorize the risk of encountering mosquito vectors of disease based on patch-matrix landscape configurations, temporal mosquito abundance and diversity, and weather data.

REVIEW OF THE PERTINENT LITERATURE

Summaries of the pertinent research on mosquito occurrence in the study region, and the significance of these mosquitoes as vectors of disease, are presented. Also discussed are the applicable concepts of landscape ecology and the technology available to differentiate land cover types in central Missouri. Finally, a summary of abiotic factors and their effect on mosquito numbers is presented.

A recent revision of the genus *Aedes* (Reinert, 2000; Reinert *et al.*, 2004) has created ambiguity among researchers regarding the appropriate binomial classification for many common mosquitoes. Although the elevation of numerous aedine subgenera to generic status has some proponents (*e.g.*, Black, 2004), it is not universally accepted as an appropriate revision (Savage and Strickman, 2004; Edman, *et al.*, 2005). A consensus of editors that represent scientific journals publishing research on mosquitoes has chosen to encourage authors to continue using the traditional names (Edman *et al.*, 2005). The naming conventions that existed prior to these revisions are used herein.

Comparatively few studies of the mosquito fauna of the central Missouri region have been conducted (Adams, 1934; Adams and Gordon, 1943;; Smith, 1967; Kessler, 1969; McCauley *et al*., 2000, Debboun *et al.*, 2005), and none have been published with a focus on the spatial or temporal occurrence within the range of suitable patch-matrix landscape combinations. Furthermore, the introduction of two invasive species [*Aedes albopictus* (Skuse) and *Aedes japonicus* Theobald] into North America in the late 20th century has potentially changed the picture of mosquito presence and abundance in the study area. An enumeration of the mosquito taxa and their abundance and occurrence in specific environs would be the first for this region of Missouri in almost half a century.

The importance of mosquitoes as agents of disease and death was considered preposterous little more than a century ago (Spielman and D'Antonio, 2001). Since then, the discoveries of Patrick Manson, Charles Laveran, Sir Ronald Ross, and the Yellow Fever Commission have made the world aware of the power of this small, frail insect. Today, humankind treats the mosquito with well-earned respect, since its ability to harbor and spread fatal illness is unparalleled among insects. Although many diseases such as malaria and yellow fever have been reduced to insignificance in North America due to past control efforts (Ross and Horsfall, 1965), many other, chiefly the encephalitides, continue to be of great concern. The most recent and noteworthy of these is West Nile virus (WNV).

WNV is a flavivirus historically found in Africa, West Asia, and the Middle East, but the emergence and spread of WNV in the western hemisphere since 1999 has resulted in thousands of human cases of West Nile Fever and hundreds of human deaths due to West Nile encephalitis (O'Leary *et al.*, 2004).

Since being detected in Missouri in 2002, the number of human cases of WNV declined annually through 2005. However, this downward trend in the number of reported human cases in Missouri was reversed in 2006 when 62 cases of West Nile Fever and five deaths due to West Nile encephalitis were reported (CDC, 2010). This was more than double the number of human cases reported in 2005. The unexpected increase in human cases underscores a concern that WNV may continue to be a serious human health risk throughout the western hemisphere (Morse, 2003).

WNV is now firmly established in Missouri and neighboring states along with several other mosquito-vectored diseases (CDC, 2010). These include eastern equine encephalitis (EEE), western equine encephalitis (WEE), St. Louis encephalitis (SLE), LaCrosse encephalitis (LAC), California and California-type encephalitides (CE), dog heartworm (HW), and Potosi virus (PO).

Mosquitoes. Some 57 mosquito taxa have ranges that extend into Missouri, with as many as 39 documented to occur in central Missouri (Smith, 1967; Darsie and Ward, 2004). Many of these taxa are known or suspected vectors of West Nile virus or other encephalitides. A summary of the mosquito taxa with ranges in central Missouri and their impacts on public health follows.

Genus *Aedes*. This genus is the most speciose in central Missouri. Its members are very diverse in their habitat exploitation and disease implication. Most are considered vectors of at least one arbovirus, and these are mentioned first.

Aedes albopictus (Skuse), or the Asian tiger mosquito, is a known vector of WNV (Turell *et al*., 2001a), and PO (Francy *et al*., 1990; Heard *et al*., 1991). Because the feeding behavior of this species is generalized (birds, humans and other mammals are all attacked), its vector potential is high, and it has also been associated with EEE, HW, SLE, and LAC. This species is a container breeding mosquito that is found in both urban and non-urban habitats. *Aedes albopictus* was imported to the United States in shipments of old automobile tires in the late 1970s (Reiter and Sprenger, 1987), and has since become one of the most important species of concern to public health (Novak, 1992). In many of the areas where *Ae. albopictus* has invaded, it has replaced *Aedes aegypti* (L.) in the ecological niches in which the two species compete (Hobbs *et al.*, 1991; O'Meara *et al.*, 1995; Juliano and Lounibos, 2005).

Aedes canadensis canadensis (Theobald) has been cited as a vector of CE (Siverly, 1972), HW (Jankowski and Bickley, 1976), and LAC (Berry *et al.*, 1986), and is considered a bridge vector for EEE (Vaidyanathan *et al.*, 1997). This mosquito is among the early emergent mosquitoes, appearing in April, and fairly long-lived, thus increasing its vector potential. It is among the few mosquitoes in Missouri that feed on reptilian blood (Carpenter, 1968).

Aedes cinereus Meigen has been implicated as a potential vector of CE (Whitney *et al.*, 1969). This mosquito is found in large numbers if heavy late summer rains occur (McCauley *et al.*, 2000).

Aedes dorsalis (Meigen) is considered a vector of CE (Reeves and Hammon, 1952) and WEE (Hammon *et al.*, 1945a). *Aedes dorsalis* is widespread throughout the state, but not common (McCauley *et al.*, 2000), and attacks hosts both during the day and at night.

Aedes hendersoni Cockerell and *Aedes triseriatus* (Say) are two closely related species with similar life histories and biologies that can be discussed together. Hybrids of the two species are known (Truman and Craig, 1968). Both species are known to vector LAC (Loor and DeFoliart, 1970; Walker, 1992), but are not commonly encountered. *Aedes triseriatus* is a bridge vector of WNV (Turell *et al.*, 2001b). The preferred breeding habitats for these mosquitoes are tree holes and tire piles (Dyar, 1928; Walker, 1992), and they are unusual in that they feed on chipmunk, squirrel, and other woodland rodents.

Aedes sticticus (Meigen) is a vector of HW (Buxton and Mullen, 1980) and possibly CE (Siverly, 1972). This species is a floodwater mosquito, with egg viability as long as three years (Dyar, 1928), and is most frequently encountered in the spring and early summer.

Aedes stimulans (Walker) is implicated in the transmission of CE (Sather, 1968). It is an early emergent mosquito, but can persist until August in Missouri (McCauley *et al.*, 2000).

Aedes trivittatus (Coquillett), which vectors WNV (Tiawsirisup *et al.*, 2005) and a virus closely related to CE (Hammon *et al.*, 1952), can be very abundant under the right circumstances. This species utilizes floodwaters in a variety of habitats (Dyar, 1928), and its bite is considered to be among the most painful of all mosquitoes (Carpenter and LaCasse, 1955).

Aedes vexans (Meigen) vectors EEE (Harwood and James, 1979), HW (Bemrick and Sandholm, 1966), and WNV (Turell *et al.*, 2001b). This species vectors Rift Valley Fever Virus (RVFV) which causes abortion and mortality in livestock and hemorrhagic fever and encephalitis in humans (Fontenille *et al.*, 1995). As yet, RVFV is not known outside of Africa and the Middle East, but the potential for spread of this disease in this area is augmented by the presence of *Ae. vexans*, should the virus be transported to the New World. *Aedes vexans* is one of the most consequential arthropod pests in the world (O'Malley, 1990), and definitely in the United States (Russo, 1977). Its occurrence is typically linked with floodwater (Dyar, 1928???). *Aedes vexans* was found to be the most common mosquito species associated with oxidation lagoons in Missouri (Smith, 1967).

Aedes grossbecki Dyar and Knab is not considered a vector of any medically important organisms. Adults of this species are among the very earliest to emerge, often as early as mid-April, and persist until June (McCauley *et al.*, 2000). *Aedes nigromaculis*

(Ludlow) is also not recognized as being of any medical importance (McCauley *et al.*, 2000). It is most commonly active during the day in proximity of irrigated pastures.

Genus *Anopheles*. These are the malaria mosquitoes. The importance of malaria in central Missouri is minimal at this time, with neither a human reservoir nor an infected mosquito pool to catalyze an outbreak of the disease.

Anopheles barberi Coquillett has demonstrated vector competence for malaria of the *Plasmodium vivax* Grassi and Feletti variety (Stratman-Thomas and Baker, 1936). This is a predatory treehole mosquito in the larval stage (Dyar, 1928).

Anopheles crucians Wiedemann has been shown to be susceptible to infection by both *Plasmodium falciparum* Welch (King, 1916) and *P. vivax* malarial parasites (Stitt, 1919).

Anopheles punctipennis (Say) is held to be a vector of malaria (King, 1916) and WNV (Furumizo *et al.*, 2005). This is the most widespread anopheline in Missouri (McCauley *et al*., 2000).

Anopheles quadrimaculatus sensu lato (Say) is the most important malaria vector in the United States east of the Rocky Mountains (Carpenter and LaCasse, 1955). It is also a vector of HW (Lewandowski *et al.*, 1980) and SLE (Horsfall, 1972).

Anopheles walkeri Theobald has demonstrated vector competence for *P. vivax* malaria (Matheson *et al.*,, 1933). It is also a vector of HW (Bemrick and Sandholm, 1966). This mosquito's occurrence is linked with that of emergent aquatic vegetation (Komp, 1926).

Genus *Coquillettidia*. This genus is represented by only *Coquillettidia perturbans* (Walker), a vector of EEE (Howitt *et al.*, 1949) and WNV (Turell *et al.*, 2005). This mosquito is unusual in that its larvae use a modified respiratory siphon to saw into roots and stems of aquatic plants to obtain oxygen (Dyar, 1928).

Genus *Culex*. The mosquitoes in this genus are substantial in their disease implications, containing the most important vectors of WNV and other encephalitides. Their tendency to feed on both birds and man makes them effective vectors of these diseases.

Culex erraticus (Dyar and Knab) is known to be a vector of EEE (Chamberlain *et al.*, 1954) and WNV (Cupp *et al.*, 2007). This is a small mosquito whose bite is not troublesome (Carpenter and LaCasse, 1955). *Culex peccator* (Dyar and Knab) is a small mosquito of no known medical importance. It is probably a specialist on cold-blooded animals (Edman, 1979). The adult female of this species is nearly indistinguishable from that of *Cx. erraticus*, differing only in the quality and quantity of certain metathoracic vestiture (Darsie and Ward, 2004).

The *Culex pipiens* complex is represented by *Culex pipiens* L. and *Culex quinquefasciatus* Say. In central Missouri, the ranges of these two species overlap, and hybrids of the two are known. The adult females of the two species cannot be reliably separated morphologically (Savage and Miller, 1995). *Culex pipiens* complex vectors SLE and WEE (Hammon *et al*., 1945b), WNV (Turell *et al*., 2001b), RVFV (Turell *et al.*, 2008) and HW (Carpenter and LaCasse, 1955).

Culex restuans Theobald is capable of exploiting many diverse types of breeding sites (Dyar, 1928). It was probably included as part of the *Cx. pipiens* complex when the latter was calculated to be the second most abundant mosquito in the region (Smith, 1967). This is understandable since female *Cx. restuans* with rubbed scuta are morphologically indistinguishable from *Cx. pipiens* complex. *Culex restuans* vectors WEE (Norris, 1946), WNV (Turell, *et al.*, 2001b), and SLE (Turell *et al*., 2005).

For the purposes of this study, *Cx. pipiens*, *Cx. quinquefasciatus*, and *Cx. restuans* were not distinguished as individual species, but were combined as the *Cx. pipiens* group. This is justified since the adult females of these three species are not reliably separated morphologically, leading many researchers to combine them in this manner (*e.g.*, Ebel, *et al.*, 2005). Furthermore, the feeding behaviors (Apperson *et al.*, 2002; Apperson *et al.*, 2004) and vector competences for these species are analogous.

Culex salinarius Coquillett is a vector of WNV (Turell *et al.*, 2001b), SLE and EEE (Vaidyanathan *et al.*, 1997). It breeds in both clean and polluted freshwater (Carpenter and LaCasse, 1955).

Culex tarsalis Coquillett is known to vector WEE, CE, SLE (Carpenter and LaCasse, 1955) and WNV (Reisen *et al*., 2008). This mosquito is far more abundant in the western United States, but definitely present in central Missouri (Darsie and Ward, 2004).

Culex territans Walker is not known to vector any diseases to man (McCauley *et al*., 2000), having instead a preference for cold-blooded animals. This species has been implicated as a vector of a trypanosome to amphibians (Desser *et al.*, 1973).

Genus *Culiseta*. The mosquitoes in this genus are among the larger mosquitoes found in central Missouri. Among them are some important disease vectors.

Culiseta impatiens (Walker) is not known to vector any diseases. They are tolerant of polluted water and are among the first mosquitoes seen in the spring (Carpenter and LaCasse, 1955).

Culiseta inornata (Williston) vectors WEE (Hammon, *et al.*, 1945b). As is *Cs. impatiens*, ii is a large species that flies early in the year, persists late in the year, and is considered by some to have the longest period of activity of any mosquito (Lysyk, 2010).

Culiseta melanura (Coquillett) vectors EEE (Chamberlain *et al.*, 1951). It is also a potential secondary vector of WNV (Molaei and Andreadis, 2006). It is not common in Missouri (McCauley *et al*., 2000).

Genus *Orthopodomyia*. This genus is represented by two very similar species in central Missouri. Both are treehole mosquitoes and neither is known to feed on mammals. *Orthopodomyia alba* Baker and *Orthopodomyia signifera* (Coquillett) are both specialists on wooden cavities such as tree holes or occasionally rain barrels (Dyar, 1928; Jenkins and Carpenter, 1946), and neither is known to vector any diseases.

Genus *Psorophora*. This genus contains several of the largest and most colorful mosquitoes found in central Missouri. Although fearsome in appearance and with painful bites, few of these mosquitoes are known vectors of arbovirus. Those implicated in arthropod-borne disease are discussed first.

Psorophora columbiae (Dyar and Knab) is implicated in the transmission of WNV (Bolling *et al.*, 2005). This moderately large mosquito may have some association with cattle facilities, and there is at least one recorded instance of swarms of *Ps. columbiae* killing cattle (Bishop, 1933). *Psorophora discolor* (Coquillett) was implicated in an outbreak of Venezuelan equine encephalitis (VEE) in 1971 (Sudia *et al.*, 1975). This mosquito is always connected with livestock (cattle, hogs, horses, and mules) (Whitehead, 1951). *Psorophora ferox* (Humboldt) has demonstrated laboratory infection with West Nile virus (Kulasekera *et al.*, 2001).

Psorophora ciliata (Fab.) is the "gallinipper" of historical reference (Siverly, 1972). It is a very large mosquito with no known disease associations. It is predaceous on other mosquitoes while in its larval stage (Dyar, 1928), as is *Psorophora howardii* Coquillett, another very large, medically benign mosquito indistinguishable from *Ps. ciliata* in the adult stage except in details of the proboscis. *Psorophora cyanescens* (Coquillett), *Psorophora horrida* (Dyar and Knab), and *Psorophora signipennis* (Coquillett) are not known vectors of any disease, however, like many of their congeners, they are persistent, painful biters (Carpenter and LaCasse, 1955; McCauley *et al*., 2000).

Genus *Toxorhynchites*. Only *Toxorhynchites rutilis septentrionalis* (Dyar and Knab) is present in Missouri as a representative of this genus. These mosquitoes are predatory in the larval stage (Dyar, 1928) and are not blood feeders as adults (Jenkins and Carpenter, 1946), and thus do not vector any diseases.

Genus *Uranotaenia*. This genus is represented in central Missouri by a single species, *Uranotaenia sapphirina* (Osten-Sacken). This mosquito is not implicated in any arbovirus transmission. They rarely bite man, and are probably cold-blooded animal feeders (Cupp *et al*., 2004a). They are very small and have iridescent sapphire scales.

Landscape Associations. This study seeks to examine the landscape associations of the mosquitoes of central Missouri. Landscape ecology is the study of the structure, function, and rate of change of the medley of interacting ecosystems occupying a landscape spatially and temporally (Forman, 1983). This scientific discipline addresses large-scale questions about the environment and land management, defines ecological models pertaining to scale, and takes advantage of the rapidly increasing availability of spatial data in order to quantify landscapes (Turner *et al*., 2001).

Forman (1995) proposed a functional model to explain landscape map elements, called the patch-corridor-matrix model. Patches are the basic element of a landscape mosaic (Urban, *et al.*, 1987). Patches are dynamic in nature, and the environmental character assigned to a given patch is entirely dependent on the scale at which the patch is viewed. A patch should be defined at a scale relevant to the phenomenon under study (Wiens, 1976). However, there are practical limits to the ability of defining patches, and for this research, the finest level of patchiness, or grain, evaluated and employed was that available with the mapping program being used, from the Center for Applied Research and Environmental Systems (CARES, 2010).

Corridors are a specific type of patch, elongate in nature, sometimes several grain-widths long but as little as a single grain-width wide. Some authors consider corridors to functionally channel dispersal or conversely, to obstruct movement (Forman and Godron, 1986), thus distinguishing them from simple patches. It was beyond the scope of this research project to consider the role of corridors in the spatial contour of mosquito abundance, and care was taken not to utilize corridors for sampling sites.

Since landscapes are composed of a mosaic of patches, an interconnected matrix of similar patches is usually discernable. Since the matrix represents the greatest extent of landscape elements, it plays the dominant role in regulating the landscape (Forman and Godron, 1986).

As noted previously, studies in landscape ecology must be scaled in such a way as to be appropriate for the system being studied. Thus, in researching the effects of landscape pattern on mosquito abundance and diversity, it is paramount to consider the operating scale of the mosquito when defining the landscape. Mosquito flight ranges are extremely variable, ranging from just a few yards from their larval habitat for most urban and woodland species, up to as many as 30 miles for some floodwater species. Such a discontinuous set of characteristics makes flight range a poor variable for determining the operating scale of mosquitoes on a landscape basis. The reason for such extremely long flight ranges is the search for a suitable host. Therefore, the placement of artificial hosts (CDC mini-light traps baited with CO_2) within the landscape matrices and patches to be studied should make the effective range of these traps an important factor in determining the scale of definition for landscape characterization.

The range of CO_2 attractiveness is rather short (perhaps < 30 m) and species dependent (Service, 1993). The attractive range of light is somewhat longer and similarly species dependent, but at very short distances (< 1 m), may act as a repellent to crepuscular insects. However, most mosquitoes are poor fliers and cannot avoid being sucked into the trap by the fan. The attractive ranges of light and CO_2 are thus somewhat ambiguous, but should be sufficient to attract mosquitoes within at least 50 m. In order to avoid bias in determining landscape character, the grain size or the finest level of spatial resolution available should be 20 – 50% of the size of the spatial features being analyzed, and the extent of the map or size of the study area two to five times larger than the largest patches (O'Neill *et al.*, 1996).

Many studies have found that the effect of the surrounding landscape (the "matrix") exerts more control over the composition of a community than the individual location itself (the "patch"). However, these studies were conducted with highly mobile, large organisms: birds (Pearson, 1993; Bolger *et al.*, 1997), arboreal marsupials (Lindenmayer and Nix, 1993), and large ungulates (Pearson *et al.*, 1995). These animals may be able to exploit much larger regions of their landscape, thus encountering high proportions of the matrix. Smaller animals with relatively poorer mobility (*e.g.*, mosquitoes) may operate at a much finer scale, making the patch a more crucial attribute in explaining species composition and abundance.

Several studies have attempted to correlate landscape parameters with mosquito community structure. In a few studies conducted in Sweden, mosquito diversity increased with decreasing latitude, independent of forest cover type (Schäfer and Lundström, 2001); mosquito larvae increased in abundance in areas with high forest cover and high percentage of temporary pools (Schäfer *et al.*, 2006), while diversity was positively related with permanent water and low forest cover; and mosquito abundance and richness were not different among three wetland types (Schäfer *et al.*, 2008). These studies tended to focus on specific landscape types (forest and wetlands) and did not characterize patches within these landscapes.

A study conducted in Thailand observed that both abundance and diversity of mosquitoes were greater in forested areas than in agricultural landscapes (Overgaard *et al.*, 2003). The research further indicated that as landscape heterogeneity decreased, species diversity among the species being studied also decreased.

Research conducted in eastern Iowa wetlands, floodplains, and bottomland forests all exhibited a positive effect on mosquito counts (DeGroote *et al.*, 2007). This study did not address the finer scale (*i.e.*, patches) of the landscapes.

<u>*Abiotic Factors*</u>. Seasonal population dynamics for mosquitoes collected with CO_2-baited CDC traps differed among landscape types in Croatia (Bogojević *et al.*,

2009). This study also concluded that water levels in nearby rivers were a correlate to population dynamics and seasonality.

The effect of abiotic factors (here loosely described as weather) on mosquito abundance may seem intuitive; warm weather and rainfall will have a positive, if temporally delayed effect; wind and rainfall will have immediate negative effects. However, the actual body of published research is more ambiguous.

Temperature can have positive effects on mosquito activity, thus increasing abundance, but these effects differ greatly among species (Clements, 1999). Rain sometimes causes a decline in capture rate (Sharp, 1983), but for many species, rain, even heavy rain, had no effect on host-seeking behavior (Mattingly, 1949; Bertram and McGregor, 1956; Chadee and Tikasingh, 1989). Rainfall is important because it acts to create or maintain breeding habitat. However, its usefulness in long-term forecasting of mosquito abundances is a subject of debate (Wegbreit and Reisen, 2000; Mokany and Mokany, 2006; Walsh *et al.*, 2008). Wind is a complicated phenomenon that has variable, and generally negative, effects on mosquito flight capability, particularly at speeds above 1 meter/second (approximately 2.2 miles/hour) (Gillies and Wilkes, 1981). There is no definitive published information on the influence of total solar radiation on mosquito abundance and behavior. Insolation acts to warm the earth, thus creating temperature increases, and in the absence of rain, augments reduction of mosquito breeding habitat. The complexity of the relationship of total solar radiation to mosquito population dynamics makes it an important variable for study.

It is possible for the spatial incidence of arboviruses to be predicted by the occurrence of vectors and from landscape characters influencing the abundance of these vectors, as well as environmental elements exerting control over them (Eisen and Eisen, 2008). Describing the dynamics of mosquito species based on rainfall and temperature data has been attempted and has been somewhat successful (Clarke and Wray, 1967; Eisenberg *et al.*, 1995; Scott *et al.*, 2000). The biology of mosquitoes intimates that the effects of weather characteristics extend over a range of time rather than a single point (Evans, *et al.*, 1987; Shone *et al.*, 2006).

MATERIALS AND METHODS

The selection of sampling sites in this study depended on the location of certain types of patches (an area distinct in nature from the surroundings) within a matrix (the predominant type of land cover, typified by widespread, highly connected landscape elements). Samples were also taken from within matrices at locations that were not different in character from the surroundings, and were designated simply “matrix” in comparison to patches within matrices. In this study, 415 samplings from 134 trapping locations were utilized (Appendix A).

The collection sites were selected based on land cover designations determined by the Center for Applied Research and Environmental Systems (CARES, 2010) and ground truthed by visual inspection of the sites (*e.g.*, Figure 1). Both private and public properties were utilized for the study. A Garmin GPS V (Garmin Corporation, Olathe, Kansas) was used to verify and record the geographic coordinates of each trapping site.

The landscape types and descriptions used in this study are based on the land cover designations given by the Missouri Landcover Metadata from the NOAA Metadata Manager's Repository (NMMR, 2010). Five different landscape types were used, some of which were a combination of more than one land cover class. These landscapes were:

1) Urban – including

a) impervious (“non-vegetated, impervious surfaces. Areas dominated by streets, parking lots, buildings. Little, if any, vegetation”),

b) high intensity urban (“Vegetated urban environments with a high density of buildings”), and

c) low intensity urban ("Vegetated urban environments with a low density of buildings");

2) Cropland

a) "Predominantly cropland (including row, close-grown, and forage crops)";

3) Grassland

a) "Grasslands (dominated by native warm season or non-native cool season grasses)";

4) Forest, including

a) deciduous forest ("Forest with greater than 60% cover of deciduous trees"),

b) evergreen forest ("Forest with greater than 60% cover of evergreen trees"), and

c) mixed forest ("Forest with greater than 60% cover of a mixture of deciduous and evergreen trees"); and

5) Wetland, including

a) woody-dominated wetland ("Forest with greater than 60% cover of trees with semi-permanent or permanent flood waters"), and

b) herbaceous-dominated wetland ("Woody shrubland with less than 60% cover of trees with semi-permanent or permanent flood waters")

Two land cover types identified in CARES were not suitable for study in this research. These were 1) open woodland, described as "open woodland (including young woodland) with less than 60% cover of deciduous (or evergreen) trees", and 2) open water, described as “rivers, lakes, ponds, and other open water areas”. Open woodland does not exist in enough continuous land surface to constitute a landscape matrix in central Missouri. Similarly, open woodland patches were unsuitable for use because of inaccessibility or location on private land, and also could not be found in conjunction with all necessary types of matrix. In addition, open water could not be sampled due to the nature of the sampling technique.

The most appropriate scale for defining matrix type would be a grain size of approximately 25 linear meters and, given that the average of the largest patch size of the matrices investigated was 260 linear meters, the most appropriate extent would be at least 520 linear meters. Since a grain size of 68 linear meters is the finest resolution available with the CARES mapping program, the minimum size for the feature being analyzed (*i.e.*, the ability of the mosquito to perceive the CDC mini-light trap) is 136 linear meters, not an unreasonable expectation given the data available on the efficacy of these traps (Service, 1993). A scale of 1:4000 was used to determine the nature of the matrix in a given study area. This scale equates to 540 linear meters and would fulfill the guidance given by O’Neill *et al.* (1996) for map extent.

Adult mosquito collection was performed using CDC mini-light traps (J.W. Hock, Gainesville, Florida) augmented with insulated “Thermos” type containers filled with CO_2 in the form of dry ice and perforated to allow the dry ice to be emitted as an attractant (Figure 2). Distribution of the CO_2 was accomplished by the trap’s fan, as well as any ambient air currents. Traps were always deployed before dusk of each sampling date, and retrieved no sooner than dawn of the following day. Each trap was labeled with site identification upon retrieval and placed in a dry ice-filled container to both kill the specimens and preserve them prior to taxonomic examination. Specimens were stored in a freezer if long-term storage (>24 hour) was necessary before taxonomic examination could be performed. Specimens were identified using a dissecting microscope according to the dichotomous keys and descriptions found in Taylor (1988); Harrison and Whitt (1996); and Darsie and Ward (2004). Voucher specimens were retained at the Enns Entomology Museum at the University of Missouri in Columbia, Missouri.

Weather data were obtained from the Agricultural Electronic Bulletin Board (AgEBB, 2010). AgEBB is sponsored by the University of Missouri and represents a collaboration of faculty, staff, farmers, extension specialists, the Missouri Departments of Agriculture and Conservation, and the Missouri Agricultural Statistics Service. Mean values for pertinent weather variables were calculated for each day during the study and used in multiple regression and canonical correspondence analysis.

Multiple regression analyses were employed to determine the relationship between several weather variables and the abundance of mosquitoes occurring in the various common central Missouri landscape matrices during 2007 – 2009. Each matrix was evaluated separately, since the mosquito taxa assemblages in each were shown to be only distantly related (see cluster analyses, Figures 3 and 4). The weather measures used were average high temperature (ºF), total rainfall (inches), average total solar radiation (MJ/m^2), and average maximum wind speed (miles per hour). Each of these four factors was compared against abundances of mosquitoes on the day of sampling, and for time periods encompassing 7, 14 and 30 days prior to sampling. Each of the weather measurements was considered to be independent, for two reasons. First, mosquito life cycles, averaging roughly 14 days, fall within the span of the 30 days of weather measurements. Second, the environmental factors affecting mosquito development and abundance are complex and may have different periodicities (*i.e.*, some environmental factors are more important on the day they occur, while others are more important for their cumulative effect). This approach is in agreement with the conclusions of recent research on weather's influence on mosquito populations (Curriero, *et al.*, 2005; Shone *et al.*, 2006; Walsh *et al.*, 2008). Variables that were determined to be collinear (*i.e.*, bivariate correlation ≥ 0.7) were not used in given multiple regressions. If significant results are obtained for the correlation of certain weather variables and mosquito abundances, these analyses may represent a model by which future mosquito activity can be predicted.

Multiple regression analyses were also employed to determine model equations that related several weather variables and the abundance of mosquitoes occurring in the various common central Missouri landscape matrices during 2007 – 2008. These equations were then used with the measured weather variables in 2009 to predict the 2009 abundances of total mosquitoes, *Ae. vexans*, *Cx. erraticus*, and *Cx. salinarius*. Each matrix was evaluated separately. The weather measures used were average high temperature, total rainfall, average total solar radiation, and average maximum wind speed, for time periods encompassing 7, 14 and 30 days prior to sampling. Variables that were determined to be collinear were not used in given multiple regressions. If significant results were obtained for the correlation of weather variables and mosquito abundances, the equations resulting from the multiple regressions were used to predict mosquito abundances. A prediction was considered successful if 1) the predicted value was ≤ 0 and the measured value (mosquitoes collected) was 0, or 2) the predicted value was a positive number and the $\log_{10}$ of the predicted value and the $\log_{10}$ of the measured value agreed within 0.5 units of $\log_{10}$.

Lastly, multiple regression was used to determine model equations that related weather variables and mosquito abundance in the common central Missouri landscape matrices during 2007, with the resulting equations used with the measured weather variables in 2008 to predict the 2008 abundances of total mosquitoes, *Ae. vexans*, *Cx. erraticus*, and *Cx. salinarius*. The same weather measures, multiple regression equation evaluations, and definitions of predictive success were used for these analyses as were used to evaluate the 2007 – 2008 data multiple regressions and 2009 predictions.

Canonical correspondence analyses (CCAs) were employed to maximize correlations of mosquito taxa abundances with total rainfall, maximum temperature, total solar radiation, and maximum wind speed (Figures 15 – 18). Unlike multiple regression, where each individual mosquito abundance and weather measure was used to calculate correlation, CCA used mean abundance per trap per month and mean weather measurements per month. Thus, both taxa and environmental data are grouped by month. The environmental data for the current month and the previous month were both used in CCA. It was not possible to characterize wetland data using CCA, because the number of "sites", in this case, months for which data were averaged, must be greater than or equal to the number of environmental variables. For the wetland matrix, only five months of sampling existed, whereas there were eight environmental variables.

ANALYSES

An arbitrary abundance rating was calculated based on the mean number of mosquitoes of a given taxon collected per trap. A mean abundance of > 100 per trap was defined “very abundant”; approximately 10 – 100, “abundant”; approximately 1 - 10, “common”; approximately 0.1 – 1, “uncommon”; and < 0.1, “rare”.

Mosquito taxa richness, diversity and evenness were calculated for each matrix and each patch within all matrix types. Diversity was represented by two factors: the Shannon index, designated H’ (Krebs, 1989), and Simpson’s reciprocal index, designated 1/D (Simpson, 1949). These calculations were performed from algorithms available online (Changbioscience, 2010).

Pearson’s correlation matrix (Pearson, 1920) was calculated and was useful in characterizing the co-occurrence of mosquito taxa in all samples, as well as the relative proportionality of those co-occurrences. The Pearson’s correlation matrix was calculated using MYSTAT version 12.02.00 (Systat Software Inc., Chicago, Illinois).

Hierarchical cluster analyses with single linkage and chi-square distances were performed on all matrices regardless of patch and on all patches within matrices. The goal of these analyses was to assess the similarities among patches or among matrices in order to elucidate the relative powers of the patch and the matrix in regard to control over mosquito taxa assemblage. Cluster analyses were performed using MYSTAT version 12.02.00 (Systat Software Inc., Chicago, Illinois).

Multiple regression analyses were performed to determine the amount of variation in mosquito taxa composition (abundance and richness) accounted for by various environmental variables (rainfall, temperature, total solar radiation, and wind). Multiple regression analyses were performed using the data analysis tool available in Microsoft Excel.

Canonical correspondence analyses (CCAs) were performed to maximize correlations of mosquito taxa abundances with a suite of environmental variables (again, rainfall, temperature, total solar radiation, and wind). CCAs were performed using PCORD for Windows, version 4.10 (MjM Software Design, Gleneden Beach, Oregon).

RESULTS

Community description

The data collected from this research establish a well-characterized baseline of the mosquito taxa of central Missouri. Altogether, 148 sample sites located in five central Missouri counties (Audrain, Boone, Callaway, Cooper, and Howard) were utilized for sampling, with 102,363 individual female mosquitoes collected during this study. Of those mosquitoes collected, 99,301 (97%) were identified, representing 36 taxa (Table 1). The remainder of the specimens (3%) could not be identified due to morphological damage.

Aedes vexans was clearly the dominant mosquito during the course of this research, making up nearly 67% of all individual mosquitoes collected. *Culex erraticus* (8.8%) and *Cx. salinarius* (4.6%) were also very abundant throughout the study. Other mosquito taxa that composed greater than 1% of the total individual mosquitoes collected were *Ae. sticticus* (4.3%), *Ae. trivittatus* (3.9%), *Cq. perturbans* (2.0%), *Ae. cinereus* (1.8%), *Ps. horrida* (1.3%), *An. punctipennis* (1.2%), and *Ae. canadensis canadensis* (1.1%).

Of the 39 mosquito taxa with ranges extending into central Missouri (Darsie and Ward, 2004), 32 were collected in this study. The seven taxa with ranges extending into central Missouri that were not collected were *Ae. hendersoni*, *An. barberi*, *Cx. territans*, *Cs. impatiens*, *Cs. melanura*, *Tx. rutilis septentrionalis*, and *Ps. signipennis*.

Collections included four taxa which were not expected to be found in the region of study: *Aedes aurifer* (Coquillett), *Ae. zoosophus*/*Ae. triseriatus* hybrid, *Ae. sollicitans*

(Walker), and *Ae. epactius* Dyar and Knab. Of these, only *Ae. aurifer* was collected in substantial numbers.

A Pearson's correlation matrix was calculated from all data in this study (Table 2, Appendix B). This analysis provides a measure of the proportionality and co-occurrence of taxa. Eleven pairs of mosquito taxa with correlations of < 0.5 were found to co-occur. These co-occurrences may imply a similarity in habitat or nutritional requisites, or a temporal coincidence. Co-occurrence coupled with a specific proportionality may indicate a measure of relative competitive success between taxa for resources.

<u>Landscape associations</u>

The characterization of mosquito taxa richness (S) and diversity in the five landscape (matrix) types, as well as in each patch type within each matrix, were determined (Tables 3 – 7). Most matrices had values of S that were roughly equivalent. Grassland matrix had the highest number of taxa, with S = 31, followed by cropland (30), forest (29), and wetland (27). The urban matrix had the least number of taxa with S = 23. Abundances (A) were much more disparate among matrices than S, with the wetland matrix containing far more mosquitoes per trap (1,377) than any other matrix. Cropland, forest, and grassland ranked next in terms of A with 317, 169, and 146, respectively. In the urban matrix, A = 38.

Diversity values indicate that the forest matrix is the most diverse, regardless of which measure (H' or 1/D) is used. The urban matrix was the next most diverse, followed by grassland and cropland. The wetland matrix was considerably less diverse than any other matrix. Ranking of matrices according to evenness was the same as that for diversity.

Patches with the highest mosquito taxon richness (S) were grassland patches on cropland matrix and forest patches on grassland matrix, each with S = 26. The poorest values for S were found in cropland patches on grassland matrix (S = 7), and urban patches on forest matrix (S = 10). Six of the seven lowest patch S values were found in urban or forest matrix. The highest average S (20) was found in the wetland patches; this matrix also had the least variation among patches, with a standard deviation < 2. The lowest average S (15) was found in the urban matrix, and this matrix's patches were also relatively invariable, with a standard deviation also < 2. Patches on cropland and grassland matrices average 19 ± 3.6 and 19 ± 3.4, respectively. Patches on forest matrix averaged S = 17, and were the most variable (standard deviation = 4.9).

Patches with the highest mosquito abundance (A) were all within wetland matrix, including all four patches with mean abundances per trap > 1,000 mosquitoes. The highest individual mean abundance per trap occurred in wetland matrix (*i.e.*, the location was not part of a patch of different landscape character), where A = 2,382. This mean abundance per trap was more than twice as high as any of the patch types in wetland matrix, contributing to the fairly high standard deviation and variability for A on this matrix. The patches with the lowest A were in urban matrix. The two lowest, and four of the lowest five, values for A were within this matrix. Only wetland patch on urban matrix, with A = 296, was atypical of this trend. Wetland patch on urban matrix explains the high degree of variation in A for patches on urban matrix, with the standard deviation actually exceeding the mean. For all other matrices, mean abundances for each patch type were 481 ± 193 for cropland, 196 ± 46 for forest, and 129 ± 59 for grassland.

Mean diversity values for patches in forest matrix were greater than all other matrix types, regardless of which measure (H’ or 1/D) is used. Patches on urban matrix were the next most diverse, followed by patches on grassland and cropland matrices. Patches on wetland matrix were the least diverse. Ranking of matrices according to evenness was the same as that for diversity. Examining individual patch-matrix diversity shows that the most diversity is found in the forest matrix (H’ = 1.837, 1/D = 4.497), with slightly higher diversity than grassland patch in urban matrix (H’ = 1.719, 1/D = 4.316). Other observations with fairly high (1/D > 3) diversity were: grassland patch in cropland matrix (H’ = 1.636, 1/D = 3.723); cropland patch in forest matrix (H’ = 1.685, 1/D = 3.514); urban patch in forest matrix (H’ = 1.476, 1/D = 3.256); wetland patch in forest matrix (H’ = 1.542, 1/D = 3.420); and wetland patch in grassland matrix (H’ = 1.792, 1/D = 3.729). Patches with the lowest diversity values were often associated with wetland matrix. The four least diverse patches in any matrix type were: wetland matrix (H’ = 0.533, 1/D = 1.239); urban patch in cropland matrix (H’ = 0.625, 1/D = 1.338); grassland patch in wetland matrix (H’ = 0.836, 1/D = 1.461); and wetland patch in urban matrix (H’ = 0.973, 1/D = 1.710).

Ranking patches within different matrices according to evenness (Table 7) gave the same qualitative results as that for diversity (Table 6). The highest to lowest ranked evenness values for each matrix were: patches on forest matrix, followed by urban, grassland, cropland, and wetland matrices. The highest evenness for a given patch occurred within cropland patches in forest matrix (E = 0.657). Three other patches with E > 0.6 were: grassland patch in urban matrix (E = 0.651); urban patch in forest matrix (E = 0.641); and wetland patch in grassland matrix (E = 0.608). Only three patches had

E < 0.3: wetland matrix (E = 0.173); urban patch in cropland matrix (E = 0.221); and grassland patch in wetland matrix (E = 0.279).

Each matrix was made up of its own unique assemblage of mosquito taxa (Table 8). In cropland matrix, 21,211 individual mosquitoes were collected. Of these, 20,451 (96%) were identified, representing 30 taxa. *Aedes vexans* was the dominant mosquito on cropland, making up 64% of all mosquitoes collected from that matrix. *Culex salinarius* (12.5%) was also very abundant on cropland. Other taxa that composed greater than 1% of the mosquitoes collected in cropland matrix were *Cx. erraticus* (6.2%), *Ae. trivittatus* (5.3%), *Ae. sticticus* (4.8%), and *Ps. horrida* (2.1%).

In forest matrix, 8,794 individual mosquitoes were collected. Of these, 8,500 (97%) were identified, representing 29 taxa (Table 8). *Aedes vexans* was the dominant mosquito in forest matrix, making up 38% of all mosquitoes collected from that matrix. *Culex erraticus* (26.6%) and *Ae. trivittatus* (11.4%) were also very abundant in forest matrix. Other taxa that composed greater than 1% of the mosquitoes collected in forest matrix were *Ae. sticticus* (8.2%), *An. punctipennis* (3.5%), *Cx. salinarius* (2.7%), *Cx. pipiens* group (2.5%), and *Ae. canadensis canadensis* (1.4%).

In grassland matrix, 22,892 individual mosquitoes were collected. Of these, 22,364 (98%) were identified, representing 31 taxa (Table 8). *Aedes vexans* was the dominant mosquito in grassland, making up 62% of the mosquitoes collected from that matrix. *Culex erraticus* (18.4%) was also very abundant in grassland matrix. Other taxa that composed greater than 1% of the mosquitoes collected in grassland matrix included *Ae. canadensis canadensis* (4.1%), *Cx. salinarius* (3.9%), *Ps. horrida* (1.9%), *An. punctipennis* (1.6%), *Ae. trivittatus* (1.4%), *Ae. sticticus* (1.1%), and *Ps. ferox* (1.0%).

The grassland matrix was the only matrix in which *Aedes grossbecki*, *Ae. epactius*, and *Or. alba* were collected. The latter two species were represented by a single specimen each. The *Ae. grossbecki* specimens were collected from a narrow range of sites and dates. All were collected in either 2008 or 2009, between the dates of April 25 and June 19. Although specimens of *Ae. grossbecki* were found at seven different sites, all the sites were in east-central Boone county within a 1 mi^2 area. The *Ae. epactius* specimen was collected on September 5, 2008 from the "Rainbow" site (Appendix A), in grassland matrix. The *Or. alba* specimen was collected June 18, 2009, from the "SCWWGR" site (Appendix A), a wetland patch in grassland matrix.

In urban matrix, 4,015 individual mosquitoes were collected. Of these, 3,881 (97%) were identified, representing 23 taxa (Table 8). *Coquillettidia perturbans* was the dominant mosquito in urban matrix, making up 42% of the mosquitoes collected. *Aedes vexans* (28.8%) and *Cx. salinarius* (10.3%) were also very abundant in urban matrix. Other taxa that composed greater than 1% of all mosquitoes collected in urban matrix included *Cx. pipiens* group (4.8%), *Ae. trivittatus* (4.4%), *Cx. erraticus* (2.0%), *An. punctipennis* (1.8%), and *Ae. albopictus* (1.0%).

The urban matrix was the only landscape in which *Or. signifera* was collected. Three specimens were collected on July 11, 2007 from the "Sanborn Trail" site (Appendix A), which represented urban matrix.

It should be noted that two samples, from sites "BGWWUU282" and "BGWWUU283", both on June 8, 2009 (Appendix A), contained a combined total of 1,494 specimens of *Cq. perturbans*. These sites were near some of the characteristic breeding sites for this species (*i.e.*, shallow ponds with a great deal of submerged vegetation). If these sites are removed from the urban matrix totals, *Ae. vexans* becomes the dominant mosquito in this matrix as well, with 50% (1,010 of 2,021) of all mosquitoes collected from urban matrix.

In wetland matrix, 45,451 individual mosquitoes were collected. Of these, 44,105 (97%) were identified, representing 27 taxa (Table 8). *Aedes vexans* was the dominant mosquito in wetland matrix, making up 79% of the mosquitoes collected. Other taxa that composed at least 1% of the mosquitoes collected in wetland matrix include *Ae. sticticus* (5.3%), *Ae. cinereus* (3.5%), *Ae. trivittatus* (3.1%), *Cx. erraticus* (2.4%), *Cx. salinarius* (1.2%), and *Ps. horrida* (1.0%).

Of the 38 specimens of *An. walkeri* taken in this study, 37 were collected in wetland matrix. Thirty-two of these specimens were collected from site "DBUUWW1" (Appendix A) on a single evening (June 18, 2009).

For individual patches on cropland matrix (Table 9), *Ae. vexans* was always the dominant mosquito, with only the grassland patch having some degree of evenness (E = 0.502, Table 7). Besides *Ae. vexans*, only *Cx. salinarius* and *Ae. sticticus* were present in all patch types within this matrix at levels greater than 1%.

For patches in forest matrix (Table 9), *Ae. vexans* was the dominant mosquito in all but forest matrix, where *Cx. erraticus* was dominant (36%) and was followed by *Ae. vexans* (25%). All patches in forest matrix were distinctly more even than almost any other patches in the study, usually with three or four taxa making up at least 10% of the total mosquitoes collected. The only exception to this trend was for grassland patches in forest matrix, which were nearly evenly split between *Ae. vexans* (46%) and *Cx. erraticus* (41%). Other patches in forest matrix with taxa composing at least 10% of the total were:

cropland patches with *Ae. vexans* (49%), *Cx. salinarius* (14%), *Ae. trivittatus* (12%), and *Cx. erraticus* (10%); forest matrix with *Cx. erraticus* (36%), *Ae. vexans* (25%), *Ae. trivittatus* (11%), and *Ae. sticticus* (10%); urban patches with *Ae. vexans* (46%), *Cx. salinarius* (27%), and *Ae. trivittatus* (14%); and wetland patches with *Ae. vexans* (45%), *Ae. trivittatus* (23%), and *Ae. sticticus* (18%).

For individual patch types on grassland matrix (Table 9), *Ae. vexans* was always the dominant mosquito. Grassland matrix was the most even, with *Ae. vexans* (45%) and *Cx. erraticus* (42%) close in total abundance. There were no patches on grassland matrix where *Ae. vexans* did not have at least twice as many specimens collected as any other mosquito taxon. In fact, besides *Ae. vexans*, only *Cx. salinarius*, with 28% for cropland patches in grassland matrix, and *Cx. erraticus*, with 17% for wetland patches in grassland matrix, exceeded 10% of the total mosquitoes collected for any patch in any matrix.

For individual patch types on urban matrix (Table 9), *Aedes vexans* was the dominant mosquito in three of the five patch types: cropland (49%); forest (67%); and urban matrix (55%). For grassland patches in urban matrix, *Cx. salinarius* was the dominant mosquito with 33% of all identified mosquitoes. For wetland patches in urban matrix, *Cq. perturbans* was dominant, with 76% of all identified mosquitoes.

Overall, some patch types in urban matrix were among of the most even assemblages sampled. Almost all (94%) the mosquitoes from cropland patches in urban matrix were three species: *Aedes vexans* (49%), *Cx. salinarius* (27%), and *Cq. perturbans* (18%). Grassland patches in urban matrix also contained a very even assemblage of mosquitoes. The three most abundant mosquito taxa were *Cx. salinarius* (33%), *Ae. vexans* (25%), and *Cx. pipiens* group (23%). Urban matrix had *Ae. vexans*

(55%) and *Cx. pipiens* group (15%) as the two most abundant taxa. Only forest patches in urban matrix, with 67% *Ae. vexans* and no other taxon > 7%, and wetland patches in urban matrix with 76% *Cq. perturbans* and no other taxon > 7%, did not follow this trend.

As already noted, wetland matrix had the least diverse and least even mosquito assemblages of all matrix types sampled. Patches of any type in wetland matrix generally support these results (Table 9). *Aedes vexans* was always the dominant mosquito, regardless of patch type, ranging from 55% of all identified mosquitoes in urban patches to 90% in wetland matrix. Besides *Ae. vexans*, only *Ae. sticticus* (20%) from cropland patches and *Ae. cinereus* (16%) from urban patches, constituted more than 10% of all mosquitoes collected.

Cluster analyses were performed to assess the similarities among assemblages of mosquito taxa in different matrices and different patch-matrix combinations. Cluster analysis indicated that none of the matrices clustered together very closely (Figure 3). This is evidence that each landscape supports a distinct assemblage of mosquito taxa. The matrix with the least similarity to all others was wetland, while the triad of cropland, grassland, and forest shared the most similar assemblages of mosquito taxa.

The outcome of cluster analysis for all patch-matrix combinations roughly confirms that for the matrix-only cluster analysis (Figure 4). The most dissimilar patch-matrix combination was wetland patch-wetland matrix. Landscapes that contained wetland elements, whether as the matrix or a patch within another matrix, were more dissimilar to other groupings, indicative of the influence of wetlands on the mosquito community. Indeed, the eight most dissimilar landscapes in the cluster analysis all contained wetland elements.

Conversely, the patch-matrix combinations that clustered with the most similarity tended to be those associated with urban and grassland habitats. The most similar cluster was the grouping of urban matrix with forest patch-urban matrix. These two patch-matrix combinations were part of a closely related quintet in the cluster analysis, also containing urban patch-grassland matrix, cropland patch-grassland matrix, and cropland patch-forest matrix.

Temporal dynamics

The abundance per trap of all mosquitoes in all matrices combined for the study period (2007 – 2009) indicate that mosquito abundances followed a discernable pattern, with an early season peak during May or June, followed by a decline during July and resurgence during August (Figure 5). After August, mosquito abundances behaved incongruously according to the year of sampling. Abundances were always lower for any given month during 2008 than in either 2007 or 2009.

Cropland matrix. The patterns of mosquito abundance in cropland matrix over the study period indicate the month of highest abundance is August (Figure 6). This is a generalized conclusion, since a specific year's data may not strictly follow this pattern. For example, during 2007, abundance per trap during July was slightly higher than during August, and during 2009, the abundance per trap was slightly higher during September than during August.

Overall, 13 mosquito taxa were identified from cropland matrix during 2007 (Table 1), including the uncommon *Ps. discolor*, represented by only three specimens collected at site "Audrain weather" on July 13 (Appendix A). During 2007, *Ae. vexans* and *Cx. erraticus* followed very similar patterns of abundance, with the exception that during October, *Cx. erraticus* abundance waned to nearly zero, while *Ae. vexans* remained relatively abundant. *Culex salinarius*, which was the third most abundant mosquito on cropland during 2007, surged in abundance during October to become the dominant mosquito for that month.

Altogether, 15 mosquito taxa were identified from cropland matrix during 2008 (Table 10). Among these was one specimen of *Ae. sollicitans*. The range of this species was not known to extend into central Missouri, and this specimen, collected from site "AUNW" on September 27 (Appendix A), was one of only four collected during this study.

For 2008, *Ae. vexans*, *Cx. erraticus*, and *Cx. salinarius* had parallel patterns of abundances throughout the year. Each species was at its highest abundance for 2008 during August.

In total, 27 mosquito taxa were identified from cropland matrix during 2009 (Table 10). Among these, several were not common: *Aedes dorsalis*, with four specimens collected from site "EBCRCR286" (Appendix A) on May 28 (only six specimens were collected during the entire study); *Ae. nigromaculis*, with one specimen of only six total for the study, collected from site "CVCRCR2" (Appendix A) on July 2; the *Ae. zoosophus*/*Ae. triseriatus* hybrid, with a single specimen (of the six total collected in the study) collected on August 15 from site "EBUUCR289" (Appendix A) (this hybrid was previously unknown from central Missouri); *An. walkeri*, with the only specimen (of 38 total collected in the study) that was not collected from wetland matrix, taken on cropland from site "EBWWCR1" (Appendix A) on May 28; and *Ps. howardii*, with one specimen (of 14 total collected during the study) taken on May 21 from site "CVGRCR" (Appendix A).

During 2009, *Ae. vexans* was the most abundant mosquito collected in every month. *Culex salinarius* abundance followed a comparable pattern to that exhibited by *Ae. vexans* throughout the year, while *Ae. trivittatus*, the second most abundant mosquito during May and June, declined after that until it was not found during August or September.

Aedes vexans abundances on cropland tended to follow a pattern of relatively high density during May and June, a decrease during July and a return to high numbers during August and September. This pattern is clear from 2008 – 2009. During 2007, July abundances appeared to be higher than subsequent months, until a sharp increase on October.

Culex erraticus abundances seemed to have a distinct pattern, with a gradual rise in numbers from May through July, a peak during August, and a decline of variable steepness from September onward.

The mean abundance of *Cx. salinarius* on cropland gradually increased throughout the year, peaking during July or August, but without a strong decrease in abundance after the peak.

Most patches on cropland matrix are similar in abundance early in the year, (late April), followed by a decline until late June (Figure 7). Most of the patches on cropland matrix then surged sharply higher by the end of July, and held at these levels through the end of August.

Two types of patches behaved differently than in this description. First, the abundance per trap for grassland patches on cropland matrix increased rather than declined during June, then increased only slightly during July. Abundances per trap for these patches were always lower than for any other patches on cropland matrix from late July until the end of the season. Second, the abundance per trap for wetland patches on cropland matrix increased through late May, followed by a slight decrease by the end of June and a gradual resurgence until the end of August.

Overall, 18 mosquito taxa were identified from cropland matrix sites that were not of a different patch type during 2009. *Aedes vexans* was the most abundant mosquito collected in every month. *Culex salinarius* abundance followed a comparable pattern to that exhibited by *Ae. vexans* throughout the year, while *Ae. trivittatus*, the second most abundant mosquito during May and June, declined after that until it was not found during August or September. One relatively uncommon species, *Ae. nigromaculis*, was among the taxa collected from these sites in cropland matrix.

Altogether, 18 mosquito taxa were identified from forest patches on cropland matrix during 2009 (Table 10). *Aedes vexans* was the most abundant mosquito collected in nearly every month. The only exception to this trend was during June, when *Cx. salinarius* was the most abundant mosquito trapped. Otherwise, *Cx. salinarius* abundances followed a comparable pattern to that exhibited by *Ae. vexans* throughout the year, while *Ae. sticticus*, the second most abundant mosquito during May, was not collected for the rest of the year. One relatively uncommon taxon, the *Ae. zoosophus*/*Ae. triseriatus* hybrid, was among the taxa collected from forest patches of the cropland matrix.

Altogether, 13 mosquito taxa were identified from grassland patches on cropland matrix during 2007 (Table 10). *Culex erraticus* and *Cx. salinarius* abundances followed very similar patterns for July through September, but diverged during October, with *Cx. erraticus* disappearing from the list of taxa collected, and *Cx. salinarius* increasing modestly in abundance. These results are somewhat unusual in that *Ae. vexans* was typically not the most abundant mosquito trapped. *Ae. vexans* was the most abundant mosquito collected during October, but for July through September, its numbers were often well below those of *Cx. erraticus* and *Cx. salinarius*. One relatively uncommon species, *Ps. discolor*, was among the taxa collected from grassland patches on cropland matrix during 2007.

Altogether, 14 mosquito taxa were identified from grassland patches on cropland matrix during 2008 (Table 10). The species assemblage of *Ae. vexans*, *Cx. erraticus* and *Cx. salinarius* had similar abundances every month. The highest abundance for any month was for *Cx. salinarius* during August, with approximately 100 individuals per trap.

For *Ae. vexans* abundance in grassland patches on cropland matrix, 2007 was dissimilar to 2008. For example, July 2007 abundances were the highest of the summer, but July 2008 numbers were the lowest for that season. Similarly, during 2007, September abundances were the lowest of any month sampled, but during September 2008, numbers were among the highest.

Culex erraticus abundances from grassland patches on cropland matrix had a distinct pattern, with a gradual rise in numbers from May through July, a peak during August, and a decline into September and October. The mean abundance of *Cx. salinarius* from grassland patches on cropland matrix gradually increased throughout the year, peaking during July or August, but without a strong decrease in abundance after the peak.

In total, 17 mosquito taxa were identified from urban patches on cropland matrix during 2009 (Table 10). Either *Ae. vexans* or *Cx. salinarius* was the most abundant taxa found, although during July, *Ae. vexans* numbers declined to zero. The late season appearance by a slightly uncommon species, *Ae. aurifer*, made it the third most common mosquito found for these patches on cropland matrix. One relatively uncommon species, *An. walkeri*, was among the taxa also collected from this patch-matrix.

Overall, 18 mosquito taxa were identified from wetland patches on cropland matrix during 2009 (Table 10). Remarkable among these was *Ae. vexans*, with mean abundances exceeding 1,000 individuals of this species per trap during September. *Aedes vexans* was the most abundant mosquito collected in every month. *Aedes trivittatus*, the second most abundant mosquito during May and June, declined after that until it was not found during August or September, while *Cx. salinarius* abundance increase sharply during July and maintained relatively high levels through September.

<u>Forest matrix.</u> The patterns of mosquito abundance in forest matrix over the study period indicate the month of highest abundance tends to be August (Table 11, Figure 8). However, during 2009, the mean abundance per trap was highest during May, though abundances did not decline greatly after that. For the years in which samples were taken, mean abundance always declined steeply from August to September.

Ten mosquito taxa were identified during 2007 from forest matrix (Table 11). *Aedes vexans* was much less abundant than *Cx. erraticus* or *Cx. pipiens* group during August, but had replaced the *Culex* taxa in dominance by September.

Altogether, nine mosquito taxa were identified from forest matrix during 2008 (Table 11). *Culex erraticus* was the most abundant mosquito in every month except April and May. *Aedes vexans* numbers peaked twice, during June and August, while the third most dominant mosquito, *Ur. sapphirina*, had a peak that was similar in magnitude to that of *Ae. vexans*, also during August.

All totaled, 29 mosquito taxa were identified from forest matrix during 2009 (Table 11). Among these, several were not common: *Aedes dorsalis*, with four specimens collected from site "AshWWFF282" (Appendix A) on June 8 (only six specimens were collected during the entire study); *Ae. sollicitans*, with one specimen of only six total for the study, collected from site "DIGRFF257" (Appendix A) on June 25; the *Ae. zoosophus*/*Ae. triseriatus* hybrid, with a single specimen of the four total collected in the study, collected on May 7 from site "RFFFFF" (Appendix A); and *Ps. howardii*, with two specimens (of 14 total collected during the study), taken on June 25 and July 2, from sites "DIGRFF257" and "3CFFFF1", respectively (Appendix A).

During 2009, an assemblage of three *Ae.* mosquitoes (*Ae. vexans*, *Ae. sticticus*, and *Ae. trivittatus*) had similar patterns of occurrence throughout the year (Table 11). *Aedes vexans* was the most abundant mosquito in every month, but was nearly matched in number by both of its congeners during May. From that point, *Ae. sticticus* abundances declined rapidly, while *Ae. trivittatus* numbers waned more slowly, actually even rebounding to approximately the same level as *Ae. vexans* during July before dropping off again during September.

Aedes vexans abundances in forest matrix were dissimilar over the three years of this study. During 2007, numbers of this mosquito species increased from August to

September, the opposite of the trend for 2008. During 2008, the species exhibited its more usual two peaks of abundance (during June and August). During 2009, *Ae. vexans* numbers peaked during May, and experienced only a shallow decline through the summer.

Culex erraticus abundances in forest matrix, as had been seen for this species on cropland, followed the pattern of a gradual rise in numbers from May through July, a peak during August, and a steep drop during September. Disparate patterns of mean abundance on forest matrix were seen for *Cx. pipiens* group between 2007 and 2008 - 2009 taken as a unit. During 2007, forest matrix was sampled only during August and September, when *Cx. pipiens* group was fairly high during August and declined during September. For 2008 – 2009 in forest matrix, this species peaked with modest numbers early in the year (May and June) before dropping off completely in late summer.

The relationship of all patches within the forest matrix in 2007 – 2009 (Figure 9) reveals a discernable pattern with regard to mean abundance per trap. Abundances seem to peak in early May, followed by a gradual decline, then a second peak occurring in variable months later in the year. For example, grassland patch and forest matrix peaked in early August, whereas urban patch and cropland patch peaked in early July.

Altogether, 13 mosquito taxa were identified from cropland patches on forest matrix during 2009 (Table 11). *Aedes vexans* was the most abundant mosquito collected in every month (June through August), followed by *Cx. salinarius* and *Ae. trivittatus*. *Aedes vexans* and *Cx. salinarius* remained at relatively high levels for all three months, while *Ae. trivittatus* numbers declined to zero during August.

Overall, nine mosquito taxa were identified from forest matrix sites that were not of a different patch type during 2007 (Table 11). *Aedes vexans* was much less abundant than *Cx. erraticus* or *Cx. pipiens* group during August, but had replaced the *Culex* taxa in dominance by September.

In total, nine mosquito taxa were identified from forest matrix sites that were not of a different patch type during 2008 (Table 11). *Culex erraticus* was the most abundant mosquito in every month except April and May. *Aedes vexans* numbers peaked twice, during June and August, while the third most abundant mosquito, *Ur. sapphirina*, had a peak that was similar in magnitude to that of *Ae. vexans*, also during August.

Twenty mosquito taxa were identified from forest matrix sites that were not of a different patch type during 2009 (Table 11). Through May, the three dominant taxa of mosquito in forest matrix, *Ae. sticticus*, *Ae. trivittatus*, and *Ae. vexans*, were very similar in their abundance. However, during June, *Ae. sticticus* numbers declined until they were no longer collected from July onward, while *Ae. vexans* and *Ae. trivittatus* continued to be relatively abundant in nearly equal numbers for the rest of the year. Two unusual taxa, an *Ae. zoosophus*/*Ae. triseriatus* hybrid, and *Ps. howardii*, were collected from forest matrix during 2009.

Aedes vexans abundances in forest matrix were dissimilar over the three years of this study. During 2007, numbers of this mosquito species increased from August to September, the opposite of the trend for 2008. During 2008, the species exhibited its more usual two peaks of abundance (during June and August). During 2009, *Ae. vexans* numbers peaked during May and experienced only a shallow decline through the summer.

Abundances for *An. punctipennis* from forest matrix were temporally disparate over the three years of this study. During 2007, numbers of this mosquito species declined slightly from August to September, the opposite of the trend for 2008. During 2008, *An. punctipennis* appeared to have two peaks (June and September). During 2009, this species' numbers were nearly identical for May through July, declining somewhat during August. The mean abundance per trap of *Cx. erraticus* from forest matrix had a distinct pattern, with a gradual rise in numbers from May through July, a peak during August, and a decline into September and October.

Overall, nine mosquito taxa were identified from grassland patches on forest matrix during 2007 (Table 11). *Aedes vexans* was much less abundant than *Cx. erraticus* or *Cx. salinarius* during August, but had replaced *Cx. erraticus* and *Cx. salinarius* in dominance by September.

In total, 19 mosquito taxa were identified from grassland patches on forest matrix during 2009 (Table 11). *Aedes vexans* was the dominant mosquito during May and June, before declining during July and resurging during August. *Culex erraticus* abundances began to climb during June, when it replaced *Ae. vexans* as the dominant mosquito during July, and continued to increase during August. *Anopheles punctipennis* abundances peaked during May, then declined steadily until it was absent in August collections. Two unusual species, *Ae. sollicitans* and *Ps. howardii*, were collected from grassland patches on forest matrix during 2009.

Aedes vexans abundances in grassland patches on forest matrix were relatively high in most months, but declined during August before climbing again during September. A similar pattern of abundances for *An. punctipennis* was seen. The mean abundance of *Cx. erraticus* from grassland patches on forest matrix had a distinct pattern, with a gradual rise in numbers from May through July, a peak during August, and a decline into September and October.

Altogether, ten mosquito taxa were identified from urban patches on forest matrix during 2009 (Table 11). *Aedes vexans* and *Cx. salinarius* abundances were very similar from June through August, while *Ae. trivittatus* abundances, relatively low during June, increased to levels similar to *Ae. vexans* and *Cx. salinarius* during July. *Aedes trivittatus* numbers declined to zero during August.

All totaled, 17 mosquito taxa were identified from wetland patches on forest matrix during 2009 (Table 11). Three mosquito species, *Ae. vexans*, *Ae. sticticus*, and *Ae. trivittatus*, had very similar abundance patterns in April and May. However, while *Ae. vexans* and *Ae. sticticus* abundances were fairly steady through June and July, *Ae. trivittatus* declined to zero abundance during June before rebounding to become the most abundant mosquito in wetland patches on forest matrix during July. One uncommon species, *Ae. dorsalis*, was among the taxa collected from wetland patches on forest matrix.

<u>Grassland matrix.</u> The patterns of mosquito abundance in grassland matrix over the study period indicate the month of highest abundance tends to be June (Table 12, Figure 10). However, during 2007, there was a second peak during September, and during 2008, a second peak occurred during August.

Overall, 23 mosquito taxa were identified from grassland matrix during 2007 (Table 12). Among these, two were not common: *Aedes nigromaculis*, with one specimen collected from site "ABC tree" (Appendix A) on June 26 (only six specimens were collected during the entire study); and *Ps. discolor*, with three specimens (of twelve total for the entire study) collected on July 17, from site "South Farm Old Marsh" (Appendix A). *Aedes vexans* was the most abundant mosquito in every month but August, when *Cx. erraticus* had the highest numbers. *Culex erraticus* abundance increased in its characteristic fashion until August, after which it receded steadily until it was not found during October. *Culex salinarius*, the third most abundant mosquito for most months, replaced *Cx. erraticus* as the second most abundant mosquito for October.

In total, 23 mosquito taxa were identified from grassland matrix during 2008 (Table 12). Among these, three were not common: *Aedes dorsalis*, with one specimen collected from site "TLSE" (Appendix A) on May 23 (only six specimens were collected during the entire study); the only specimen of *Ae. epactius* collected, from site "Rainbow" (Appendix A) on September 5; and *Ae. grossbecki*, with seven specimens (of 18 total collected during the entire study) collected from three sites ("TLSE", "TLFFGR219", and "ABC Daily") between May 23 and June 19 (Appendix A). *Aedes vexans* was the most abundant mosquito in every month until August, when it was replaced by *Cx. erraticus*. During September, however, *Cx. erraticus* declined and *Ae. vexans* became dominant again. *Aedes canadensis canadensis* was the third most abundant mosquito, peaking during June and disappearing by August.

Altogether, of 23 mosquito taxa were identified from grassland matrix during 2009 (Table 12). Among these, three were not common: *Aedes grossbecki*, with eleven specimens (of 18 total collected during the entire study) collected from five sites ("TLFFGR215", "TLFFGR216", "TLFFGR219", "DSWWGR" and "SCWWGR") between April 25 and June 18 (Appendix A); the *Ae. zoosophus*/*Ae. triseriatus* hybrid, with two specimens collected from sites “TLFFGR219” and “MGWWGR3” on April 25 and June 18, respectively (Appendix A); and *Or. alba*, with the only specimen collected in this entire study taken on June 18 from site “SCWWGR” (Appendix A). The abundances of the three most common mosquito taxa of the grassland during 2009 were very similar to those seen for that during 2008. *Aedes vexans* was the most abundant mosquito in every month until July, when it was replaced by *Cx. salinarius*. *Aedes canadensis canadensis* was the third most abundant mosquito, peaking during June and disappearing during July.

Aedes vexans abundances in grassland matrix were similar in all three years of sampling. Peak numbers tended to occur during June and September, with the low point variably during July or August.

Culex erraticus abundances in grassland matrix, as had been seen in other matrices, followed a pattern of a gradual rise in numbers from May through July, a peak during August, and a steep drop during September through October. This temporal pattern occurred a month earlier during 2009, with the peak observed during July and decline beginning during August. The mean abundance of *Cx. salinarius* on grassland matrix tended to gradually increase until at least July, with continuing increase through October during 2007, and slight decreases during August and September in 2008 and 2009.

The relationship of all patches within the grassland matrix in the years 2007 - 2009 with regard to mean abundance per trap indicate that abundances seem to peak in late May, followed by a decline for a variable amount of time, and in some patches, a second peak later in the year (Figure 11). For example, the forest patch on grassland matrix experienced a peak in abundance in late August of the same magnitude as in late May. The urban patch on grassland matrix followed a similar pattern, although the peak in late August was not as high as in late May. Incongruously, abundances from grassland matrix sites that were not of a different patch type remained stable from late May until late September.

All totaled, seven mosquito taxa were identified from cropland patches on grassland matrix during 2009 (Table 12). *Aedes vexans* was the most abundant mosquito collected until July, when it was replaced by *Cx. salinarius*. *Culex pipiens* group was the third most abundant mosquito taxon, peaking with numbers lower than *Ae. vexans* and *Cx. salinarius* during June.

Fifteen mosquito taxa were identified from forest patches on grassland matrix during 2007 (Table 12). *Aedes vexans* was the most abundant mosquito collected every month except August, when it was replaced by *Cx. erraticus*. *Culex salinarius* was the third most abundant mosquito, and was never more abundant than *Ae. vexans* or *Cx. erraticus* except for during October, when it was the second most abundant mosquito.

Overall, 23 mosquito taxa were identified from forest patches on grassland matrix during 2008 (Table 12). Three species (*Ae. vexans*, *Cx. erraticus*, and *Ps. horrida*) were the dominant species at various times. Early in the year (April – July), *Ae. vexans* had the highest abundances, but during August this species was surpassed by both *Cx. erraticus* and *Ps. horrida*. *Culex erraticus* abundances were reduced to zero by September, when *Ps. horrida* became the dominant mosquito. Two of the species collected from this patch-matrix combination were uncommon: *Aedes dorsalis*; and *Ae. grossbecki*. The occurrence of these two species in this matrix has been discussed previously.

In total, ten mosquito taxa were identified from forest patches on grassland matrix during 2009 (Table 12). The three most abundant taxa were *Ae. vexans*, *An. punctipennis*, and *Ae. grossbecki*. Samples were taken from forest patches on grassland matrix only during April and May, so the dominance of *Ae. grossbecki*, an early season mosquito, may be overrepresented by these data. Specimens of two uncommon mosquito taxa were found on this patch/matrix combination: *Aedes grossbecki* and the *Ae. zoosophus*/*Ae. triseriatus* hybrid.

Aedes vexans abundances in forest patches on grassland matrix were similar during 2007 and 2008. Two peaks in abundance were noted, during June and September. During 2009, April abundances were greater than those during May, the opposite of the trend seen during 2008.

The mean abundances of *Cx. erraticus* from forest patches on grassland matrix had a distinct pattern, with a gradual rise in numbers from May through July, a peak during August, and a decline into September and October. Abundances for *Cx. salinarius* in forest patches on grassland matrix exhibited disparate patterns over the three years of this study. During 2007, a broad peak for this species was seen during August and September, while during 2008, this same broad peak was seen during June and July.

Altogether, 21 mosquito taxa were identified from grassland matrix sites that were not of a different patch type during 2007 (Table 12). *Aedes vexans* was the most abundant mosquito in every month but August, when *Cx. erraticus* had the highest numbers. *Culex erraticus* abundance increased in its characteristic fashion until August, after which it receded steadily until it was not found during October. *Culex salinarius*, the third most abundant mosquito for most months, replaced *Cx. erraticus* in this role for

October. *Aedes nigromaculis* and *Ps. discolor*, two uncommon species, were sampled from this matrix.

All totaled, 19 mosquito taxa were identified from grassland matrix sites that were not of a different patch type during 2008 (Table 12). *Aedes vexans* was the most abundant mosquito early in the year (through June), when it was surpassed by Cx. *erraticus*. *Culex salinarius*, the third of the most abundant mosquito, had a temporal pattern similar to that of *Cx. erraticus*. *Aedes epactius*, an uncommon species, was sampled from this matrix.

Aedes vexans abundances in grassland matrix were similar during 2007 and 2008. Two peaks in abundance were noted, during June and August/September. Abundances were much greater during 2007 than during 2008.

As was repeatedly demonstrated in other landscapes in this study, the mean abundance of *Cx. erraticus* from grassland matrix had a distinct pattern, with a gradual rise in numbers from May through July, a peak during August, and a decline into September and October. Abundances of *Cx. salinarius* for grassland matrix gradually increased until August, declined during September, then, at least during 2007, increased again during October.

Eight mosquito taxa were identified from urban patches on grassland matrix during 2007 (Table 12). *Culex pipiens* group was the most abundant taxon during July, but declined sharply until it was absent during September sampling. Conversely, both *Ae. vexans* and *Cx. salinarius* increased during July through September.

Overall, eight mosquito taxa were identified from urban patches on grassland matrix during 2008 (Table 12). The most abundant mosquito in any month of the year was *Cx. erraticus* during August. *Aedes vexans* and *Cx. salinarius* were also abundant at the same order of magnitude as *Cx. erraticus*, but no taxon's abundance was > 2 mosquitoes per trap at any point.

In total, 19 mosquito taxa were identified from urban patches on grassland matrix during 2009 (Table 12). *Aedes vexans* was exceedingly dominant during June, but abundances of this species were more in line with two other abundant taxa, *Cx. erraticus* and *Cx. salinarius*, during July and August.

Aedes vexans abundances in urban patches on grassland matrix were disparate among the three years of this study. During 2007, abundances were highest during September, but for 2008, August was the month with highest abundance, followed by a decline during September. During 2009, June was the month with the highest abundance, and numbers during July and August were lower, but still higher than at any point in the previous two years.

The mean abundance of *Cx. pipiens* group from urban patches on grassland matrix peaked early in the year (June or July) followed by a decline. Abundances of *Cx. salinarius* for urban patches on grassland matrix gradually increased throughout the year.

Altogether, 19 mosquito taxa were identified from wetland patches on grassland matrix during 2009 (Table 12). *Aedes vexans* was the most abundant mosquito most of the year, but was surpassed by *Cx. erraticus* during July. *Aedes canadensis canadensis* was the second most abundant mosquito during June, but was not present the rest of the year. Unusual taxa found in these patches were *Ae. grossbecki*, the *Ae. zoosophus*/*Ae. triseriatus* hybrid, and *Or. alba*.

Urban matrix. The patterns of mosquito abundance in urban matrix over the study period did not indicate a consistent month of highest abundance (Table 13, Figure 12). During 2007, the peak mean abundance per trap appeared to be during September; during 2008, August; and during 2009, June. Mean abundance per trap was consistently lower during April and May than in other months.

All totaled, 13 mosquito taxa were identified from urban matrix during 2007 (Table 13). During 2007, *Ae. vexans* was the most abundant mosquito during July, followed closely by *Cx. pipiens* group. *Cx. erraticus* was the third most abundant during July, but exceeded all others during August, before receding during September. *Aedes vexans* was much more abundant during September than either *Cx. pipiens* group or *Cx. erraticus*.

Twenty mosquito taxa were identified from urban matrix during 2008 (Table 13). The uncommon *Ae. zoosophus*/*Ae. triseriatus* hybrid was collected in this matrix during 2008 (one specimen of six total collected during the study, from site "Citation" on August 8).

Aedes vexans was the most abundant mosquito taxon during May through July, receding during August and September. *Culex salinarius* abundances increased until it was the most abundant mosquito during August and September. Another abundant taxon was the *Cx. pipiens* group, with an abundance pattern very similar to that of *Cx. salinarius*.

Overall, 20 mosquito taxa were identified from urban matrix during 2009 (Table 13). *Orthopodomyia signifera*, an uncommon species, was collected in this matrix during 2009 (all three of the specimens of this species were taken from site "CPCRUU" on August 29).

Aedes vexans, followed closely by *Cx. salinarius*, was the most abundant mosquito during most of 2009. There was however, a spike of *Cq. perturbans* during June. All three taxa exhibited nearly identical abundances during July and August.

Aedes vexans abundances in urban matrix were similar in all three years of sampling. Peak numbers tended to occur during June or July.

There appeared to be two peaks for *Cx. pipiens* group abundances in urban matrix, one during June and one during August, although during 2007, there may have been a peak during July. The mean abundance of *Cx. salinarius* on urban matrix tended to gradually increase until at least July, with a general leveling off of numbers afterward.

The mean abundances per trap among all patches on urban matrix over the course of this study indicate no uniform pattern (Figure 13). The abundances for wetland patches on urban matrix were typically higher than for any other patch, peaking in early June. With the exception of this June peak, the abundances for the cropland and forest patches on urban matrix approximated those of the wetland patch. Abundances from grassland patches and urban matrix sites that were not of a different patch type were always lower than any of the other patches. The urban matrix increased erratically over the season, while the grassland patch's abundances demonstrated a relatively stable rate of increase until a peak in late July followed by a decline at the end of August.

In total, eleven mosquito taxa were identified from cropland patches on urban matrix during 2009 (Table 13). *Aedes vexans* was always the most abundant or second most abundant mosquito collected in a given month, with *Cx. salinarius* being the most abundant during July. *Coquillettidia perturbans* was also abundant, especially during June.

Altogether, 16 mosquito taxa were identified from forest patches on urban matrix during 2009 (Table 13). *Aedes vexans* was usually the most abundant mosquito collected in a given month, although *Cs. inornata* was most abundant during April. *Coquillettidia perturbans* was a third abundant mosquito, and one whose temporal abundance pattern closely paralleled that of *Ae. vexans*. The uncommon hybrid of *Ae. zoosophus*/*Ae. triseriatus* was also found in this patch-matrix.

All totaled, 14 mosquito taxa were identified from grassland patches on urban matrix during 2008 (Table 13). *Aedes vexans* was the most abundant mosquito collected during April – July, peaking during June. During August, both *Cx. salinarius* and *Cx. pipiens* group surpassed *Ae. vexans* in abundance and remained dominant during September.

Fourteen mosquito taxa were identified from urban matrix sites that were not of a different patch type during 2007 (Table 13). *Aedes vexans* was the most abundant mosquito during July, followed closely by *Cx. pipiens* group. *Cx. erraticus* was the third most abundant during July, but exceeded all others during August, before receding during September. *Aedes vexans* was much more abundant during September than either *Cx. pipiens* group or *Cx. erraticus*. *Orthopodomyia signifera*, an uncommon mosquito, was also taken from this matrix.

Overall, 14 mosquito taxa were identified from urban matrix sites that were not of a different patch type during 2008 (Table 13). *Aedes vexans* was the most abundant mosquito until September. During September, both *Cx. erraticus* and *Cx. salinarius* surpassed *Ae. vexans* in abundance.

Aedes vexans abundances in urban matrix were dissimilar during 2007 and 2008. Two peaks in abundance occur in this matrix, offset one month from 2007 (peaks during July and September) to 2008 (peaks during June and August).

A one month lag in the mean abundance of *Cx. erraticus* from urban matrix, similar to that seen for *Ae. vexans*, may have occurred, albeit with only a single peak (August 2007 or July 2008). The temporal pattern of abundance for the *Cx. pipiens* group in urban matrix is difficult to ascertain, because its abundance in July 2007 was much higher than at any other point in the study, and its abundance for the remainder of 2007 was relatively high compared to its abundance during 2008. Judging from 2008 only indicates a temporal peak in August.

In total, 18 mosquito taxa were identified from wetland patches on urban matrix during 2009 (Table 13). *Coquillettidia perturbans* was the most abundant mosquito, with a June peak in numbers. Two other abundant mosquito species, *Ae. vexans* and *Cx. salinarius*, had temporal abundance patterns similar to *Cq. perturbans*.

<u>Wetland matrix.</u> Wetland matrix was sampled only during 2009; therefore, there is no year-to-year comparison for this matrix. A total of 27 mosquito taxa were identified from wetland matrix during 2009 (Table 14). Among these, several were not common: *Aedes nigromaculis*, with four specimens collected from site "DIUUWW336" (Appendix A) on June 25 (only six specimens were collected during the entire study); *Aedes sollicitans*, with two of only four specimens of this mosquito collected in this entire study (both taken May 18 from site "DIWWWW252") (Appendix A); *Anopheles*

walkeri, a mosquito found almost exclusively within the wetland matrix, with 37 of 38 specimens found from four sites on either June 18 (32 specimens from site "DBUUWW1"), or September 14 (five specimens taken from three sites, "DIFFWW", "DIGRWWX", and "DIWWWW252") (Appendix A); *Psorophora discolor*, with six specimens (of twelve total for the entire study) collected from three sites on three dates (two from "EBCRWW" on July 9, two from "DIUUWW" on August 15, and two from "DIGRWWX" on September 14) (Appendix A); and *Ps. howardii*, with eleven specimens taken on one date (June 25) from two sites (four from "DIFFWW" and seven from "DIGRWW254") (Appendix A).

In 2009, *Aedes vexans* was the most abundant mosquito in wetland matrix every month of the year. *Aedes sticticus* began the year (May) as the second most abundant mosquito collected, but by August had a mean density per trap of < 1. *Aedes cinereus* was a third mosquito which maintained relatively high abundances.

The relationship of all patches within the wetland matrix during 2009 with regard to mean abundance per trap indicate that most patches seemed to behave dissimilarly with regard to abundances (Figure 14); the wetland matrix sites that were not of a different patch type were probably the most dominant over the entire sampling year, with forest patch on wetland matrix following a similar temporal pattern with less abundance. The urban patch demonstrated the most restrained abundances.

Altogether, 20 mosquito taxa were identified from cropland patches on wetland matrix in 2009 (Table 14). *Aedes vexans* was by far the most abundant mosquito regardless of month sampled. *Aedes sticticus* and *Ae. trivittatus* also had impressive numbers during 2009.

All totaled, 23 mosquito taxa were identified from forest patches on wetland matrix in 2009 (Table 14). *Aedes vexans* was usually the dominant mosquito on a monthly basis, but was exceeded by *Ae. sticticus* in April and *Cx. erraticus* in July.

Thirteen mosquito taxa were identified from grassland patches on wetland matrix in 2009 (Table 14). *Aedes vexans* was always the most abundant mosquito. *Psorophora ciliata* and *Ae. cinereus* also were very abundant.

Overall, 18 mosquito taxa were identified from urban patches on wetland matrix in 2009 (Table 14). *Aedes vexans* was always the most abundant mosquito. *Aedes cinereus* and *Cq. perturbans* were also very abundant.

In total, 22 mosquito taxa were identified from wetland matrix sites that were not of a different patch type in 2009 (Table 14). *Aedes vexans* was almost always the most abundant mosquito. *Culex erraticus* peaked in July and exceeded *Ae. vexans* numbers for that month. *Aedes trivittatus* was the third most abundant mosquito on wetland matrix in 2009.

<u>Relationship between weather factors and mosquito abundance, 2007 – 2009</u>

Most of the multiple regression analyses resulted in significant F values ($p < 0.5$) (Tables 15 – 18). However, none of the multiple regressions for wetland data were significant, nor were the results for total mosquitoes in cropland matrix, *Aedes vexans* in forest matrix, and *Cx. salinarius* in forest matrix. Additionally, although the overall multiple regression for *Culex erraticus* in urban matrix was significant, none of the individual weather variables were significant.

For *Ae. vexans* abundance in cropland matrix (Table 15), the significant weather variables detected were rainfall (Rain – 7 and Rain – 30); maximum temperature (T – 0);

and maximum wind speed (W – 0). *Aedes vexans* abundance in cropland matrix was positively associated with Rain – 7, and negatively associated with Rain – 30, T – 0, and W – 0.

For *Cx. erraticus* abundance on cropland matrix (Table 15), the significant weather variables detected were rainfall (Rain – 7) and maximum temperature (T – 0). *Culex erraticus* abundance was positively associated with T – 0 and negatively associated with Rain – 7.

For *Cx. salinarius* abundance on cropland matrix (Table 15), the significant weather variables detected were rainfall (Rain – 30) and maximum wind speed (W – 7). *Culex salinarius* abundance was negatively associated with both Rain – 30 and W – 7.

In forest matrix (Table 16), the significant weather variables associated with total mosquito abundance were maximum temperature (T – 0) and total solar radiation (TSR - 0). Both variables were positively associated with total mosquito abundance.

For *Cx. erraticus* abundance in forest matrix (Table 16), the significant weather variables detected were rainfall (Rain – 0 and Rain – 14); maximum temperature (T – 0 and T – 14); and total solar radiation (TSR – 0). *Culex erraticus* abundance was positively associated with Rain – 0, T – 0, and TSR – 0, and negatively associated with Rain – 14 and T – 14.

For total mosquito abundance on grassland matrix (Table 17), the significant weather variables detected were rainfall (Rain – 30) and maximum wind speed (W – 30). Total mosquito abundance was negatively associated with both of these weather variables.

For *Ae. vexans* abundance in grassland matrix (Table 17), the significant weather variables detected were rainfall (Rain – 7 and Rain – 30); total solar radiation (TSR – 0); and maximum wind speed (W – 0 and Wind – 30). *Aedes vexans* abundance was positively with TSR – 0 and W – 0, and negatively associated with Rain - 7, Rain – 30, and Wind – 30.

For *Cx. erraticus* abundance in grassland matrix (Table 17), the significant weather variables detected were maximum temperature (T – 0) and total solar radiation (TSR – 0). *Culex erraticus* abundance was positively associated with T – 30, and negatively associated with TSR – 0.

For *Cx. salinarius* abundance in grassland matrix (Table 17), the only significant weather variable detected was rainfall (Rain – 30). *Culex salinarius* abundance was negatively associated with Rain – 30.

For total mosquito abundance in urban matrix (Table 18), the significant weather variables detected were rainfall (Rain – 0); maximum temperature (T – 7); total solar radiation (TSR – 0 and TSR – 14); and maximum wind speed (W – 14). Total mosquito abundance was positively associated with Rain – 0, TSR – 0, and TSR – 14, and negatively associated with T – 7, and W – 14.

For *Ae. vexans* abundance on urban matrix (Table 18), the significant weather variables detected were rainfall (Rain – 0 and Rain – 30) and total solar radiation (TSR - 0 and TSR – 14). *Aedes vexans* abundance was positively associated with Rain - 0, TSR – 0 and TSR – 14, and negatively associated with Rain - 30.

For *Cx. erraticus* abundance on urban matrix (Table 18), the significant weather variables detected were rainfall (Rain – 30) and total solar radiation (TSR – 14). *Culex* *erraticus* abundance was positively associated with TSR – 14 and negatively associated with Rain – 30.

For *Cx. salinarius* abundance on urban matrix (Table 18), the significant weather variables detected were rainfall (Rain – 0 and Rain – 7) and maximum wind speed (W - 14). *Culex salinarius* abundance was positively associated with Rain – 0 and negatively associated with Rain – 7 and W – 14.

Use of previous years' data to predict subsequent mosquito abundances

Predictions for 2009. Most of the multiple regression analyses resulted in significant F values ($p < 0.5$) (Tables 19 – 21). However, none of the multiple regressions for forest data were significant, nor were the results for *Ae. vexans* in cropland matrix.

For total mosquito abundance, *Cx. erraticus* abundance, and *Cx. salinarius* abundance in cropland matrix during 2007 – 2008 (Table 19), the significant weather variables detected were maximum temperature (T – 0); total solar radiation (TSR – 0 and TSR – 7); and maximum wind speed (W – 7). Total mosquito abundance, *Cx. erraticus* abundance, and *Cx. salinarius* in cropland matrix were positively associated with T – 0 and TSR – 7, and negatively associated with TSR – 0 and W – 7.

For total mosquito abundance in grassland matrix during 2007 – 2008 (Table 20), the significant weather variables detected were rainfall (Rain – 7 and Rain – 30) and maximum wind speed (W – 0 and W – 7). Total mosquito abundance in grassland matrix was positively associated with W – 0 and negatively associated with Rain – 7, Rain – 30, and W – 7.

For *Ae. vexans* abundance on grassland matrix during 2007 – 2008 (Table 20), the significant weather variables detected were rainfall (Rain – 0, Rain – 7, and Rain – 30); total solar radiation (TSR – 0); and maximum wind speed (W – 0 and W – 7). *Aedes vexans* abundance was positively associated with Rain – 0, TSR – 0, and W – 0, and negatively associated with Rain – 7, Rain – 30, and W – 7.

For *Cx. erraticus* abundance on grassland matrix during 2007 – 2008 (Table 20), the significant weather variables detected were rainfall (Rain – 0); maximum temperature (T – 0); and total solar radiation (TSR – 0). *Culex erraticus* abundance was positively associated with T – 0 and negatively associated with Rain – 0 and TSR – 0.

For *Cx. salinarius* abundance on grassland matrix during 2007 – 2008 (Table 20), the significant weather variables detected were rainfall (Rain – 30) and maximum temperature (T – 30). *Culex salinarius* abundance was positively associated with T – 30 and negatively associated with Rain – 30.

For total mosquito abundance in urban matrix during 2007 – 2008 (Table 21), the significant weather variables detected were rainfall (Rain – 0 and Rain – 30); maximum temperature (T – 0); and total solar radiation (TSR – 0). Total mosquito abundance in urban matrix was positively associated with Rain – 0 and negatively associated with Rain – 30, T – 0, and TSR – 0.

For *Ae. vexans* abundance on urban matrix during 2007 – 2008 (Table 21), the significant weather variables detected were rainfall (Rain – 30); maximum temperature (T – 0); and total solar radiation (TSR – 0). *Aedes vexans* abundance was positively associated with TSR – 0 and negatively associated with Rain – 30, and T – 0.

For *Cx. erraticus* abundance on urban matrix during 2007 – 2008 (Table 21), the significant weather variables detected were rainfall (Rain – 0, Rain – 7, and Rain – 30) and total solar radiation (TSR – 7). *Culex erraticus* abundance was positively associated with Rain – 0 and Rain – 7, and negatively associated with Rain – 30 and TSR – 7.

For *Cx. salinarius* abundance on urban matrix during 2007 – 2008 (Table 21), the only significant weather variable detected was rainfall (Rain – 30). *Culex salinarius* abundance was positively associated with Rain – 30.

Using the significant variables determined from multiple regression analyses of weather variables and mosquito abundances in cropland, grassland, and urban matrices, predictive equations were used to forecast the abundance of mosquitoes in these matrices in 2009 (Tables 22 – 24).

For total mosquito abundance on cropland matrix, only five of 29 collected values met the acceptance criteria for a successful prediction (either the predicted value was ≤ 0 and the number of mosquitoes collected was 0, or the predicted value was a positive number and the $\log_{10}$ of the predicted value and the $\log_{10}$ of the measured value agreed within 0.5 units of $\log_{10}$) (Table 22). For *Cx. erraticus* abundance on cropland matrix, none, and for *Cx. salinarius* on cropland matrix, only five, of the 29 collected values met either acceptance criterion for a successfully predicted value.

For total mosquito abundance on grassland matrix, only one of 24 collected values met the acceptance criteria for a successful prediction (Table 23). For *Ae. vexans* abundance on grassland matrix, eight of 24 collected values were considered successfully predicted. For *Cx. erraticus* abundance on grassland matrix, 17 of 24 values met the criteria for a successful prediction, but for *Cx. salinarius* on grassland matrix, only two of the 24 collected values met either acceptance criterion for a successfully predicted value.

For total mosquito abundance on urban matrix, 15 of 29 collected values met the acceptance criteria for a successful prediction (Table 24). For *Ae. vexans* abundance on urban matrix, nine of 29 collected values were considered successfully predicted. For *Cx. erraticus* abundance on urban matrix, only twelve of 29 values met the criteria for a successful prediction, and for *Cx. salinarius* on urban matrix, only nine of the 29 collected values met either acceptance criterion for a successfully predicted value.

<u>Predictions for 2008.</u> Fewer than half of the multiple regression analyses resulted in significant F values ($p < 0.5$) (Tables 25 – 26). None of the multiple regressions for cropland or grassland data were significant, nor were the results for *Ae. vexans* in forest matrix and *Cx. salinarius* in urban matrix.

For total mosquito abundance, *Cx. erraticus* abundance, and *Cx. salinarius* abundance in forest matrix during 2007 (Table 25), the significant weather variables detected were maximum temperature (T – 7); total solar radiation (TSR – 7); and maximum wind speed (W – 7). Total mosquito abundance, *Cx. erraticus* abundance, and *Cx. salinarius* in forest matrix were positively associated with T – 7 and TSR – 7, and negatively associated with W – 7.

For total mosquito abundance on urban matrix during 2007 (Table 26), the significant weather variables detected were maximum temperature (T – 0 and T – 14) and maximum wind speed (W – 0 and W – 14). Total mosquito abundance was positively associated with T – 0, W – 0, and W – 14, and negatively associated with T – 14.

For *Ae. vexans* abundance on urban matrix during 2007 (Table 26), the significant weather variables detected were rainfall (Rain – 14); maximum temperature (T – 0 and T - 14); total solar radiation (TSR – 0 and TSR – 14); and maximum wind speed (W – 0 and W – 14). *Aedes vexans* abundance was positively associated with T - 0, TSR – 14, W - 0, and W – 14, and negatively associated with Rain – 14, T – 14, and TSR – 0.

For *Cx. erraticus* abundance on urban matrix during 2007 (Table 26), the significant weather variables detected were rainfall (Rain – 14) and maximum wind speed (W – 0). *Culex erraticus* abundance was negatively associated with both of these variables.

For total mosquito abundance on forest matrix, four of six collected values met the acceptance criteria for a successful prediction (Table 27). For *Cx. erraticus* abundance on forest matrix, four of six values met the criteria for a successful prediction, but for *Cx. salinarius* on urban matrix, only one of the six collected values met either acceptance criterion for a successfully predicted value.

For total mosquito abundance on urban matrix, only six of 57 collected values met the acceptance criteria for a successful prediction (Table 28). For *Ae. vexans* abundance on urban matrix, only three of 57 collected values were considered successfully predicted, and for *Cx. erraticus* abundance on urban matrix, only one of 57 values met the criteria for a successful prediction.

<u>Canonical correspondence analysis</u>

CCA of data from cropland matrix, regardless of patch, revealed that the environmental variables with the strongest influence over mosquito community abundance were average maximum temperature and average total solar radiation, both for the month of sampling and the previous month (Figure 15, Table 29). Average maximum wind speed was also moderately powerful as a variable, but total rainfall, particularly in the previous month, had a weaker influence on mosquito abundance. The cumulative amount of variance in mosquito abundance explained by weather variables using CCA for cropland matrix was 58.1% (Appendix C).

With regard to environmental variables and their relation to months when sampling occurred, the data demonstrate appropriate relationships (*e.g.*, average maximum temperature has the most positive influence in July and August). A number of relationships were discerned between weather variables and individual mosquito taxa (Figure 15, Table 30).

The most abundant mosquito taxa did not have strong links to any weather cues. *Aedes vexans* appeared on the portion of the CCA plot where all weather factors were exhibiting negative influence, but again, none of the influences showed a strong relationship with this mosquito. *Culex erraticus* was ordinated with the positive influences of the weather variables, but not strongly with any of them. The taxon score for *Culex salinarius* indicates a vaguely positive effect on its abundance by TSR – 1.

CCA of data from forest matrix, regardless of patch, revealed that the environmental variables with the strongest influence over mosquito community abundance were T, T – 1, TSR – 1, and W – 1 (Figure 16). R, TSR, and W were also moderately powerful variables, but R – 1 had a weak influence on abundance of mosquitoes. The cumulative amount of variance in mosquito abundance explained by CCA for forest matrix was 56.0% (Appendix C).

Environmental variables exhibited logical relationships to months when sampling occurred, (*e.g.*, average maximum temperature and average total solar radiation had the most positive influence during August). Only two mosquito species, *Culex tarsalis* and *Uranotaenia sapphirina*, were shown to be strongly influenced by weather variables in forest matrix (Figure 16, Table 30).

Most mosquito taxa did not have strong links to any weather variables used in the analysis. *Aedes vexans* appeared on the portion of the CCA plot where R, R – 1, W, and W – 1 were showing positive influence, while T, T – 1, TSR, and TSR – 1 were negative influences. *Culex erraticus* was ordinated opposite to *Ae. vexans*, and *Cx. salinarius* was separated from any weather influence.

As mentioned previously, most mosquito taxa were not strongly affected by any weather factor, and were not even oriented close enough to these factors on the CCA plot to make an interpretation. One mosquito in particular, *Cs. inornata*, had a taxon score that was so distant from the rest of the data that it could not be plotted (Figure 16, lower left side). *Culiseta inornata* has a disjunct temporal pattern that may be responsible for this wide separation from other mosquito taxa.

CCA of data from grassland matrix, regardless of patch, revealed that the environmental variable with the strongest influence over mosquito community composition was W (Figure 17), and most other factors also exhibited a strong influence. Only TSR had a weak influence on mosquito abundance. The cumulative amount of variance in mosquito abundance explained by CCA for grassland was 51.7% (Appendix C).

Environmental variables displayed logical relationships to months when sampling occurred, (*e.g.*, TSR had the most positive influence during August). A number of relationships were discerned between weather variables and individual mosquito taxa (Figure 17, Table 30).

The two most abundant mosquito taxa did not have strong links to any weather factors examined in this study. *Aedes vexans* appeared on the portion of the CCA plot where all weather factors were demonstrating negative influence, but again, none of the influences showed a strong relationship with the species. *Culex erraticus* was ordinated opposite to *Ae. vexans*, in the region of the CCA plot where weather factors exhibited a positive influence.

CCA of data from urban matrix, regardless of patch, revealed that the environmental variable with the strongest influence over mosquito abundance was W (Figure 18). Most of the other weather measures also solidly influenced mosquito abundance, but W – 1 was only a moderate influence, and R – 1 was only a weak influence. The cumulative amount of variance in mosquito abundance explained by CCA for urban matrix was 54.4% (Appendix C).

The data demonstrated appropriate relationships in relation to months when sampling occurred (*e.g.*, T – 1 has the most positive influence during July and August). A number of strong relationships were discerned between weather variables and mosquito species (Figure 18, Table 30).

The most abundant mosquito taxa did not show strong links to any weather variables examined in this study. *Aedes vexans* and *Cx. salinarius* were ordinated very closely with W and R, which were both negative. *Culex erraticus*' site score placed it in the region of the graph where weather influences were positive, but none strongly influenced the abundance of *Cx. erraticus*. *Culiseta inornata* again was oriented very far from the remainder of the taxa.

DISCUSSION

The mosquito fauna of five central Missouri counties was characterized according to taxa occurrence and abundance in various landscapes during three years (2007 – 2009). Altogether, 102,363 mosquito specimens were trapped over the course of this research, resulting in 99,301 identifications. The remaining 3,062 specimens were unable to be identified due to morphological damage, resulting from a combination of field wear and damage during trapping, killing, or storage). Nevertheless, 97% of the mosquitoes collected were able to be identified to taxon. Such a high percentage of identification should lend confidence to conclusions based on the identity of the mosquito fauna of the region.

The use of only CDC mini-light traps for specimen collection in this research may bring into discussion the issue of trap bias. This type of trap is effective for collection of many mosquitoes, including most of the species in the genera *Aedes*, *Anopheles*, and *Psorophora* (GMCA, 2010), as well as *Cq. perturbans*, *Cx. erraticus*, and *Ur. sapphirina*. This trap is also the most common type used by mosquito abatement authorities, and researchers monitoring the temporal occurrence and presence or absence of mosquitoes (Service, 1993; DeGroote *et al.*, 2007). This trap type is not, however, the optimal collection technique for several mosquito taxa, particularly *Ae. albopictus*, *Ae. sollicitans*, *Ae. triseriatus*, *An. walkeri*, the *Cx. pipiens* group, and *Cx. tarsalis*. Therefore, although these latter mosquito taxa were collected in this study, their numbers were probably underrepresented. Nevertheless, the data collected in this study are certainly considered adequate to characterize the mosquito assemblages found in each of the central Missouri landscapes.

Overall, 36 different mosquito taxa were identified from collections taken in this research. While there is merit in discussing each taxon found, certain mosquitoes had abundances which were so substantial that they deserve discussion of greater magnitude and priority. These species were *Ae*. *vexans*, *Cx*. *erraticus*, *Cx*. *salinarius*, *Ae*. *sticticus*, and *Ae*. *trivittatus*. Each of these species represented at least 3.9% of the total mosquitoes identified from this research, and are presented here first, followed by the remaining 31 mosquito taxa.

Aedes vexans. Without question, the most abundant mosquito in the study region over the course of the research was *Ae. vexans*. Altogether, 66,472 specimens of this mosquito were collected. *Aedes vexans* was the most numerically dominant mosquito in four of the five landscapes studied. Wetland matrix in particular was dominated by *Ae. vexans*, with nearly 80% of the mosquitoes collected belonging to that taxon. With 33 sampling events on wetland matrix sites, 35,018 specimens of *Ae. vexans* were taken, or nearly 1,100 per trap. In two samples of wetland matrix, both from Diana Bend Conservation Area in Howard County, taken on May 18 and September 14, 2009, *Ae*. *vexans* totaled 5,231 and 9,388 specimens, respectively. Greater than 60% of the collected mosquitoes on both cropland and grassland matrix were *Ae. vexans* as well. For the forest matrix, *Ae. vexans* still accounted for the highest percentage of mosquitoes collected (38%). Only in urban landscapes was another mosquito, *Cq. perturbans*, collected in greater numbers. The numbers of *Cq. perturbans* in the urban matrix were greatly influenced by two trapping events at sites that may have been particularly favorable for its collection.

Aedes vexans often exhibited peak in abundance early in the summer (June or July) followed by a brief abatement in numbers during July or August. A second period of high abundance was usually seen during August or September. These data suggest a bivoltine life history for *Ae. vexans* in the study region. Although this pattern could be seen for many patch/matrix combinations, the wetland matrix during 2009 seemed to produce high numbers of *Ae. vexans* regardless of the sampling date. Given that *Ae. vexans* is a "floodwater" mosquito, capable of dormancy in the egg stage for months or even years until favorable environmental conditions are established (high rainfall, semi-permanent water levels), it may be that the wetland structure is conducive to constant generation of mosquitoes with this life history. It is also possible that 2009, which saw nearly twice as much June rainfall (8 inches) as 2007 or 2008, was a year in which environmental conditions overrode the typical pattern of two abundance peaks for *Ae. vexans*.

It is known that *Ae. vexans* is a highly consequential pest, from both disease and annoyance standpoints. The results of this study confirm the status of *Aedes vexans* as the major pest mosquito in the central Missouri region, much as it has been considered previously for the entire United States (Russo, 1977). The data for this study suggest that for any generalized encounter with a mosquito in the region of study, there is a 67% chance that the mosquito is *Ae. vexans*. The chances are nearly 80% in wetland situations, and even for landscapes where the occurrence of *Ae. vexans* is less predominant, there is at least a 30% chance that a mosquito encounter is with *Ae. vexans*. The species is an important disease vector, harboring eastern equine encephalitis, dog heartworm and West Nile virus. Possibly due to its incredible abundance, *Ae. vexans* is also one of the most annoying mosquitoes. In the author's personal experience, one can be literally driven to panicked retreat from an onslaught of these mosquitoes, hundreds of which appear only a few seconds after entering an infested environment. *Aedes vexans* mounts an extremely persistent attack and shows no lack of preference for any exposed area of the body, even the eyes, nose and mouth. Fortunately, very liberal application of mosquito repellant (the author used Deep Woods Off™) seems to be effective in quelling the attack of *Ae. vexans*.

These results of this research suggest that for avoidance of *Ae. vexans*, late summer is the most favorable time of the year. This is probably due to the usual "dry spell" in central Missouri during July and August curbing the production of this floodwater specialist. However, higher amounts of rainfall in early summer, as seen during 2009, may lead to a constant risk of encountering this mosquito, and the environmental conditions of wetlands probably are favorable for producing huge numbers of *Ae. vexans* regardless of the prevailing environmental conditions.

Culex erraticus. The second most commonly found mosquito in this study was *Cx. erraticus*, making up 8.8% of all mosquitoes identified. *Culex erraticus* was at the zenith of its abundance in forest matrix, where it composed 26.6% of the identified specimens. It was also rather prevalent in grassland matrix, making up 18.4% of the collections there. Cropland, wetland and urban landscapes all had fewer than 10% of the mosquitoes identified as *Cx. erraticus*. When abundance data are normalized on a per trap basis, the abundance of this mosquito in different landscape matrices breaks down as 36% forest, 26% wetland, 22% grassland, and 16% cropland. *Culex erraticus*, then, is a mosquito that does not seem to strongly prefer any central Missouri landscape over the others.

The peak abundance for *Cx. erraticus* was uniformly in late summer, usually August, although some situations indicated a peak in late July. Interestingly, these peaks usually coincided with the decline of the *Ae. vexans* population. In studies in a Mississippi wetland from 1997-2002, the abundance of *Cx. erraticus* was found to be inversely related to the amount of rainfall during the six month sampling period of a given year (Cupp *et al.*, 2004b). Other researchers (Hayes and Hess, 1964: Horsfall, 1972) have noted that high abundance of this mosquito does not depend on high rainfall amounts in the season prior to occurrence, noting rather its ability to flourish in habitats with irregular rainfall patterns. This is also the model that *Cx. erraticus* abundances followed in this study, peaking in later, generally dryer months when abundances of other mosquitoes were waning. It is not clear whether changes in a suite of environmental conditions produced this switch in numeric dominance between *Ae. vexans* and *Cx. erraticus*. Perhaps relative to prevailing temporal and environmental factors, resource partitioning of the available habitat favored the development of *Cx. erraticus* over *Ae. vexans*.

Culex erraticus is a small mosquito whose bite (in the author's experience) is not noticeable. In fact, it is uncertain whether the large numbers of *Cx. erraticus* collected were proportional to the mosquito's attraction to humans, or whether the light plus CO_2 trapping technique is much superior to the combination of attractants presented by humans. However, *Cx. erraticus* is known to be an effective vector of eastern equine encephalitis and West Nile virus, so its presence and occasional dominance should not be overlooked. The best practice for avoiding an encounter with *Cx. erraticus* would be to abstain from unprotected mid-summer to late summer exposure to forest and grassland matrices.

Culex salinarius. This was the third most common mosquito found in the region, with 4.6% of all identified mosquitoes. *Culex salinarius* was never the numerically dominant mosquito for any landscape matrix, and was most abundant only in grassland patches on urban matrix, where it made up 33% of the identified specimens. Cropland and urban matrices were the landscapes where this mosquito made up its largest proportion of the total, exceeding 10% in each case. Other landscapes contained fewer than 4% *Cx. salinarius*. When abundance data are normalized on a per trap basis, 56% of the abundance of this mosquito was found on cropland and 24% on wetland. None of the other matrices accounted for > 10% of the abundance of *Cx. salinarius*.

In matrices where *Cx. salinarius* is important, particularly cropland matrix and grassland patches, its abundance tended to steadily increase throughout the year, until it was frequently the most abundant mosquito during September or October. *Culex salinarius* has a generalized breeding preference (Carpenter and LaCasse, 1955), so it may be that the environment constantly provides suitable habitat. *Culex salinarius* is also known to prefer avian hosts (Siverly, 1972). Bird abundance tends to increase over the year, so *Cx. salinarius* abundances may simply be following the numbers of their hosts.

Culex salinarius is a known vector of West Nile virus, St. Louis encephalitis, and eastern equine encephalitis. Based on the temporal profile of this mosquito, the likelihood of encountering this disease vector increases throughout the summer and into the fall. The most likely landscape for this occurrence is grassland patches in urban matrix, which includes expanses of lawn in residential areas.

Aedes sticticus. The fourth most abundant mosquito in this research, *Ae. sticticus*, is another floodwater mosquito, but is not nearly as abundant in North America as is the other floodwater culicid, *Ae. vexans*. A total of 4.3% of all identified mosquitoes were *Ae. sticticus*. It was the second most abundant mosquito on wetland matrix, composing 5.3% of the mosquito taxa taken from there. In the more diverse forest matrix, it made up 8.2% of the identified specimens. In all other matrices, *Ae. sticticus* represented < 5% of the mosquitoes identified. When abundance data are normalized on a per trap basis, 71% of the abundance of this mosquito was on wetland matrix, while cropland and forest accounted for 14% and 13%, respectively. The landscape preference profile for *Ae. sticticus* is thus very similar to that for *Ae. vexans*.

Temporal occurrence of *Ae. sticticus* was typically early in the year, though in some matrices, it persisted until mid-summer. This mosquito has a life history similar to *Ae. vexans*, with eggs that can remain viable for up to three years (Carpenter and LaCasse, 1955) which are probably laid on dry areas of floodplains, waiting for the early spring rains to activate them. For mosquitoes in the central Missouri region, *Ae. sticticus* has one of the longest flight ranges, sometimes travelling as much as 30 miles from its breeding site (Gjullin *et al.*, 1950). Mosquitoes capable of such long distance dispersal may not be able to be identified as “belonging” to one matrix preferentially. However, the placement of attractive traps within given landscapes should capture the snapshot of the mosquito assemblage present at that time, regardless of their point of origin.

Aedes sticticus is a known vector of dog heartworm, and possibly California-type encephalitis. The author's experience with these mosquitoes is that they are persistent, swarming biters, and because of their abundance early in the year, sometimes seem to be the only mosquitoes about. Risk of encountering this mosquito is greatest in the months of May and June in forest and wetland landscapes.

Aedes trivittatus. The fifth most abundant mosquito collected in this research, totaling 3.9% of all identified specimens, was *Ae. trivittatus*. This mosquito was particularly abundant in wetland patches, regardless of matrix, composing nearly a quarter of the identified mosquitoes from wetland patches on forest matrix, and 10% of the abundance from wetland patches on cropland matrix, though for the wetland matrix itself, *Ae. trivittatus* never accounted for more than 4% of the total mosquitoes identified, probably in part because *Ae. vexans* was so dominant on wetlands. *Aedes trivittatus* was also found in high proportions in forest matrix, making up 11.4% of the identified mosquitoes. When abundance data are normalized on a per trap basis, 52% of the abundance of this mosquito was found on wetlands, 24% on forest matrix, and 20% on cropland, a pattern similar to that of *Ae. vexans* and *Ae. sticticus*.

Temporally, *Ae. trivittatus* was most abundant during May and June, and specimens were still collected during September. *Aedes trivittatus* is a vector of West Nile virus and California encephalitis, and an aggressive and painful biter. The likelihood of encountering *Ae. trivittatus* decreases over the summer.

Aedes vexans, *Ae. sticticus* and *Ae. trivittatus* were abundant to very abundant in the landscapes of central Missouri. Each of these mosquitoes was more abundant on wetland matrix than any other landscape (Table 31). Two other mosquitoes in the genus

Aedes could be regarded as common: *Aedes canadensis canadensis* and *Ae. cinereus*. Both had peak abundance during June, with *Ae. canadensis canadensis* occurring more abundantly in grasslands and *Ae. cinereus* more common in wetlands. *Aedes canadensis canadensis* is notable as a vector of several arboviruses, including California encephalitis, dog heartworm. LaCrosse encephalitis, and eastern equine encephalitis. This mosquito is readily identified in the field, with clearly visible broad white bands on all tarsi. *Aedes cinereus* is implicated only in the transmission of California encephalitis. Some authors (McCauley *et al.*, 2000) have indicated that this mosquito can be very abundant after heavy late summer rains, but peak abundance in this research was during May.

Four other species of *Aedes* that were present but uncommon in collections during this research were *Ae. albopictus*, *Ae. aurifer*, *Ae. triseriatus*, and *Ae. stimulans*. Both *Ae. albopictus* and *Ae. triseriatus* are noted as not readily being trapped by CDC mini-light traps baited with CO_2. Therefore, the numbers of both species in the landscapes where they were collected may be much greater than we recorded.

Aedes albopictus, an urban mosquito with abundance peaking during July and August, is highly pestiferous, vectoring West Nile virus, eastern equine encephalitis, dog heartworm, St. Louis encephalitis, and LaCrosse encephalitis. This is also an easily identifiable mosquito due to its bright white banding on thorax and legs contrasting with the remainder of its nearly black integument.

Aedes triseriatus was linked in this study with grassland matrix, and was characterized as having peak abundances during June. This mosquito is a confirmed vector of LaCrosse encephalitis.

Aedes aurifer was an unexpected find in this study because Missouri is at the extreme western border its published range (Darsie and Ward, 2004). Nevertheless, 201 individuals of this mosquito were collected and identified during 2007 – 2009. *Aedes aurifer* was associated with wetland matrix and peaked in abundance during August. It has not been implicated as a vector of any disease.

Aedes stimulans was taken primarily from grassland matrix. This mosquito was most abundant during June. This stout mosquito is known to transmit California encephalitis.

Several mosquito taxa in the genus *Aedes* were collected but characterized as rare in central Missouri. These taxa include *Ae. dorsalis*, *Ae. epactius*, *Ae. grossbecki*, *Ae. nigromaculis*, *Ae. sollicitans*, and a hybrid of *Ae. zoosophus* and *Ae. triseriatus*.

Aedes dorsalis is a known vector of western equine encephalitis and California encephalitis. It is an inhabitant of cropland matrix and peaked in abundance during May.

Aedes epactius was another unexpected find during this study, since its published distribution is primarily southwestern Missouri (Darsie and Ward, 2004). Only a single specimen of *Ae. epactius* was collected, so assessing habitat connection and temporal abundance is dubious. It is not known to vector arboviruses.

Aedes grossbecki is a grassland-associated mosquito with an abundance peak during April, the earliest of any mosquito collected in this research. It is not considered to be an arbovirus vector.

Aedes nigromaculis is also not considered to be medically important. Its abundance peaked during June and its incidence was most related to wetland patches and matrix.

Aedes sollicitans vectors eastern equine encephalitis, and dog heartworm. This mosquito was not expected to be taken in this study due to its discontinuous distribution. Prior to this study, published records of *Ae. sollicitans* were from the boot heel of Missouri, the extreme northwestern corner of the state, and from near urban centers of the eastern and western borders (McCauley *et al.*, 2000; Darsie and Ward, 2004). This mosquito can disperse as far as 100 miles (Carpenter and Middlekauff, 1944), so it is possible the specimens taken originated in one of the previously documented locations. *Aedes sollicitans* was associated with wetlands and its abundance peaked during May.

Little is published on the biology or disease implications of the hybrid of *Ae. zoosophus* and *Ae. triseriatus*. The specimens of this hybrid were linked with forest matrix and had no discernable temporal peak in abundance.

Mosquitoes of the genus *Anopheles* collected during this study were typically most abundant on wetland patches and matrix, though *An. crucians* and *An. punctipennis* were also associated with cropland and forest matrices, respectively. Abundance peaks were usually during June, but *An. crucians* may produce several generations per year (Siverly, 1972), so a second peak during August is not illogical.

Probably the only anopheline of medical concern in central Missouri is *An. punctipennis*. It was much more commonly encountered in central Missouri than all of its congeners combined, and is a vector of West Nile virus. Like many *An.* mosquitoes, it can be identified by distinctive wing bands; in the case of *An. punctipennis*, there is much more yellow in the wings along with dark “spots”. Avoidance of wetlands during June is the most likely scenario to limit encounters with this mosquito.

Culex erraticus and *Cx. salinarius* were among the most abundant mosquitoes collected during this study. Members of the *Cx. pipiens* group (*Cx. pipiens*, *Cx. quinquefasciatus*, and *Cx. restuans*) were also common. Despite the common name "house mosquito" the *Cx. pipiens* group was most abundant in forest matrix in this study, with abundances peaking during August. The abundance of *Cx. pipiens* group is probably underrepresented due to its lack of attraction to the light traps employed during this study. The *Cx. pipiens* group vectors many arboviruses, including West Nile virus, St. Louis encephalitis, western equine encephalitis, and dog heartworm, so protecting oneself against encounters with this mosquito is important. The likelihood of encountering a member of *Cx. pipiens* group increases throughout the summer, and peaks during August.

Culex tarsalis was uncommon in this study, and was associated with cropland and wetland matrices. It peaked in abundance late in the summer (August/September). This mosquito, like the members of the *Cx. pipiens* group, is also not easily collected with CDC mini-light traps, thus its true numbers are probably somewhat higher than were recorded in this study. *Culex tarsalis* is an important disease vector, having been implicated in the transmission of western equine encephalitis, California encephalitis, St. Louis encephalitis, and West Nile virus.

A relatively minor member of *Culex* collected in this study was *Cx. peccator*, a small mosquito of no known medical importance. It was linked with forest matrix and peaked in abundance during August.

The genus *Psorophora* is well represented in central Missouri (Table 31), with seven species collected, four of which were common. Two of these common species, *Ps.*

columbiae and *Ps. ferox*, have been linked to arboviruses. Specifically, *Psorophora columbiae* was most abundant in wetland matrix during June and July. This mosquito is a vector of West Nile virus. *Psorophora ferox* was collected in greatest numbers during June. This mosquito, unlike other members of this genus in this study, was not strictly connected to wetlands, being common on grassland and forest landscapes as well. *Psorophora ferox* has demonstrated laboratory infection with West Nile virus.

Psorophora ciliata was another common mosquito, with abundance reaching its peak during June. This very large mosquito is not a known vector of any disease.

Psorophora horrida was common, with abundance peaking during May. No diseases are known to be vectored by this mosquito, but veritable clouds of this mosquito were encountered during his research. These great numbers and the tenacity exhibited by *Ps. horrida* in pursuing a host frequently drove the author from the field to the safety of his vehicle.

Three other species of the genus *Psorophora* collected in this research were uncommon to rare, and included *Ps. cyanescens*, *Ps. discolor*, and *Ps. howardii*. Only *Ps. discolor* is implicated in any disease, having been associated with an outbreak of Venezuelan equine encephalitis in 1971.

Of the five remaining mosquito species found during this study, only *Cq. perturbans*, a vector of West Nile virus and eastern equine encephalitis, was common. This mosquito was linked to urban landscapes, and was at its maximum abundance during June.

Culiseta inornata, a vector of western equine encephalitis, was collected infrequently during this study. This mosquito had an unusual temporal distribution, with peaks during April and October, being rarely found at any other time. *Culiseta inornata* was not strongly connected with any one matrix, and relatively equal in its occurrence in forest, urban, and wetland landscapes.

Uranotaenia sapphirina was another uncommon mosquito taken in this research. Most commonly found in forest matrix, it reached its greatest numbers during August. No diseases are known to be vectored by this mosquito.

Orthopodomyia alba and *Or. signifera* were collected but rare. Their numbers were so low that an assessment of their temporal peak and landscape association is tentative (Table 31). Mosquitoes in this genus have no known association with any arbovirus.

The seven mosquito taxa with ranges extending into central Missouri that were not collected during this study were *Ae. hendersoni*, *An. barberi*, *Cx. territans*, *Cs. impatiens*, *Cs. melanura*, *Tx. r. septentrionalis*, and *Ps. signipennis*. Of these, *Ae. hendersoni* did not show a predilection for coming to light traps; *Culex territans* is a cold-blooded animal specialist; *Toxorhynchites rutilis septentrionalis* does not take blood meals, and *Cs. melanura* has a range that may not extend into central Missouri. For the other taxa (*An. barberi*, *Cs. impatiens*, and *Ps. signipennis*), it is unclear why no specimens were collected during the 415 sampling events occurring over a three year period.

The results of multiple regression analysis suggest that a model for prediction of mosquito abundances based upon habitat or landscape pattern and weather input can be achieved. For two environmental matrices in particular (cropland and urban), the correlation coefficients for multiple regressions of weather data against total mosquito abundance were robust (approximately 0.7). In some cases, correlations for individual mosquito taxa against weather variables were also approximately 0.7.

Evaluating individual weather factors themselves for significance produces a complex pattern. For example, in multiple regression of weather variables against total mosquito abundance in cropland (Table 15) rainfall on the day of sampling and total rainfall for the previous 30 days had significant values for *p*. However, rainfall the day of the sampling was positively associated with total abundance, while total rainfall for 30 days prior was negatively associated with total mosquito abundance. As explained previously, each of these rainfall factors can be considered independent from the other, affecting different aspects of mosquito biology and behavior. Nonetheless, it is intuitively logical to expect these factors to act, at least in some ways, in concert. An overarching examination of all weather factors, including those with *p* values that are not significant, only reinforces the concept that this is a complex model with some uncertain relationships.

It is interesting to note that the highest correlations between weather and mosquito abundance were found for what could be considered the most disturbed landscapes: cropland, and urban. The impact of monoculture practices for cropland, and the intricate interplay of human habitation with the environment in urban areas, may interfere with, reduce, or even negate the importance of more subtle environmental influences within these landscapes. Conversely, it may be necessary to evaluate a more complete suite of environmental variables, including but not limited to weather, for grassland, wetland and forest matrices, before robust models for predicting mosquito abundances in those landscapes can be approached.

Most of the landscapes had significant F values from analyses of variance for the regressions, even if the correlation coefficients were poor (*e.g.*, grassland and forest matrices). However, multiple regression of data from wetland systems failed to produce any significant results. It is clear from the cluster analyses that wetland influence is strong, producing mosquito assemblages and abundances that are not closely related to those in other landscapes. The results of multiple regression analysis suggest that the wetland habitat itself is rather unpredictable and could be the reason behind this distance of association. The wetland is certainly a landscape that has the ability to sustain a diverse community of organisms, and as such, may be considered the least impacted landscape with regard to weather factors, especially for aquatic fauna.

Because of the potential for unusual effects created by wetland influence, additional multiple regressions were performed with the wetland data excluded. Most of the data thus generated were not different in significance of F or r^2. However, in cropland matrix, the range of correlation coefficients increased approximately 10%, from approximately 0.7 to approximately 0.8, with all F values continuing to be highly significant. Similar changes in r^2 were noted for forest matrix analyses, but again, no change in significance of F. These data suggest that any model for mosquito abundance should account for strongly influential landscapes such as wetland, even when the influence is limited to that of a patch within another landscape pattern.

Multiple regression analyses were employed to determine model equations that related weather variables and abundance of mosquitoes in the common central Missouri landscape matrices during 2007 – 2008. These equations were then used with the measured weather variables in 2009 to predict the 2009 abundances of total mosquitoes, *Ae. vexans*, *Cx. erraticus*, and *Cx. salinarius*. Altogether, eleven of 16 multiple regressions were significant, but only two of the eleven models were successful at predicting mosquito abundances (Tables 22 – 24). One of the two successful models was for *Culex erraticus* abundance in grassland matrix, where every successfully predicted value (17 of 24) was due to collecting none of this species when the prediction was also zero. The other model that was judged successful was for total mosquito abundance in urban matrix, where 15 of 29 collections met the acceptance criteria for agreement with the predicted value.

The lack of overall success in generating predictive models for mosquito abundance in 2009 based on 2007 – 2008 data may be due to the profile of the mosquito collections in 2009. A much higher proportion of the collections in 2009 were from wetland patches than in 2007 – 2008. These results underscore that the wetland influence is profound with regard to mosquito abundance, and also suggest that patches in general, and wetland patches in particular, are less important to mosquito taxonomic composition than to mosquito abundance.

Similarly, multiple regression analyses were employed to determine model equations that related weather variables and the abundance of mosquitoes in central Missouri landscapes during 2007. These equations were then used with the measured weather variables in 2008 to predict the 2008 abundances of total mosquitoes, *Ae. vexans*, *Cx. erraticus*, and *Cx. salinarius*.

Altogether, six of 16 multiple regressions were significant, but only two of the six models were successful at predicting mosquito abundances (Tables 27 – 28). Both of these successful models occurred in the forest matrix, where total mosquito abundance was successfully predicted in four of six sample collections, and *Culex erraticus* abundance was successfully predicted in three of six sample collections.

CCA was performed to further explore the relationship between weather factors and mosquito abundances. The amount of variance explained by CCA, regardless of matrix, was always approximately 60%. This value suggests that weather variables play a keystone role in the abundance of mosquitoes, but underscores that a large portion of the variance (approximately 40% with regard to CCA) is mediated by other factors. The mosquito taxa that were most abundant for central Missouri landscapes were only rarely influenced strongly by specific weather variables [(*e.g.*, *Cx. salinarius* was positively affected by the previous month's rainfall in grassland matrix (Figure 17 and Table 30)]. This does not contradict the results of multiple regression analysis, where a number of variables were usually found to be significantly correlated with mosquito abundance; because CCA helps to better explain the impact of these variables on individual mosquito taxa. CCA clarifies that certain environmental variables may be at the root of the influence of the environment on mosquito abundance.

This study confirms that a few mosquito taxa are influenced by similar weather factors regardless of the matrix under study. For example, *Ps. cyanescens* was positively affected by total rainfall, either in the month of sampling or in the previous month, in both cropland and grassland matrices; similarly, *An. quadrimaculatus* was positively influenced by total solar radiation in both previous and current months on both cropland and grassland matrices. Overall, though, most mosquito taxa were not strongly influenced by weather factors according to CCA, at least not based upon the criterion of the taxon score coinciding with (or nearly so) an environmental gradient's line.

Further examination of the CCA plots indicates that there is a rough bisection of the data into taxa positively influenced by each of the weather factors and taxa negatively influenced. For most matrices, the number of taxa positively affected by each of the weather factors was greater than those negatively affected. However, the opposite was true for the forest landscape, with eleven taxa positively affected by each of the weather factors and 18 taxa negatively affected. It is not intuitively clear why this would be the case, but forest is the matrix with the most diversity in landscape structure, so perhaps factors like rainfall and temperature destabilize the intricate balance of this diversity and thus negatively affect abundances of individual mosquito taxa.

In evaluating the CCA ordination of the most abundant mosquitoes, *Ae. vexans* was generally affected negatively by increases in temperature and rainfall, although this was not the case in forest, where its abundance was affected positively by these influences. *Culex erraticus*, conversely, was always positively affected by such increases, and *Cx. salinarius* was ambiguously affected (positively in cropland and grassland, negatively in forest and urban). Given the fact that all of these influences (in the case of *Ae. vexans* and *Cx. erraticus*) were not considered strongly mediating of mosquito abundance, it may be difficult to draw a conclusion from these data. Weather factors do not characterize the complete model of mosquito abundances, although it is possible to present a good approximation of such a model.

Relative humidity (RH) was not among the weather variables measured in this study, because of the lack of easily obtainable RH measurements during the study period, although there is evidence that it may be important in mosquito behavior. RH has a complex effect on mosquito activity. Generally, increased RH increases mosquito catches, but RH gradients tend to cause avoidance behavior (turning) in mosquitoes, regardless of whether the gradient is positive or negative (Muirhead Thomson, 1938).

CONCLUSION AND POTENTIAL FOR FUTURE RESEARCH

The mosquito fauna of five central Missouri counties, and moreover, five distinct landscape matrix types, were characterized over the course of three years (2007 – 2009). *Aedes vexans* was determined to be the dominant mosquito in most of the landscape matrices, and also, in most patch types in any given matrix. This mosquito is a worldwide pest and the results of this research confirm that within the study area, one is more likely to encounter this mosquito than all other mosquito taxa combined. This is cause for concern given the status of *Ae. vexans* as a vector of several important diseases, including the most prominent mosquito-borne disease of the 21st century in North America, West Nile virus.

Other mosquito taxa were also abundant, including *Cx. erraticus* and *Cx. salinarius*. These mosquitoes are also vectors of West Nile virus, and adding their abundance to that of *Ae. vexans* means that for any given meeting with a mosquito in central Missouri, there is an approximately 80% chance that it will be with one of these three disease vectors. The chance of encountering a specific mosquito taxon increases during the times of its peak abundances (*i.e.*, May/June or September for *Ae. vexans*, August for *Cx. erraticus*, July/August or October for *Cx. salinarius*) and decreases at other times, but the assemblage of these three most abundant mosquitoes is the most likely to be encountered at any time of the year that mosquitoes are active.

A few mosquito taxa were collected that were not expected in the study area. In some cases, the abundances of these taxa were very low, and it is possible that our specimens represent spurious collections, or are otherwise not indicative of an expansion of range. However, two mosquito taxa were collected either in sufficient abundance or in enough different landscape types that their presence in central Missouri deserves notice.

First, *Ae. aurifer* was not known to be established west of the regions immediately adjacent to the Mississippi River, but 201 specimens of this mosquito were collected during this study. Even accounting for wind-blown or accidentally transported specimens, it is clear that the range of *Ae. aurifer* has extended into central Missouri.

Second, six specimens of a hybrid of *Ae. zoosophus* and *Ae. triseriatus*, not described before 1988, were collected from every landscape matrix except wetland. *Aedes triseriatus* is not uncommon in the study area, but *Ae. zoosophus* was not known to range further northeast than the border between Oklahoma and Missouri. The range of this hybrid is unknown, but its presence in the collections from this study imparts valuable information to mosquito researchers in Missouri.

Further studies of the mosquito fauna in Missouri should consider the presence of some of the unexpected mosquito taxa from this study. Awareness of their presence can contribute to the accuracy of range maps and disease surveillance.

Temporal distribution of mosquito abundance was evaluated, and typically was taxon-specific. In considering the three most abundant mosquito taxa for this region, three distinct temporal patterns of abundance were noted. *Aedes vexans* usually exhibited a high point in abundance during May or June, with a decline in abundance that was usually strongly evident during August, followed by another peak during September. *Culex erraticus* was scarcely collected until July and reached its numerical peak during August, followed by a rapid decline through September. *Culex salinarius* abundance tended to increase throughout the year, often reaching its maximum during September or October. Many other mosquito taxa also displayed characteristic temporal patterns. This information can be valuable in developing and refining models for risk of exposure to disease vectors, planning control strategies, or assessing the impact of control measures.

Multiple regression analysis was used to generate elementary linear models of mosquito abundance that can be tested with further mosquito collection efforts. These models can be used to develop a web-based information system for forecasting mosquito activity. The concept of this type of web-based prediction was inspired by the Horizon Point Weather System (Horizonpoint, 2010), a service provided by the University of Missouri Extension program for weather forecasting. The format for such a website could be based upon that used by Horizon Point.

The significant variables in these models can also be used as starting points for more focused sampling pursuant to further model development. The results of CCA lend support to the selection of specific variables as keystone components in model building and model testing.

It is also clear that the most robust models will need to include more than just the weather measurements used in this study. Relative humidity and non-weather factors such as distance from breeding sites (Barker *et al.*, 2009), amount of aquatic vegetation present in breeding sites, amount and dryness of senescing vegetation (Sanford *et al.*, 2003) present in habitats, particularly wetlands, and proximity to potential host populations (Brown and Sethi, 2002) are all potential variables for inclusion in additional modeling experiments.

It may also be important to incorporate degree-day values into models, especially for very abundant and pestiferous taxa such as *Aedes vexans*, which can be used as a surrogate or signal for overall risk. Degree-day modeling was not used on this study because only adult mosquitoes, not larvae, were sampled. Since mosquitoes pass most of their critical development stages in water, and since no measurements of water temperature were taken in this study, it was believed that degree-day modeling would be important only if larvae and adults were sampled.

The importance of choosing the right variables, an adequate number of samples, and samples from all of matrices represented in a landscape is underscored by the performance of models based on data from 2007 – 2008. The performance of these models was generally poor, possibly because too few samples were used to generate models and because samples which were underrepresented for a particular matrix type (wetland) were used to generate a model to predict, in part, wetland abundances.

In conclusion, predicting the risk of encountering disease-vectoring mosquitoes is dependent on a complex set of factors, including the abundance and temporal occurrence of the vector mosquito, the landscape pattern being considered, and a suite of weather variables measured prior to and including the date being forecast. The results of this research provide mathematical models that can be used to project abundances of mosquitoes and thus characterize risk.

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TABLE 1 — Total number and proportion of total mosquitoes collected from all patch-matrix landscape combinations during 2007 – 2009 in five counties of central Missouri.

Taxon	Total Collected	% of total
Ae. vexans	66,472	66.9
Cx. erraticus	8,767	8.8
Cx. salinarius	4,617	4.6
Ae. sticticus	4,273	4.3
Ae. trivittatus	3,873	3.9
Cq. perturbans	2,028	2.0
Ae. cinereus	1,748	1.8
Ps. horrida	1,316	1.3
An. punctipennis	1,211	1.2
Ae. canadensis canadensis	1,045	1.1
Cx. pipiens group	640	0.6
Ps. ciliata	610	0.6
Ps. columbiae	519	0.5
An. quadrimaculatus	386	0.4
Ps. ferox	376	0.4
An. crucians	270	0.3
Ae. aurifer	201	0.2
Ae. stimulans	168	0.2
Ps. cyanescens	140	0.1
Ae. triseriatus	124	0.1
Ur. sapphirina	98	0.1
Ae. albopictus	91	0.1
Cs. inornata	85	0.1
Cx. peccator	67	0.1
Cx. tarsalis	67	0.1
An. walkeri	38	<0.1
Ae. grossbecki	18	<0.1
Ps. howardii	14	<0.1
Ps. discolor	12	<0.1
Ae. dorsalis	6	<0.1
Ae. nigromaculis	6	<0.1
Ae. zoosophus/Ae. triseriatus hybrid	6	<0.1
Ae. sollicitans	4	<0.1
Or. signifera	3	<0.1
Ae. epactius	1	<0.1
Or. alba	1	<0.1

TABLE 2 — Mosquito taxa correlations greater than 0.5 according to Pearson's correlation matrix, indicating a linear relationship between occurrences of the taxa in five counties of central Missouri during 2007 – 2009.

Taxa	correlation
Ae. cinereus x *Ps. ciliata*	0.803
Ae. cinereus x *Ae. nigromaculis*	0.805
Ae. sticticus x *Ps. horrida*	0.548
Ae. stimulans x *Ps. ferox*	0.674
Ae. triseriatus x *Ps. ferox*	0.511
Ae. trivittatus x *An. punctipennis*	0.533
An. punctipennis x *Ps. ciliata*	0.626
An. punctipennis x *Ps. howardii*	0.641
An. quadrimaculatus x *Ps. howardii*	0.521
Cx. pipiens group x *Ur. sapphirina*	0.739
Ps. ciliata x *Ps. howardii*	0.788

TABLE 3 — Mosquito taxa richness (S), mean abundance per trap (A), diversity measures (H', 1/D), and taxa evenness (E) for each landscape matrix type sampled in five counties of central Missouri during 2007 – 2009.

	Cropland	Forest	Grassland	Urban	Wetland
S	30	29	31	23	27
A	317	169	146	38	1,377
H'	1.352	1.846	1.402	1.702	0.974
1/D	2.270	4.209	2.345	3.649	1.571
E	0.397	0.548	0.408	0.543	0.296

TABLE 4 — Mosquito taxa richness (S) for each patch-matrix landscape combination plus overall mean and standard deviation for each matrix type in five counties of central Missouri during 2007 – 2009. Patch-matrix combinations of the same type (*i.e.*, cropland-cropland, forest-forest, etc.) indicate samples from the matrix only.

		Matrix				
		Cropland	Forest	Grassland	Urban	Wetland
Patch	Cropland	18	13	7	11	19
	Forest	18	22	26	16	23
	Grassland	26	22	24	14	20
	Urban	17	10	19	18	18
	Wetland	18	17	19	18	22
	Mean	**19**	**17**	**19**	**15**	**20**
	Std. Dev.	**3.6**	**4.9**	**3.4**	**1.7**	**1.9**

TABLE 5 — Mean mosquito abundance per trap (A) for each patch-matrix landscape combination and overall mean and standard deviation for each matrix type for five counties of central Missouri during 2007 – 2009. Patch-matrix combinations of the same type (*i.e.*, cropland-cropland, forest-forest, etc.) indicate samples from the matrix only.

		Matrix				
		Cropland	Forest	Grassland	Urban	Wetland
Patch	Cropland	564	75	27	69	1,002
	Forest	498	154	248	32	1,151
	Grassland	148	269	107	8	1,115
	Urban	521	236	105	18	734
	Wetland	676	248	156	296	2,382
	Mean	**481**	**196**	**129**	**85**	**1,277**
	Std. Dev.	**193**	**46**	**59**	**120**	**621**

TABLE 6 — Diversity measures for each patch-matrix landscape combination and overall mean and standard deviation for each matrix type for five counties of central Missouri during 2007 – 2009. Patch-matrix combinations of the same type (*i.e.*, cropland-cropland, forest-forest, etc.) indicate samples from the matrix only.

		Matrix				
		Cropland	Forest	Grassland	Urban	Wetland
Patch	Cropland	H’ = 1.156	H’ = 1.685	H’ = 1.117	H’ = 1.280	H’ = 1.215
		1/D = 2.069	1/D = 3.514	1/D = 2.327	1/D = 2.865	1/D = 2.172
	Forest	H’ = 1.141	H’ = 1.837	H’ = 1.224	H’ = 1.393	H’ = 1.215
		1/D = 1.968	1/D = 4.497	1/D = 1.874	1/D = 2.151	1/D = 1.893
	Grassland	H’ = 1.636	H’ = 1.313	H’ = 1.272	H’ = 1.719	H’ = 0.836
		1/D = 3.723	1/D = 2.652	1/D = 2.663	1/D = 4.316	1/D = 1.461
	Urban	H’ = 0.625	H’ = 1.476	H’ = 1.207	H’ = 1.612	H’ = 1.610
		1/D = 1.338	1/D = 3.256	1/D = 1.899	1/D = 2.930	1/D = 2.933
	Wetland	H’ = 1.074	H’ = 1.542	H’ = 1.792	H’ = 0.973	H’ = 0.533
		1/D = 1.774	1/D = 3.420	1/D = 3.729	1/D = 1.710	1/D = 1.239
Mean ± Std. Dev. For H’		**1.13 ± 0.36**	**1.57 ± 0.20**	**1.32 ± 0.27**	**1.40 ± 0.29**	**1.08 ± 0.41**
Mean ± Std. Dev. For 1/D		**2.17 ± 0.91**	**3.47 ± 0.67**	**2.50 ± 0.76**	**2.79 ± 0.99**	**1.94 ± 0.66**

H’ = Shannon Index and 1/D = Simpson’s Reciprocal Index

TABLE 7 — Taxon evenness for each patch-matrix landscape combination and overall mean and standard deviation for each matrix type for five counties of central Missouri during 2007 – 2009. Patch-matrix combinations of the same type (*i.e.*, cropland-cropland, forest-forest, etc.) indicate samples from the matrix only.

		Matrix				
		Cropland	Forest	Grassland	Urban	Wetland
Patch	Cropland	0.400	0.657	0.574	0.534	0.413
	Forest	0.395	0.594	0.376	0.502	0.387
	Grassland	0.502	0.425	0.400	0.651	0.279
	Urban	0.221	0.641	0.410	0.558	0.557
	Wetland	0.371	0.544	0.608	0.337	0.173
	Mean	**0.38**	**0.57**	**0.47**	**0.52**	**0.36**
	Std. Dev.	**0.10**	**0.09**	**0.11**	**0.11**	**0.14**

TABLE 8 — Total abundance and percent of total for each mosquito taxon collected from each matrix type during 2007 - 2009 in five counties of central Missouri.

	Cropland Matrix		Forest Matrix		Grassland Matrix		Urban Matrix		Wetland Matrix	
Taxon	Abundance	%	Abundance	%	Abundance	%	Abundance	%	Abundance	%
Ae. albopictus	2	<0.1	1	<0.1	26	0.1	61	1.6	1	<0.1
Ae. aurifer	86	0.4	1	<0.1	3	<0.1	0	0.0	111	0.3
Ae. canadensis canadensis	0	0.0	120	1.4	921	4.1	4	0.1	0	0.0
Ae. cinereus	140	0.7	61	0.7	10	<0.1	1	<0.1	1,536	3.5
Ae. dorsalis	4	<0.1	1	<0.1	1	<0.1	0	0.0	0	0.0
Ae. epactius	0	0.0	0	0.0	1	<0.1	0	0.0	0	0.0
Ae. grossbecki	0	0.0	0	0.0	18	0.1	0	0.0	0	0.0
Ae. nigromaculis	1	<0.1	0	0.0	1	<0.1	0	0.0	4	<0.1
Ae. sollicitans	1	<0.1	1	<0.1	0	0.0	0	0.0	2	<0.1
Ae. sticticus	977	4.8	700	8.2	243	1.1	7	0.2	2,346	5.3
Ae. stimulans	0	0.0	8	0.1	159	0.7	1	<0.1	0	0.0
Ae. triseriatus	13	0.1	2	<0.1	94	0.4	15	0.4	0	0.0
Ae. trivittatus	1,077	5.3	971	11.4	304	1.4	170	4.4	1,351	3.1
Ae. vexans	13,179	64.4	3,226	38.0	13,931	62.3	1,118	28.8	35,018	79.4
Ae. zoosophus/*Ae. triseriatus* hybrid	1	<0.1	2	<0.1	2	<0.1	1	<0.1	0	0.0
An. crucians	85	0.4	12	0.1	76	0.3	35	0.9	62	0.1
An. punctipennis	168	0.8	299	3.5	363	1.6	70	1.8	311	0.7
An. quadrimaculatus	62	0.3	65	0.8	45	0.2	17	0.4	197	0.4
An. walkeri	1	<0.1	0	0.0	0	0.0	0	0.0	37	0.1
Cq. perturbans	16	0.1	54	0.6	46	0.2	1,624	41.8	288	0.7
Cs. inornata	5	<0.1	23	0.3	20	0.1	29	0.7	8	<0.1
Cx. erraticus	1,274	6.2	2,258	26.6	4,116	18.4	76	2.0	1,043	2.4
Cx. peccator	2	<0.1	50	0.6	0	0.0	0	0.0	15	<0.1
Cx. pipiens group	43	0.2	216	2.5	195	0.9	185	4.8	1	<0.1
Cx. salinarius	2,562	12.5	231	2.7	882	3.9	399	10.3	543	1.2
Cx. tarsalis	22	0.1	2	<0.1	23	0.1	14	0.4	6	<0.1
Or. alba	0	0.0	0	0.0	1	<0.1	0	0.0	0	0.0
Or. signifera	0	0.0	0	0.0	0	0.0	3	0.1	0	0.0
Ps. ciliata	121	0.6	33	0.4	35	0.2	17	0.4	404	0.9
Ps. columbiae	135	0.7	24	0.3	89	0.4	9	0.2	262	0.6
Ps. cyanescens	11	0.1	8	0.1	65	0.3	0	0.0	56	0.1
Ps. discolor	3	<0.1	0	0.0	3	<0.1	0	0.0	6	<0.1
Ps. ferox	27	0.1	52	0.6	232	1.0	5	0.1	60	0.1
Ps. horrida	430	2.1	25	0.3	417	1.9	20	0.5	424	1.0
Ps. howardii	1	<0.1	2	<0.1	0	0.0	0	0.0	11	<0.1
Ur. sapphirina	2	<0.1	52	0.6	42	0.2	0	0.0	2	<0.1

TABLE 9 — Mosquito taxa that made up at least 1% of the total identified mosquitoes from each patch type within each matrix during 2007 – 2009 for five counties in central Missouri. Patch-matrix combinations of the same type (*i.e.*, cropland-cropland, forest-forest, etc.) indicate samples from the matrix only.

		Percent From Patch Type				
Matrix	Taxon	Cropland	Forest	Grassland	Urban	Wetland
Cropland	*Ae. aurifer*	<1.0	<1.0	<1.0	2.0	<1.0
	Ae. cinereus	<1.0	<1.0	<1.0	<1.0	2.4
	Ae. sticticus	5.1	11.7	4.9	1.0	1.6
	Ae. trivittatus	6.8	5.5	2.7	<1.0	10.2
	Ae. vexans	67.6	69.7	40.0	86.1	74.1
	An. crucians	<1.0	<1.0	1.5	<1.0	<1.0
	An. punctipennis	<1.0	<1.0	1.0	<1.0	1.3
	Cx. erraticus	<1.0	<1.0	21.0	<1.0	<1.0
	Cx. salinarius	13.0	6.6	24.6	7.9	4.3
	Ps. ciliata	<1.0	<1.0	<1.0	<1.0	1.3
	Ps. columbiae	<1.0	<1.0	<1.0	<1.0	1.1
	Ps. horrida	4.9	2.9	<1.0	<1.0	2.5
Forest	*Ae. canadensis canadensis*	<1.0	2.7	<1.0	<1.0	1.9
	Ae. cinereus	1.0	<1.0	1.8	<1.0	<1.0
	Ae. sticticus	<1.0	10.1	1.7	<1.0	17.6
	Ae. trivittatus	11.5	11.3	3.5	14.1	23.0
	Ae. vexans	48.7	25.1	45.9	45.9	45.1
	An. punctipennis	4.8	2.5	1.1	4.1	<1.0
	An. quadrimaculatus	3.4	<1.0	<1.0	<1.0	<1.0
	Cq. perturbans	2.0	<1.0	<1.0	2.4	<1.0
	Cx. erraticus	9.9	36.0	40.5	1.2	5.9
	Cx. peccator	<1.0	<1.0	1.5	<1.0	<1.0
	Cx. pipiens group	<1.0	6.9	<1.0	2.9	<1.0
	Cx. salinarius	13.9	<1.0	1.0	27.1	2.9
	Ps. ciliata	2.2	<1.0	<1.0	1.2	<1.0
	Ps. columbiae	2.0	<1.0	<1.0	<1.0	<1.0
	Ps. ferox	<1.0	1.0	<1.0	<1.0	1.0
	Ur. sapphirina	<1.0	1.8	<1.0	<1.0	<1.0

TABLE 9 (CONTINUED) — Mosquito taxa that made up at least 1% of the total identified mosquitoes from each patch type within each matrix during 2007 – 2009 for five counties in central Missouri. Patch-matrix combinations of the same type (*i.e.*, cropland-cropland, forest-forest, etc.) indicate samples from the matrix only.

		Percent From Patch Type				
Matrix	Taxon	Cropland	Forest	Grassland	Urban	Wetland
Grassland	*Ae. canadensis canadensis*	<1.0	5.5	<1.0	2.2	2.5
	Ae. cinereus	<1.0	<1.0	<1.0	<1.0	1.1
	Ae. sticticus	<1.0	1.5	<1.0	<1.0	1.6
	Ae. stimulans	<1.0	1.1	<1.0	<1.0	<1.0
	Ae. trivittatus	1.9	1.9	<1.0	1.1	1.8
	Ae. vexans	59.0	72.3	44.5	71.7	61.0
	An. punctipennis	1.3	1.4	1.8	<1.0	1.5
	Cx. erraticus	<1.0	7.5	41.5	3.6	17.2
	Cx. pipiens group	7.1	<1.0	1.0	6.0	<1.0
	Cx. salinarius	27.6	1.9	6.9	8.2	6.8
	Ps. ciliata	1.3	<1.0	<1.0	<1.0	<1.0
	Ps. columbiae	1.9	<1.0	<1.0	<1.0	<1.0
	Ps. columbiae	<1.0	<1.0	<1.0	2.7	<1.0
	Ps. ferox	<1.0	1.5	<1.0	<1.0	<1.0
	Ps. horrida	<1.0	3.0	<1.0	<1.0	1.2

TABLE 9 (CONTINUED) — Mosquito taxa that made up at least 1% of the total identified mosquitoes from each patch type within each matrix during 2007 – 2009 for five counties in central Missouri. Patch-matrix combinations of the same type (*i.e.*, cropland-cropland, forest-forest, etc.) indicate samples from the matrix only.

		Percent From Patch Type				
Matrix	Taxon	Cropland	Forest	Grassland	Urban	Wetland
Urban	*Ae. albopictus*	<1.0	1.9	4.7	4.4	<1.0
	Ae. sticticus	<1.0	1.0	<1.0	<1.0	<1.0
	Ae. triseriatus	<1.0	<1.0	1.2	1.1	<1.0
	Ae. trivittatus	<1.0	3.6	1.6	1.9	6.7
	Ae. vexans	49.4	67.2	25.3	55.3	6.8
	An. crucians	<1.0	1.2	<1.0	<1.0	1.4
	An. punctipennis	1.5	3.6	2.8	4.0	<1.0
	An. quadrimaculatus	<1.0	<1.0	<1.0	1.5	<1.0
	Cq. perturbans	18.1	6.3	<1.0	<1.0	75.5
	Cs. inornata	<1.0	6.1	<1.0	<1.0	<1.0
	Cx. erraticus	<1.0	<1.0	6.3	6.5	<1.0
	Cx. pipiens group	<1.0	1.5	22.9	14.7	<1.0
	Cx. salinarius	26.8	3.4	32.8	6.7	7.0
	Cx. tarsalis	<1.0	<1.0	<1.0	1.4	<1.0
	Ps. columbiae	1.5	<1.0	<1.0	<1.0	<1.0
	Ps. horrida	<1.0	2.2	<1.0	1.1	<1.0
Wetland	*Ae. cinereus*	1.2	3.0	5.1	15.8	1.4
	Ae. sticticus	20.3	7.6	<1.0	5.9	1.9
	Ae. trivittatus	4.0	2.1	1.7	3.8	3.4
	Ae. vexans	64.5	71.9	82.4	55.1	89.7
	An. punctipennis	1.1	<1.0	1.5	<1.0	<1.0
	An. quadrimaculatus	<1.0	1.7	<1.0	<1.0	<1.0
	Cq. perturbans	<1.0	<1.0	<1.0	6.3	<1.0
	Cx. erraticus	1.5	6.0	<1.0	4.2	1.6
	Cx. salinarius	1.6	2.0	2.2	2.5	<1.0
	Ps. ciliata	<1.0	<1.0	2.9	2.3	<1.0
	Ps. columbiae	1.4	<1.0	1.7	<1.0	<1.0
	Ps. horrida	3.0	2.1	<1.0	<1.0	<1.0

TABLE 10 — Mean abundance per trap by month for mosquito taxa taken from cropland matrix during 2007 – 2009 in five counties of central Missouri. Patch-matrix combinations of the same type (*i.e.*, cropland-cropland) indicate samples from the matrix only.

			Sample Date														
Matrix	Taxon	Patch	Jul-07	Aug-07	Sep-07	Oct-07	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	May-09	Jun-09	Jul-09	Aug-09	Sep-09
Cropland	*Ae. albopictus*	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	NS	0.0	0.0	2.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	7.0
		Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	NS	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	36.0	26.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	8.0	1.0
	Ae. aurifer	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	NS	0.0	0.0	2.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	7.0
		Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	36.0	26.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	8.0	1.0
	Ae. cinereus	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	3.0	NS	0.0	0.0	2.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	6.0	0.0	0.0	0.0	0.0
		Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.0	0.0	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.3	92.0	0.0	3.0	5.0
	Ae. nigromaculis	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	NS	0.5	0.0	0.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
	Ae. sollicitans	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	NS	0.0	0.0	0.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	NS	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
	Ae. sticticus	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	66.3	NS	0.5	0.0	0.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	198.5	0.0	0.0	0.0	0.0
		Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	139.0	NS	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	31.0	0.0	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	20.3	0.0	8.0	1.0	1.0
	Ae. triseriatus	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	NS	0.0	0.0	0.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	2.0	0.0
		Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	NS	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		NS = No sample															

TABLE 10 (CONTINUED) — Mean abundance per trap by month for mosquito taxa taken from cropland matrix during 2007 - 2009 in five counties of central Missouri. Patch-matrix combinations of the same type (*i.e.*, cropland-cropland, forest-forest, etc.) indicate samples from the matrix only.

			Sample Date														
Matrix	Taxon	Patch	Jul-07	Aug-07	Sep-07	Oct-07	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	May-09	Jun-09	Jul-09	Aug-09	Sep-09
Cropland	*Ae. trivittatus*	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	80.0	NS	13.0	0.0	0.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	87.0	0.0	6.0	0.0	0.0
		Grassland	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.0	78.0	NS	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	21.0	0.0	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	45.3	299.0	16.0	0.0	0.0
	Ae. vexans	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	490.3	NS	12.5	771.0	359.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	444.0	3.0	6.0	436.0	1019.0
		Grassland	48.0	6.0	0.5	107.0	0.0	0.0	15.3	5.8	28.2	NS	760.0	NS	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	226.0	1.0	0.0	1087.0	1322.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	340.0	666.0	252.0	322.0	1018.0
	Ae. zoosophus/*Ae. triseriatus* hybrid	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	NS	0.0	0.0	0.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	1.0	0.0
		Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	0.0	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
	An. crucians	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	NS	0.0	0.0	1.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Grassland	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.8	11.0	4.5	NS	1.0	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.0	0.0	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
	An. punctipennis	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	7.0	10.0	0.0	0.0	0.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	6.5	3.0	0.5	0.0	5.0
		Grassland	2.8	0.0	0.5	0.0	0.0	0.0	0.3	0.8	3.2	0.5	NS	NS	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	7.0	0.0	0.5	2.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.3	46.0	0.0	2.0	5.0
	An. quadrimaculatus	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	NS	0.0	2.0	0.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	4.0	0.0	0.0	3.0	1.0
		Grassland	1.0	1.5	2.0	0.0	0.0	0.0	0.0	0.4	2.4	0.3	NS	0.0	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	3.0	0.0	0.0	1.0	6.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.7	2.0	0.0	1.0	6.0
	An. walkeri	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	NS	0.0	0.0	0.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	0.0	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.0	0.0	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		NS = No sample															

TABLE 10 (CONTINUED) — Mean abundance per trap by month for mosquito taxa taken from cropland matrix during 2007 - 2009 in five counties of central Missouri. Patch-matrix combinations of the same type (*i.e.*, cropland-cropland) indicate samples from the matrix only.

			Sample Date														
Matrix	Taxon	Patch	Jul-07	Aug-07	Sep-07	Oct-07	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	May-09	Jun-09	Jul-09	Aug-09	Sep-09
Cropland	*Cq. perturbans*	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	NS	0.5	0.0	0.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Grassland	0.4	0.5	1.0	0.0	0.0	0.0	0.0	0.0	1.2	0.3	NS	0.0	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	1.0	0.0	1.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	1.0	0.0
	Cs. inornata	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	NS	0.0	0.0	0.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Grassland	0.0	0.0	0.0	2.0	NS	NS	NS	NS	NS	NS	NS	0.0	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	1.0	0.0
	Cx. erraticus	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	NS	0.5	13.0	4.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.5	29.0	2.0
		Grassland	49.6	117.5	16.5	0.0	0.0	0.0	1.5	26.0	105.4	4.0	NS	0.0	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	3.0	2.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	8.0	5.0	11.0
	Cx. peccator	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	NS	0.0	0.0	0.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	0.0	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	1.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	1.0
	Cx. pipiens group	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.7	NS	0.0	0.0	0.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	5.0	0.0	0.0	0.0	0.0
		Grassland	2.4	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.8	0.5	NS	0.0	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	8.0	0.0	0.0	1.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.3	0.0	0.0	0.0	1.0
	Cx. salinarius	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	10.7	NS	14.0	279.0	168.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	10.5	18.0	4.0	118.0	57.0
		Grassland	118.8	72.5	11.5	58.5	0.0	0.3	8.8	26.6	63.4	7.3	NS	4.5	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	11.0	27.0	4.5	121.0	74.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.3	0.0	80.0	1.0	106.0
	Cx. tarsalis	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	NS	0.0	0.0	1.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	2.0	0.0	0.0	0.0	0.0
		Grassland	1.2	1.5	0.5	2.0	0.0	0.0	0.0	0.0	0.4	0.3	NS	0.0	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		NS =No sample															

TABLE 10 (CONTINUED) — Mean abundance per trap by month for mosquito taxa taken from cropland matrix during 2007 - 2009 in five counties of central Missouri. Patch-matrix combinations of the same type (*i.e.*, cropland-cropland) indicate samples from the matrix only.

			Sample Date														
Matrix	Taxon	Patch	Jul-07	Aug-07	Sep-07	Oct-07	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	May-09	Jun-09	Jul-09	Aug-09	Sep-09
Cropland	*Ps. ciliata*	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	2.3	NS	1.5	0.0	5.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.5	0.0	0.5	0.0	0.0
		Grassland	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	3.3	6.0	NS	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	6.0	0.0	0.0	0.0	2.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	2.3	48.0	3.0	0.0	0.0
	Ps. columbiae	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.7	NS	1.5	5.0	10.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.5	0.0	0.0	0.0	0.0
		Grassland	3.0	2.5	1.5	0.0	0.0	0.0	0.0	0.2	1.8	1.8	0.0	NS	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	14.0	0.0	0.0	0.0	5.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.3	46.0	0.0	2.0	0.0
	Ps. cyanescens	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	NS	0.0	0.0	1.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.5	0.0	0.0	0.0	0.0
		Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	NS	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	3.0	1.0	0.0
	Ps. discolor	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	NS	0.0	0.0	0.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Grassland	0.6	0.0	0.0	0.0	NS	NS	NS	NS	NS	NS	0.0	NS	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
	Ps. ferox	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	NS	0.0	0.0	0.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	3.5	0.0	0.0	4.0	0.0
		Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	NS	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.7	0.0	0.0	0.0	0.0
	Ps. horrida	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	64.0	NS	0.0	0.0	0.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	49.0	0.0	0.0	0.0	0.0
		Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	NS	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	4.0	0.0	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	36.7	0.0	1.0	0.0	0.0
	Ps. howardii	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	NS	0.0	0.0	0.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	NS	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		NS = No sample															

TABLE 10 (CONTINUED) — Mean abundance per trap by month for mosquito taxa taken from cropland matrix during 2007 - 2009 in five counties of central Missouri. Patch-matrix combinations of the same type (*i.e.*, cropland-cropland) indicate samples from the matrix only.

			Sample Date														
Matrix	Taxon	Patch	Jul-07	Aug-07	Sep-07	Oct-07	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	May-09	Jun-09	Jul-09	Aug-09	Sep-09
Cropland	*Ur. sapphirina*	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	NS	0.0	0.0	0.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	NS	NS	NS	NS	NS
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		NS = No sample															

TABLE 11 — Mean abundance per trap by month for mosquito taxa taken from forest matrix during 2007 – 2009 in five counties of central Missouri. Patch-matrix combinations of the same type (*i.e.*, forest-forest) indicate samples from the matrix only.

			Sample Date												
Matrix	Taxon	Patch	Aug-07	Sep-07	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Apr-09	May-09	Jun-09	Jul-09	Aug-09
Forest	*Ae. albopictus*	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	0.0	1.0
		Grassland	0.0	0.0	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	NS
	Ae. aurifer	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	0.0	0.0
		Grassland	0.0	0.0	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.3	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	NS
	Ae. canadensis canadensis	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	17.8	NS	0.5	0.0
		Grassland	0.0	0.0	NS	NS	NS	NS	NS	NS	0.0	0.5	0.0	0.0	0.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	3.8	24.0	0.0	NS
	Ae. cinereus	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	1.3	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	0.0	0.0
		Grassland	0.0	0.0	NS	NS	NS	NS	NS	NS	0.0	1.5	44.0	0.0	0.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.3	0.0	0.0	NS
	Ae. dorsalis	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	0.0	0.0
		Grassland	0.0	0.0	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	1.0	0.0	NS
	Ae. sollicitans	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	0.0	0.0
		Grassland	0.0	0.0	NS	NS	NS	NS	NS	NS	0.0	0.0	1.0	0.0	0.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	NS
	Ae. sticticus	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.3	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	71.3	NS	0.0	0.0
		Grassland	0.0	0.0	NS	NS	NS	NS	NS	NS	0.0	20.0	3.0	1.0	0.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	87.3	15.0	1.3	NS
		NS = No sample													

TABLE 11 (CONTINUED) — Mean abundance per trap by month for mosquito taxa taken from forest matrix during 2007 – 2009 in five counties of central Missouri. Patch-matrix combinations of the same type (*i.e.*, forest-forest) indicate samples from the matrix only.

			Sample Date												
Matrix	Taxon	Patch	Aug-07	Sep-07	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Apr-09	May-09	Jun-09	Jul-09	Aug-09
Forest	*Ae. stimulans*	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	NS	0.0	0.0
		Grassland	0.0	0.0	NS	NS	NS	NS	NS	NS	0.0	2.5	0.0	0.0	0.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	NS
	Ae. triseriatus	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	0.5	1.0
		Grassland	0.0	0.0	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	NS
	Ae. trivittatus	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	2.0	13.5	0.0
		Forest	0.5	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.5	NS	102.5	2.0
		Grassland	0.0	0.0	NS	NS	NS	NS	NS	NS	0.0	27.0	38.0	0.0	0.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.7	9.5	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	108.8	0.0	14.7	NS
	Ae. vexans	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	22.0	47.3	12.0
		Forest	6.0	95.0	0.0	1.0	10.0	0.0	4.0	0.0	0.0	97.8	NS	47.5	2.0
		Grassland	2.5	25.0	NS	NS	NS	NS	NS	NS	0.0	362.0	380.0	3.0	53.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	9.7	24.0	1.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	232.3	4.0	3.0	NS
	Ae. zoosophus/*Ae. triseriatus* hybrid	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	NS	0.5	0.0
		Grassland	0.0	0.0	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	NS
	An. crucians	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	NS	0.0	0.0
		Grassland	0.0	0.0	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	4.0	2.0	NS
	An. punctipennis	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	2.5	4.0	3.0
		Forest	1.0	0.5	0.0	0.0	1.0	0.0	0.0	1.0	0.0	10.5	NS	10.0	2.0
		Grassland	0.5	1.0	NS	NS	NS	NS	NS	NS	2.0	55.5	11.0	1.0	0.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.3	1.5	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	2.3	1.0	1.0	NS
		NS = No sample													

TABLE 11 (CONTINUED) — Mean abundance per trap by month for mosquito taxa taken from forest matrix during 2007 – 2009 in five counties of central Missouri. Patch-matrix combinations of the same type (*i.e.*, forest-forest) indicate samples from the matrix only.

			Sample Date												
Matrix	Taxon	Patch	Aug-07	Sep-07	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Apr-09	May-09	Jun-09	Jul-09	Aug-09
Forest	*An. quadrimaculatus*	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.5	2.3	7.0
		Forest	2.0	1.5	0.0	0.0	0.0	0.0	1.0	0.0	0.5	0.0	NS	0.0	0.0
		Grassland	2.0	1.5	NS	NS	NS	NS	NS	NS	0.0	0.0	3.0	1.0	0.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.3	0.0	0.3	NS
	Cq. perturbans	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.5	0.5	7.0
		Forest	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.3	NS	0.5	1.0
		Grassland	0.0	0.0	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.7	1.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.3	3.0	0.3	NS
	Cs. inornata	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	2.3	NS	0.0	0.0
		Grassland	0.0	0.0	NS	NS	NS	NS	NS	NS	3.0	0.0	0.0	0.0	0.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	5.0	0.0	0.0	0.0	NS
	Cx. erraticus	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	11.3	5.0
		Forest	359.5	10.0	0.0	0.0	22.0	51.0	188.0	3.0	0.0	0.0	NS	0.0	8.0
		Grassland	416.5	11.0	NS	NS	NS	NS	NS	NS	0.0	0.0	4.0	22.0	189.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.5	1.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	1.0	40.7	NS
	Cx. peccator	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	0.0	0.0
		Grassland	0.0	0.0	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	40.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	3.3	NS
	Cx. pipiens group	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.5	0.0	0.0
		Forest	93.5	2.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	0.0	0.0
		Grassland	6.0	0.5	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.7	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	1.0	0.0	0.0	NS
	Cx. salinarius	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	4.0	13.5	8.0
		Forest	7.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	NS	0.0	0.0
		Grassland	8.5	0.5	NS	NS	NS	NS	NS	NS	0.0	2.0	1.0	2.0	1.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	9.3	8.0	2.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.5	21.0	12.3	NS
		NS = No sample													

TABLE 11 (CONTINUED) — Mean abundance per trap by month for mosquito taxa taken from forest matrix during 2007 – 2009 in five counties of central Missouri. Patch-matrix combinations of the same type (*i.e.*, forest-forest) indicate samples from the matrix only.

			Sample Date												
Matrix	Taxon	Patch	Aug-07	Sep-07	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Apr-09	May-09	Jun-09	Jul-09	Aug-09
Forest	*Cx. tarsalis*	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	0.0	0.0
		Grassland	0.5	0.0	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	1.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	NS
	Ps. ciliata	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	1.0	7.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	2.0	0.0
		Grassland	0.0	0.0	NS	NS	NS	NS	NS	NS	0.0	4.5	7.0	0.0	0.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	1.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	NS
	Ps. columbiae	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.3	9.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	0.0	0.0
		Grassland	0.0	0.0	NS	NS	NS	NS	NS	NS	0.0	4.5	2.0	0.0	3.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	NS
	Ps. cyanescens	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	1.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	NS	0.0	0.0
		Grassland	0.0	0.0	NS	NS	NS	NS	NS	NS	0.0	0.0	1.0	0.0	0.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	NS
	Ps. ferox	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	NS	8.0	0.0
		Grassland	0.0	0.0	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	1.0	0.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	4.3	2.0	0.7	NS
	Ps. horrida	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Forest	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	NS	1.0	0.0
		Grassland	0.0	0.5	NS	NS	NS	NS	NS	NS	0.0	4.5	4.0	0.0	0.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	1.0	0.0	0.0	NS
	Ps. howardii	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Forest	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	0.5	0.0
		Urban	0.0	0.0	NS	NS	NS	NS	NS	NS	0.0	0.0	1.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		NS = No sample													

TABLE 11 (CONTINUED) — Mean abundance per trap by month for mosquito taxa taken from forest matrix during 2007 – 2009 in five counties of central Missouri. Patch-matrix combinations of the same type (*i.e.*, forest-forest) indicate samples from the matrix only.

			Sample Date												
Matrix	Taxon	Patch	Aug-07	Sep-07	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Apr-09	May-09	Jun-09	Jul-09	Aug-09
Forest	*Ur. sapphirina*	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	NS
		Forest	13.5	7.5	0.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0	NS	1.0	0.0
		Grassland	0.0	0.5	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	0.0
		Urban	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0	NS
		NS = no sample													

TABLE 12 — Mean abundance per trap by month for mosquito taxa taken from grassland matrix during 2007 – 2009 in five counties of central Missouri. Patch-matrix combinations of the same type (*i.e.*, grassland-grassland) indicate samples from the matrix only.

			Sample Date															
Matrix	Taxon	Patch	Jun-07	Jul-07	Aug-07	Sep-07	Oct-07	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Apr-09	May-09	Jun-09	Jul-09	Aug-09
Grassland	*Ae. albopictus*	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
		Forest	0.0	0.0	1.0	0.5	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	NS	NS	NS
		Grassland	0.0	0.1	0.0	1.3	0.0	0.0	0.0	0.1	0.2	0.6	0.1	0.0	NS	NS	NS	NS
		Urban	NS	0.0	0.0	0.0	NS	NS	0.5	0.0	0.0	2.0	0.0	NS	NS	0.5	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	1.0
	Ae. aurifer	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
		Forest	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	NS	NS	NS
		Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS	NS
		Urban	NS	0.0	0.0	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
	Ae. canadensis canadensis	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	4.2	42.6	5.9	0.0	0.0	0.0	1.0	NS	NS	NS
		Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS	NS
		Urban	NS	0.0	0.0	0.0	NS	NS	0.0	0.5	0.0	0.0	0.0	NS	NS	6.5	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	51.7	0.0	0.0
	Ae. cinereus	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS
		Grassland	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS	NS
		Urban	NS	0.0	0.0	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0	NS	NS	0.5	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	2.7	0.0	0.0
	Ae. dorsalis	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS
		Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS	NS
		Urban	NS	0.0	0.0	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
	Ae. epactius	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS
		Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	NS	NS	NS	NS
		Urban	NS	0.0	0.0	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
	Ae. grossbecki	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.3	0.0	0.0	0.0	1.2	1.5	NS	NS	NS
		Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS	NS
		Urban	NS	0.0	0.0	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.7	0.0	0.0
		NS = No sample																

TABLE 12 (CONTINUED) — Mean abundance per trap by month for mosquito taxa taken from grassland matrix during 2007 - 2009 in five counties of central Missouri. Patch-matrix combinations of the same type (*i.e.*, grassland-grassland) indicate samples from the matrix only.

			Sample Date															
Matrix	Taxon	Patch	Jun-07	Jul-07	Aug-07	Sep-07	Oct-07	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Apr-09	May-09	Jun-09	Jul-09	Aug-09
Grassland	*Ae. nigromaculis*	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS
		Grassland	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS	NS
		Urban	NS	0.0	0.0	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
	Ae. sticticus	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	17.5	5.6	6.1	0.9	1.3	0.0	0.2	1.0	NS	NS	NS
		Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.1	0.0	1.0	NS	NS	NS	NS
		Urban	NS	0.0	0.0	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0	NS	NS	0.5	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	7.0	1.0	0.0
	Ae. stimulans	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	3.0	7.1	2.1	0.0	0.0	0.2	0.5	NS	NS	NS
		Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS	NS
		Urban	NS	0.0	0.0	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0	NS	NS	1.5	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	3.0	0.0	0.0
	Ae. triseriatus	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
		Forest	0.0	0.8	0.5	1.0	0.0	0.0	0.0	2.9	2.4	0.3	0.0	0.0	0.0	NS	NS	NS
		Grassland	0.0	0.2	0.3	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.5	0.0	NS	NS	NS	NS
		Urban	NS	0.0	0.0	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.3	1.5	1.0
	Ae. trivittatus	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	1.0	0.0	0.0
		Forest	0.0	6.0	1.5	0.0	0.0	0.0	0.0	4.6	5.6	18.7	20.7	0.0	0.0	NS	NS	NS
		Grassland	0.0	0.8	0.3	0.0	0.0	0.0	0.0	0.0	0.1	0.9	0.4	0.0	NS	NS	NS	NS
		Urban	NS	0.0	0.0	0.0	NS	NS	0.0	0.5	0.5	1.0	0.0	NS	NS	1.5	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.3	2.0	0.0
	Ae. vexans	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	3.0	28.3	3.0	1.0
		Forest	1465.0	636.8	36.0	1696.5	146.0	2.0	28.4	94.4	45.3	5.3	11.7	28.2	4.0	NS	NS	NS
		Grassland	366.0	117.1	26.8	358.0	103.0	0.0	1.8	16.3	2.0	7.7	4.5	22.0	NS	NS	NS	NS
		Urban	NS	4.0	1.5	39.0	NS	NS	0.5	0.5	0.5	2.0	0.0	NS	NS	195.5	6.0	5.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	85.0	1.0	14.0
	Ae. zoosophus/*Ae. triseriatus* hybrid	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	NS	NS	NS
		Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS	NS
		Urban	NS	0.0	0.0	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.3	0.0	0.0
		NS = No sample																

TABLE 12 (CONTINUED) — Mean abundance per trap by month for mosquito taxa taken from grassland matrix during 2007 - 2009 in five counties of central Missouri. Patch-matrix combinations of the same type (*i.e.*, grassland-grassland) indicate samples from the matrix only.

			Sample Date															
Matrix	Taxon	Patch	Jun-07	Jul-07	Aug-07	Sep-07	Oct-07	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Apr-09	May-09	Jun-09	Jul-09	Aug-09
Grassland	*An. crucians*	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.9	0.0	5.7	0.3	0.0	0.0	NS	NS	NS
		Grassland	0.0	0.1	0.2	0.3	0.0	0.0	0.0	2.4	0.2	1.9	0.4	0.0	NS	NS	NS	NS
		Urban	NS	0.0	0.0	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
	An. punctipennis	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.3	1.0	0.0
		Forest	13.0	6.3	9.5	7.5	0.0	0.8	0.4	3.7	4.6	3.3	0.0	1.6	3.0	NS	NS	NS
		Grassland	4.0	4.6	5.5	1.3	0.0	0.0	0.0	1.3	1.3	1.6	0.3	4.0	NS	NS	NS	NS
		Urban	NS	1.0	0.0	0.0	NS	NS	0.0	0.0	0.5	0.0	0.0	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	10.0	0.0	0.0
	An. quadrimaculatus	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
		Forest	0.0	1.3	0.5	2.5	0.0	0.0	0.0	0.1	0.5	0.7	0.0	0.2	0.0	NS	NS	NS
		Grassland	0.0	0.4	1.5	1.3	0.0	0.0	0.0	0.0	0.7	0.1	0.0	0.0	NS	NS	NS	NS
		Urban	NS	0.0	0.0	0.0	NS	NS	0.0	0.0	0.0	0.0	0.5	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.3	0.0	0.0
	Cq. perturbans	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	4.0	0.3	0.0	0.0	NS	NS	NS
		Grassland	0.0	0.2	0.8	0.0	0.0	0.0	0.0	0.3	0.1	1.6	0.0	0.0	NS	NS	NS	NS
		Urban	NS	0.0	0.0	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0	NS	NS	1.5	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.3	0.0	0.0
	Cs. inornata	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	NS	NS	NS
		Grassland	0.0	0.0	0.0	0.0	2.0	0.2	0.0	0.0	0.0	0.0	0.0	8.0	NS	NS	NS	NS
		Urban	NS	0.0	0.0	0.0	NS	NS	0.5	0.0	0.0	0.0	0.0	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
	Cx. erraticus	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
		Forest	6.0	20.0	138.5	28.0	0.0	0.0	0.0	1.7	25.4	122.0	0.0	0.0	0.0	NS	NS	NS
		Grassland	3.0	51.1	170.2	11.0	0.0	0.0	0.0	7.9	19.2	128.2	5.3	0.0	NS	NS	NS	NS
		Urban	NS	0.0	2.5	0.0	NS	NS	0.0	0.0	0.0	2.5	2.0	NS	NS	0.0	8.0	1.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	2.3	12.5	3.0
	Cx. pipiens group	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	3.7	0.0	0.0
		Forest	6.0	2.0	2.0	2.5	0.0	3.5	1.4	0.9	0.6	0.0	0.7	0.0	0.0	NS	NS	NS
		Grassland	5.0	5.0	0.2	0.0	1.0	0.0	0.9	0.6	0.0	0.1	0.3	0.0	NS	NS	NS	NS
		Urban	NS	26.0	0.5	0.0	NS	NS	0.0	0.5	0.0	0.0	0.0	NS	NS	5.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.3	1.5	0.0
		NS = no sample																

TABLE 12 (CONTINUED) — Mean abundance per trap by month for mosquito taxa taken from grassland matrix during 2007 - 2009 in five counties of central Missouri. Patch-matrix combinations of the same type (*i.e.*, grassland-grassland) indicate samples from the matrix only.

			Sample Date															
Matrix	Taxon	Patch	Jun-07	Jul-07	Aug-07	Sep-07	Oct-07	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Apr-09	May-09	Jun-09	Jul-09	Aug-09
Grassland	*Cx. salinarius*	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	10.3	11.0	1.0
		Forest	0.0	8.8	20.5	20.0	2.0	0.0	0.4	5.3	4.9	0.7	1.3	0.0	2.0	NS	NS	NS
		Grassland	1.0	11.4	21.0	10.3	61.0	0.0	0.1	3.9	5.2	7.0	3.0	0.0	NS	NS	NS	NS
		Urban	NS	2.0	3.5	12.0	NS	NS	0.0	0.0	1.0	0.5	1.0	NS	NS	0.5	16.0	9.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	6.7	1.0	6.0
	Cx. tarsalis	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
		Forest	0.0	0.0	4.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS
		Grassland	0.0	0.0	0.0	1.3	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS	NS
		Urban	NS	0.0	0.0	3.0	NS	NS	0.0	0.0	0.0	0.0	0.0	NS	NS	0.0	0.0	1.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
	Or. alba	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS
		Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS	NS
		Urban	NS	0.0	0.0	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.3	0.0	0.0
	Ps. ciliata	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.3	1.0	0.0
		Forest	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	NS	NS	NS
		Grassland	0.0	1.7	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.0	NS	NS	NS	NS
		Urban	NS	0.0	0.0	0.0	NS	NS	0.0	0.0	0.0	0.5	0.0	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
	Ps. columbiae	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.3	0.0	2.0
		Forest	0.0	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS
		Grassland	0.0	4.3	0.7	1.0	0.0	0.0	0.0	0.0	0.0	1.2	0.1	0.0	NS	NS	NS	NS
		Urban	NS	6.0	1.5	1.0	NS	NS	0.0	0.0	0.0	0.0	0.0	NS	NS	0.0	5.0	2.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
	Ps. cyanescens	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	2.0	4.0	0.0	0.0	0.0	NS	NS	NS
		Grassland	0.0	2.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS	NS
		Urban	NS	4.0	0.0	0.0	NS	NS	0.0	0.5	0.0	0.0	0.0	NS	NS	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
	Ps. discolor	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS
		Grassland	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS	NS
		Urban	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		NS = No sample																

TABLE 12 (CONTINUED) — Mean abundance per trap by month for mosquito taxa taken from grassland matrix during 2007 - 2009 in five counties of central Missouri. Patch-matrix combinations of the same type (*i.e.*, grassland-grassland) indicate samples from the matrix only.

			Sample Date															
Matrix	Taxon	Patch	Jun-07	Jul-07	Aug-07	Sep-07	Oct-07	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Apr-09	May-09	Jun-09	Jul-09	Aug-09
Grassland	*Ps. ferox*	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
		Forest	0.0	0.3	0.0	0.0	0.0	0.0	0.0	7.9	3.5	7.7	8.7	0.0	0.0	NS	NS	NS
		Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.4	0.0	0.0	NS	NS	NS	NS
		Urban	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	5.0	3.5	0.0
	Ps. horrida	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.7	7.0	33.7	14.7	0.0	0.0	NS	NS	NS
		Grassland	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	NS	NS	NS	NS
		Urban	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	2.3	0.5	0.0
	Ur. sapphirina	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
		Forest	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.1	1.1	4.0	0.0	0.0	0.0	NS	NS	NS
		Grassland	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.1	0.0	NS	NS	NS	NS
		Urban	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Wetland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		NS = No sample																

TABLE 13 — Mean abundance per trap by month for mosquito taxa taken from urban matrix during 2007 – 2009 in five counties of central Missouri. Patch-matrix combinations of the same type (*i.e.*, urban-urban) indicate samples from the matrix only.

			Sample Date												
Matrix	Taxon	Patch	Jul-07	Aug-07	Sep-07	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Apr-09	May-09	Jun-09	Jul-09	Aug-09
Urban	*Ae. albopictus*	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Forest	NS	NS	NS	NS	NS	0.0	NS	NS	0.0	0.0	2.0	0.7	0.0
		Grassland	2.3	NS	NS	0.0	0.3	0.0	0.3	0.2	NS	NS	NS	NS	NS
		Urban	1.8	1.8	0.3	0.0	1.1	0.3	0.5	0.0	0.0	0.0	NS	NS	NS
		Wetland	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS	0.0	0.0	3.0	0.0
	Ae. canadensis canadensis	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Forest	NS	NS	NS	NS	NS	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0
		Grassland	0.0	NS	NS	0.0	0.2	0.0	0.0	0.0	NS	NS	NS	NS	NS
		Urban	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS
		Wetland	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS	0.0	1.0	0.0	0.0
	Ae. cinereus	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Forest	NS	NS	NS	NS	NS	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0
		Grassland	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS
		Urban	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS
		Wetland	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS	0.0	0.0	0.5	0.0
	Ae. sticticus	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Forest	NS	NS	NS	NS	NS	0.0	NS	NS	0.0	0.0	0.7	0.7	0.0
		Grassland	0.0	NS	NS	0.0	0.2	0.0	0.0	0.0	NS	NS	NS	NS	NS
		Urban	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	NS	NS	NS
		Wetland	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS	0.0	0.3	0.0	0.0
	Ae. stimulans	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Forest	NS	NS	NS	NS	NS	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0
		Grassland	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS
		Urban	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS
		Wetland	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
	Ae. triseriatus	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Forest	NS	NS	NS	NS	NS	0.0	NS	NS	0.0	0.0	0.3	0.7	0.0
		Grassland	1.0	NS	NS	0.0	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS
		Urban	0.6	0.3	0.0	0.0	0.3	0.0	0.3	0.0	0.0	0.0	NS	NS	NS
		Wetland	0.0	0.0	0.0	0.0	NS	NS	NS	0.0	0.0	0.0	NS	NS	NS
	Ae. trivittatus	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.3	0.0
		Forest	NS	NS	NS	NS	NS	0.0	NS	NS	0.0	0.0	4.7	0.0	1.0
		Grassland	0.3	NS	NS	0.0	0.0	0.0	0.3	0.2	NS	NS	NS	NS	NS
		Urban	1.4	0.0	0.0	0.0	0.1	0.0	0.3	0.0	0.0	0.0	NS	NS	NS
		Wetland	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS	0.0	44.7	0.0	1.0
		NS = No sample													

TABLE 13 (CONTINUED) — Mean abundance per trap by month for mosquito taxa taken from urban matrix during 2007 – 2009 in five counties of central Missouri. Patch-matrix combinations of the same type (*i.e.*, urban-urban) indicate samples from the matrix only.

			Sample Date												
Matrix	Taxon	Patch	Jul-07	Aug-07	Sep-07	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Apr-09	May-09	Jun-09	Jul-09	Aug-09
Urban	*Ae. vexans*	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	72.5	14.7	10.0
		Forest	NS	NS	NS	NS	NS	63.5	NS	NS	0.5	7.0	35.3	3.0	13.0
		Grassland	4.0	NS	NS	0.0	4.3	2.3	1.7	0.3	NS	NS	NS	NS	NS
		Urban	15.9	1.8	55.3	1.2	3.6	1.8	7.0	0.3	0.0	0.5	NS	NS	NS
		Wetland	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS	3.0	36.0	8.0	11.0
	Ae. zoosophus/Ae. triseriatus hybrid	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Forest	NS	NS	NS	NS	NS	0.0	NS	NS	0.0	0.0	0.3	0.0	0.0
		Grassland	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS
		Urban	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS
		Wetland	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
	An. crucians	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.3	0.0
		Forest	NS	NS	NS	NS	NS	0.5	NS	NS	0.0	0.0	1.3	0.0	0.0
		Grassland	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS
		Urban	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS
		Wetland	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS	0.0	9.3	0.5	0.0
	An. punctipennis	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	2.0	0.0
		Forest	NS	NS	NS	NS	NS	2.5	NS	NS	0.0	0.7	1.7	1.0	0.0
		Grassland	0.7	NS	NS	0.0	0.0	0.5	0.3	0.0	NS	NS	NS	NS	NS
		Urban	2.3	0.0	0.0	0.0	0.4	0.8	0.3	0.3	0.0	0.0	NS	NS	NS
		Wetland	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS	0.0	1.7	2.5	0.0
	An. quadrimaculatus	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.7	0.0
		Forest	NS	NS	NS	NS	NS	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0
		Grassland	0.0	NS	NS	0.0	0.0	0.0	0.2	0.0	NS	NS	NS	NS	NS
		Urban	1.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.0	0.0	NS	NS	NS
		Wetland	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS	0.0	0.3	0.0	1.0
	Cq. perturbans	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	19.5	11.0	1.0
		Forest	NS	NS	NS	NS	NS	0.0	NS	NS	0.0	0.0	5.0	0.7	9.0
		Grassland	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS
		Urban	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	NS	NS	NS
		Wetland	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS	0.0	498.0	8.5	13.0
	Cs. inornata	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Forest	NS	NS	NS	NS	NS	0.0	NS	NS	12.5	0.0	0.0	0.0	0.0
		Grassland	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS
		Urban	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.5	0.0	NS	NS	NS
		Wetland	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS	2.0	0.0	0.0	0.0
		NS = No sample													

TABLE 13 (CONTINUED) — Mean abundance per trap by month for mosquito taxa taken from urban matrix during 2007 – 2009 in five counties of central Missouri. Patch-matrix combinations of the same type (*i.e.*, urban-urban) indicate samples from the matrix only.

			Sample Date												
Matrix	Taxon	Patch	Jul-07	Aug-07	Sep-07	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Apr-09	May-09	Jun-09	Jul-09	Aug-09
Urban	*Cx. erraticus*	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.3	2.0
		Forest	NS	NS	NS	NS	NS	0.0	NS	NS	0.0	0.0	0.0	0.0	2.0
		Grassland	1.0	NS	NS	0.0	0.0	0.3	1.0	0.8	NS	NS	NS	NS	NS
		Urban	2.6	4.0	0.5	0.0	0.0	0.3	0.3	2.3	0.0	0.0	NS	NS	NS
		Wetland	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS	0.0	1.0	0.0	0.0
	Cx. pipiens group	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Forest	NS	NS	NS	NS	NS	0.5	NS	NS	0.0	0.3	1.3	0.0	0.0
		Grassland	3.0	NS	NS	0.2	0.5	0.0	4.5	3.0	NS	NS	NS	NS	NS
		Urban	11.1	1.3	0.8	0.0	0.1	0.0	2.0	0.0	0.0	0.0	NS	NS	NS
		Wetland	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS	0.0	0.0	0.5	3.0
	Cx. salinarius	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	3.5	31.0	8.0
		Forest	NS	NS	NS	NS	NS	0.0	NS	NS	0.0	1.3	3.3	0.0	0.0
		Grassland	0.3	NS	NS	0.0	0.0	1.0	9.5	3.2	NS	NS	NS	NS	NS
		Urban	2.8	0.5	0.8	0.2	0.0	0.5	3.3	1.8	0.0	0.0	NS	NS	NS
		Wetland	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS	5.0	25.7	11.5	36.0
	Cx. tarsalis	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.3	0.0
		Forest	NS	NS	NS	NS	NS	0.0	NS	NS	0.0	0.0	0.0	0.0	1.0
		Grassland	0.0	NS	NS	0.0	0.0	0.0	0.2	0.0	NS	NS	NS	NS	NS
		Urban	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.5	0.0	0.0	NS	NS	NS
		Wetland	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
	Or. signifera	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Forest	NS	NS	NS	NS	NS	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0
		Grassland	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS
		Urban	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS
		Wetland	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS	0.0	0.0	0.0	0.0
	Ps. ciliata	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	1.0	0.0
		Forest	NS	NS	NS	NS	NS	0.0	NS	NS	0.0	0.0	0.3	0.0	0.0
		Grassland	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS
		Urban	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS
		Wetland	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS	0.0	0.3	1.0	10.0
	Ps. columbiae	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	2.0	0.0
		Forest	NS	NS	NS	NS	NS	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0
		Grassland	0.0	NS	NS	0.0	0.0	0.0	0.2	0.0	NS	NS	NS	NS	NS
		Urban	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	NS	NS	NS
		Wetland	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS	0.0	0.0	0.0	1.0
		NS = No sample													

TABLE 13 (CONTINUED) — Mean abundance per trap by month for mosquito taxa taken from urban matrix during 2007 – 2009 in five counties of central Missouri. Patch-matrix combinations of the same type (*i.e.*, urban-urban) indicate samples from the matrix only.

			Sample Date												
Matrix	Taxon	Patch	Jul-07	Aug-07	Sep-07	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Apr-09	May-09	Jun-09	Jul-09	Aug-09
Urban	*Ps. ferox*	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Forest	NS	NS	NS	NS	NS	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0
		Grassland	0.0	NS	NS	0.0	0.0	0.0	0.2	0.0	NS	NS	NS	NS	NS
		Urban	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NS	NS	NS
		Wetland	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS	0.0	1.0	0.0	0.0
	Ps. horrida	Cropland	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.0	0.0	0.0
		Forest	NS	NS	NS	NS	NS	4.5	NS	NS	0.0	0.0	0.0	0.0	0.0
		Grassland	0.0	NS	NS	0.0	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS
		Urban	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	NS	NS	NS
		Wetland	0.0	0.0	0.0	0.0	NS	NS	NS	NS	NS	0.0	0.7	0.0	0.0
		NS = No sample													

TABLE 14 — Mean abundance per trap by month for mosquito taxa taken from wetland matrix during 2009 in five counties of central Missouri. Patch-matrix combinations of the same type (*i.e.*, wetland-wetland) indicate samples from the matrix only.

			Sample Date				
Matrix	Taxon	Patch	May-09	Jun-09	Jul-09	Aug-09	Sep-09
Wetland	*Ae. albopictus*	Cropland	0.0	NS	0.0	0.0	NS
		Forest	0.0	0.0	0.0	1.0	0.0
		Grassland	0.0	0.0	0.0	0.0	0.0
		Urban	0.0	0.0	0.0	0.0	NS
		Wetland	0.0	0.0	0.0	0.0	0.0
	Ae. aurifer	Cropland	0.0	NS	0.0	9.0	NS
		Forest	0.0	6.5	0.0	0.0	0.0
		Grassland	0.0	0.0	0.0	6.0	8.0
		Urban	0.0	0.0	0.0	10.0	NS
		Wetland	0.0	0.0	0.0	19.0	0.0
	Ae. cinereus	Cropland	19.0	NS	10.3	0.0	NS
		Forest	9.0	85.5	3.0	0.0	17.0
		Grassland	0.0	0.0	0.0	0.0	0.0
		Urban	21.0	305.0	0.0	22.0	NS
		Wetland	45.0	51.0	69.0	10.0	0.0
	Ae. nigromaculis	Cropland	0.0	NS	0.0	0.0	NS
		Forest	0.0	0.0	0.0	0.0	0.0
		Grassland	0.0	0.0	0.0	0.0	0.0
		Urban	0.0	2.0	0.0	0.0	NS
		Wetland	0.0	0.0	0.0	0.0	0.0
	Ae. sollicitans	Cropland	0.0	NS	0.0	0.0	NS
		Forest	0.0	0.0	0.0	0.0	0.0
		Grassland	0.0	0.0	0.0	0.0	0.0
		Urban	0.0	0.0	0.0	0.0	NS
		Wetland	0.7	0.0	0.0	0.0	0.0
	Ae. sticticus	Cropland	543.5	NS	27.7	0.0	NS
		Forest	443.0	32.0	5.0	0.0	0.0
		Grassland	1.0	0.0	12.0	0.0	0.5
		Urban	235.0	4.0	0.5	0.0	NS
		Wetland	135.0	0.0	0.0	0.3	0.0
	Ae. trivittatus	Cropland	108.0	NS	4.3	0.0	NS
		Forest	51.0	41.5	3.0	0.0	5.0
		Grassland	6.0	81.0	20.0	0.0	0.5
		Urban	155.0	0.5	1.0	0.0	NS
		Wetland	229.0	0.0	27.0	0.0	0.0
	Ae. vexans	Cropland	769.5	NS	501.0	664.0	NS
		Forest	337.0	1298.0	74.0	122.0	1715.0
		Grassland	703.0	2601.0	102.0	479.0	708.0
		Urban	448.0	469.0	21.5	853.0	NS
		Wetland	1948.3	757.0	188.0	902.3	9388.0
	An. crucians	Cropland	3.0	NS	0.3	2.0	NS
		Forest	1.0	9.5	1.0	2.0	0.0
		Grassland	0.0	0.0	0.0	0.0	0.0
		Urban	0.0	1.5	3.0	0.0	NS
		Wetland	0.0	1.0	0.0	2.3	4.0
	An. punctipennis	Cropland	29.5	NS	2.0	0.0	NS
		Forest	10.0	17.0	0.0	5.0	2.0
		Grassland	5.0	90.0	0.0	0.0	1.5
		Urban	12.0	1.0	0.0	1.0	NS
		Wetland	21.0	4.0	6.0	1.3	5.0
		NS = No sample					

TABLE 14 (CONTINUED) — Mean abundance per trap by month for mosquito taxa taken from wetland matrix during 2009 in five counties of central Missouri. Patch-matrix combinations of the same type (*i.e.*, wetland-wetland) indicate samples from the matrix only.

			Sample Date				
Matrix	Taxon	Patch	May-09	Jun-09	Jul-09	Aug-09	Sep-09
Wetland	*An. quadrimaculatus*	Cropland	3.0	NS	1.3	2.0	NS
		Forest	11.0	21.0	58.0	3.0	2.0
		Grassland	0.0	0.0	0.0	0.0	0.0
		Urban	5.0	8.0	1.5	1.0	NS
		Wetland	0.3	2.0	0.0	0.0	1.0
	An. walkeri	Cropland	0.0	NS	0.0	0.0	NS
		Forest	0.0	0.0	0.0	0.0	1.0
		Grassland	0.0	0.0	0.0	0.0	0.5
		Urban	0.0	16.0	0.0	0.0	NS
		Wetland	0.0	0.0	0.0	0.0	3.0
	Cq. perturbans	Cropland	0.0	NS	1.0	1.0	NS
		Forest	1.0	0.0	3.0	0.0	0.0
		Grassland	0.0	0.0	0.0	3.0	0.5
		Urban	0.0	123.5	5.5	2.0	NS
		Wetland	0.0	0.0	0.0	5.3	0.0
	Cs. inornata	Cropland	0.0	NS	0.3	0.0	NS
		Forest	1.0	0.0	0.0	0.0	0.0
		Grassland	0.0	0.0	0.0	0.0	0.0
		Urban	0.0	0.0	0.0	0.0	NS
		Wetland	1.7	0.0	0.0	0.0	0.0
	Cx. erraticus	Cropland	0.0	NS	22.7	19.0	NS
		Forest	1.0	1.5	351.0	45.0	3.0
		Grassland	0.0	9.0	22.0	15.0	0.5
		Urban	0.0	1.5	67.0	38.0	NS
		Wetland	0.0	0.0	228.0	32.3	6.0
	Cx. peccator	Cropland	0.0	NS	0.0	3.0	NS
		Forest	0.0	0.0	9.0	0.0	0.0
		Grassland	0.0	0.0	0.0	1.0	0.5
		Urban	0.0	0.0	0.0	0.0	NS
		Wetland	0.0	0.0	0.0	0.3	0.0
	Cx. pipiens group	Cropland	0.0	NS	0.0	0.0	NS
		Forest	1.0	0.0	0.0	0.0	0.0
		Grassland	0.0	0.0	0.0	0.0	0.0
		Urban	0.0	0.0	0.0	0.0	NS
		Wetland	0.0	0.0	0.0	0.0	0.0
	Cx. salinarius	Cropland	9.0	NS	18.7	20.0	NS
		Forest	13.0	15.5	85.0	5.0	4.0
		Grassland	3.0	99.0	5.0	16.0	9.5
		Urban	9.0	36.5	2.0	17.0	NS
		Wetland	0.7	1.0	8.0	14.3	12.0
	Cx. tarsalis	Cropland	0.0	NS	0.0	0.0	NS
		Forest	2.0	0.0	0.0	0.0	0.0
		Grassland	0.0	0.0	0.0	0.0	0.0
		Urban	0.0	0.0	0.0	0.0	NS
		Wetland	0.3	0.0	0.0	0.3	0.0
	Ps. ciliata	Cropland	6.0	NS	6.0	0.0	NS
		Forest	1.0	20.5	0.0	0.0	0.0
		Grassland	14.0	169.0	1.0	1.0	1.5
		Urban	3.0	45.5	0.5	2.0	NS
		Wetland	5.0	26.0	0.0	0.3	5.0
		NS = No sample					

TABLE 14 (CONTINUED) — Mean abundance per trap by month for mosquito taxa taken from wetland matrix during 2009 in five counties of central Missouri. Patch-matrix combinations of the same type (*i.e.*, wetland-wetland) indicate samples from the matrix only.

			Sample Date				
Matrix	Taxon	Patch	May-09	Jun-09	Jul-09	Aug-09	Sep-09
Wetland	*Ps. columbiae*	Cropland	3.5	NS	24.7	0.0	NS
		Forest	0.0	3.5	4.0	0.0	0.0
		Grassland	9.0	45.0	22.0	1.0	17.0
		Urban	8.0	10.0	1.0	9.0	NS
		Wetland	2.3	1.0	0.0	0.7	10.0
	Ps. cyanescens	Cropland	0.0	NS	0.3	0.0	NS
		Forest	42.0	5.0	0.0	0.0	1.0
		Grassland	0.0	0.0	0.0	0.0	0.0
		Urban	0.0	0.0	0.0	0.0	NS
		Wetland	0.0	2.0	0.0	0.0	0.0
	Ps. discolor	Cropland	0.0	NS	0.7	0.0	NS
		Forest	0.0	0.0	0.0	0.0	0.0
		Grassland	0.0	0.0	0.0	0.0	1.0
		Urban	0.0	0.0	0.0	2.0	NS
		Wetland	0.0	0.0	0.0	0.0	0.0
	Ps. ferox	Cropland	0.0	NS	1.0	0.0	NS
		Forest	2.0	10.0	0.0	1.0	4.0
		Grassland	0.0	0.0	0.0	0.0	0.0
		Urban	0.0	12.5	0.0	0.0	NS
		Wetland	0.3	0.0	3.0	0.3	0.0
	Ps. horrida	Cropland	86.0	NS	1.0	0.0	NS
		Forest	116.0	11.0	5.0	0.0	0.0
		Grassland	0.0	0.0	0.0	0.0	0.0
		Urban	6.0	0.0	0.0	0.0	NS
		Wetland	0.0	0.0	98.0	0.0	0.0
	Ps. howardii	Cropland	0.0	NS	0.0	0.0	NS
		Forest	0.0	2.0	0.0	0.0	0.0
		Grassland	0.0	0.0	0.0	0.0	0.0
		Urban	0.0	0.0	0.0	0.0	NS
		Wetland	0.0	0.0	0.0	0.0	0.0
	Ur. sapphirina	Cropland	0.0	NS	0.0	0.0	NS
		Forest	0.0	0.0	0.0	0.0	0.0
		Grassland	0.0	0.0	0.0	0.0	0.0
		Urban	0.0	0.0	0.0	0.0	NS
		Wetland	0.0	0.0	2.0	0.0	0.0
		NS = No sample					

TABLE 15 — Multiple regression equation coefficients and correlations for weather variables with total mosquito abundance and abundance of the three most common mosquito taxa collected from all patch types within cropland matrix during 2007 – 2009 in five counties of central Missouri.

	Total Abundance		*Ae. vexans*		*Cx. erraticus*		*Cx. salinarius*	
	F = 2.04; r^2 = 0.220; Intercept = 3,055.26		F = 3.07**; r^2 = 0.297; Intercept = 3,077.26		F = 4.63***; r^2 = 0.390; Intercept = -215.23		F = 5.61***; r^2 = 0.436; Intercept = 35.55	
Variable	coefficient	*p*	coefficient	*p*	coefficient	*p*	coefficient	*p*
Rainfall, day of sampling (Rain – 0)	-138.45	0.496	-96.99	0.532	19.69	0.246	7.24	0.750
Rainfall, total for previous 7 days (Rain – 7)	176.36	0.061	176.20	0.015	-19.12	0.015	2.72	0.792
Rainfall, total for previous 30 days (Rain – 30)	-61.60	0.009	-61.59	0.001	2.37	0.212	-9.12	0.001
Maximum temperature, day of sampling (Temp – 0)	-25.22	0.019	-25.66	0.002	3.15	0.001	1.78	0.133
Total solar radiation, day of sampling (TSR – 0)	-5.29	0.770	3.06	0.824	-1.23	0.415	1.39	0.492
Average total solar radiation, previous 14 days (TSR – 14)	10.37	0.690	-12.13	0.541	3.43	0.116	2.57	0.378
Maximum wind speed, day of sampling (Wind – 0)	-41.32	0.037	-34.58	0.023	1.82	0.262	1.08	0.619
Average maximum wind speed, previous 7 days (Wind – 7)	-10.20	0.751	-7.16	0.770	-3.57	0.184	-10.39	0.005

Asterisks denote level of significance: *** = 0.001 ≥ *p*; ** = 0.01 ≥ *p* > 0.001

TABLE 16 — Multiple regression equation coefficients and correlations for weather variables with total mosquito abundance and abundance of the three most common mosquito taxa collected from all patch types within forest matrix during 2007 – 2009 in five counties of central Missouri.

	Total Abundance		*Ae. vexans*		*Cx. erraticus*		*Cx. salinarius*	
	F = 3.20**; r^2 = 0.468; Intercept = -243.35		F = 1.91; r^2 = 0.344; Intercept = 210.29		F = 8.74***; r^2 = 0.706; Intercept = -222.64		F = 1.15; r^2 = 0.240; Intercept = -8.67	
Variable	coefficient	*p*	coefficient	*p*	coefficient	*p*	coefficient	*p*
Rain – 0	105.41	0.535	-15.14	0.877	162.02	0.030	0.52	0.927
Rain – 7	58.33	0.349	23.80	0.505	-10.27	0.699	-0.84	0.684
Rain – 14	-16.82	0.687	36.32	0.135	-72.12	<0.001	-0.02	0.987
Rain – 30	-24.68	0.312	-8.72	0.533	-4.41	0.672	-0.31	0.697
Temp – 0	17.48	0.029	-7.10	0.118	22.47	<0.001	0.22	0.392
Temp – 14	-13.63	0.057	-1.46	0.717	-9.29	0.003	-0.04	0.879
TSR – 0	40.04	0.015	13.22	0.150	16.77	0.017	-0.27	0.603
TSR – 7	14.29	0.320	9.80	0.237	-7.76	0.208	0.69	0.151
Wind – 0	3.73	0.771	-2.62	0.722	5.68	0.302	0.00	0.994
Wind – 7	-35.21	0.190	-2.96	0.847	-19.05	0.100	-0.06	0.950
Wind – 30	-19.11	0.716	1.05	0.972	-25.22	0.265	-0.26	0.882

Asterisks denote level of significance: *** = $0.001 \geq p$; ** = $0.01 \geq p > 0.001$

TABLE 17 — Multiple regression equation coefficients and correlations for weather variables with total mosquito abundance and abundance of the three most common mosquito taxa collected from all patch types within grassland matrix during 2007 – 2009 in five counties of central Missouri.

	Total Abundance		*Ae. vexans*		*Cx. erraticus*		*Cx. salinarius*	
	F = 3.76***; r^2 = 0.187; Intercept = 986.64		F = 3.56***; r^2 = 0.179; Intercept = 1,317.76		F = 3.69***; r^2 = 0.184; Intercept = -131.23		F = 4.09***; r^2 = 0.200; Intercept = -6.29	
Variable	coefficient	*p*	coefficient	*p*	coefficient	*p*	coefficient	*p*
Rain – 0	155.69	0.178	206.17	0.063	-30.35	0.238	-1.57	0.611
Rain – 7	-72.35	0.074	-79.72	0.040	2.51	0.779	-0.18	0.868
Rain – 30	-27.12	0.047	-27.17	0.037	-1.72	0.567	-0.93	0.011
Temp – 0	3.82	0.541	-0.49	0.934	3.46	0.014	0.23	0.169
Temp – 14	-6.92	0.395	-9.22	0.236	1.17	0.516	0.22	0.301
TSR – 0	13.35	0.153	20.40	0.023	-7.39	<0.001	-0.35	0.164
TSR – 7	1.00	0.944	-3.51	0.798	3.26	0.309	0.16	0.686
Wind – 0	14.95	0.053	17.89	0.016	-3.14	0.068	0.01	0.962
Wind – 30	-54.89	0.001	-56.46	<0.001	-0.88	0.811	-0.60	0.177

Asterisks denote level of significance: *** = $0.001 \geq p$

TABLE 18 — Multiple regression equation coefficients and correlations for weather variables with total mosquito abundance and abundance of the three most common mosquito taxa collected from all patch types within urban matrix during 2007 – 2009 in five counties of central Missouri.

	Total Abundance		*Ae. vexans*		*Cx. erraticus*		*Cx. Salinarius*	
	F = 9.49***; r^2 = 0.439; Intercept = 498.00		F = 3.76***; r^2 = 0.236; Intercept = 60.43		F = 2.41*; r^2 = 0.166; Intercept = -1.82		F = 2.33*; r^2 = 0.161; Intercept = 53.28	
Variable	coefficient	*p*	coefficient	*p*	coefficient	*p*	coefficient	*P*
Rain – 0	714.03	<0.001	57.55	0.003	-0.51	0.724	28.31	0.001
Rain – 7	-14.93	0.137	-2.00	0.345	0.20	0.214	-1.92	0.040
Rain – 30	-5.03	0.396	-3.11	0.015	-0.17	0.084	0.32	0.556
Temp – 0	-3.53	0.117	-0.81	0.089	-0.01	0.873	0.03	0.886
Temp – 7	-6.63	0.012	-0.70	0.202	0.03	0.490	-0.43	0.074
TSR – 0	7.56	0.009	2.04	0.001	-0.04	0.367	0.36	0.172
TSR – 14	21.60	<0.001	3.02	0.017	0.18	0.060	0.17	0.759
Wind – 14	-17.78	0.005	-1.63	0.223	-0.05	0.621	-1.86	0.002

Asterisks denote level of significance: *** = 0.001 ≥ *p*; * = 0.05 ≥ *p* > 0.01

TABLE 19 — Multiple regression equation coefficients and correlations for weather variables with total mosquito abundance and abundance of the three most common mosquito taxa collected from all patch types within cropland matrix during 2007 – 2008 in five counties of central Missouri.

	Total Abundance		*Ae. vexans*		*Cx. erraticus*		*Cx. salinarius*	
	F = 12.86***; r^2 = 0.713; Intercept = -582.38*		F = 1.27; r^2 = 0.198; Intercept = -42.36		F = 10.38***; r^2 = 0.668; Intercept = -210.05		F = 11.18***; r^2 = 0.684; Intercept = -332.44**	
Variable	coefficient	*p*	coefficient	*p*	coefficient	*p*	coefficient	*p*
Rain – 0	-41.50	0.371	0.99	0.966	-14.14	0.506	-38.61	0.073
Rain – 14	-5.05	0.763	-7.40	0.381	-3.69	0.631	6.92	0.367
Temp – 0	11.09	<0.001	2.07	0.109	4.48	<0.001	4.10	0.001
TSR – 0	-19.57	0.010	2.80	0.441	-9.63	0.006	-11.68	0.001
TSR – 7	27.91	0.013	-5.71	0.294	11.70	0.023	19.68	<0.001
W – 7	-17.27	<0.001	-0.48	0.823	-7.44	0.001	-6.49	0.002

Asterisks denote level of significance: *** = $0.001 \geq p$; ** = $0.01 \geq p > 0.001$; * = $0.05 \geq p > 0.01$

TABLE 20 — Multiple regression equation coefficients and correlations for weather variables with total mosquito abundance and abundance of the three most common mosquito taxa collected from all patch types within grassland matrix during 2007 – 2008 in five counties of central Missouri.

	Total Abundance		*Ae. vexans*		*Cx. erraticus*		*Cx. Salinarius*	
	F = 3.29**; r^2 = 0.194; Intercept = 404.73		F = 3.19**; r^2 = 0.189; Intercept = 929.16		F = 4.00***; r^2 = 0.226; Intercept = -317.66*		F = 4.26***; r^2 = 0.238; Intercept = -30.66	
Variable	coefficient	*p*	coefficient	*p*	coefficient	*p*	coefficient	*P*
Rain – 0	229.08	0.126	319.63	0.027	-66.31	0.043	-1.78	0.645
Rain – 7	-131.69	0.014	-147.01	0.004	10.89	0.345	-1.80	0.189
Rain – 30	-43.67	0.012	-46.39	0.005	0.00	1.000	-0.99	0.027
Temp – 0	-4.66	0.614	-10.69	0.229	4.77	0.019	0.05	0.843
Temp – 30	10.35	0.336	7.09	0.491	2.50	0.287	0.73	0.009
TSR – 0	17.53	0.167	28.73	0.019	-11.64	<0.001	-0.45	0.174
TSR – 7	-21.90	0.208	-28.94	0.083	5.87	0.122	-0.25	0.574
W – 0	19.50	0.049	22.55	0.018	-3.42	0.112	0.24	0.348
W – 7	-32.14	0.041	-35.08	0.020	0.54	0.873	-0.02	0.958

Asterisks denote level of significance: *** = $0.001 \geq p$; ** = $0.01 \geq p > 0.001$; * = $0.05 \geq p > 0.01$

TABLE 21 — Multiple regression equation coefficients and correlations for weather variables with total mosquito abundance and abundance of the three most common mosquito taxa collected from all patch types within urban matrix during 2007 – 2008 in five counties of central Missouri.

	Total Abundance		*Ae. vexans*		*Cx. erraticus*		*Cx. salinarius*	
	F = 4.80***; r^2 = 0.361; Intercept = 142.33**		F = 3.64**; r^2 = 0.300; Intercept = 91.46**		F = 7.36***; r^2 = 0.464; Intercept = 6.83*		F = 2.71*; r^2 = 0.242; Intercept = 9.63	
Variable	coefficient	*p*	coefficient	*p*	coefficient	*p*	coefficient	*p*
Rain – 0	106.82	0.031	35.26	0.363	15.22	<0.001	5.54	0.529
Rain – 7	-4.22	0.164	-4.04	0.093	0.15	<0.001	-0.57	0.293
Rain – 30	-6.25	0.001	-4.27	0.003	-0.60	0.020	0.64	0.047
Temp – 0	-2.07	0.001	-1.53	0.003	0.10	0.117	-0.01	0.895
TSR – 0	3.80	<0.001	2.63	0.001	0.10	0.287	0.13	0.427
TSR – 7	1.72	0.244	0.31	0.788	-0.11	<0.001	-0.06	0.807
W – 0	-1.68	0.233	0.16	0.888	-0.62	0.530	-0.17	0.498
W – 14	-2.03	0.150	-0.80	0.474	-0.06	0.453	-0.50	0.052
Asterisks denote level of significance: *** = 0.001 ≥ *p*; ** = 0.01 ≥ *p* > 0.001; * = 0.05 ≥ *p* > 0.01								

TABLE 22 — Comparison of predicted values of 2009 mosquito abundance based on 2007-2008 data and actual values for mosquitoes collected from cropland matrix in 2009 along with assessment of how well predictions matched actual mosquito abundance for five counties in central Missouri.

	Total mosquitoes			*Culex erraticus*			*Culex salinarius*		
Date	Log_{10} Predicted Value	Log_{10} Collected Value	Pass/ Fail	Log_{10} Predicted Value	Log_{10} Collected Value	Pass/ Fail	Log_{10} Predicted Value	Log_{10} Collected Value	Pass/ Fail
18-May-09	a	3.2	Fail	2.0	a	Fail	a	0.8	Fail
18-May-09	a	2.6	Fail	2.0	a	Fail	a	0.0	Fail
18-May-09	a	2.7	Fail	2.0	a	Fail	a	a	Pass
21-May-09	1.3	2.5	Fail	2.3	a	Fail	a	0.9	Fail
21-May-09	1.3	2.5	Fail	2.3	a	Fail	a	1.0	Fail
21-May-09	1.3	2.5	Fail	2.3	a	Fail	a	1.2	Fail
21-May-09	1.3	2.8	Fail	2.3	a	Fail	a	0.5	Fail
28-May-09	1.9	3.2	Fail	2.4	a	Fail	1.3	1.1	Pass
28-May-09	1.9	3.1	Fail	2.4	a	Fail	1.3	0.6	Fail
28-May-09	1.9	2.5	Fail	2.4	a	Fail	1.3	1.0	Pass
28-May-09	1.9	2.7	Fail	2.4	a	Fail	1.3	a	Fail
18-Jun-09	0.9	1.4	Pass	2.3	a	Fail	a	1.3	Fail
18-Jun-09	0.9	1.6	Fail	2.3	a	Fail	a	1.4	Fail
25-Jun-09	1.9	3.1	Fail	2.4	a	Fail	a	a	Pass
2-Jul-09	2.0	1.4	Fail	2.4	a	Fail	1.7	0.9	Fail
2-Jul-09	2.0	1.8	Pass	2.4	0.0	Fail	1.7	1.3	Pass
2-Jul-09	2.0	1.6	Pass	2.4	0.0	Fail	1.7	0.8	Fail
9-Jul-09	2.1	2.6	Pass	2.4	0.9	Fail	1.2	1.9	Fail
30-Jul-09	2.4	0.3	Fail	2.5	a	Fail	2.1	0.3	Fail
30-Jul-09	2.4	0.7	Fail	2.5	a	Fail	2.1	0.7	Fail
30-Jul-09	2.4	0.7	Fail	2.5	a	Fail	2.1	0.6	Fail
15-Aug-09	2.2	3.0	Fail	2.4	1.1	Fail	1.6	2.4	Fail
15-Aug-09	2.2	2.8	Fail	2.4	1.5	Fail	1.6	2.1	Fail
15-Aug-09	2.2	3.1	Fail	2.4	0.5	Fail	1.6	2.1	Fail
15-Aug-09	2.2	2.6	Pass	2.4	0.7	Fail	1.6	0.0	Fail
14-Sep-09	2.0	2.7	Fail	2.4	0.6	Fail	0.6	2.2	Fail
14-Sep-09	2.0	3.0	Fail	2.4	0.3	Fail	0.6	1.8	Fail
14-Sep-09	2.0	3.2	Fail	2.4	0.3	Fail	0.6	1.9	Fail
14-Sep-09	2.0	3.1	Fail	2.4	1.0	Fail	0.6	2.0	Fail

a Value ≤ 0, thus log_{10} value was inexpressible

TABLE 23 — Comparison of predicted values of 2009 mosquito abundance based on 2007-2008 data and actual values for mosquitoes collected from grassland matrix in 2009 along with assessment of how well predictions matched actual mosquito abundance for five counties in central Missouri.

	Total mosquitoes			*Aedes vexans*			*Culex erraticus*			*Culex salinarius*		
Date	Log_{10} Predicted Value	Log_{10} Collected Value	Pass/ Fail	Log_{10} Predicted Value	Log_{10} Collected Value	Pass/ Fail	Log_{10} Predicted Value	Log_{10} Collected Value	Pass/ Fail	Log_{10} Predicted Value	Log_{10} Collected Value	Pass/ Fail
16-Apr-09	a	a	Pass	a	a	Pass	a	a	Pass	1.5	a	Fail
22-Apr-09	a	0.0	Fail	1.1	a	Fail	a	a	Pass	1.5	a	Fail
25-Apr-09	a	2.0	Fail	2.1	1.9	Pass	a	a	Pass	1.5	a	Fail
25-Apr-09	a	a	Fail	2.1	a	Fail	a	a	Pass	1.5	a	Fail
25-Apr-09	a	1.8	Fail	2.1	1.8	Pass	a	a	Pass	1.5	a	Fail
25-Apr-09	a	1.5	Fail	2.1	1.3	Fail	a	a	Pass	1.5	a	Fail
11-May-09	a	1.1	Fail	a	0.7	Fail	a	a	Pass	1.6	0.5	Fail
11-May-09	a	1.4	Fail	a	0.5	Fail	a	a	Pass	1.6	0.0	Fail
21-May-09	a	0.6	Fail	a	0.5	Fail	a	a	Pass	1.6	a	Fail
1-Jun-09	a	2.5	Fail	2.0	2.4	Pass	a	a	Pass	1.6	a	Fail
1-Jun-09	a	2.1	Fail	2.0	2.1	Pass	a	a	Pass	1.6	0.0	Fail
4-Jun-09	a	2.6	Fail	1.9	2.3	Pass	a	a	Pass	1.6	0.3	Fail
4-Jun-09	a	1.9	Fail	1.9	1.7	Pass	a	a	Pass	1.6	0.8	Fail
4-Jun-09	a	1.6	Fail	1.9	1.5	Pass	a	a	Pass	1.6	0.9	Fail
18-Jun-09	a	2.1	Fail	a	1.2	Fail	a	0.7	Fail	1.6	1.0	Fail
18-Jun-09	a	1.4	Fail	a	0.7	Fail	a	a	Pass	1.6	1.2	Pass
18-Jun-09	a	1.6	Fail	a	1.4	Fail	a	0.3	Fail	1.6	0.8	Fail
23-Jul-09	a	1.2	Fail	2.2	0.5	Fail	a	a	Pass	1.7	1.0	Fail
23-Jul-09	a	1.3	Fail	2.2	0.3	Fail	a	0.3	Fail	1.7	0.3	Fail
23-Jul-09	a	1.4	Fail	2.2	a	Fail	a	1.4	Fail	1.7	a	Fail
30-Jul-09	a	1.6	Fail	1.5	0.8	Fail	a	0.9	Fail	1.7	1.2	Pass
29-Aug-09	a	0.6	Fail	2.4	0.0	Fail	a	a	Pass	1.7	0.0	Fail
29-Aug-09	a	1.3	Fail	2.4	0.7	Fail	a	0.0	Fail	1.7	1.0	Fail
29-Aug-09	a	1.4	Fail	2.4	1.1	Fail	a	0.5	Fail	1.7	0.8	Fail

a Value ≤ 0, thus $\log_{10}$ value was inexpressible

TABLE 24 — Comparison of predicted values of 2009 mosquito abundance based on 2007-2008 data and actual values for mosquitoes collected from urban matrix in 2009 along with assessment of how well predictions matched actual mosquito abundance for five counties in central Missouri.

	Total mosquitoes			*Aedes vexans*			*Culex erraticus*			*Culex salinarius*		
Date	Log_{10} Predicted Value	Log_{10} Collected Value	Pass/ Fail	Log_{10} Predicted Value	Log_{10} Collected Value	Pass/ Fail	Log_{10} Predicted Value	Log_{10} Collected Value	Pass/ Fail	Log_{10} Predicted Value	Log_{10} Collected Value	Pass/ Fail
16-Apr-09	1.9	a	Fail	1.7	a	Fail	a	a	Pass	0.3	a	Fail
22-Apr-09	1.9	0.0	Fail	1.7	a	Fail	0.3	a	Fail	0.5	a	Fail
23-Apr-09	1.7	1.2	Pass	1.4	a	Fail	a	a	Pass	0.5	a	Fail
23-Apr-09	1.7	1.0	Fail	1.4	0.0	Fail	a	a	Pass	0.5	a	Fail
7-May-09	1.8	1.3	Pass	1.0	1.3	Pass	a	a	Pass	0.6	a	Fail
7-May-09	1.8	0.8	Fail	1.0	0.0	Fail	a	a	Pass	0.6	a	Fail
11-May-09	1.9	0.6	Fail	1.6	0.0	Fail	0.0	a	Fail	0.6	0.5	Pass
11-May-09	1.9	0.8	Fail	1.6	0.3	Fail	0.0	a	Fail	0.6	0.0	Fail
11-May-09	1.9	1.0	Fail	1.6	0.5	Fail	0.0	a	Fail	0.6	0.7	Pass
1-Jun-09	1.8	2.3	Pass	1.4	2.1	Fail	0.0	a	Fail	0.5	0.6	Pass
4-Jun-09	1.9	2.1	Pass	1.7	1.9	Pass	a	a	Pass	0.5	0.7	Pass
4-Jun-09	1.9	a	Fail	1.7	a	Fail	a	a	Pass	0.5	a	Fail
4-Jun-09	1.9	a	Fail	1.7	a	Fail	a	a	Pass	0.5	a	Fail
8-Jun-09	2.0	2.9	Fail	1.1	1.6	Pass	0.8	0.0	Fail	0.5	1.8	Fail
8-Jun-09	2.0	3.0	Fail	1.1	1.8	Fail	0.8	0.3	Pass	0.5	1.3	Fail
18-Jun-09	1.3	1.1	Pass	a	0.7	Fail	a	a	Pass	0.8	0.5	Pass
25-Jun-09	1.4	1.4	Pass	0.0	0.7	Fail	0.3	a	Fail	0.7	0.3	Pass
25-Jun-09	1.4	1.7	Pass	0.0	1.2	Fail	0.3	a	Fail	0.7	0.5	Pass
23-Jul-09	1.7	1.8	Pass	1.4	1.3	Pass	0.3	a	Fail	0.5	0.8	Pass
23-Jul-09	1.7	1.8	Pass	1.4	1.3	Pass	0.3	a	Fail	0.5	1.3	Fail
23-Jul-09	1.7	1.0	Fail	1.4	0.8	Fail	0.3	a	Fail	0.5	a	Fail
23-Jul-09	1.7	1.9	Pass	1.4	0.5	Fail	0.3	0.0	Fail	0.5	1.8	Fail
23-Jul-09	1.7	0.5	Fail	1.4	0.0	Fail	0.3	a	Fail	0.5	a	Fail
23-Jul-09	1.7	0.8	Fail	1.4	0.0	Fail	0.3	a	Fail	0.5	a	Fail
23-Jul-09	1.7	1.2	Pass	1.4	0.0	Fail	0.3	a	Fail	0.5	0.8	Pass
23-Jul-09	1.7	1.8	Pass	1.4	1.2	Pass	0.3	a	Fail	0.5	1.2	Fail
29-Aug-09	1.8	1.3	Pass	1.5	1.0	Pass	0.3	0.3	Pass	0.3	0.9	Fail
29-Aug-09	1.8	1.4	Pass	1.5	1.1	Pass	0.3	0.3	Pass	0.3	a	Fail
29-Aug-09	1.8	1.9	Pass	1.5	1.0	Pass	0.3	a	Fail	0.3	1.6	Fail

a Value ≤ 0, thus log_{10} value was inexpressible

TABLE 25 — Multiple regression equation coefficients and correlations for weather variables with total mosquito abundance and abundance of the three most common mosquito taxa collected from all patch types within forest matrix during 2007 in five counties of central Missouri.

	Total Abundance		*Ae. vexans*		*Cx. erraticus*		*Cx. salinarius*	
	F = 105.89***; r^2 = 0.988; Intercept = -2,426.76**		F = 2.06; r^2 = 0.607; Intercept = 657.33		F = 175.19***; r^2 = 0.992; Intercept = -2,610.41***		F = 168.73***; r^2 = 0.992; Intercept = -50.56***	
Variable	coefficient	*p*	coefficient	*p*	coefficient	*p*	coefficient	*p*
Temp – 7	46.41	0.004	-9.59	0.130	47.21	0.001	0.80	0.001
TSR – 7	44.44	0.012	2.12	0.758	35.93	0.006	0.88	0.003
W – 7	-97.30	0.002	3.80	0.700	-85.23	0.001	-1.31	0.002
Asterisks denote level of significance: *** = $0.001 \geq p$; ** = $0.01 \geq p > 0.001$								

TABLE 26 — Multiple regression equation coefficients and correlations for weather variables with total mosquito abundance and abundance of the three most common mosquito taxa collected from all patch types within urban matrix during 2007 in five counties of central Missouri.

	Total Abundance		*Ae. vexans*		*Cx. erraticus*		*Cx. salinarius*	
	F = 4.26*; r^2 = 0.713; Intercept = 1,143.78***		F = 16.11***; r^2 = 0.904; Intercept = 972.64		F = 10.48***; r^2 = 0.859; Intercept = 34.90*		F = 0.534; r^2 = 0.237; Intercept = 24.32	
Variable	coefficient	*p*	coefficient	*p*	coefficient	*p*	coefficient	*p*
Rain – 14	-3.43	0.613	-7.67	0.026	-1.50	0.001	-0.06	0.935
Temp – 0	12.87	0.007	9.28	<0.001	0.44	0.067	0.30	0.511
Temp – 14	-43.72	0.001	-36.34	<0.001	-0.87	0.145	-0.85	0.474
TSR – 0	-0.17	0.955	-3.55	0.025	0.10	0.554	0.24	0.488
TSR – 14	6.77	0.323	10.86	0.004	-0.55	0.151	-0.03	0.964
W – 0	19.37	0.006	18.49	<0.001	-0.73	0.041	0.06	0.928
W – 14	57.00	0.002	47.88	<0.001	1.63	0.059	0.94	0.568
Asterisks denote level of significance: *** = 0.001 ≥ *p*; * = 0.05 ≥ *p* > 0.01								

TABLE 27 — Comparison of predicted values of mosquito abundance based on 2007 data with actual mosquito abundance in forest matrix during 2008 along with an assessment of how well the predicted values matched actual values.

	Total mosquitoes			*Culex erraticus*			*Culex salinarius*		
Date	Log_{10} Predicted Value	Log_{10} Collected Value	Pass/ Fail	Log_{10} Predicted Value	Log_{10} Collected Value	Pass/ Fail	Log_{10} Predicted Value	Log_{10} Collected Value	Pass/ Fail
25-Apr-08	a	a	Pass	a	2.0	Fail	a	0.5	Fail
23-May-08	a	0.5	Fail	2.0	0.5	Fail	a	1.6	Fail
27-Jun-08	2.1	1.6	Pass	1.6	1.6	Pass	0.5	1.8	Fail
25-Jul-08	2.0	1.8	Pass	1.8	1.8	Pass	0.5	2.3	Fail
23-Aug-08	2.7	2.3	Pass	2.6	2.3	Pass	0.8	0.6	Pass
27-Sep-08	2.5	0.6	Fail	2.3	0.6	Fail	0.5	a	Fail

a Value ≤ 0, thus log_{10} value was inexpressible

TABLE 28 — Comparison of predicted values of mosquito abundance based on 2007 data with actual mosquito abundance in urban matrix during 2008 along with an assessment of how well the predicted values matched actual values.

	Total mosquitoes			*Aedes vexans*			*Culex erraticus*		
Date	Log_{10} Predicted Value	Log_{10} Collected Value	Pass/ Fail	Log_{10} Predicted Value	Log_{10} Collected Value	Pass/ Fail	Log_{10} Predicted Value	Log_{10} Collected Value	Pass/ Fail
9-May-08	2.7	a	Fail	2.9	a	Fail	1.3	a	Fail
9-May-08	2.7	a	Fail	2.9	a	Fail	1.3	a	Fail
9-May-08	2.7	a	Fail	2.9	a	Fail	1.3	a	Fail
9-May-08	2.7	a	Fail	2.9	a	Fail	1.3	a	Fail
9-May-08	2.7	0	Fail	2.9	a	Fail	1.3	a	Fail
9-May-08	2.7	a	Fail	2.9	a	Fail	1.3	a	Fail
9-May-08	2.7	0.3	Fail	2.9	0.3	Fail	1.3	a	Fail
9-May-08	2.7	a	Fail	2.9	a	Fail	1.3	a	Fail
9-May-08	2.7	a	Fail	2.9	a	Fail	1.3	a	Fail
9-May-08	2.7	a	Fail	2.9	a	Fail	1.3	a	Fail
28-May-08	2.5	0.7	Fail	2.8	0.5	Fail	1.3	a	Fail
29-May-08	2.6	0.3	Fail	2.8	0.3	Fail	1.3	a	Fail
6-Jun-08	2.5	0.8	Fail	2.9	0.6	Fail	1	a	Fail
6-Jun-08	2.5	a	Fail	2.9	a	Fail	1	a	Fail
6-Jun-08	2.5	a	Fail	2.9	a	Fail	1	a	Fail
6-Jun-08	2.5	1.1	Fail	2.9	1	Fail	1	a	Fail
6-Jun-08	2.5	0.9	Fail	2.9	0.9	Fail	1	a	Fail
6-Jun-08	2.5	0.7	Fail	2.9	0.6	Fail	1	a	Fail
6-Jun-08	2.5	0.5	Fail	2.9	0.5	Fail	1	a	Fail
6-Jun-08	2.5	a	Fail	2.9	a	Fail	1	a	Fail
6-Jun-08	2.5	0.8	Fail	2.9	0.5	Fail	1	a	Fail

a Value ≤ 0, thus log_{10} value was inexpressible

TABLE 28 (CONTINUED) — Comparison of predicted values of mosquito abundance based on 2007 data with actual mosquito abundance in urban matrix during 2008 along with an assessment of how well the predicted values matched actual values.

Total mosquitoes				*Aedes vexans*			*Culex erraticus*		
Date	Log_{10} Predicted Value	Log_{10} Collected Value	Pass/ Fail	Log_{10} Predicted Value	Log_{10} Collected Value	Pass/ Fail	Log_{10} Predicted Value	Log_{10} Collected Value	Pass/ Fail
6-Jun-08	2.5	a	Fail	2.9	a	Fail	1	a	Fail
16-Jun-08	1.5	a	Fail	2.5	a	Fail	1.3	a	Fail
16-Jun-08	1.5	1.3	Pass	2.5	1	Fail	1.3	a	Fail
17-Jun-08	0.7	1.1	Pass	2.5	0.9	Fail	1.3	a	Fail
1-Jul-08	a	2	Fail	2.5	1.9	Fail	1.3	a	Fail
9-Jul-08	1.8	1.6	Pass	2.5	1.6	Fail	1.3	a	Fail
9-Jul-08	1.8	1.3	Pass	2.5	0.7	Fail	1.3	0	Fail
11-Jul-08	1.5	0.7	Fail	2.6	a	Fail	1.3	0.3	Fail
11-Jul-08	1.5	0.8	Fail	2.6	0.8	Fail	1.3	a	Fail
11-Jul-08	1.5	0.7	Fail	2.6	0.5	Fail	1.3	a	Fail
11-Jul-08	1.5	0.6	Fail	2.6	0	Fail	1.3	a	Fail
11-Jul-08	1.5	0.8	Fail	2.6	0.5	Fail	1.3	a	Fail
11-Jul-08	1.5	0.7	Fail	2.6	a	Fail	1.3	a	Fail
11-Jul-08	1.5	0.6	Fail	2.6	0.3	Fail	1.3	a	Fail
11-Jul-08	1.5	0	Fail	2.6	a	Fail	1.3	a	Fail
11-Jul-08	1.5	a	Fail	2.6	a	Fail	1.3	a	Fail
8-Aug-08	a	1.3	Fail	a	0.6	Fail	1.3	0.6	Fail
8-Aug-08	a	1.7	Fail	a	a	Pass	1.3	0	Fail
8-Aug-08	a	0.7	Fail	a	0	Fail	1.3	a	Fail
8-Aug-08	a	1.2	Fail	a	a	Pass	1.3	0	Fail
8-Aug-08	a	1	Fail	a	0.5	Fail	1.3	a	Fail

a Value ≤ 0, thus log_{10} value was inexpressible

TABLE 28 (CONTINUED) — Comparison of predicted values of mosquito abundance based on 2007 data with actual mosquito abundance in urban matrix during 2008 along with an assessment of how well the predicted values matched actual values.

	Total mosquitoes			*Aedes vexans*			*Culex erraticus*		
Date	Log_{10} Predicted Value	Log_{10} Collected Value	Pass/ Fail	Log_{10} Predicted Value	Log_{10} Collected Value	Pass/ Fail	Log_{10} Predicted Value	Log_{10} Collected Value	Pass/ Fail
8-Aug-08	a	0.8	Fail	a	0.3	Fail	1.3	a	Fail
8-Aug-08	a	1.1	Fail	a	0.8	Fail	1.3	a	Fail
8-Aug-08	a	1	Fail	a	0.8	Fail	1.3	a	Fail
8-Aug-08	a	1.6	Fail	a	1.1	Fail	1.3	0	Fail
8-Aug-08	a	a	Pass	a	a	Pass	1.3	a	Fail
5-Sep-08	a	0	Fail	1	a	Fail	1.3	0	Fail
5-Sep-08	a	1	Fail	1	0	Fail	1.3	0.3	Fail
5-Sep-08	a	a	Pass	1	a	Fail	1.3	a	Fail
5-Sep-08	a	1	Fail	1	0	Fail	1.3	0.3	Fail
5-Sep-08	a	1.4	Fail	1	a	Fail	1.3	a	Fail
5-Sep-08	a	0	Fail	1	a	Fail	1.3	a	Fail
5-Sep-08	a	0.8	Fail	1	a	Fail	1.3	0.5	Fail
5-Sep-08	a	0.6	Fail	1	a	Fail	1.3	a	Fail
5-Sep-08	A	1	Fail	1	a	Fail	1.3	0.8	Pass
5-Sep-08	A	0.6	Fail	1	0	Fail	1.3	a	Fail

a Value ≤ 0, thus log_{10} value was inexpressible

TABLE 29 — Key to abbreviations used in graphs of CCA analysis.

Symbol or Abbreviation	Variable or taxon
R	Total rainfall for month
R – 1	Total rainfall for previous month
T	Average maximum temperature for month
T – 1	Average maximum temperature for previous month
TSR	Average total solar radiation for month
TSR – 1	Average total solar radiation for previous month
W	Average maximum wind speed for month
W – 1	Average maximum wind speed for previous month
albo	*Ae. albopictus*
auri	*Ae. aurifer*
cana	*Ae. canadensis canadensis*
cine	*Ae. cinereus*
dors	*Ae. dorsalis*
epac	*Ae. epactius*
gros	*Ae. grossbecki*
nigr	*Ae. nigromaculis*
soll	*Ae. sollicitans*
stic	*Ae. sticticus*
stim	*Ae. stimulans*
tris	*Ae. triseriatus*
triv	*Ae. trivittatus*
vexa	*Ae. vexans*
zoos	*Ae. zoosophus*/*Ae. triseriatus* hybrid
cruc	*An. crucians*
punc	*An. punctipennis*
quad	*An. quadrimaculatus*
walk	*An. walkeri*
pert	*Cq. perturbans*
erra	*Cx. erraticus*
pecc	*Cx. peccator*
pipi	*Cx. pipiens* group
sali	*Cx. salinarius*
tars	*Cx. tarsalis*
inor	*Cs. inornata*
alba	*Or. alba*
sign	*Or. signifera*
cili	*Ps. ciliata*
colu	*Ps. columbiae*
cyan	*Ps. cyanescens*
disc	*Ps. discolor*
fero	*Ps. ferox*
horr	*Ps. horrida*
howa	*Ps. howardii*
sapp	*Ur. sapphirina*

TABLE 30 — Mosquito taxa over which certain weather variables exhibited a strong influence according to canonical correspondence analysis during 2007 – 2009 in five counties of central Missouri.

Taxon	Matrix	Weather Variable	Influence (+/—)
Ae. albopictus	Cropland	T – 1	—
Ae. cinereus	Cropland	R	+
Ae. cinereus	Cropland	W	+
Ae. dorsalis	Cropland	T – 1	—
Ae. nigromaculis	Grassland	R – 1	—
Ae. sticticus	Cropland	T – 1	—
Ae. sticticus	Urban	R – 1	+
Ae. zoosophus/*Ae. triseriatus* hybrid	Urban	R	+
An. crucians	Urban	R	+
An. quadrimaculatus	Cropland	TSR – 1	+
An. quadrimaculatus	Grassland	TSR	+
An. quadrimaculatus	Urban	W	—
An. walkeri	Cropland	T – 1	—
Cq. perturbans	Urban	R	+
Cx. peccator	Cropland	R – 1	—
Cx. salinarius	Grassland	R – 1	+
Cx. tarsalis	Forest	R – 1	—
Cx. tarsalis	Grassland	T – 1	+
Ps. ciliata	Urban	W	—
Ps. cyanescens	Cropland	R	+
Ps. cyanescens	Cropland	W	+
Ps. cyanescens	Grassland	R – 1	+
Ps. ferox	Urban	TSR	+
Ps. horrida	Cropland	T – 1	—
Ps. howardii	Cropland	T – 1	—
Ur. sapphirina	Cropland	T	+
Ur. sapphirina	Forest	R	—

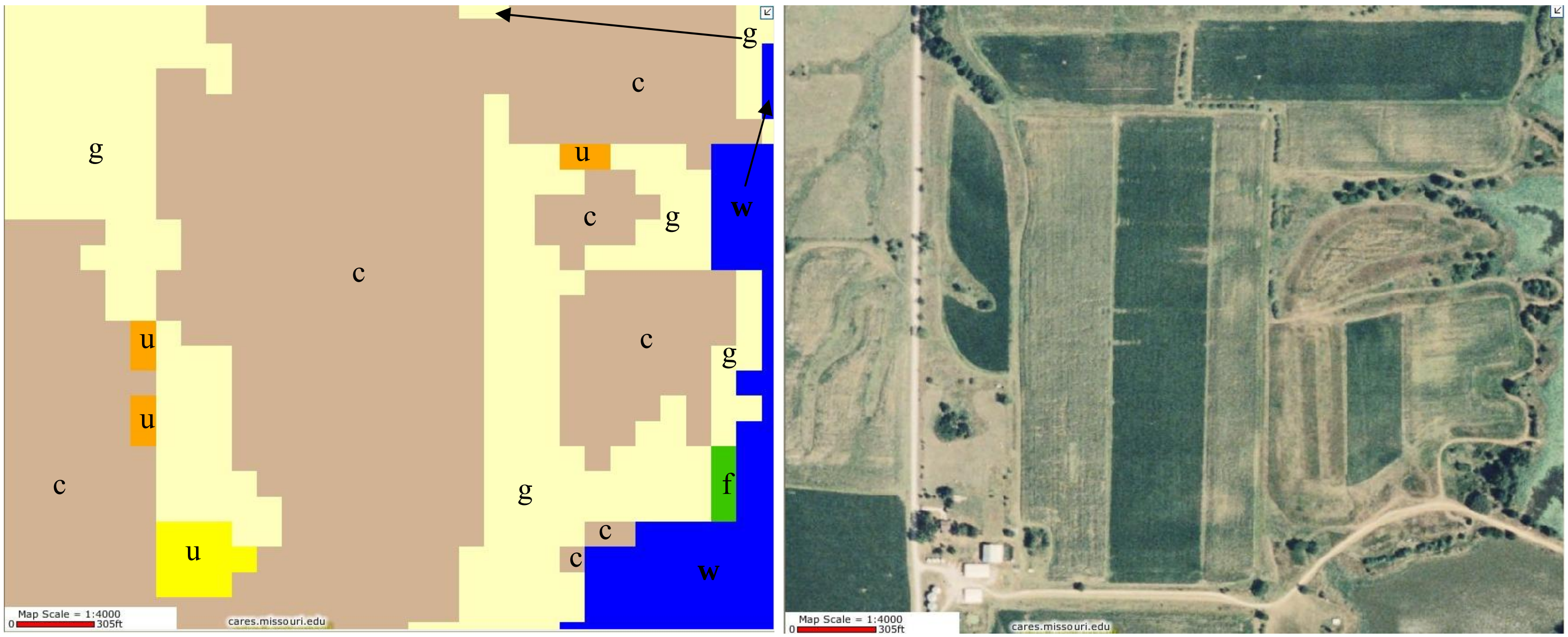
TABLE 31 — Summary of mosquito taxa collected from different patch-matrix landscape configurations in five counties of central Missouri during 2007 – 2009.

Taxon	Percent of total	Temporal peak	Landscape association	Abundance
Ae. albopictus	0.1	July/August	Urban	Uncommon
Ae. aurifer	0.2	August	Wetland	Uncommon
Ae. canadensis canadensis	1.1	June	Grassland	Common
Ae. cinereus	1.8	June	Wetland	Common
Ae. dorsalis	<0.1	May	Cropland	Rare
Ae. epactius	<0.1	September	Grassland	Rare
Ae. grossbecki	<0.1	April	Grassland	Rare
Ae. nigromaculis	<0.1	June	Wetland	Rare
Ae. sollicitans	<0.1	May	Wetland	Rare
Ae. sticticus	4.3	May	Wetland	Abundant
Ae. stimulans	0.2	June	Grassland	Uncommon
Ae. triseriatus	0.1	June	Grassland	Uncommon
Ae. trivittatus	3.9	June	Wetland	Abundant
Ae. vexans	66.9	May/June, September	Wetland	Very abundant
Ae. zoosophus/*Ae. triseriatus* hybrid	<0.1	Indefinite	Forest	Rare
An. crucians	0.3	June, August	Wetland, Cropland	Uncommon
An. punctipennis	1.2	June	Wetland, Forest	Common
An. quadrimaculatus	0.4	June/July	Wetland	Common
An. walkeri	<0.1	June	Wetland	Rare

TABLE 31 (CONTINUED) — Summary of mosquito taxa collected from different patch-matrix landscape configurations in five counties of central Missouri during 2007 – 2009.

Taxon	Percent of total	Temporal peak	Landscape association	Abundance
Cq. perturbans	2.0	June	Urban	Common
Cs. inornata	0.1	April, October	Forest, Urban, Wetland	Uncommon
Cx. erraticus	8.8	August	Forest, Wetland, Grassland	Abundant
Cx. peccator	0.1	August	Forest	Uncommon
Cx. pipiens group	0.6	August	Forest	Common
Cx. salinarius	4.6	July/August, October	Cropland	Abundant
Cx. tarsalis	0.1	August/September	Cropland, Wetland	Uncommon
Or. alba	<0.1	June	Grassland	Rare
Or. signifera	<0.1	July	Urban	Rare
Ps. ciliata	0.6	June	Wetland	Common
Ps. columbiae	0.5	June/July	Wetland	Common
Ps. cyanescens	0.1	May	Wetland	Uncommon
Ps. discolor	<0.1	July	Wetland	Rare
Ps. ferox	0.4	June	Wetland, Grassland, Forest	Common
Ps. horrida	1.3	May	Wetland	Common
Ps. howardii	<0.1	June	Wetland	Rare
Ur. sapphirina	0.1	August	Forest	Uncommon

FIGURE 1 — Typical land cover map and corresponding aerial photograph generated by the CARES mapping system used to determine sampling sites (example is of cropland matrix in Audrain county).



c – cropland
f – forest
g – grassland
u – urban
w – open water

FIGURE 2 — CDC mini-light trap used for mosquito collection in this study.

a – thermos baited with dry ice
b – weather guard
c – light and fan
d – trap funnel and catch basin
e – battery

FIGURE 3 — Hierarchical cluster analyses with single linkage and chi-square distances showing similarity in mosquito community composition among common landscape matrix types in five counties of central Missouri during 2007 – 2009.

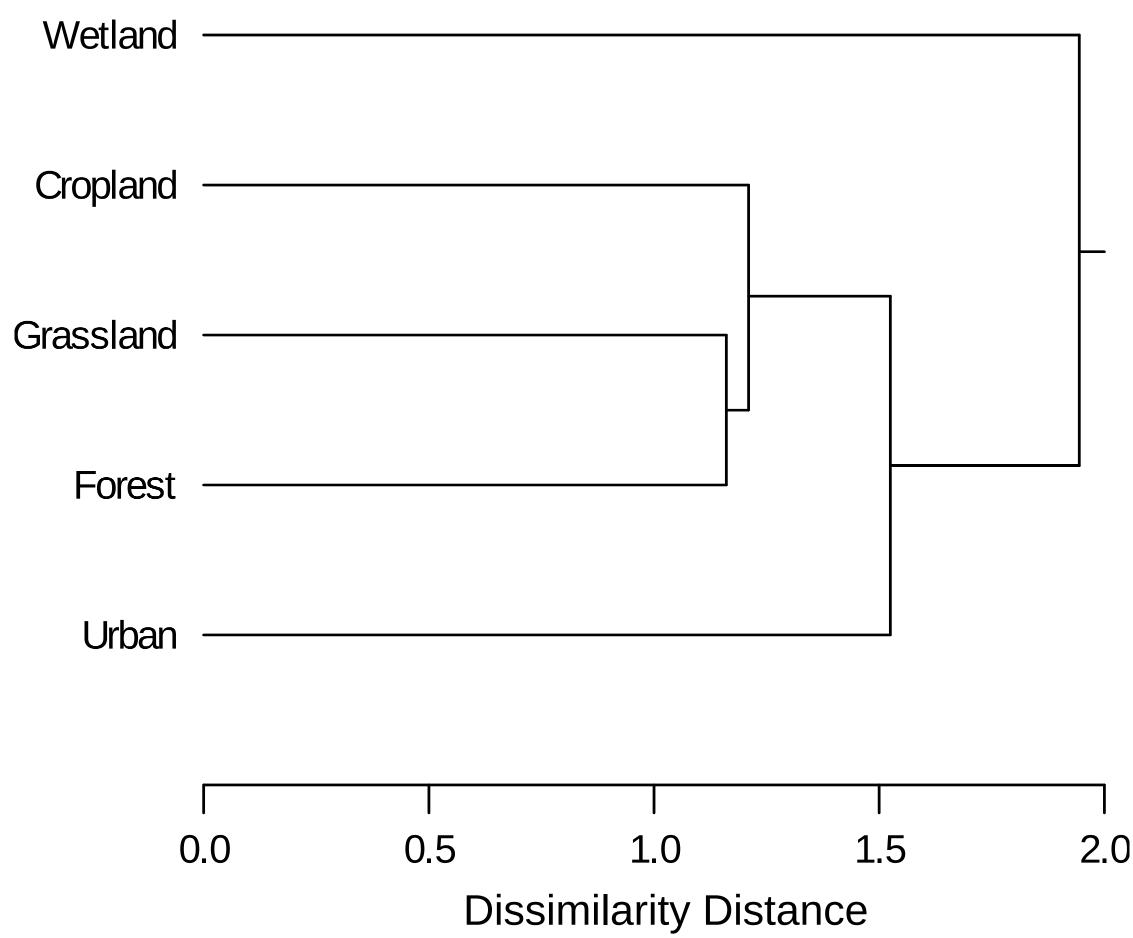


FIGURE 4 — Hierarchical cluster analyses with single linkage and chi-square distances showing similarity in mosquito community composition among several patch-matrix landscape combinations (patch listed first, matrix second) in five counties of central Missouri during 2007 – 2009.

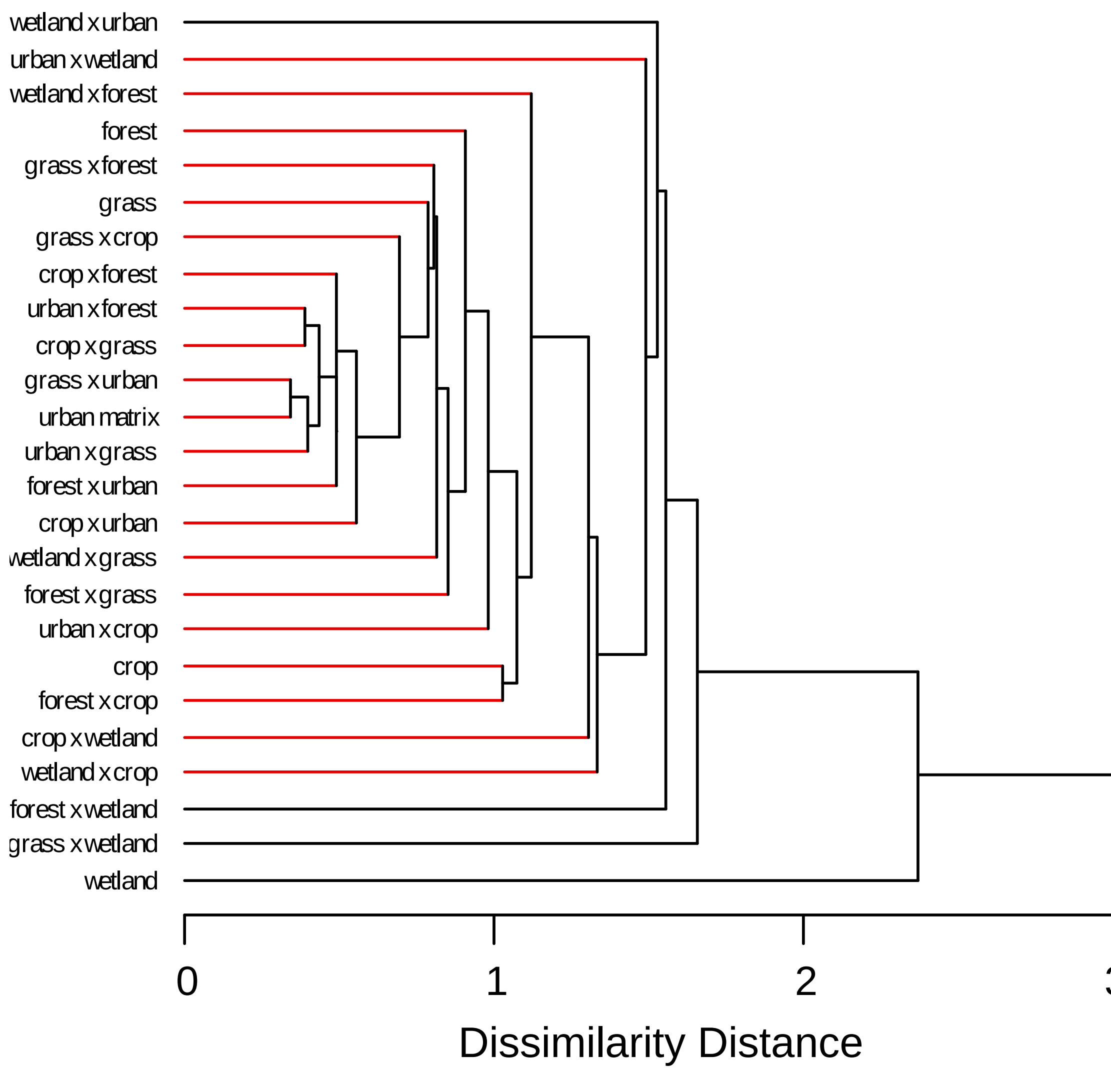


Figure 5 — Mean abundance of mosquitoes collected per trap for each month on all matrices in five counties of central Missouri during 2007 – 2009

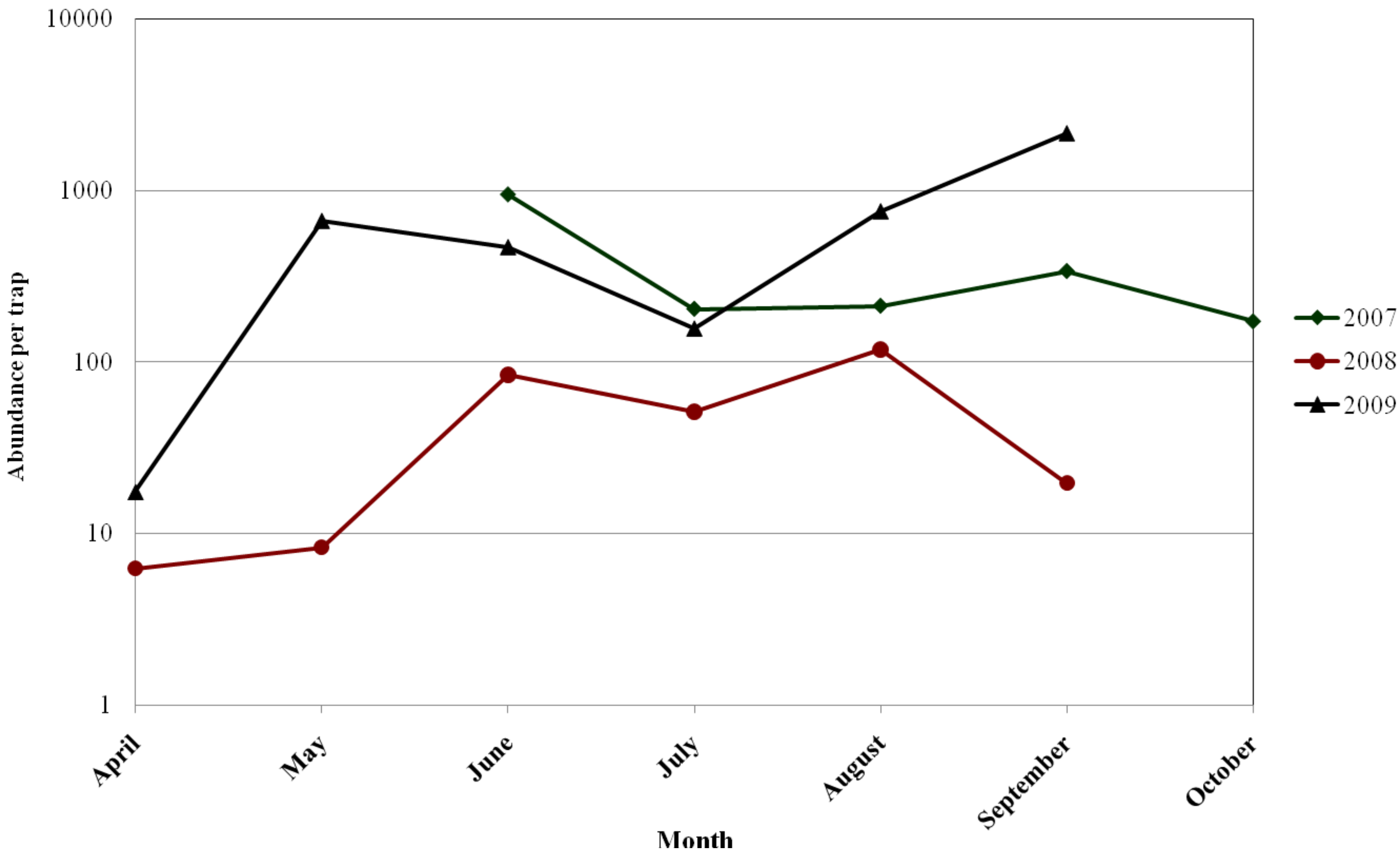


Figure 6 — Mean abundance of mosquitoes per trap on cropland, regardless of patch, for each month in five counties of central Missouri during 2007 – 2009

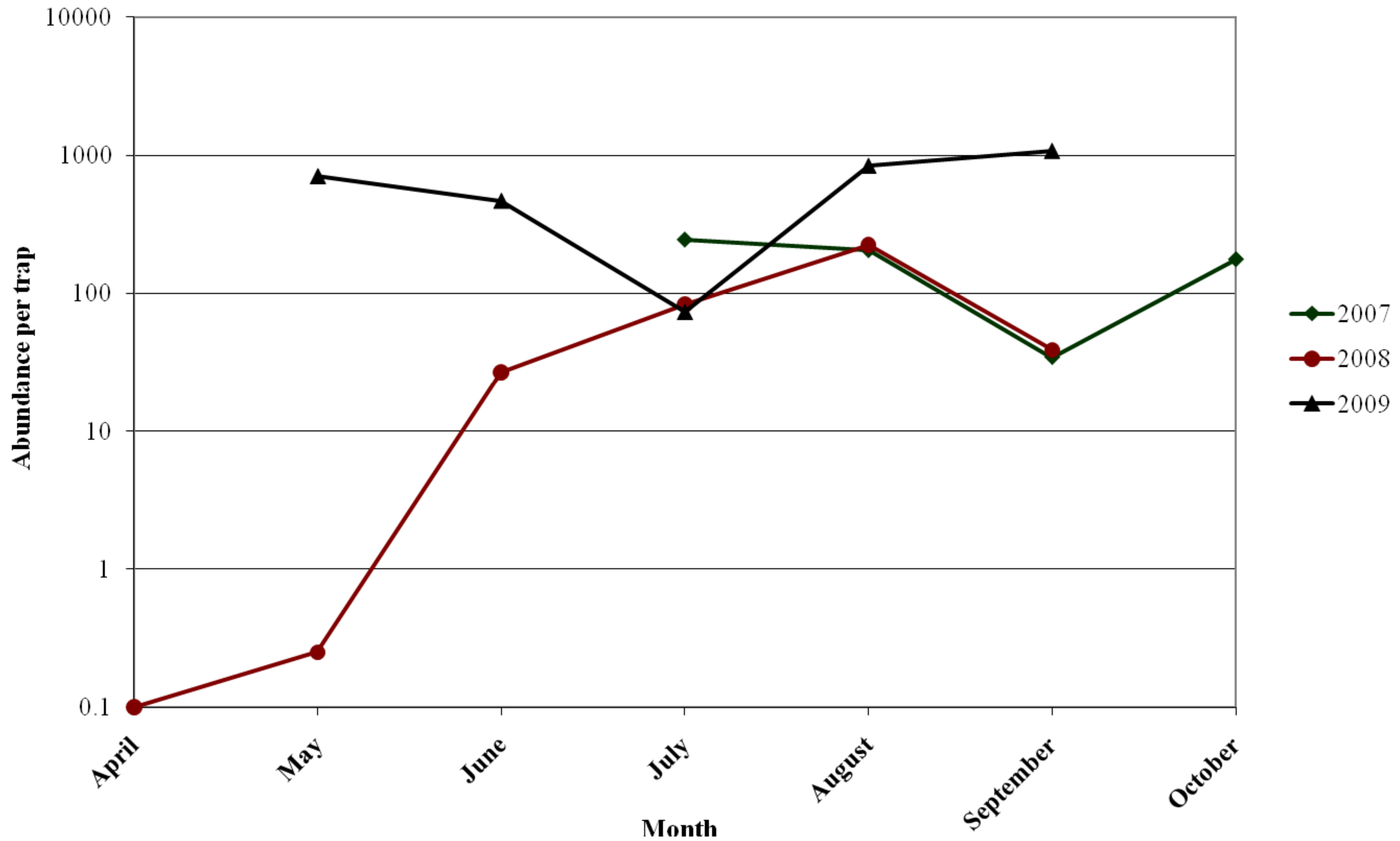


Figure 7 — Comparison of mean abundances of mosquitoes per trap on different patches within cropland matrix, for each month during the course of the study (2007 – 2009)

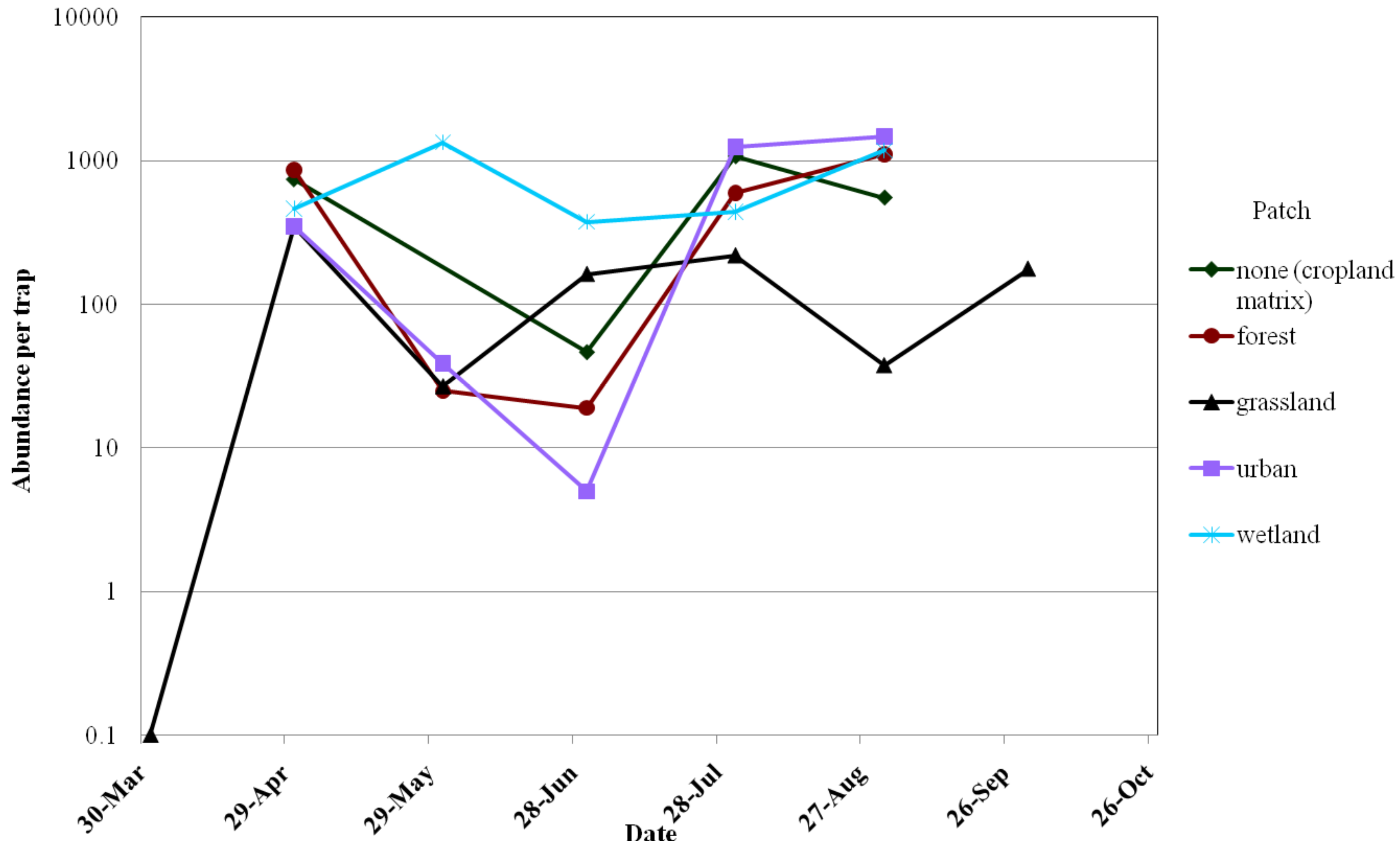


Figure 8 — Mean abundance of mosquitoes per trap on forest, regardless of patch, for each month in five counties of central Missouri during 2007 – 2009

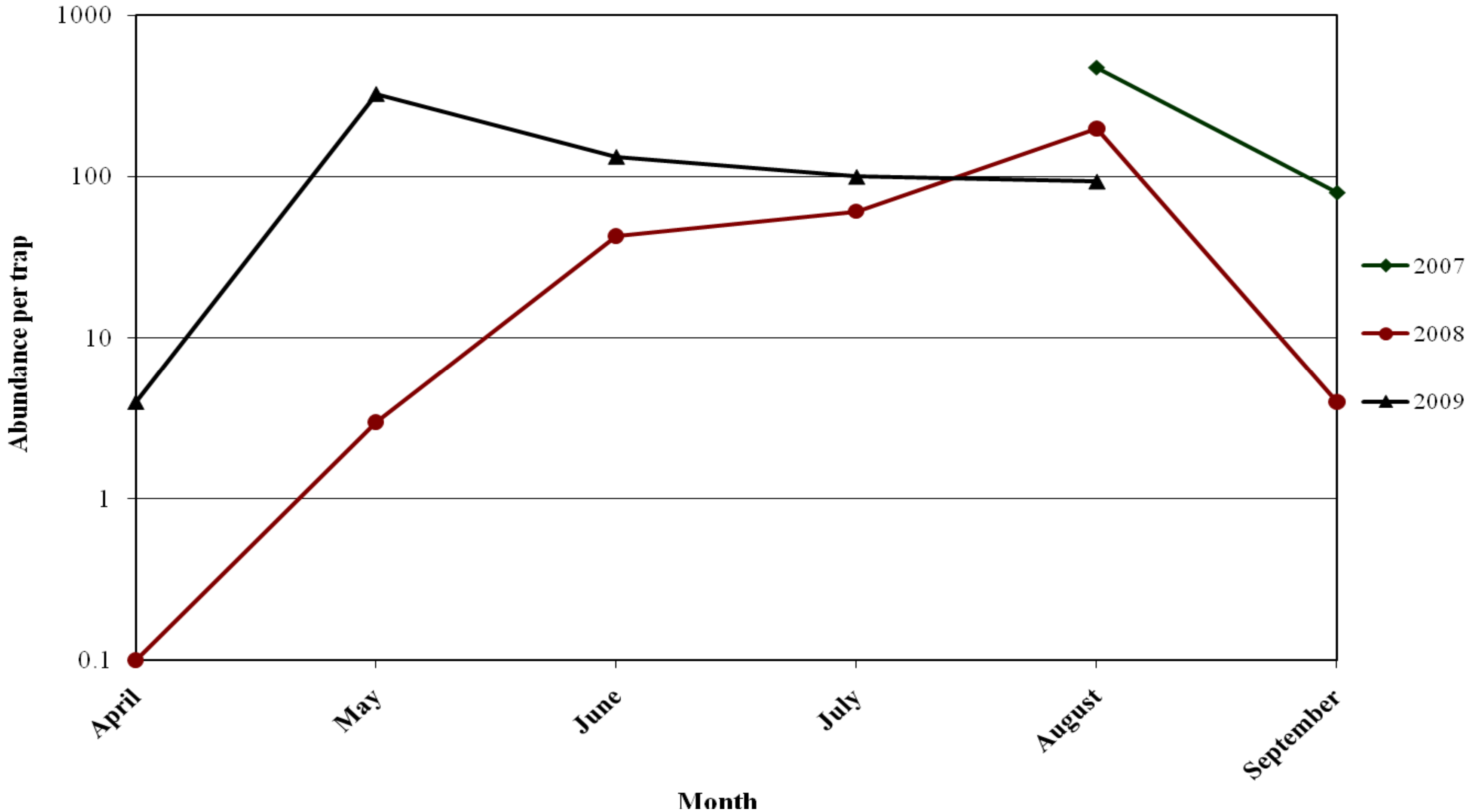


Figure 9 — Comparison of mean abundances of mosquitoes per trap on different patches within forest matrix, for each month during the course of the study (2007 – 2009)

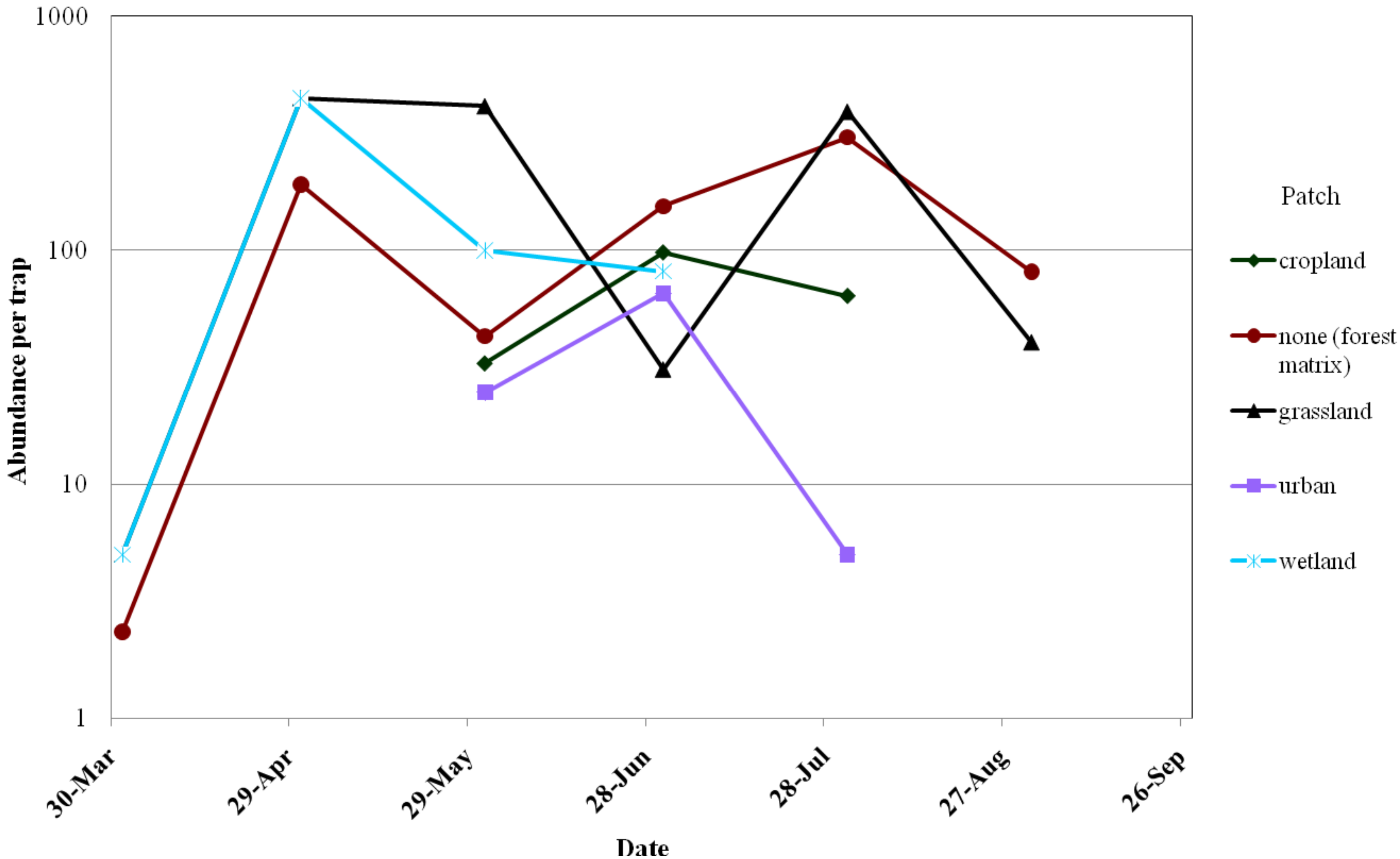


Figure 10 — Mean abundance of mosquitoes per trap on grassland, regardless of patch, for each month in five counties of central Missouri during 2007 – 2009

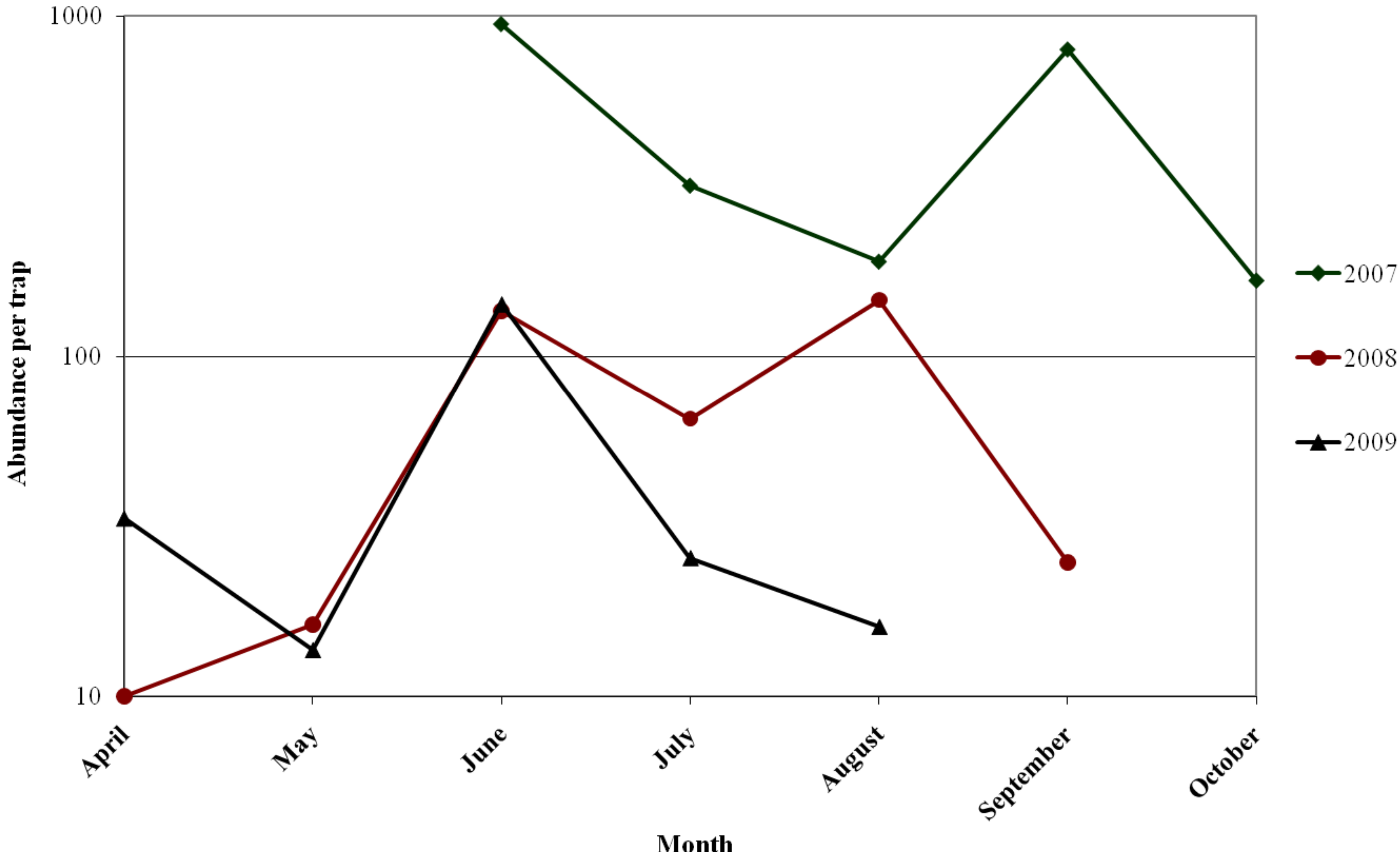


Figure 11 — Comparison of mean abundances of mosquitoes per trap on different patches within grassland matrix, for each month during the course of the study (2007 – 2009)

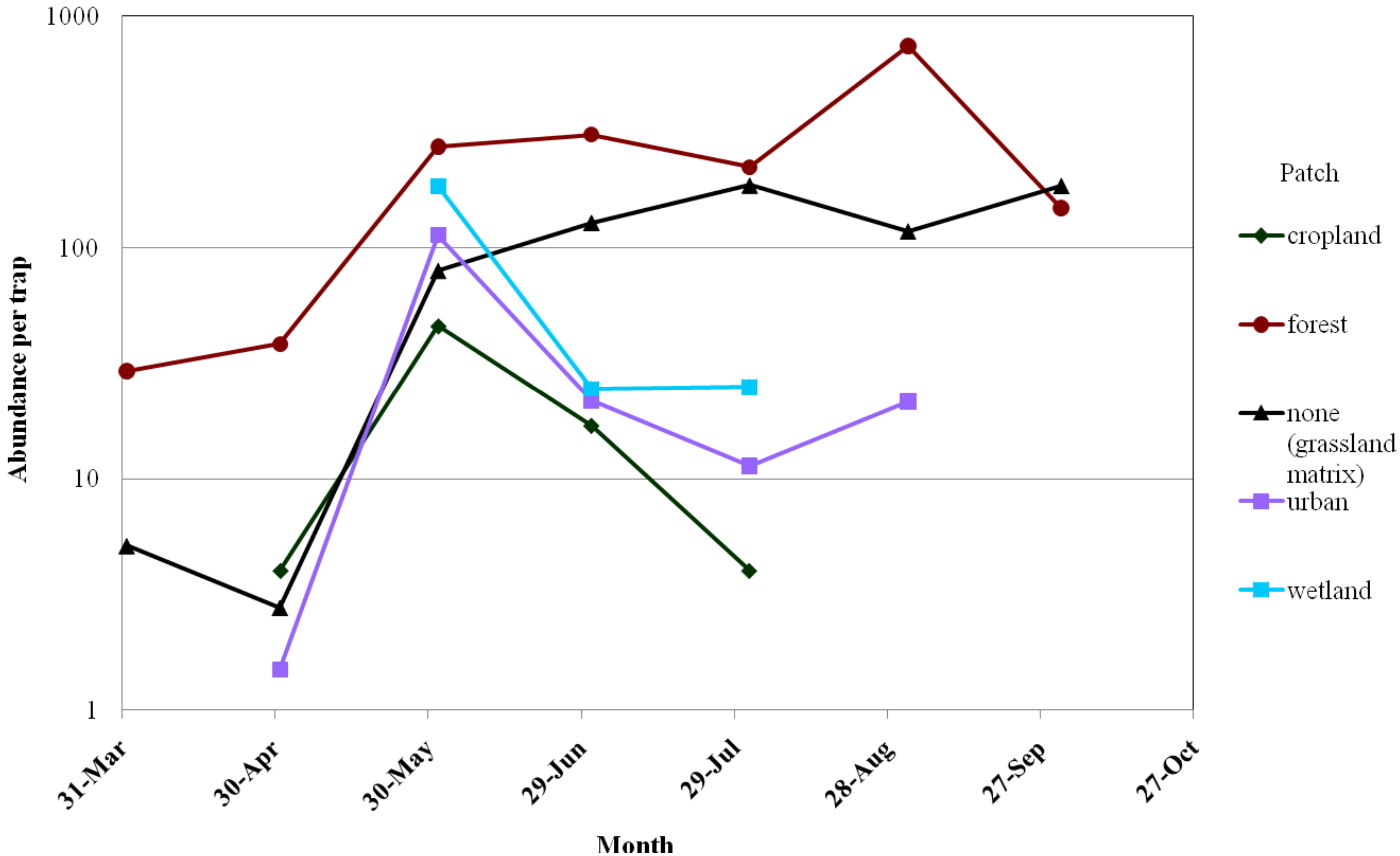


Figure 12 — Mean abundance of mosquitoes per trap on urban matrix, regardless of patch, for each month in five counties of central Missouri during 2007 – 2009

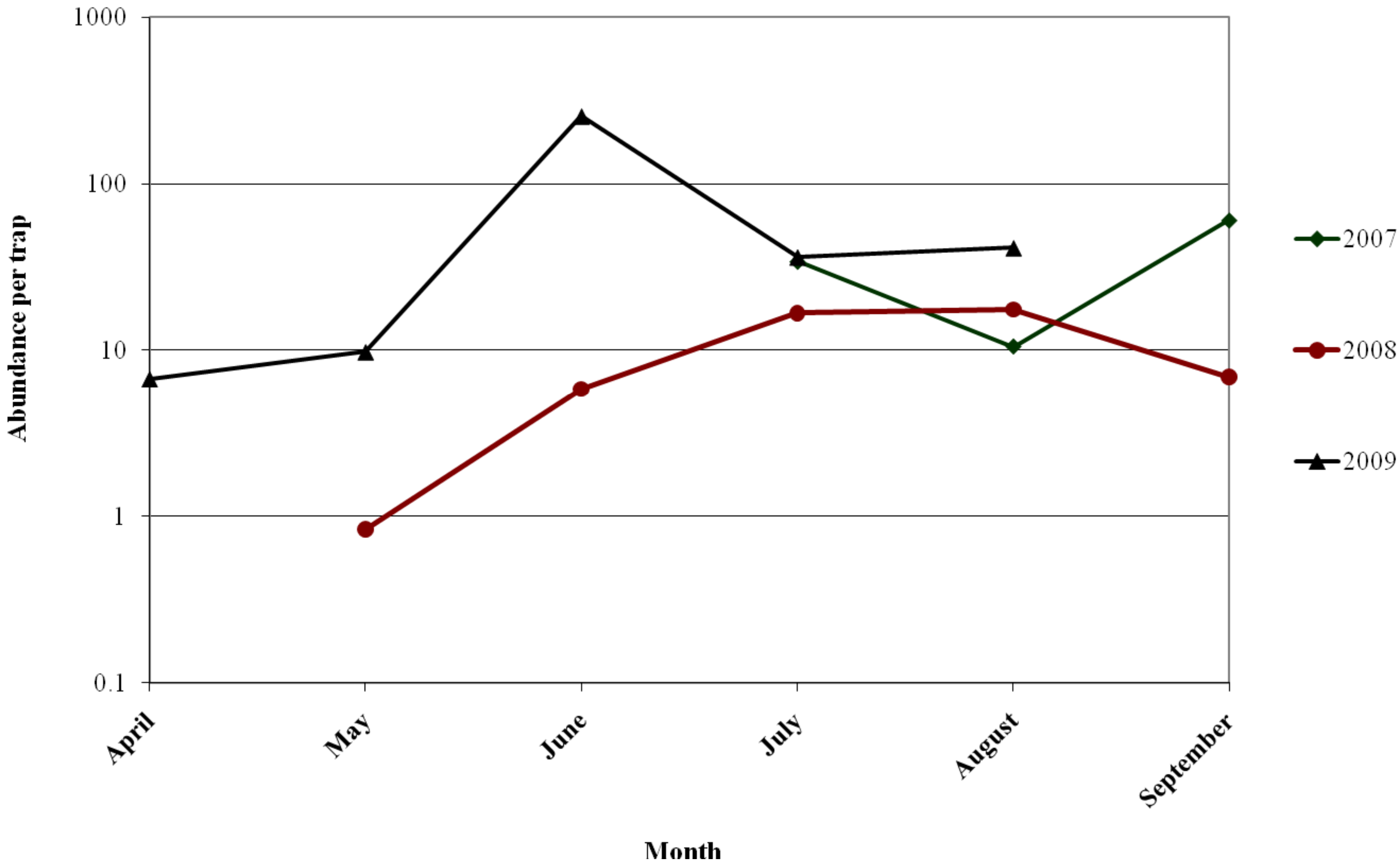


Figure 13 — Comparison of mean abundances of mosquitoes per trap on different patches within urban matrix, for each month during the course of the study (2007 – 2009)

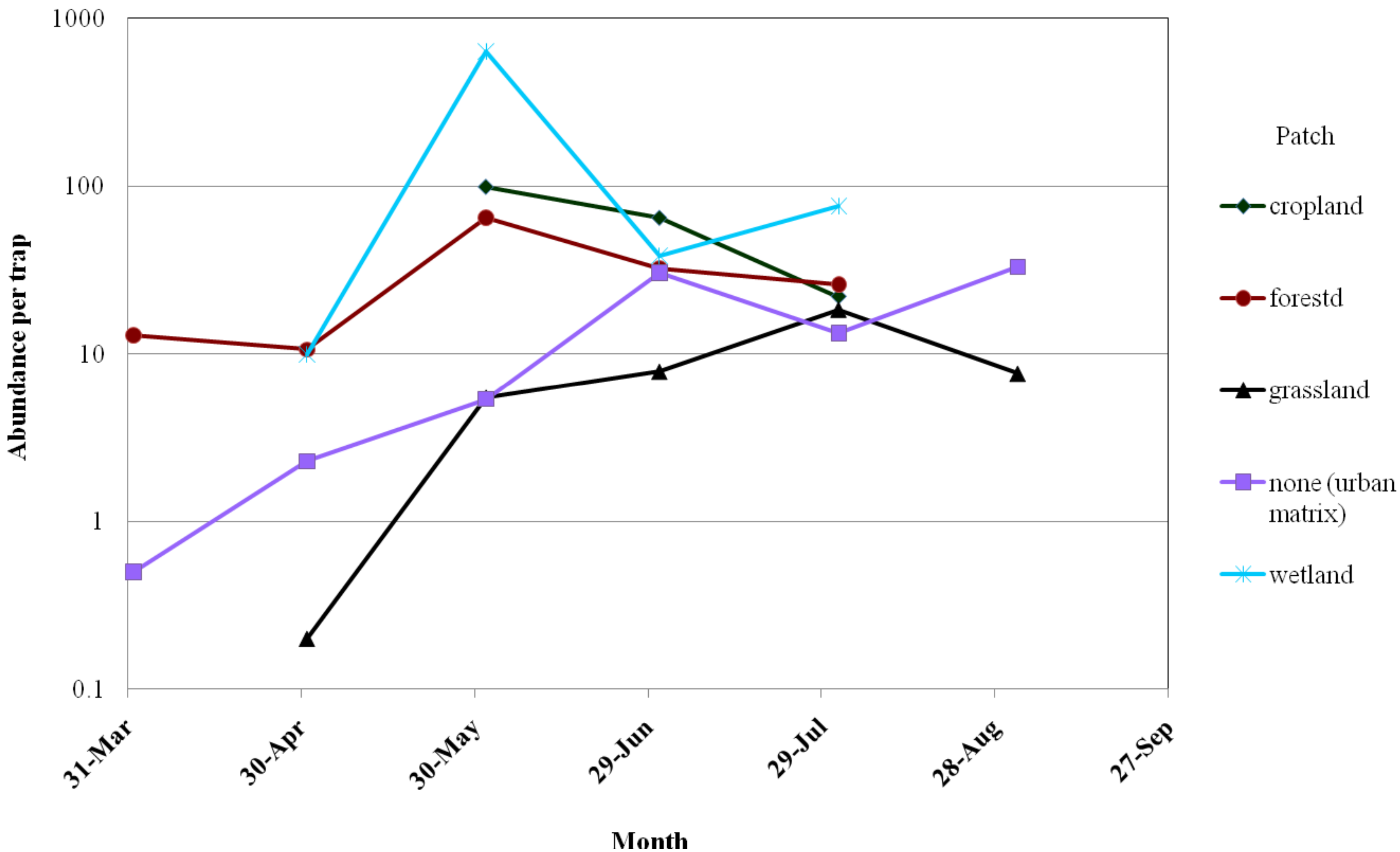


Figure 14 — Comparison of mean abundances of mosquitoes per trap on different patches within wetland matrix, for each month during the course of the study (2007 – 2009)

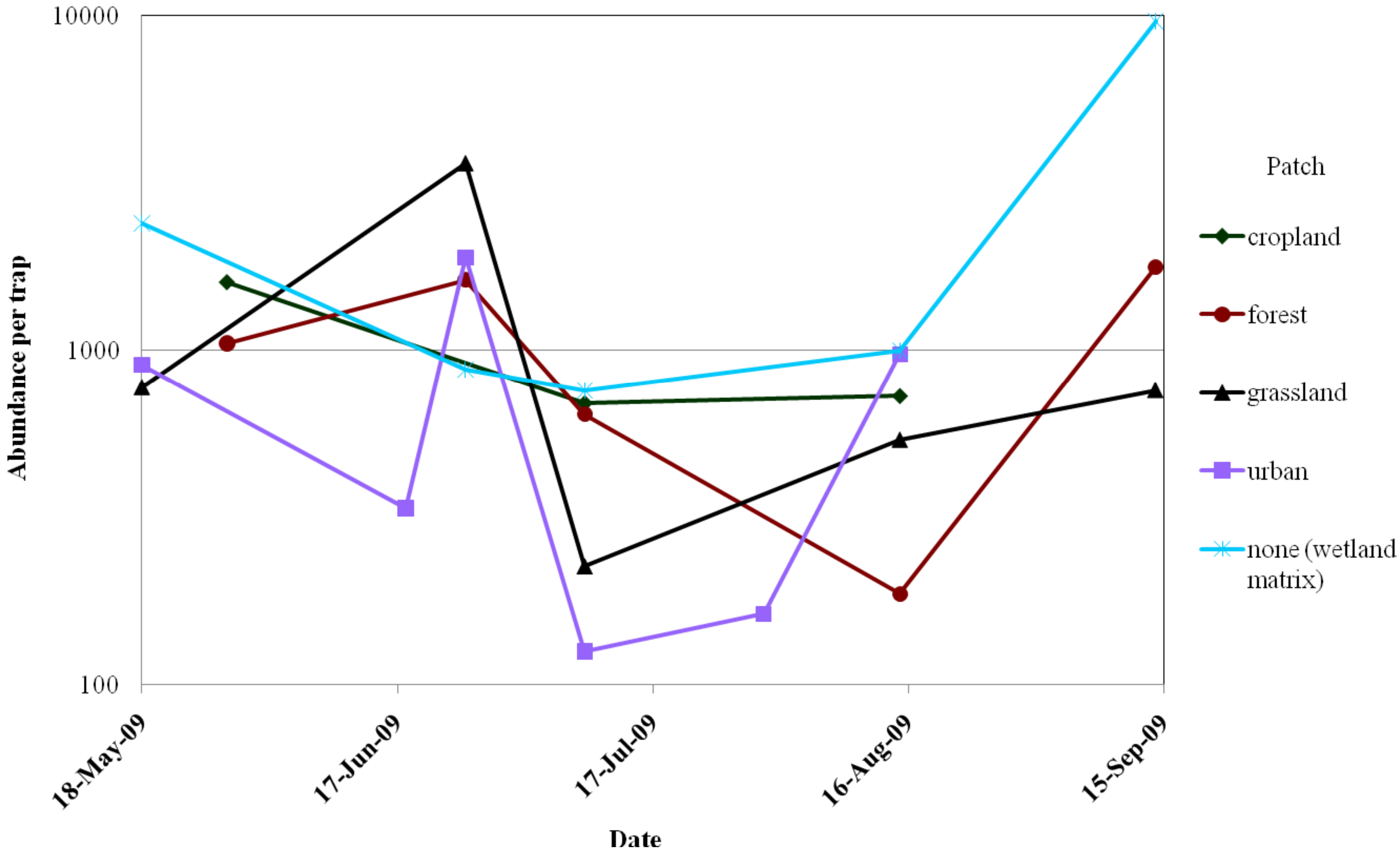


Figure 15 — Canonical correspondence analysis for cropland mosquito species, month of sampling, and weather variables. Circles are month of sampling scores; triangles are taxon scores; arrows represent the indicated environmental variable scores. See Table 29 for key to abbreviations.

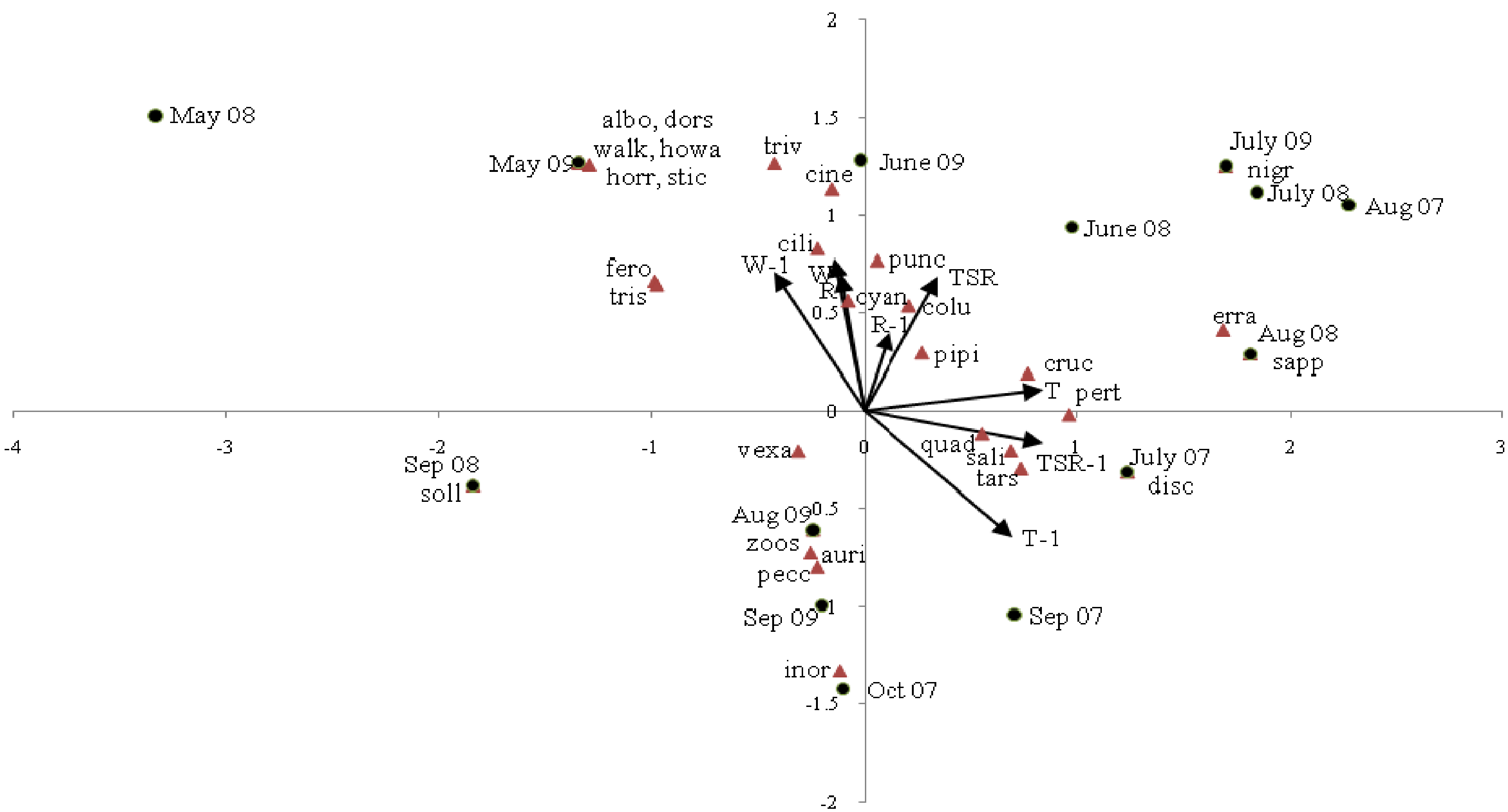


Figure 16 — Canonical correspondence analysis for forest mosquito species, month of sampling, and weather variables. Circles are month of sampling scores; triangles are taxon scores; arrows represent the indicated environmental variable scores. See Table 29 for key to abbreviations.

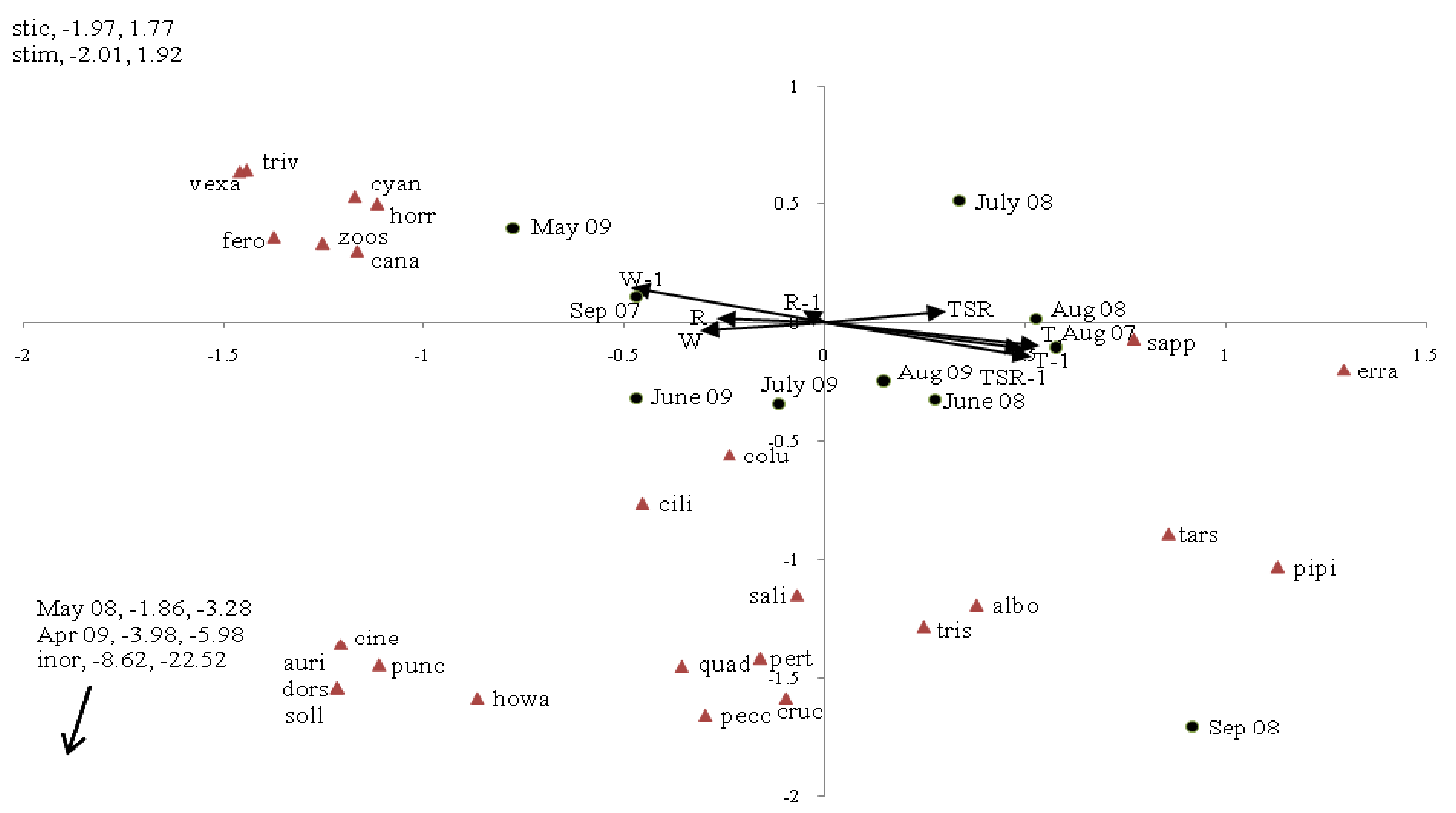


Figure 17 — Canonical correspondence analysis for grassland mosquito species, month of sampling, and weather variables. Circles are month of sampling scores; triangles are taxon scores; arrows represent the indicated environmental variable scores. See Table 29 for key to abbreviations.

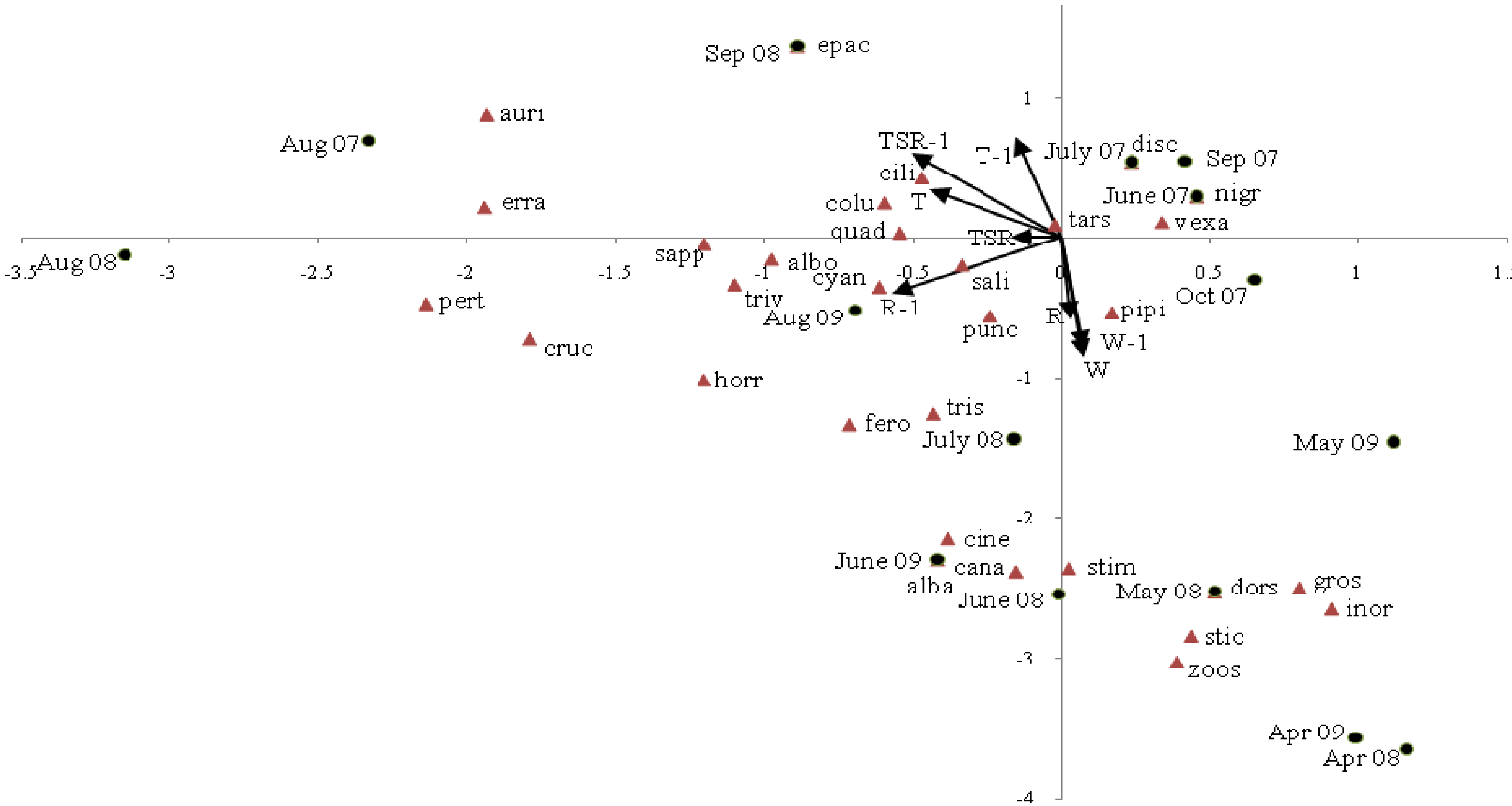
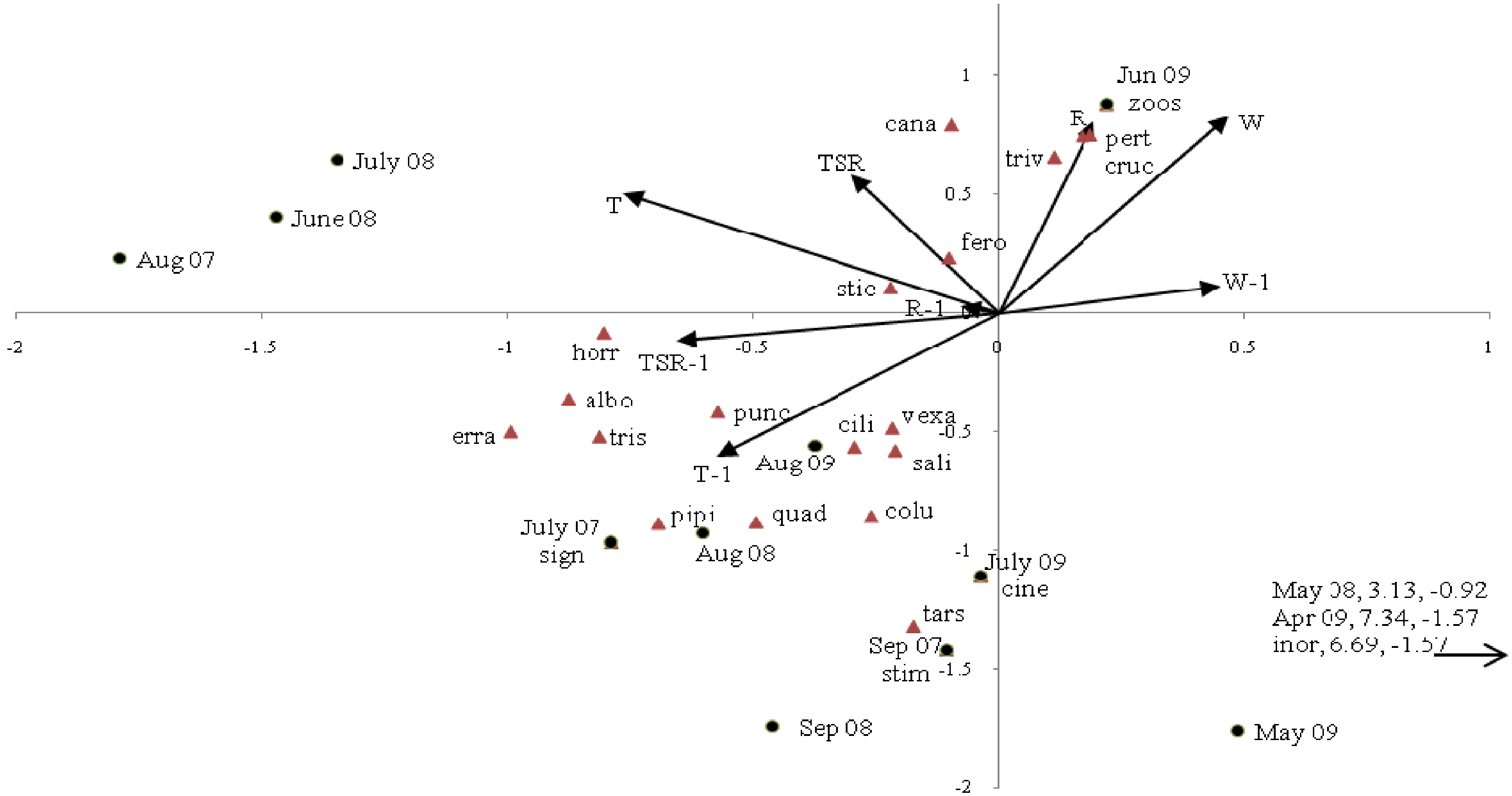


Figure 18 — Canonical correspondence analysis for urban mosquito species, month of sampling, and weather variables. Circles are month of sampling scores; triangles are taxon scores; arrows represent the indicated environmental variable scores. See Table 29 for key to abbreviations.



<u>Appendix A</u>. Trap locations and associated information

Site name	Latitude	Longitude	Location	Matrix	Patch	Total Samples	Dates of Sampling
3801 front	N 38.9888	W 92.3143	Private property, Boone Co.	urban	none	2	July, September 2007
3CCRFF1	N 38.8512	W 92.278	Three Creeks Conservation Area, Boone Co.	forest	cropland	2	June, July 2009
3CCRFF2	N38.8466	W 92.2846	Three Creeks Conservation Area, Boone Co.	forest	cropland	2	June, July 2009
3CFFFF1	N 38.82746	W 92.286	Three Creeks Conservation Area, Boone Co.	forest	none	3	May, July 2009
3CFFFF2	N 38.82617	W 92.28358	Three Creeks Conservation Area, Boone Co.	forest	none	3	May, July, August 2009
3CFFFF205	N 38.84713	W 92.28223	Three Creeks Conservation Area, Boone Co.	forest	none	1	April 2009
3CFFFF208	N 38.85187	W 92.28322	Three Creeks Conservation Area, Boone Co.	forest	none	1	April 2009
3CUUFF	N 38.8507	W 92.2781	Three Creeks Conservation Area, Boone Co.	forest	urban	3	June - August 2009
3CWWFF1	N 38.8272	W 92.28393	Three Creeks Conservation Area, Boone Co.	forest	wetland	2	May 2009
3CWWFF2	N 38.8305	W 92.28313	Three Creeks Conservation Area, Boone Co.	forest	wetland	2	May, July 2009
3CWWFF212	N 38.85172	W 92.28509	Three Creeks Conservation Area, Boone Co.	forest	wetland	1	April 2009
763CRUU	N 38.9863	W 92.325	Private property, Boone Co.	urban	cropland	1	July 2009
ABC Daily	N 38.96308	W 92.23317	Private property, Boone Co.	grassland	forest	24	June - September 2007; April - July 2008; April, May 2009
ABC fence	N 38.963	W 92.2311	Private property, Boone Co.	grassland	forest	5	July, August 2007
ABC field	N 38.9612	W 92.2315	Private property, Boone Co.	grassland	forest	1	July 2007
ABC tree	N 38.9623	W 92.2328	Private property, Boone Co.	grassland	forest	2	June, July 2007
Apple Valley	N 38.9724	W 92.3806	Private property, Boone Co.	urban	grassland	5	May - September 2008
Ashland pond	N 38.762	W 92.2059	Ashland Lake Conservation Area, Boone Co.	forest	grassland	2	August, September 2007
Ashland woods	N 38.7639	W 92.2057	Ashland Lake Conservation Area,	forest	none	2	August, September 2007

			Boone Co.				
AshWWFF	N 38.76302	W 92.20664	Ashland Lake Conservation Area, Boone Co.	forest	wetland	1	May 2009
AshWWFF276	N 38.76235	W 92.20659	Ashland Lake Conservation Area, Boone Co.	forest	wetland	1	July 2009
AshWWFF282	N 38.7631	W 92.20648	Ashland Lake Conservation Area, Boone Co.	forest	wetland	2	June, July 2009
AUCE	N 39.09028	W 91.99462	Private property, Audrain Co.	cropland	grassland	4	April, July - September 2009
Audrain pond 1	N 39.0897	W 91.9989	Private property, Audrain Co.	cropland	grassland	4	July - October 2007
Audrain pond 2	N 39.0895	W 91.9991	Private property, Audrain Co.	cropland	grassland	1	July 2007
Audrain weather	N 39.0891	W 91.9985	Private property, Audrain Co.	cropland	grassland	5	July - October 2007
AUNE	N 39.09307	W 91.98666	Private property, Audrain Co.	cropland	grassland	5	April - August 2008
AUNW	N 39.09319	W 91.99931	Private property, Audrain Co.	cropland	grassland	6	April - September 2008
AUSE	N 39.08749	W 91.98958	Private property, Audrain Co.	cropland	grassland	6	April - September 2008
AUSW (AU house)	N 39.08916	W 91.99929	Private property, Audrain Co.	cropland	grassland	7	July 2007; April - September 2008
BCFFUU	N 38.98315	W 92.31715	Bear Creek Trail, Boone Co.	urban	forest	6	July 2008; April - July 2009
BCWWUU	N 38.97652	W 92.32389	Private property, Boone Co.	urban	wetland	1	July 2009
BeCRUU	N 38.9907	W 92.322	Private property, Boone Co.	urban	cropland	2	June, July 2009
BeWWUU249	N 38.99015	W 92.32081	Private property, Boone Co.	urban	none	4	May - August 2009
BGWWUU282	N 38.98045	W 92.3425	Bear Creek Nature Area, Boone Co.	urban	wetland	1	June 2009
BGWWUU283	N 38.97996	W 92.34299	Bear Creek Nature Area, Boone Co.	urban	wetland	1	June 2009
BRCRUU	N 38.9573	W 92.2858	Private property, Boone Co.	urban	cropland	1	June 2009
Broadview	N 38.9511	W 92.2234	Private property, Boone Co.	grassland	urban	5	May - September 2008
Capen mulch pond	N 38.9293	W 92.3218	Capen Park, Boone Co.	forest	grassland	2	August, September 2007
Capen woods	N 38.9287	W 92.3207	Capen Park, Boone Co.	forest	none	2	August, September 2007
Citation	N 38.9889	W 92.31467	Private property, Boone Co.	urban	none	17	July -September 2007; May - September 2008; April - June 2009
Cosmos	N 38.97744	W 92.35993	Cosmos Park, Boone Co.	grassland	forest	2	June, July 2008
CPCRUU	N 38.9296	W 92.3223	Capen Park, Boone Co.	urban	cropland	2	July, August 2009
CPFFUU250	N 38.9318	W 92.32153	Capen Park, Boone Co.	urban	forest	2	May, June 2009
CVCRCR1	N 38.64493	W 92.20394	Capitol View Conservation Area, Boone Co.	cropland	none	2	May, July 2009
CVCRCR2	N 38.64443	W 92.20344	Capitol View Conservation Area,	cropland	none	2	May, July 2009

			Boone Co.				
CVFFCR272	N 38.645	W 92.2033	Capitol View Conservation Area, Boone Co.	cropland	forest	2	May, July 2009
CVGRCR	N 38.64469	W 92.20295	Capitol View Conservation Area, Boone Co.	cropland	grassland	1	May 2009
Dahlia	N 38.9748	W 92.3824	Private property, Boone Co.	urban	grassland	5	May - September 2008
DBUUWW1	N 38.9421	W 92.8727	De Bourgmont Conservation Area, Cooper Co.	wetland	urban	1	June 2009
DBUUWW2	N 38.9417	W 92.8712	De Bourgmont Conservation Area, Cooper Co.	wetland	urban	1	July 2009
DIFFWW	N 38.9823	W 92.6131	Diana Bend Conservation Area, Howard Co.	wetland	forest	3	June, August, September 2009
DIGRCR256	N 38.98635	W 92.61483	Diana Bend Conservation Area, Howard Co.	cropland	grassland	1	May 2009
DIGRFF257	N 38.99191	W 92.61653	Diana Bend Conservation Area, Howard Co.	forest	grassland	3	May, June, August 2009
DIGRWW254	N 38.98269	W 92.61765	Diana Bend Conservation Area, Howard Co.	wetland	grassland	3	May, June, September 2009
DIGRWWX	N 38.9825	W 92.6168	Diana Bend Conservation Area, Howard Co.	wetland	grassland	2	August, September 2009
DIUUWW	N 38.9822	W 92.6159	Diana Bend Conservation Area, Howard Co.	wetland	urban	1	August 2009
DIUUWW336	N 38.98222	W 92.61598	Diana Bend Conservation Area, Howard Co.	wetland	urban	1	June 2009
DIWWCR255	N 38.98113	W 92.62376	Diana Bend Conservation Area, Howard Co.	cropland	wetland	1	May 2009
DIWWWW252	N 38.98154	W 92.61604	Diana Bend Conservation Area, Howard Co.	wetland	none	3	May, August, September 2009
DIWWWW253	N 38.98236	W 92.61917	Diana Bend Conservation Area, Howard Co.	wetland	none	2	May, August 2009
DIWWWW254	N 38.98269	W 92.61765	Diana Bend Conservation Area, Howard Co.	wetland	none	2	June, August 2009
DSWWGR	N 38.9769	W 92.1739	Private property, Boone Co.	grassland	wetland	2	June, July 2009
EBCRCR1	N 38.86514	W 92.45223	Eagle Bluffs Conservation Area, Boone Co.	cropland	none	2	August, September 2009
EBCRCR286	N 38.86216	W 92.45224	Eagle Bluffs Conservation Area, Boone Co.	cropland	none	1	May 2009
EBCRWW	N 38.8331	W 92.4292	Eagle Bluffs Conservation Area, Boone Co.	wetland	cropland	2	May, July 2009

EBCRWW295	N 38.83399	W 92.42947	Eagle Bluffs Conservation Area, Boone Co.	wetland	cropland	3	May, July, August 2009
EBCRWW299	N 38.83109	W 92.42809	Eagle Bluffs Conservation Area, Boone Co.	wetland	cropland	1	July 2009
EBFFCR2	N 38.8624	W 92.4524	Eagle Bluffs Conservation Area, Boone Co.	cropland	forest	3	May, August, September 2009
EBFFWW	N 38.8321	W 92.4286	Eagle Bluffs Conservation Area, Boone Co.	wetland	forest	2	May, July 2009
EBGRWW296	N 38.83463	W 92.43055	Eagle Bluffs Conservation Area, Boone Co.	wetland	grassland	1	July 2009
EBUUCR289	N 38.86147	W 92.45059	Eagle Bluffs Conservation Area, Boone Co.	cropland	urban	2	August, September 2009
EBUUCRx	N 38.8318	W 92.4246	Eagle Bluffs Conservation Area, Boone Co.	cropland	urban	1	May 2009
EBUUWW	N 38.8312	W 92.4278	Eagle Bluffs Conservation Area, Boone Co.	wetland	urban	2	May, July 2009
EBWWCR1	N 38.86166	W 92.45161	Eagle Bluffs Conservation Area, Boone Co.	cropland	cropland	3	May, July, September 2009
EBWWWW	N 38.83352	W 92.43037	Eagle Bluffs Conservation Area, Boone Co.	wetland	none	1	July 2009
FIFFWW2	N 38.988	W 92.6884	Franklin Island Conservation Area, Howard Co.	wetland	forest	1	June 2009
FIWWCR261	N 38.9924	W 92.67962	Franklin Island Conservation Area, Howard Co.	cropland	wetland	3	May, June, August 2009
FIWWWW259	N 38.99031	W 92.6793	Franklin Island Conservation Area, Howard Co.	wetland	none	1	May 2009
Furlong	N 38.9884	W 92.3157	Private property, Boone Co.	urban	grassland	5	May - September 2008
Grayson	N 38.9739	W 92.3848	Private property, Boone Co.	urban	grassland	5	May - September 2008
Mayberry	N 38.9762	W 92.3822	Private property, Boone Co.	urban	grassland	5	May - September 2008
MGUUGR	N 38.98516	W 92.20901	Private property, Boone Co.	grassland	urban	1	June 2009
MGWWGR3	N 38.9864	W 92.196	Private property, Boone Co.	grassland	wetland	3	June - August 2009
OLFFUU	N 38.9804	W 92.31169	Albert-Oakland Park, Boone Co.	urban	forest	3	April, July, August 2009
PFCE	N 38.8923	W 91.74024	Prairie Fork Conservation Area, Callaway Co.	grassland	none	5	April, May, July - September 2008
PFNE (PF Pond)	N 38.89432	W 91.7359	Prairie Fork Conservation Area, Callaway Co.	grassland	none	8	July, August 2007; April - September 2008
PFNW (PF Field)	N 38.8973	W 91.74335	Prairie Fork Conservation Area, Callaway Co.	grassland	none	11	July - October 2007; April - September 2008
PFSE	N 38.88618	W 91.73825	Prairie Fork Conservation Area,	grassland	forest	6	April - September 2008

			Callaway Co.				
PFSW	N 38.89155	W 91.74322	Prairie Fork Conservation Area, Callaway Co.	forest	forest	6	April - September 2008
Prairie Fork CA trail	N 38.8937	W 91.7369	Prairie Fork Conservation Area, Callaway Co.	grassland	forest	2	July, September 2007
Prairie Fork CA Trail 2	N 38.8942	W 91.7364	Prairie Fork Conservation Area, Callaway Co.	grassland	forest	2	July, October 2007
Preakness	N 38.9898	W 92.3159	Private property, Boone Co.	urban	none	5	May - September 2008
PRUUFF1	N 38.7584	W 92.1471	Private property, Boone Co.	forest	urban	1	June 2009
PRUUFF2	N 38.7609	W 92.1495	Private property, Boone Co.	forest	urban	2	June, July 2009
Rainbow	N 38.9496	W 92.2255	Private property, Boone Co.	grassland	grassland	5	May - September 2008
RFCRFF1	N 39.0766	W 92.3106	Rocky Fork Lake Conservation Area, Boone Co.	forest	cropland	1	July 2009
RFCRFF2	N 39.0751	W 92.3114	Rocky Fork Lake Conservation Area, Boone Co.	forest	cropland	2	July, August 2009
RFFFFF	N 39.08649	W 92.29563	Rocky Fork Lake Conservation Area, Boone Co.	forest	none	1	May 2009
RFGRFF1	N 39.08691	W 92.29781	Rocky Fork Lake Conservation Area, Boone Co.	forest	grassland	1	May 2009
RFGRFF206	N 39.07869	W 92.30606	Rocky Fork Lake Conservation Area, Boone Co.	forest	grassland	3	April, June, July 2009
Rose	N 38.9754	W 92.3793	Private property, Boone Co.	urban	none	4	May, June, August, September 2009
RPFFUU251	N 38.94333	W 92.31263	Rock Hill Park, Boone Co.	urban	forest	3	May - July 2009
S. Farm new marsh	N 38.9101	W 92.2854	University of Missouri property, Boone Co.	grassland	none	4	July - September 2007
S. Farm old marsh	N 38.9088	W 92.2814	University of Missouri property, Boone Co.	grassland	none	3	July - August 2007
S. Farm weather	N 38.9051	W 92.2731	University of Missouri property, Boone Co.	grassland	urban	4	July - September 2007
Sanborn Large Lot	N 38.9403	W 92.3157	University of Missouri property, Boone Co.	urban	grassland	2	July 2007
Sanborn Large Lot (2)	N 38.9406	W 92.3158	University of Missouri property, Boone Co.	urban	grassland	1	July 2007
Sanborn Small Lot	N 38.9423	W 92.3167	Rock Hill Park, Boone Co.	urban	none	8	July - September 2007; June, July 2008
Sanborn Trail	N 38.9418	W 92.3157	Rock Hill Park, Boone Co.	urban	none	4	July - September 2007
Sanborn Trail 2	N 38.9418	W 92.3154	Rock Hill Park, Boone Co.	urban	none	1	July 2007

SCWWGR	N 38.9777	W 92.17368	Private property, Boone Co.	grassland	wetland	1	June 2009
Seattle Slew	N 38.9882	W 92.3197	Private property, Boone Co.	urban	none	5	May - September 2008
SFCRGR	N 38.906	W 92.2817	University of Missouri property, Boone Co.	grassland	cropland	1	May 2009
SFCRGR334	N 38.90729	W 92.28166	University of Missouri property, Boone Co.	grassland	cropland	1	June 2009
Southern	N 38.9539	W 92.2254	Private property, Boone Co.	grassland	none	5	May - September 2008
Suncrest	N 38.9532	W 92.2272	Private property, Boone Co.	grassland	none	5	May - September 2008
Sunnyside	N 38.9519	W 92.226	Private property, Boone Co.	grassland	urban	5	May - September 2008
TFCRGR1	N 38.9758	W 92.1859	Turkey Farm Lake Conservation Area, Boone Co.	grassland	cropland	2	June, August 2009
TFCRGR2	N 38.976	W 92.1846	Turkey Farm Lake Conservation Area, Boone Co.	grassland	cropland	2	June, July 2009
TFUUGR	N 38.9745	W 92.1853	Turkey Farm Lake Conservation Area, Boone Co.	grassland	urban	3	June - August 2009
TLCE	N 38.96995	W 92.18647	Turkey Farm Lake Conservation Area, Boone Co.	grassland	none	5	April, May, July - September 2008
TLFFGR215	N 38.96624	W 92.18624	Turkey Farm Lake Conservation Area, Boone Co.	grassland	forest	1	April 2009
TLFFGR216	N 38.96614	W 92.18634	Turkey Farm Lake Conservation Area, Boone Co.	grassland	forest	2	April, May 2009
TLFFGR219	N 38.96651	W 92.18607	Turkey Farm Lake Conservation Area, Boone Co.	grassland	forest	6	June, July 2008; April 2009
TLGRGR218	N 38.9668	W 92.18594	Turkey Farm Lake Conservation Area, Boone Co.	grassland	none	1	April 2009
TLNE	N 38.97545	W 92.18431	Turkey Farm Lake Conservation Area, Boone Co.	grassland	none	5	April - August 2008
TLNW	N 38.97545	W 92.18845	Turkey Farm Lake Conservation Area, Boone Co.	grassland	none	6	April - September 2008
TLSE	N 38.96436	W 92.18475	Turkey Farm Lake Conservation Area, Boone Co.	grassland	forest	5	April, May, July - September 2008
TLSW	N 38.96428	W 92.18755	Turkey Farm Lake Conservation Area, Boone Co.	grassland	forest	6	April - September 2008
TUFFCR	N 39.07895	W 92.16048	Private property, Boone Co.	cropland	forest	2	June, July 2009
TUUUCR1	N 39.0787	W 92.1606	Private property, Boone Co.	cropland	urban	1	July 2009
TUUUCR2	N 39.07829	W 92.1606	Private property, Boone Co.	cropland	urban	2	June, July 2009
War Admiral	N 38.9869	W 92.3157	Private property, Boone Co.	urban	grassland	5	May - September 2008

<u>Appendix B</u>. Pearson's Correlation Matrix for all trapping data

	VAR_1	VAR_2	VAR_3	VAR_4	VAR_5	VAR_6	VAR_7	VAR_8	VAR_9	VAR_10	VAR_11	VAR_12	VAR_13	VAR_14	VAR_15	VAR_16	VAR_17	VAR_18
VAR_1	1																	
VAR_2	-0.036	1																
VAR_3	-0.004	-0.023	1															
VAR_4	-0.035	0.02	-0.017	1														
VAR_5	-0.021	0.065	0.01	0.007	1													
VAR_6	-0.015	-0.006	-0.009	-0.006	-0.003	1												
VAR_7	-0.039	-0.017	0.181	-0.014	0.06	-0.006	1											
VAR_8	-0.018	-0.008	-0.011	**0.805**	-0.004	-0.003	-0.008	1										
VAR_9	-0.024	-0.01	-0.014	0.016	-0.006	-0.004	-0.01	-0.005	1									
VAR_10	-0.025	-0.01	-0.002	0.098	0.032	-0.008	-0.012	-0.004	-0.011	1								
VAR_11	-0.025	-0.013	**0.382**	-0.011	-0.004	-0.005	0.059	-0.006	-0.008	0.016	1							
VAR_12	0.098	-0.035	0.507	-0.031	-0.019	-0.013	0.101	-0.016	-0.022	0.058	**0.422**	1						
VAR_13	-0.037	-0.013	-0.015	0.216	-0.002	-0.011	-0.025	-0.011	0.01	**0.44**	0.006	0.055	1					
VAR_14	-0.047	0.168	-0.017	0.268	0.084	-0.012	-0.013	0.055	0.014	**0.21**	-0.011	-0.033	0.362	1				
VAR_15	-0.037	-0.016	0.078	-0.014	-0.008	-0.006	0.044	-0.007	-0.01	-0.014	0.003	0.058	-0.001	-0.008	1			
VAR_16	-0.056	-0.026	-0.027	0.131	0.005	-0.013	-0.022	-0.015	-0.013	0.054	-0.005	-0.024	0.032	0.129	-0.031	1		
VAR_17	-0.018	-0.009	0.123	**0.434**	0.095	-0.018	0.037	-0.021	0.011	**0.382**	0.08	0.088	**0.533**	0.452	0.073	0.196	1	
VAR_18	-0.039	0.012	-0.029	**0.381**	-0.015	-0.011	-0.017	0.143	0.008	0.067	-0.009	-0.036	0.067	0.19	-0.011	0.261	**0.335**	1
VAR_19	-0.018	-0.001	-0.01	-0.006	-0.004	-0.003	-0.008	-0.003	-0.005	-0.009	-0.006	-0.016	-0.01	0.063	-0.007	0.05	-0.001	0.027
VAR_20	-0.023	-0.009	-0.007	-0.007	-0.006	-0.004	-0.011	-0.002	-0.007	-0.013	-0.009	-0.023	0.096	-0.013	-0.005	**0.379**	-0.004	0.003
VAR_21	-0.05	-0.018	0.02	-0.02	-0.012	-0.009	0.051	-0.011	0.158	-0.003	-0.009	-0.048	-0.032	-0.025	0.1	-0.044	0.008	-0.024
VAR_22	-0.036	0.004	-0.042	-0.01	-0.018	-0.009	-0.034	-0.016	-0.019	-0.039	-0.022	-0.03	-0.041	-0.033	-0.024	0.196	0.032	**0.207**
VAR_23	-0.024	0.012	-0.014	-0.008	-0.006	-0.004	-0.01	-0.005	-0.006	-0.012	-0.008	-0.021	-0.012	-0.003	-0.01	0.006	-0.025	0.143
VAR_24	0.089	-0.018	-0.011	-0.018	-0.011	-0.008	-0.016	-0.009	-0.012	-0.02	0	0.008	-0.022	-0.018	-0.011	-0.029	-0.011	0.021

VAR_25	-0.069	0.15	-0.044	0.134	-0.009	-0.02	-0.036	0.075	-0.025	-0.03	-0.028	-0.05	-0.031	0.145	0.046	0.181	0.104	**0.236**
VAR_26	0.043	0	-0.036	-0.017	-0.014	-0.01	-0.026	-0.012	0.009	0.076	-0.02	-0.055	0.003	0.018	-0.025	0.005	0.014	0.019
VAR_27	-0.015	-0.006	0.088	-0.003	-0.003	-0.002	0.139	-0.003	-0.004	-0.001	0.08	0.031	-0.009	-0.011	-0.006	-0.013	0.142	-0.011
VAR_28	-0.015	-0.006	-0.009	-0.006	-0.003	-0.002	-0.006	-0.003	-0.004	-0.008	-0.005	0.075	-0.007	-0.01	-0.006	-0.013	-0.004	0.002
VAR_29	-0.03	-0.004	-0.026	**0.803**	0.018	-0.007	-0.019	**0.422**	0.046	0.017	-0.015	-0.023	0.162	**0.262**	-0.014	0.194	**0.626**	**0.434**
VAR_30	-0.069	0.086	-0.045	**0.391**	0.039	-0.013	-0.033	0.133	0.045	0.043	-0.026	-0.068	0.191	**0.292**	-0.031	0.094	0.45	**0.277**
VAR_31	0	0.002	0.039	0.022	-0.009	-0.007	-0.017	-0.008	-0.003	0.31	0.152	0.103	0.071	0.027	-0.016	0.024	0.11	0.157
VAR_32	-0.033	0.111	-0.019	0.013	-0.008	-0.005	-0.014	-0.006	-0.009	0.006	-0.011	-0.029	-0.017	0.062	-0.013	-0.021	-0.008	-0.01
VAR_33	-0.029	-0.019	**0.408**	**0.288**	-0.01	-0.011	0.012	**0.292**	-0.019	0.112	**0.674**	**0.511**	0.159	0.048	0.024	0.062	0.123	0.13
VAR_34	-0.009	-0.011	-0.014	**0.477**	-0.006	-0.004	-0.011	-0.005	0.043	0.012	-0.008	0.042	0.113	**0.243**	-0.01	**0.308**	**0.641**	**0.521**
VAR_35	-0.038	-0.018	0.142	0.048	-0.012	-0.009	-0.02	-0.01	-0.01	**0.548**	**0.458**	0.191	0.191	0.074	-0.021	0.029	**0.248**	0.079
VAR_36	-0.038	-0.019	-0.025	-0.011	-0.01	-0.007	-0.019	-0.009	-0.012	-0.023	-0.013	-0.01	-0.012	-0.007	-0.018	0.09	-0.003	0.046

Pearson Correlation Matrix (contd...)

	VAR_19	VAR_20	VAR_21	VAR_22	VAR_23	VAR_24	VAR_25	VAR_26	VAR_27	VAR_28	VAR_29	VAR_30	VAR_31	VAR_32	VAR_33	VAR_34	VAR_35	VAR_36
VAR_1																		
VAR_2																		
VAR_3																		
VAR_4																		
VAR_5																		
VAR_6																		
VAR_7																		
VAR_8																		
VAR_9																		
VAR_10																		
VAR_11																		
VAR_12																		
VAR_13																		
VAR_14																		
VAR_15																		
VAR_16																		
VAR_17																		
VAR_18																		
VAR_19	1																	
VAR_20	**0.217**	1																
VAR_21	-0.01	-0.016	1															
VAR_22	-0.013	-0.016	-0.046	1														
VAR_23	-0.005	-0.006	-0.014	0.146	1													

VAR_24	-0.009	-0.013	-0.025	**0.373**	-0.012	1												
VAR_25	0.01	0.064	-0.034	0.134	0.022	0.001	1											
VAR_26	-0.012	-0.015	0.045	0.088	-0.012	-0.013	0.21	1										
VAR_27	-0.003	-0.004	-0.009	-0.01	-0.004	-0.008	0	-0.01	1									
VAR_28	-0.003	-0.004	-0.009	-0.012	-0.004	0.056	-0.02	-0.01	-0.002	1								
VAR_29	0	-0.005	-0.012	-0.003	-0.011	-0.019	0.177	-0.021	-0.007	-0.007	1							
VAR_30	0.059	-0.007	-0.01	0.018	0.018	-0.021	0.21	-0.015	-0.013	-0.013	0.603	1						
VAR_31	-0.007	-0.01	0.012	0.114	-0.011	-0.002	-0.001	0.087	-0.007	-0.007	0.048	0.024	1					
VAR_32	0.005	-0.008	-0.019	-0.005	-0.009	0	0.109	0.012	-0.005	-0.005	0.028	**0.356**	-0.015	1				
VAR_33	-0.012	0.01	-0.039	-0.024	-0.014	-0.013	-0.012	-0.031	0.127	-0.011	0.151	0.014	**0.216**	-0.02	1			
VAR_34	-0.005	-0.008	-0.015	-0.016	-0.007	-0.013	0.14	-0.017	-0.004	-0.004	**0.788**	**0.389**	0.046	-0.009	0.117	1		
VAR_35	-0.01	-0.011	-0.017	0.013	-0.011	-0.012	-0.03	0.064	-0.003	-0.009	-0.002	-0.014	**0.377**	-0.017	**0.416**	0.013	1	
VAR_36	-0.008	-0.01	-0.026	**0.485**	-0.011	**0.739**	-0.022	-0.024	-0.007	-0.007	-0.021	-0.036	0.001	-0.016	0.001	-0.005	0.014	1

VAR_1	*Ae. albopictus*
VAR_2	*Ae. aurifer*
VAR_3	*Ae. canadensis canadensis*
VAR_4	*Ae. cinereus*
VAR_5	*Ae. dorsalis*
VAR_6	*Ae. epactius*
VAR_7	*Ae. grossbecki*
VAR_8	*Ae. nigromaculis*
VAR_9	*Ae. sollicitans*
VAR_10	*Ae. sticticus*
VAR_11	*Ae. stimulans*
VAR_12	*Ae. triseriatus*
VAR_13	*Ae. trivittatus*
VAR_14	*Ae. vexans*
VAR_15	*Ae. zoosophus*/*Ae. triseriatus* hybrid
VAR_16	*An. crucians*
VAR_17	*An. punctipennis*
VAR_18	*An. quadrimaculatus*
VAR_19	*An. walkeri*
VAR_20	*Cq. perturbans*
VAR_21	*Cs. inornata*
VAR_22	*Cx. erraticus*
VAR_23	*Cx. peccator*
VAR_24	*Cx. pipiens* group
VAR_25	*Cx. salinarius*
VAR_26	*Cx. tarsalis*
VAR_27	*Or. alba*
VAR_28	*Or. signifera*
VAR_29	*Ps. ciliata*
VAR_30	*Ps. columbiae*
VAR_31	*Ps. cyanescens*
VAR_32	*Ps. discolor*
VAR_33	*Ps. ferox*
VAR_34	*Ps. howardii*
VAR_35	*Ps. horrida*
VAR_36	*Ur. sapphirina*

Appendix C. Canonical Correspondence Analysis Results (from .txt files)

Cropland:

```
********************* Canonical Correspondence Analysis
*********************
PC-ORD, Version 4.10
 7 Mar 2010, 19:56
CCA cropland

DATA MATRICES
--------------------------------------
    Main matrix:
        14 sites    (rows)
        31 species (columns)

    Second matrix:
        14 Sites    (rows)
         8 Environ (columns)

    Finished reading data.
--------------------------------------

OPTIONS SELECTED
    Axis scores centered and standardized to unit variance
    Axes scaled to optimize representation of columns: species
      (Scores for species are weighted mean scores for sites   )
    Scores for graphing sites    are linear combinations of Environ
    No Monte Carlo tests

RAW CORRELATIONS AMONG VARIABLES IN SECOND MATRIX
          T       T-1      R       R-1      tsr     tsr-1    w       w-1
T        1.000   0.597  -0.103   0.065   0.596   0.799  -0.044  -0.326
T-1      0.597   1.000  -0.249  -0.106  -0.030   0.834  -0.661  -0.684
R       -0.103  -0.249   1.000   0.084   0.081  -0.053   0.403   0.233
R-1      0.065  -0.106   0.084   1.000   0.426  -0.053  -0.072   0.530
tsr      0.596  -0.030   0.081   0.426   1.000   0.331   0.231   0.282
tsr-1    0.799   0.834  -0.053  -0.053   0.331   1.000  -0.375  -0.595
w       -0.044  -0.661   0.403  -0.072   0.231  -0.375   1.000   0.581
w-1     -0.326  -0.684   0.233   0.530   0.282  -0.595   0.581   1.000

WEIGHTED CORRELATIONS AMONG VARIABLES IN SECOND MATRIX
(weighted by row totals in main matrix)
          T       T-1      R       R-1      tsr     tsr-1    w       w-1
T        1.000   0.604   0.197  -0.120   0.490   0.913   0.212  -0.537
T-1      0.604   1.000  -0.388  -0.223  -0.206   0.835  -0.560  -0.884
```

R	0.197	-0.388	1.000	0.235	0.514	-0.013	0.807	0.387
R-1	-0.120	-0.223	0.235	1.000	0.358	-0.165	0.064	0.539
tsr	0.490	-0.206	0.514	0.358	1.000	0.260	0.507	0.282
tsr-1	0.913	0.835	-0.013	-0.165	0.260	1.000	-0.131	-0.744
w	0.212	-0.560	0.807	0.064	0.507	-0.131	1.000	0.469
w-1	-0.537	-0.884	0.387	0.539	0.282	-0.744	0.469	1.000

ITERATION REPORT

Calculating axis 1
Residual = 0.39E+04 at iteration 1
Residual = 0.58E+00 at iteration 2
Residual = 0.62E-01 at iteration 3
Residual = 0.21E-02 at iteration 4
Residual = 0.72E-04 at iteration 5
Residual = 0.39E-05 at iteration 6
Residual = 0.45E-06 at iteration 7
Residual = 0.79E-07 at iteration 8
Residual = 0.15E-07 at iteration 9
Residual = 0.30E-08 at iteration 10
Residual = 0.40E-13 at iteration 17
Solution reached tolerance of 0.100000E-12 after 17 iterations.

Calculating axis 2
Residual = 0.20E+01 at iteration 1
Residual = 0.12E-03 at iteration 2
Residual = 0.21E-04 at iteration 3
Residual = 0.33E-05 at iteration 4
Residual = 0.53E-06 at iteration 5
Residual = 0.85E-07 at iteration 6
Residual = 0.14E-07 at iteration 7
Residual = 0.22E-08 at iteration 8
Residual = 0.35E-09 at iteration 9
Residual = 0.56E-10 at iteration 10
Residual = 0.60E-13 at iteration 14
Solution reached tolerance of 0.100000E-12 after 14 iterations.

Calculating axis 3
Residual = 0.20E+01 at iteration 1
Residual = 0.65E-04 at iteration 2
Residual = 0.13E-05 at iteration 3
Residual = 0.34E-06 at iteration 4
Residual = 0.12E-06 at iteration 5
Residual = 0.46E-07 at iteration 6
Residual = 0.17E-07 at iteration 7
Residual = 0.63E-08 at iteration 8

Residual = 0.23E-08 at iteration 9
Residual = 0.86E-09 at iteration 10
Residual = 0.37E-13 at iteration 20
Solution reached tolerance of 0.100000E-12 after 20 iterations.

AXIS SUMMARY STATISTICS
Number of canonical axes: 3
Total variance ("inertia") in the species data: 0.5445

	Axis 1	Axis 2	Axis 3
Eigenvalue	0.219	0.097	0.039
Variance in species data			
% of variance explained	40.3	17.8	7.1
Cumulative % explained	40.3	58.1	65.2
Pearson Correlation, Spp-Envt*	0.901	0.932	0.723
Kendall (Rank) Corr., Spp-Envt	0.363	0.341	0.187

* Correlation between sample scores for an axis derived from the species data and the sample scores that are linear combinations of the environmental variables. Set to 0.000 if axis is not canonical.

MULTIPLE REGRESSION RESULTS:
Regression of sites in species space on Environ

	Canonical Coefficients						
	Standardized			Original Units			
Variable	Axis 1	Axis 2	Axis 3	Axis 1	Axis 2	Axis 3	S.Dev
1 T	1.519	0.251	0.544	0.354	0.058	0.127	0.429E+01
2 T-1	0.314	-1.391	-1.214	0.040	-0.178	-0.155	0.783E+01
3 R	-0.071	0.140	1.363	-0.026	0.050	0.491	0.278E+01
4 R-1	-0.023	0.038	0.223	-0.011	0.019	0.110	0.203E+01
5 tsr	-0.222	-0.254	-0.486	-0.088	-0.100	-0.192	0.253E+01
6 tsr-1	-0.127	1.345	-0.011	-0.053	0.559	-0.004	0.241E+01
7 w	-0.581	-0.196	-0.770	-0.217	-0.073	-0.287	0.268E+01
8 w-1	0.942	0.710	-1.351	0.339	0.255	-0.486	0.278E+01

Scores that are derived from the scores of species (WA Scores)
FINAL SCORES and raw data totals (weights) for 14 sites

Raw Data

	Axis 1	Axis 2	Axis 3	Totals
1 Jul-07	1.480771	-0.121368	-0.462395	475.2000
2 Aug-07	2.791476	0.883398	-1.638092	407.5000
3 Sep-07	2.539351	0.851458	-1.291570	69.5000
4 Oct-07	0.110021	-1.070699	-0.186865	346.0000
5 May-08	1.578817	-1.014744	-0.392155	0.5000
6 Jun-08	0.392849	-0.717693	0.376073	53.5000
7 Jul-08	1.991763	0.440938	-0.789936	140.4000
8 Aug-08	2.322076	0.767010	-0.509455	442.6000
9 Sep-08	0.602538	0.274523	3.671663	77.5000
10 May-09	-1.102046	1.232363	-1.587152	1393.9089
11 Jun-09	-0.533453	1.747116	3.288589	889.6666
12 Jul-09	-0.093858	0.161878	0.413804	146.0000
13 Aug-09	-0.265002	-0.962368	0.018034	1657.0000
14 Sep-09	-0.453062	-0.971531	0.126306	2136.7500

Scores that are linear combinations of Environ (LC Scores)
FINAL SCORES and raw data totals (weights) for 14 sites

	Axis 1	Axis 2	Axis 3	Raw Data Totals
1 Jul-07	1.233968	-0.314302	-0.535143	475.2000
2 Aug-07	2.269303	1.056282	-0.256388	407.5000
3 Sep-07	0.703932	-1.038457	-2.422222	69.5000
4 Oct-07	-0.105049	-1.421844	-0.487692	346.0000
5 May-08	-3.331133	1.508344	-0.072538	0.5000
6 Jun-08	0.975190	0.939448	-0.629482	53.5000
7 Jul-08	1.843555	1.118673	1.750872	140.4000
8 Aug-08	1.809699	0.290908	-0.478697	442.6000
9 Sep-08	-1.839039	-0.381502	5.585741	77.5000
10 May-09	-1.344586	1.275136	-0.997117	1393.9089
11 Jun-09	-0.019237	1.285789	1.414304	889.6666
12 Jul-09	1.694421	1.255926	-1.082078	146.0000
13 Aug-09	-0.246227	-0.607400	0.782981	1657.0000
14 Sep-09	-0.205700	-0.993314	-0.348685	2136.7500

FINAL SCORES and raw data totals (weights) for 31 species

	Axis 1	Axis 2	Axis 3	Raw Data Totals
1 totl	0.003849	0.008148	0.010057	4199.4102

2 albo	-1.344586	1.275136	-0.997117	0.1818
3 auri	-0.257634	-0.726472	0.239992	20.5455
4 cine	-0.157819	1.137102	1.089654	36.6212
5 dors	-1.344586	1.275136	-0.997117	0.3636
6 nigr	1.694421	1.255926	-1.082078	0.1429
7 soll	-1.839040	-0.381500	5.585740	0.2500
8 stic	-1.294738	1.263279	-0.991561	89.6039
9 tris	-0.978467	0.647624	-0.403751	1.5000
10 triv	-0.427729	1.270636	0.387142	173.9628
11 vexa	-0.316248	-0.206969	-0.004330	2540.5281
12 zoos	-0.246227	-0.607400	0.782981	0.2500
13 cruc	0.766601	0.191725	1.138000	17.8227
14 punc	0.054621	0.771021	0.487269	34.0781
15 quad	0.553212	-0.116927	-0.334397	14.3985
16 walk	-1.344586	1.275136	-0.997117	0.0909
17 pert	0.960795	-0.018032	-0.285270	4.3262
18 inor	-0.120735	-1.331350	-0.346506	2.2500
19 erra	1.682329	0.414245	-0.216946	339.1786
20 pecc	-0.225964	-0.800357	0.217148	0.5000
21 pipi	0.270818	0.297098	0.124007	9.0485
22 Sali	0.688505	-0.205189	-0.040561	638.1344
23 tars	0.734933	-0.296940	-0.380289	6.4636
24 cili	-0.225022	0.830655	1.286258	27.3818
25 colu	0.208641	0.540093	0.657817	34.1937
26 cyan	-0.081554	0.565529	-0.609932	1.4740
27 disc	1.233969	-0.314303	-0.535143	0.6000
28 fero	-0.989235	0.666080	-0.421203	3.0909
29 howa	-1.344586	1.275136	-0.997117	0.0909
30 horr	-1.333495	1.275066	-0.997427	39.1429
31 sapp	1.809699	0.290908	-0.478697	0.4000

CORRELATIONS AND BIPLOT SCORES for 8 Environ

Variable	Correlations* Axis 1	Axis 2	Axis 3	Biplot Scores Axis 1	Axis 2	Axis 3
1 T	0.844	0.114	0.366	0.844	0.114	0.366
2 T-1	0.696	-0.645	0.252	0.696	-0.645	0.252
3 R	-0.115	0.707	0.599	-0.115	0.707	0.599
4 R-1	0.121	0.409	-0.202	0.121	0.409	-0.202
5 tsr	0.351	0.691	0.035	0.351	0.691	0.035
6 tsr-1	0.844	-0.164	0.398	0.844	-0.164	0.398
7 w	-0.148	0.779	0.259	-0.148	0.779	0.259
8 w-1	-0.431	0.715	-0.412	-0.431	0.715	-0.412

* Correlations are "intraset correlations" of ter Braak (1986)

INTER-SET CORRELATIONS for 8 Environ

Variable	Correlations Axis 1	Axis 2	Axis 3
1 T	0.760	0.107	0.265
2 T-1	0.627	-0.601	0.182
3 R	-0.104	0.659	0.433
4 R-1	0.109	0.381	-0.146
5 tsr	0.316	0.644	0.026
6 tsr-1	0.760	-0.153	0.288
7 w	-0.133	0.726	0.187
8 w-1	-0.389	0.666	-0.298

Note: Obtain joint plots or biplots by selecting GRAPH, then requesting "Joint plots" from the GRAPH menu.

**************************** Operation completed ****************************

Forest:

********************* Canonical Correspondence Analysis *********************
PC-ORD, Version 4.10
7 Mar 2010, 14:25
forest

DATA MATRICES

Main matrix:
12 sites (rows)
30 species (columns)

Second matrix:
12 sites (rows)
8 environs (columns)

Finished reading data.

OPTIONS SELECTED
Axis scores centered and standardized to unit variance

Axes scaled to optimize representation of rows: sites
(Scores for sites are weighted mean scores for species)
Scores for graphing sites are linear combinations of environs
No Monte Carlo tests

RAW CORRELATIONS AMONG VARIABLES IN SECOND MATRIX

	W	W-1	tsr	tsr-1	rain	rain-1	T	T-1
W	1.000	0.633	-0.026	-0.646	0.205	-0.262	-0.474	-0.802
W-1	0.633	1.000	0.092	-0.763	0.057	0.375	-0.520	-0.737
tsr	-0.026	0.092	1.000	0.371	-0.210	0.436	0.762	0.260
tsr-1	-0.646	-0.763	0.371	1.000	-0.187	-0.040	0.837	0.922
rain	0.205	0.057	-0.210	-0.187	1.000	-0.126	-0.179	-0.194
rain-1	-0.262	0.375	0.436	-0.040	-0.126	1.000	0.144	0.039
T	-0.474	-0.520	0.762	0.837	-0.179	0.144	1.000	0.771
T-1	-0.802	-0.737	0.260	0.922	-0.194	0.039	0.771	1.000

WEIGHTED CORRELATIONS AMONG VARIABLES IN SECOND MATRIX
(weighted by row totals in main matrix)

	W	W-1	tsr	tsr-1	rain	rain-1	T	T-1
W	1.000	0.225	0.258	-0.342	0.540	-0.489	-0.168	-0.578
W-1	0.225	1.000	-0.337	-0.947	0.501	0.552	-0.928	-0.832
tsr	0.258	-0.337	1.000	0.389	0.049	-0.125	0.587	0.114
tsr-1	-0.342	-0.947	0.389	1.000	-0.451	-0.405	0.959	0.919
rain	0.540	0.501	0.049	-0.451	1.000	0.201	-0.377	-0.430
rain-1	-0.489	0.552	-0.125	-0.405	0.201	1.000	-0.457	-0.181
T	-0.168	-0.928	0.587	0.959	-0.377	-0.457	1.000	0.816
T-1	-0.578	-0.832	0.114	0.919	-0.430	-0.181	0.816	1.000

ITERATION REPORT

Calculating axis 1
Residual = 0.66E+04 at iteration 1
Residual = 0.23E+00 at iteration 2
Residual = 0.91E-01 at iteration 3
Residual = 0.40E-01 at iteration 4
Residual = 0.64E-01 at iteration 5
Residual = 0.93E-01 at iteration 6
Residual = 0.69E-01 at iteration 7
Residual = 0.30E-01 at iteration 8
Residual = 0.10E-01 at iteration 9
Residual = 0.30E-02 at iteration 10
Residual = 0.12E-07 at iteration 20
Residual = 0.50E-13 at iteration 30
Solution reached tolerance of 0.100000E-12 after 30 iterations.

Calculating axis 2

Residual =   0.20E+01 at iteration   1
Residual =   0.16E-06 at iteration   2
Residual =   0.24E-07 at iteration   3
Residual =   0.35E-08 at iteration   4
Residual =   0.53E-09 at iteration   5
Residual =   0.79E-10 at iteration   6
Residual =   0.11E-10 at iteration   7
Residual =   0.16E-11 at iteration   8
Residual =   0.23E-12 at iteration   9
Residual =   0.79E-13 at iteration 10
Solution reached tolerance of 0.100000E-12 after 10 iterations.

Calculating axis 3
Residual =   0.17E+01 at iteration   1
Residual =   0.20E+00 at iteration   2
Residual =   0.17E-01 at iteration   3
Residual =   0.22E-02 at iteration   4
Residual =   0.34E-03 at iteration   5
Residual =   0.61E-04 at iteration   6
Residual =   0.12E-04 at iteration   7
Residual =   0.24E-05 at iteration   8
Residual =   0.48E-06 at iteration   9
Residual =   0.99E-07 at iteration 10
Residual =   0.23E-13 at iteration 20
Solution reached tolerance of 0.100000E-12 after 20 iterations.

AXIS SUMMARY STATISTICS
Number of canonical axes: 3
Total variance ("inertia") in the species data: 1.0602

	Axis 1	Axis 2	Axis 3
Eigenvalue	0.386	0.207	0.080
Variance in species data			
% of variance explained	36.4	19.6	7.5
Cumulative % explained	36.4	56.0	63.5
Pearson Correlation, Spp-Envt*	0.975	0.829	0.833
Kendall (Rank) Corr., Spp-Envt	0.667	0.424	0.727

* Correlation between sample scores for an axis derived from the species data and the sample scores that are linear combinations of the environmental variables. Set to 0.000 if axis is not canonical.

MULTIPLE REGRESSION RESULTS:
Regression of sites in species space on environs

Canonical Coefficients

	Standardized			Original Units			
Variable	Axis 1	Axis 2	Axis 3	Axis 1	Axis 2	Axis 3	S.Dev
1 W	-0.553	-0.909	-0.239	-0.296	-0.487	-0.128	0.187E+01
2 W-1	-0.003	-0.022	0.896	-0.001	-0.007	0.271	0.331E+01
3 tsr	-0.328	1.017	-0.409	-0.308	0.956	-0.385	0.106E+01
4 tsr-1	-0.923	-2.131	1.171	-0.251	-0.578	0.318	0.368E+01
5 rain	0.164	0.174	-0.085	0.066	0.070	-0.034	0.249E+01
6 rain-1	0.063	-1.062	-0.013	0.020	-0.333	-0.004	0.319E+01
7 T	2.026	-0.355	0.697	0.320	-0.056	0.110	0.633E+01
8 T-1	-0.509	1.362	-1.049	-0.050	0.134	-0.103	0.102E+02

Scores that are derived from the scores of species (WA Scores)
FINAL SCORES and raw data totals (weights) for 12 sites

	Axis 1	Axis 2	Axis 3	Raw Data Totals
1 Aug-07	0.596292	-0.149406	0.123940	931.2500
2 Sep-07	-0.454219	0.199728	-0.186804	159.5000
3 May-08	0.134206	-0.237456	0.272295	6.0000
4 Jun-08	0.087377	-0.064436	-0.359076	85.0000
5 Jul-08	0.590071	-0.090469	0.100297	112.0000
6 Aug-08	0.608194	-0.092110	0.086533	398.0000
7 Sep-08	0.347204	-0.254935	-0.433297	8.0000
8 Apr-09	-3.624147	-9.400423	2.309006	8.5000
9 May-09	-0.765140	0.364197	0.160866	719.1000
10 Jun-09	-0.558343	-0.064289	-0.771900	258.3201
11 Jul-09	-0.364579	0.066646	0.163065	190.8100
12 Aug-09	-0.127736	-0.267905	-1.171251	56.3200

Scores that are linear combinations of environs (LC Scores)
FINAL SCORES and raw data totals (weights) for 12 sites

	Axis 1	Axis 2	Axis 3	Raw Data Totals
1 Aug-07	0.575559	-0.102110	0.088777	931.2500
2 Sep-07	-0.471482	0.109659	-0.208390	159.5000
3 May-08	-1.867671	-3.282016	0.384059	6.0000

4 Jun-08	0.274184	-0.326736	-0.136640	85.0000
5 Jul-08	0.336939	0.513013	-0.289263	112.0000
6 Aug-08	0.527823	0.017569	-0.036966	398.0000
7 Sep-08	0.917076	-1.703977	0.062851	8.0000
8 Apr-09	-3.982205	-5.976810	0.613788	8.5000
9 May-09	-0.777939	0.399013	0.136382	719.1000
10 Jun-09	-0.469187	-0.319476	-0.638042	258.3201
11 Jul-09	-0.114468	-0.343012	0.557401	190.8100
12 Aug-09	0.146872	-0.246871	-0.680865	56.3200

FINAL SCORES and raw data totals (weights) for 30 species

	Axis 1	Axis 2	Axis 3	Raw Data Totals
1 total mo	0.000247	-0.000163	-0.012441	1489.9600
2 albo	0.380465	-1.189784	-8.540211	0.3300
3 auri	-1.215405	-1.539698	-8.003074	0.1300
4 cana	-1.165168	0.301617	-1.193137	16.2800
5 cine	-1.206388	-1.356987	-6.611919	7.3200
6 dors	-1.215405	-1.539698	-8.003074	0.1300
7 soll	-1.215405	-1.539698	-8.003074	0.1300
8 stic	-1.974602	1.774654	1.403224	70.4000
9 stim	-2.015211	1.923018	1.710666	0.8000
10 tris	0.248370	-1.280192	-5.509617	0.4100
11 triv	-1.440573	0.644015	2.488614	94.1300
12 vexa	-1.457907	0.638268	-0.413783	379.5700
13 zoos	-1.251350	0.333621	4.057740	0.1800
14 cruc	-0.095638	-1.582750	-1.530541	2.1300
15 punc	-1.109992	-1.443376	-4.122029	37.8300
16 quad	-0.355050	-1.450014	-3.674225	11.8500
17 pert	-0.160060	-1.416621	-5.149151	11.6200
18 inor	-8.617870	-22.519632	6.474000	4.4000
19 erra	1.295547	-0.198483	0.235140	683.8800
20 pecc	-0.296524	-1.653127	6.991582	0.8300
21 pipi	1.131201	-1.031256	1.042438	54.1500
22 sali	-0.067863	-1.148993	-0.839418	30.2100
23 tars	0.859125	-0.889064	-4.379110	0.5800
24 cili	-0.454024	-0.762856	-3.967365	4.9400
25 colu	-0.236375	-0.556929	-6.033681	4.2300
26 cyan	-1.171298	0.529266	-2.671952	1.0600
27 fero	-1.372616	0.359781	2.154616	5.0100
28 howa	-0.865355	-1.582909	-2.290823	0.2100
29 horr	-1.114357	0.498214	-0.453792	3.0500
30 sapp	0.772665	-0.069264	-0.326857	17.0500

CORRELATIONS AND BIPLOT SCORES for 8 environs

Variable	Correlations* Axis 1	Axis 2	Axis 3	Biplot Scores Axis 1	Axis 2	Axis 3
1 W	-0.503	-0.080	-0.333	-0.312	-0.036	-0.094
2 W-1	-0.776	0.320	0.171	-0.482	0.146	0.048
3 tsr	0.488	0.107	-0.108	0.303	0.049	-0.030
4 tsr-1	0.834	-0.309	-0.027	0.518	-0.141	-0.008
5 rain	-0.431	0.038	-0.450	-0.268	0.017	-0.127
6 rain-1	-0.089	0.124	0.103	-0.055	0.056	0.029
7 T	0.866	-0.212	-0.105	0.538	-0.097	-0.030
8 T-1	0.803	-0.240	-0.071	0.499	-0.109	-0.020

* Correlations are "intraset correlations" of ter Braak (1986)

INTER-SET CORRELATIONS for 8 environs

Variable	Correlations Axis 1	Axis 2	Axis 3
1 W	-0.490	-0.066	-0.277
2 W-1	-0.756	0.265	0.142
3 tsr	0.476	0.089	-0.090
4 tsr-1	0.813	-0.256	-0.023
5 rain	-0.420	0.032	-0.374
6 rain-1	-0.087	0.103	0.086
7 T	0.845	-0.176	-0.087
8 T-1	0.783	-0.199	-0.059

Note: Obtain joint plots or biplots by selecting GRAPH, then requesting "Joint plots" from the GRAPH menu.

**************************** Operation completed ****************************

Grassland:

********************* Canonical Correspondence Analysis *********************

PC-ORD, Version 4.10
7 Mar 2010, 19:59
CCA grassland

DATA MATRICES

Main matrix:
15 sites (rows)
32 species (columns)

Second matrix:
15 sites (rows)
8 environs (columns)

Finished reading data.

OPTIONS SELECTED
Axis scores centered and standardized to unit variance
Axes scaled to optimize representation of columns: species
(Scores for species are weighted mean scores for sites)
Scores for graphing sites are linear combinations of environs
No Monte Carlo tests

RAW CORRELATIONS AMONG VARIABLES IN SECOND MATRIX

	W	W-1	tsr	tsr-1	rain	rain-1	T	T-1
W	1.000	0.756	-0.233	-0.661	0.248	-0.053	-0.587	-0.808
W-1	0.756	1.000	-0.106	-0.754	0.203	0.410	-0.593	-0.779
tsr	-0.233	-0.106	1.000	0.495	-0.130	0.317	0.721	0.346
tsr-1	-0.661	-0.754	0.495	1.000	-0.070	-0.126	0.883	0.919
rain	0.248	0.203	-0.130	-0.070	1.000	0.049	-0.129	-0.162
rain-1	-0.053	0.410	0.317	-0.126	0.049	1.000	0.008	-0.123
T	-0.587	-0.593	0.721	0.883	-0.129	0.008	1.000	0.839
T-1	-0.808	-0.779	0.346	0.919	-0.162	-0.123	0.839	1.000

WEIGHTED CORRELATIONS AMONG VARIABLES IN SECOND MATRIX
(weighted by row totals in main matrix)

	W	W-1	tsr	tsr-1	rain	rain-1	T	T-1
W	1.000	0.617	-0.195	-0.362	0.471	-0.057	-0.279	-0.535
W-1	0.617	1.000	-0.207	-0.566	0.444	0.433	-0.521	-0.439
tsr	-0.195	-0.207	1.000	0.193	0.244	0.402	0.673	-0.281
tsr-1	-0.362	-0.566	0.193	1.000	-0.336	-0.175	0.662	0.751
rain	0.471	0.444	0.244	-0.336	1.000	0.308	-0.041	-0.581
rain-1	-0.057	0.433	0.402	-0.175	0.308	1.000	0.096	-0.332
T	-0.279	-0.521	0.673	0.662	-0.041	0.096	1.000	0.260
T-1	-0.535	-0.439	-0.281	0.751	-0.581	-0.332	0.260	1.000

ITERATION REPORT

Calculating axis 1
Residual =   0.47E+04 at iteration   1
Residual =   0.64E-01 at iteration   2
Residual =   0.91E-01 at iteration   3
Residual =   0.18E+00 at iteration   4
Residual =   0.11E+00 at iteration   5
Residual =   0.26E-01 at iteration   6
Residual =   0.46E-02 at iteration   7
Residual =   0.77E-03 at iteration   8
Residual =   0.13E-03 at iteration   9
Residual =   0.21E-04 at iteration 10
Residual =   0.37E-12 at iteration 20
Residual =   0.81E-13 at iteration 21
Solution reached tolerance of 0.100000E-12 after 21 iterations.

Calculating axis 2
Residual =   0.20E+01 at iteration   1
Residual =   0.31E-07 at iteration   2
Residual =   0.70E-08 at iteration   3
Residual =   0.16E-08 at iteration   4
Residual =   0.37E-09 at iteration   5
Residual =   0.84E-10 at iteration   6
Residual =   0.19E-10 at iteration   7
Residual =   0.47E-11 at iteration   8
Residual =   0.10E-11 at iteration   9
Residual =   0.23E-12 at iteration 10
Residual =   0.71E-13 at iteration 11
Solution reached tolerance of 0.100000E-12 after 11 iterations.

Calculating axis 3
Residual =   0.21E+01 at iteration   1
Residual =   0.16E-01 at iteration   2
Residual =   0.99E-04 at iteration   3
Residual =   0.19E-04 at iteration   4
Residual =   0.64E-05 at iteration   5
Residual =   0.23E-05 at iteration   6
Residual =   0.80E-06 at iteration   7
Residual =   0.28E-06 at iteration   8
Residual =   0.10E-06 at iteration   9
Residual =   0.36E-07 at iteration 10
Residual =   0.13E-11 at iteration 20
Residual =   0.73E-13 at iteration 23
Solution reached tolerance of 0.100000E-12 after 23 iterations.

AXIS SUMMARY STATISTICS

Number of canonical axes: 3
Total variance ("inertia") in the species data: 0.7423

	Axis 1	Axis 2	Axis 3
Eigenvalue	0.273	0.111	0.053
Variance in species data			
% of variance explained	36.7	15.0	7.2
Cumulative % explained	36.7	51.7	58.9
Pearson Correlation, Spp-Envt*	0.963	0.862	0.727
Kendall (Rank) Corr., Spp-Envt	0.714	0.695	0.714

* Correlation between sample scores for an axis derived from the species data and the sample scores that are linear combinations of the environmental variables. Set to 0.000 if axis is not canonical.

MULTIPLE REGRESSION RESULTS:
Regression of sites in species space on environs

Canonical Coefficients

	Standardized			Original Units			
Variable	Axis 1	Axis 2	Axis 3	Axis 1	Axis 2	Axis 3	S.Dev
1 W	0.071	-1.114	-0.522	0.040	-0.629	-0.295	0.177E+01
2 W-1	0.091	0.291	0.227	0.057	0.181	0.141	0.161E+01
3 tsr	0.968	-0.280	-0.065	0.386	-0.112	-0.026	0.251E+01
4 tsr-1	-1.216	0.593	1.709	-0.669	0.326	0.941	0.182E+01
5 rain	0.159	-0.064	-0.648	0.072	-0.029	-0.293	0.221E+01
6 rain-1	-0.882	-0.545	-0.169	-0.395	-0.244	-0.076	0.223E+01
7 T	-0.402	0.173	-1.153	-0.108	0.047	-0.309	0.373E+01
8 T-1	1.015	-0.539	-1.881	0.148	-0.078	-0.274	0.687E+01

Scores that are derived from the scores of species (WA Scores)
FINAL SCORES and raw data totals (weights) for 15 sites

	Axis 1	Axis 2	Axis 3	Raw Data Totals
1 Jun-07	0.580483	0.450839	0.004982	1879.5000
2 Jul-07	-0.046778	0.386179	0.164402	628.3125
3 Aug-07	-2.524839	0.572142	0.865461	372.5000
4 Sep-07	0.494601	0.457498	-0.047947	1585.8333
5 Oct-07	0.358897	0.132303	-0.118594	327.5000

6 Apr-08	0.718794	-9.915039	19.061769	20.0000
7 May-08	0.460275	-2.975017	2.223298	31.8125
8 Jun-08	-0.128779	-3.443332	-2.335469	268.6400
9 Jul-08	-1.273762	-0.900186	-0.880170	126.8421
10 Aug-08	-3.004534	0.197777	0.358294	291.1429
11 Sep-08	-1.386760	-1.377880	-2.558413	48.4615
12 Apr-09	0.628930	-1.053115	3.831738	66.3333
13 May-09	0.202105	-2.991772	3.575456	23.3333
14 Jun-09	0.244164	-2.066382	-1.188484	280.3750
15 Aug-09	-0.792118	-0.318955	-0.489307	36.3750

Scores that are linear combinations of environs (LC Scores)
FINAL SCORES and raw data totals (weights) for 15 sites

	Axis 1	Axis 2	Axis 3	Raw Data Totals
1 Jun-07	0.452667	0.293917	-0.046904	1879.5000
2 Jul-07	0.234786	0.540698	0.366547	628.3125
3 Aug-07	-2.333699	0.690124	0.552443	372.5000
4 Sep-07	0.412511	0.550092	-0.026103	1585.8333
5 Oct-07	0.647125	-0.300343	-0.344310	327.5000
6 Apr-08	1.160572	-3.654762	6.104742	20.0000
7 May-08	0.512190	-2.527491	3.270364	31.8125
8 Jun-08	-0.008899	-2.547487	-1.231986	268.6400
9 Jul-08	-0.158922	-1.433735	-3.276436	126.8421
10 Aug-08	-3.152601	-0.123226	0.294879	291.1429
11 Sep-08	-0.888263	1.366099	0.320309	48.4615
12 Apr-09	0.990599	-3.572731	6.120421	66.3333
13 May-09	1.116417	-1.455353	2.708726	23.3333
14 Jun-09	-0.419463	-2.296509	-0.850211	280.3750
15 Aug-09	-0.696021	-0.521942	-0.152570	36.3750

FINAL SCORES and raw data totals (weights) for 32 species

	Axis 1	Axis 2	Axis 3	Raw Data Totals
1 total mo	-0.001623	-0.003222	-0.000215	3022.7346
2 albo	-0.974642	-0.151728	-0.043132	2.4784
3 auri	-1.932189	0.877895	0.487961	0.2769
4 cana	-0.152133	-2.381115	-1.014139	52.7729
5 cine	-0.385030	-2.147182	-0.786172	1.1875
6 dors	0.512189	-2.527490	3.270364	0.0625

7 epac	-0.888262	1.366098	0.320308	0.0769
8 gros	0.801706	-2.496171	3.409318	2.5750
9 nigr	0.452668	0.293917	-0.046904	0.5000
10 stic	0.434882	-2.838649	2.488182	17.5506
11 stim	0.024640	-2.357730	-0.573079	8.3522
12 tris	-0.433427	-1.253810	-1.073842	5.4494
13 triv	-1.098566	-0.332031	-0.459569	19.2105
14 vexa	0.337157	0.113454	-0.005065	2290.0825
15 zoos	0.386286	-3.025778	3.133007	0.2917
16 cruc	-1.789349	-0.721021	-0.183670	4.5132
17 punc	-0.239047	-0.556633	0.250235	37.1989
18 quad	-0.545644	0.037768	-0.012495	4.2117
19 pert	-2.135600	-0.466861	-0.086194	3.4170
20 inor	0.909647	-2.647341	4.253558	3.5625
21 erra	-1.940053	0.219224	0.149608	329.2323
22 pipi	0.169604	-0.531426	0.482156	19.6731
23 sali	-0.336807	-0.193413	-0.180187	103.2852
24 tars	-0.021372	0.094961	-0.087597	4.9833
25 alba	-0.419464	-2.296509	-0.850211	0.1250
26 cili	-0.472137	0.429960	0.258664	2.4995
27 colu	-0.596339	0.251742	0.226859	7.2043
28 cyan	-0.614081	-0.349958	-0.618841	3.8909
29 disc	0.234786	0.540698	0.366547	0.1875
30 fero	-0.714310	-1.330668	-0.896693	12.8973
31 horr	-1.201964	-1.011681	-0.744835	22.9520
32 sapp	-1.200246	-0.042370	-0.448460	3.5266

CORRELATIONS AND BIPLOT SCORES for 8 environs

	Correlations*			Biplot Scores		
Variable	Axis 1	Axis 2	Axis 3	Axis 1	Axis 2	Axis 3
1 W	0.073	-0.854	0.044	0.073	-0.854	0.044
2 W-1	0.076	-0.792	0.017	0.076	-0.792	0.017
3 tsr	-0.171	0.026	-0.153	-0.171	0.026	-0.153
4 tsr-1	-0.509	0.605	-0.171	-0.509	0.605	-0.171
5 rain	0.033	-0.589	-0.295	0.033	-0.589	-0.295
6 rain-1	-0.571	-0.396	-0.053	-0.571	-0.396	-0.053
7 T	-0.449	0.346	-0.518	-0.449	0.346	-0.518
8 T-1	-0.153	0.716	-0.268	-0.153	0.716	-0.268

* Correlations are "intraset correlations" of ter Braak (1986)

INTER-SET CORRELATIONS for 8 environs

Variable	Correlations Axis 1	Axis 2	Axis 3
1 W	0.070	-0.736	0.032
2 W-1	0.073	-0.682	0.013
3 tsr	-0.165	0.022	-0.111
4 tsr-1	-0.491	0.521	-0.124
5 rain	0.032	-0.508	-0.214
6 rain-1	-0.550	-0.342	-0.038
7 T	-0.433	0.299	-0.376
8 T-1	-0.147	0.617	-0.195

Note: Obtain joint plots or biplots by selecting GRAPH, then
requesting "Joint plots" from the GRAPH menu.

***************************** Operation completed
****

Urban:

********************* Canonical Correspondence Analysis
****

PC-ORD, Version 4.10
7 Mar 2010, 20:01
CCA urban

DATA MATRICES

Main matrix:
13 sites (rows)
24 species (columns)

Second matrix:
13 sites (rows)
8 environs (columns)

Finished reading data.

OPTIONS SELECTED

Axis scores centered and standardized to unit variance
Axes scaled to optimize representation of columns: species
(Scores for species are weighted mean scores for sites)
Scores for graphing sites are linear combinations of environs
No Monte Carlo tests

RAW CORRELATIONS AMONG VARIABLES IN SECOND MATRIX

	W	W-1	tsr	tsr-1	rain	rain-1	T	T-1
W	1.000	0.666	-0.182	-0.661	0.279	-0.227	-0.508	-0.805
W-1	0.666	1.000	-0.083	-0.771	0.142	0.379	-0.551	-0.744
tsr	-0.182	-0.083	1.000	0.408	-0.333	0.328	0.748	0.308
tsr-1	-0.661	-0.771	0.408	1.000	-0.232	-0.053	0.843	0.924
rain	0.279	0.142	-0.333	-0.232	1.000	-0.098	-0.235	-0.234
rain-1	-0.227	0.379	0.328	-0.053	-0.098	1.000	0.123	0.025
T	-0.508	-0.551	0.748	0.843	-0.235	0.123	1.000	0.779
T-1	-0.805	-0.744	0.308	0.924	-0.234	0.025	0.779	1.000

WEIGHTED CORRELATIONS AMONG VARIABLES IN SECOND MATRIX
(weighted by row totals in main matrix)

	W	W-1	tsr	tsr-1	rain	rain-1	T	T-1
W	1.000	0.398	0.276	-0.512	0.776	-0.162	0.004	-0.822
W-1	0.398	1.000	0.007	-0.548	0.338	0.465	-0.368	-0.498
tsr	0.276	0.007	1.000	0.127	0.286	0.274	0.698	-0.325
tsr-1	-0.512	-0.548	0.127	1.000	-0.352	-0.069	0.680	0.777
rain	0.776	0.338	0.286	-0.352	1.000	0.090	0.116	-0.676
rain-1	-0.162	0.465	0.274	-0.069	0.090	1.000	0.066	-0.145
T	0.004	-0.368	0.698	0.680	0.116	0.066	1.000	0.238
T-1	-0.822	-0.498	-0.325	0.777	-0.676	-0.145	0.238	1.000

ITERATION REPORT

```
-----------------------------------------------------------------
Calculating axis 1
Residual =   0.84E+04 at iteration   1
Residual =   0.11E+00 at iteration   2
Residual =   0.66E-01 at iteration   3
Residual =   0.35E-01 at iteration   4
Residual =   0.15E-01 at iteration   5
Residual =   0.56E-02 at iteration   6
Residual =   0.20E-02 at iteration   7
Residual =   0.73E-03 at iteration   8
Residual =   0.26E-03 at iteration   9
Residual =   0.92E-04 at iteration  10
Residual =   0.29E-08 at iteration  20
Residual =   0.16E-12 at iteration  30
Residual =   0.21E-13 at iteration  31
Solution reached tolerance of 0.100000E-12 after  31 iterations.
-----------------------------------------------------------------
Calculating axis 2
Residual =   0.20E+01 at iteration   1
Residual =   0.34E-04 at iteration   2
Residual =   0.16E-04 at iteration   3
```

Residual =   0.70E-05 at iteration   4
Residual =   0.32E-05 at iteration   5
Residual =   0.14E-05 at iteration   6
Residual =   0.65E-06 at iteration   7
Residual =   0.29E-06 at iteration   8
Residual =   0.13E-06 at iteration   9
Residual =   0.60E-07 at iteration 10
Residual =   0.21E-10 at iteration 20
Residual =   0.18E-13 at iteration 28
Solution reached tolerance of 0.100000E-12 after 28 iterations.

Calculating axis 3
Residual =   0.20E+01 at iteration   1
Residual =   0.97E-08 at iteration   2
Residual =   0.36E-09 at iteration   3
Residual =   0.67E-10 at iteration   4
Residual =   0.13E-10 at iteration   5
Residual =   0.29E-11 at iteration   6
Residual =   0.50E-12 at iteration   7
Residual =   0.90E-13 at iteration   8
Solution reached tolerance of 0.100000E-12 after   8 iterations.

AXIS SUMMARY STATISTICS
Number of canonical axes: 3
Total variance ("inertia") in the species data: 1.0893

	Axis 1	Axis 2	Axis 3
Eigenvalue	0.371	0.221	0.149
Variance in species data			
% of variance explained	34.1	20.3	13.6
Cumulative % explained	34.1	54.4	68.0
Pearson Correlation, Spp-Envt*	0.945	0.893	0.978
Kendall (Rank) Corr., Spp-Envt	0.615	0.436	0.821

* Correlation between sample scores for an axis derived from the species data and the sample scores that are linear combinations of the environmental variables. Set to 0.000 if axis is not canonical.

MULTIPLE REGRESSION RESULTS:
Regression of sites in species space on environs

Canonical Coefficients

Standardized   Original Units

Variable	Axis 1	Axis 2	Axis 3	Axis 1	Axis 2	Axis 3	S.Dev
1 W	1.252	0.954	1.103	0.512	0.391	0.452	0.244E+01
2 W-1	-0.251	-0.287	0.505	-0.146	-0.166	0.293	0.173E+01
3 tsr	0.705	0.011	0.418	0.352	0.006	0.209	0.200E+01
4 tsr-1	0.826	-0.104	-1.291	0.603	-0.076	-0.943	0.137E+01
5 rain	-0.198	0.188	0.096	-0.069	0.065	0.033	0.287E+01
6 rain-1	0.300	0.292	-0.398	0.150	0.146	-0.199	0.200E+01
7 T	-1.983	0.366	0.127	-0.597	0.110	0.038	0.332E+01
8 T-1	0.299	0.200	2.469	0.043	0.029	0.354	0.697E+01

Scores that are derived from the scores of species (WA Scores)
FINAL SCORES and raw data totals (weights) for 13 sites

	Axis 1	Axis 2	Axis 3	Raw Data Totals
1 Jul-07	-0.619666	-1.248662	-0.973081	67.1667
2 Aug-07	-0.972671	-1.155587	-2.527959	20.7500
3 Sep-07	-0.269051	-1.191873	1.974922	120.7500
4 May-08	-0.342183	-1.152042	0.945694	1.5833
5 Jun-08	-0.474015	-0.995070	0.780869	11.6154
6 Jul-08	-0.362419	-0.983689	1.364481	31.9167
7 Aug-08	-0.525986	-1.274078	-1.510579	35.1000
8 Sep-08	-0.682699	-1.413206	-2.714436	13.8000
9 Apr-09	8.668519	-3.464880	-1.402931	13.5000
10 May-09	0.130307	-1.135969	0.507530	17.6000
11 Jun-09	0.114961	1.053275	0.078779	502.1112
12 Jul-09	-0.244354	-0.645561	-0.768342	71.7500
13 Aug-09	-0.239503	-0.668110	-0.713136	82.3333

Scores that are linear combinations of environs (LC Scores)
FINAL SCORES and raw data totals (weights) for 13 sites

	Axis 1	Axis 2	Axis 3	Raw Data Totals
1 Jul-07	-0.787116	-0.968900	-0.848042	67.1667
2 Aug-07	-1.787093	0.230791	-2.082776	20.7500
3 Sep-07	-0.105684	-1.422658	1.858217	120.7500
4 May-08	3.125509	-0.918924	-0.451772	1.5833
5 Jun-08	-1.470039	0.403603	1.647857	11.6154
6 Jul-08	-1.345988	0.647069	1.950365	31.9167

7 Aug-08	-0.601399	-0.929865	-1.560654	35.1000
8 Sep-08	-0.460857	-1.743489	-2.840466	13.8000
9 Apr-09	7.335155	-1.569304	-0.584315	13.5000
10 May-09	0.485242	-1.760023	0.130210	17.6000
11 Jun-09	0.221299	0.881898	0.007987	502.1112
12 Jul-09	-0.036115	-1.110226	-0.835022	71.7500
13 Aug-09	-0.374379	-0.559948	-0.599996	82.3333

FINAL SCORES and raw data totals (weights) for 24 species

	Axis 1	Axis 2	Axis 3	Raw Data Totals
1 total mo	-0.000549	0.002529	0.001405	502.7156
2 albo	-0.876695	-0.362324	-0.737268	6.9359
3 cana	-0.095827	0.792218	0.315462	0.4103
4 cine	-0.036115	-1.110226	-0.835022	0.1250
5 stic	-0.218973	0.106490	0.064331	0.7372
6 stim	-0.105684	-1.422658	1.858217	0.2500
7 tris	-0.811072	-0.521471	-0.781179	1.5316
8 triv	0.112668	0.658782	-0.105293	18.8797
9 vexa	-0.215246	-0.485259	0.630715	155.9536
10 zoos	0.221299	0.881898	0.007987	0.1111
11 cruc	0.171166	0.748801	-0.004584	3.8889
12 punc	-0.571455	-0.417112	-0.424330	7.4752
13 quad	-0.494470	-0.882414	-1.043199	1.8444
14 pert	0.187432	0.751625	-0.047985	186.2667
15 inor	6.691773	-1.574847	-0.458939	7.1500
16 erra	-0.993607	-0.500436	-1.362158	10.8083
17 pipi	-0.691718	-0.887383	-1.048516	18.6271
18 sali	-0.209376	-0.580055	-0.709023	55.1778
19 tars	-0.172656	-1.319034	1.047907	3.0083
20 sign	-0.787116	-0.968900	-0.848042	0.2500
21 cili	-0.292144	-0.565573	-0.602814	4.1806
22 colu	-0.257963	-0.857968	-0.678887	1.2603
23 fero	-0.100581	0.232719	-0.433690	0.5167
24 horr	-0.802027	-0.083109	0.032027	1.8722

CORRELATIONS AND BIPLOT SCORES for 8 environs

	Correlations*			Biplot Scores		
Variable	Axis 1	Axis 2	Axis 3	Axis 1	Axis 2	Axis 3
1 W	0.467	0.832	0.192	0.467	0.832	0.192

2 W-1	0.453	0.114	0.226	0.453	0.114	0.226
3 tsr	-0.301	0.584	-0.233	-0.301	0.584	-0.233
4 tsr-1	-0.656	-0.115	-0.082	-0.656	-0.115	-0.082
5 rain	0.194	0.805	0.007	0.194	0.805	0.007
6 rain-1	-0.076	0.026	-0.479	-0.076	0.026	-0.479
7 T	-0.764	0.502	-0.068	-0.764	0.502	-0.068
8 T-1	-0.573	-0.607	0.196	-0.573	-0.607	0.196

* Correlations are "intraset correlations" of ter Braak (1986)

INTER-SET CORRELATIONS for 8 environs

Variable	Correlations Axis 1	Axis 2	Axis 3
1 W	0.442	0.743	0.188
2 W-1	0.428	0.102	0.221
3 tsr	-0.285	0.521	-0.228
4 tsr-1	-0.620	-0.102	-0.080
5 rain	0.184	0.718	0.007
6 rain-1	-0.071	0.023	-0.469
7 T	-0.722	0.448	-0.067
8 T-1	-0.542	-0.542	0.191

Note: Obtain joint plots or biplots by selecting GRAPH, then requesting "Joint plots" from the GRAPH menu.

**************************** Operation completed ****************************

VITA

Alfred Thomas “Tom” Leak is a lifelong resident of Missouri, and graduated from Thomas Hart Benton High School in St. Joseph, Missouri in 1980. He graduated from the University of Missouri with a Bachelor of Science degree in Agriculture, emphasis in biochemistry, in 1984.

Tom joined the staff of ABC Laboratories, Inc., a leading contract research organization providing chemistry support to agrochemical, pharmaceutical and industrial chemical organizations, in 1985. Tom is still employed by ABC, where he is a senior chemist and team leader in the Ecotoxicology group.

In 1997, Tom decided to pursue a degree in entomology, a long-time hobby and source of fascination. Advised by Dr. Robert Sites, Tom graduated from the University of Missouri with a Master of Science degree in Entomology in 2003, with a thesis entitled “Subterranean arthropod communities in tallgrass prairie: effects of seasonal prescribe fires.” Tom then entered the doctoral program at Mizzou, where he was advised by Dr. Richard Houseman and awarded the Doctor of Philosophy degree in 2010.

Tom has been married to his high school sweetheart, Johnna (*nee* Barnes) since 1983. They have raised four children and many more than four cats, and they continue to reside in Columbia, Missouri.