Insect diversity in Pelham Bay Park, 2003
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Abstract

Several sites in Pelham Bay Park, Bronx, NYC, were sampled for insects in summer of 2003, primarily by sweeping. Among the samples fully analyzed, the greatest diversity of morphospecies was found under an old white oak tree and in a nearby field in the Southern Zone. A remnant field of East-Coast grassland, dominated by *Tripsacum dactyloides*, at Orchard Beach and a nearby stand of invasive European Poplar were found to have about half the diversity of the other sites. Family-level diversity of all sites was similar. Hypotheses are offered to account for the differences, and recommendations are made for future sampling.

Methods

Sweep-sampling and foliage-beating were done at the six sites indicated. The time of day, at least for the last six dates, was between 11:00 and 15:00. The sweeping consisted of 5 minutes (less on first two sampling dates) of continuous left-and-right motion in grasses, herbs and low shrubs using a 15-inch-diameter butterfly net of white polyester 24x20/inch mesh. Specimens were clamped with the bag end in an ethyl acetate kill jar until stunned, then transferred to vials of 70% ethanol. Beating consisted of 30 seconds of continuous rapping on branches and foliage of indicated trees over a white linen bedsheet spread on the ground and/or vegetation. Specimens were transferred from sheet to alcohol vial with forceps.

A) Field near large white oak tree, northeast of playing fields and south of Veterans' Memorial, South Zone of PBP. GPS: 18T 0599260, 4523005.

B) Underneath large white oak tree, northeast of playing fields and south of Veterans' Memorial, South Zone of PBP. GPS: near 18T 0599260, 4523005.

C) "Wet field," surrounded by low trees and shrubs, off east end of north side of the trail along southern perimeter of South Zone, PBP (about where forest gives way to more open space, but inland from the *Phragmites* thicket). GPS: 18T 0599800, 4522706.

D) Field dominated by *Tripsacum dactyloides* "gama grass," behind Orchard Beach and south of Parking Lot complex, North Zone of PBP. GPS: 18T 0601312, 4524339.

E) European Poplar stand, on north side of trail leading from free parking lot to Orchard Beach, southern branch of trail, 25 paces shoreward of fork.

F) Underneath and around "Big Red" oak tree, Hunter's Island, PBP. GPS: 18T 0602190, 4525901.

Table 1. Dates, sites and methods used. s = sweep, b = beat.

Site\Date	4 July	13 July	20 July	27 July	3 Aug.	10 Aug.	17 Aug.	31 Aug.
A		s	s		s b		s b	
B		s	s		s b		s b	
C	s	s	s		s b		s b	
D	s	s		s b		s b		s b
E				s b		s b		s b
F				s b		s b		s b

Other sites:

Old *Tripsacum dactyloides* field, behind breakwater in South Zone of PBP, northeast of site C. Sweeping, 20 July.

Occasional trailside collection, done in South Zone by hand or net; specified on vial label.

Identifications were made with a bifocal dissecting microscope and the specimens immersed in 70% ethanol, using references *1*, *2*, and *3*. Specimens were identified to family except for Thysanoptera, Psocoptera, Araneae and some Lepidoptera; the first three because of difficulty of identification and relative ecological homogeneity, and the last because of difficulty of identifying specimens in alcohol.

Vegetational profiles

The following is a list of plants (and one fungus) identified in passing by D. Burg, M. Sundew, or J. Hayden. This list is by no means complete, and the identifications are not authoritative. Plants are listed very roughly in order of abundance. Some sites (Under Oak, *T. dactyloides* field) were strongly dominated

by one or a few species, while other sites showed no clear domination (though closer inspection and quantification are warranted).

Field near Oak, SZ: *Solidago* spp., several grasses, young sweetgum, young crabapple, red maple, milkweed.

Under Oak, SZ: white oak, jewelweed, smartweed, hawthorn, polypore shelf fungus, *Viburnum*.

Wet field, SZ: large umbellifer (*Heracleum?*), rushes & sedges, indian hemp, purple loostrife, *Phragmites*, mugwort, *Solidago*, mint, *Iris* spp: one blue/violet, and yellow flag, red maple, *Viburnum*.

Tripsacum dactyloides field, OB: *T. dactyloides*, bayberry, winged sumac, staghorn sumac, purple loostrife, *Rosa* spp., *Aster* sp, milkweed, poison ivy.

European Poplar, OB: *Populus alba (?)*, both mature and saplings, oriental bittersweet, Japanese porcelainberry, arrowwood, *Rubus*, daylily, oak (red?), birch (gray?), poison ivy.

Under Big Red Oak, HI: *Eupatorium*, Virginia creeper, Japanese porcelainberry, oriental bittersweet, young hickory, wild geranium, mulberry with vines (porcelainberry or grape).

Specimens were identified from all visits to these sites, but only a subset have been collated by order to determine the number of species within each site. These include the samples from sites A and B of Jul. 20, Aug. 3 and Aug. 17, and from sites D and E of Jul. 27, Aug. 10 and Aug. 31.

Beating samples from sites D and E, July 27, were mixed up and are given in one vial.

Findings

At least 125 families of adult insects are recorded here, counting at least one family for the "macrolepidoptera," "other Araneae," etc. The scarabaeids and other Coleoptera collected and identified by Kyle Beucke on 13 July 2003 remain in his collection. The adult Lepidoptera were discarded, since immersion in alcohol destroys their identifiability. The spiders that were not identified to family probably belong in large part to the Linyphiidae, Erigonidae, or other families of small sheet-web spiders.

Table 2. Breakdown of morphospecies and families of adult insects obtained by sweeping and beating at each of four sites. SZ (Southern Zone) specimens collated from 20 Jul., 3 Aug. & 17 Aug.; OB (Orchard Beach) specimens collated from 27 Jul., 10 Aug. & 31 Aug.

	Field near Oak, SZ	Under Oak, SZ	*T. dact*. field, OB	Euro. Poplar, OB	mean
m'spp.	167	132	68	78	111.25
families	66	61	40	51	54.5

A chi-squared test suggests that the sites differ from one another significantly in numbers of species, but not in numbers of families. The sites of secondary succession in the Southern Zone, formerly mown, show at least twice the species diversity as the *Tripsacum dactyloides* field and the undergrowth in the European Poplar area. The clearest differences between the forested sites, Under Oak and the European Poplar, is that the former was better shaded, its primary growth was native white oak and hawthorn, and its undergrowth was dominated by jewelweed and smartweed. The European Poplar site was somewhat more exposed and included a larger and more even variety of undergrowth, some of it non-native. The relatively greater exposure was not due to the site's location by a trail, since the site underneath the Oak was also on a trailside; rather, the exposure was due to the nature of the poplar clone's radial growth and dieback, which left a much more open canopy. It is hypothesized (non-exclusively) that (1) jewelweed is especially conducive to insect diversity, more so than a variety of vegetation (jewelweed's long flowering period supports this), (2) that some characteristics of the non-native vegetation at the Poplar site lead to decreased insect diversity, and (3) closed canopy, with its lower temperature and higher humidity, leads to greater insect diversity. The difficulty of sweeping in some parts of the Poplar site should be noted and controlled for in future by using a wider variety of methods.

On the other hand, the lower diversity of the gama-grass field, compared with the field near the Oak, is probably due to its lower vegetational diversity. Although the jewelweed patch under the Oak in the Southern Zone is also almost monodominant, gama grass does not seem to offer large and long-standing nectar benefits like jewelweed. The difficulty in sweeping in gama grass (which has blades hundreds of times larger in area than the grasses of the other field) should be considered, as well as the hydrology of the soil (which was always waterlogged).

No specimens of *"Amphipoea" erepta ryensis* were found. This is unsurprising, because the adults usually emerge in June after a long period of concealed feeding by the larva (the larva bores in the

plant's center), and neither larva nor adult are likely to be taken by the sampling methods used. The larva burrows in *T. dactyloides*, leaving the youngest, central leaf blades dead but upright (Eric Quinter, *pers. comm.*). These should be sought as a sign of a feeding caterpillar.

On August 10, very large numbers of oniscids of two species were found at the Hunter's Island site (~90% of specimens). One species was much more abundant than the other and had an apparently even age structure, so the population must be large under normal circumstances. Since the foliage was wet from recent rain, the best explanation is that the moisture drew the oniscids out. Mosquitoes also abounded at Hunter's Island through July 27 but were almost absent on Aug. 10 and 31; they undoubtedly came from the salt marsh nearby.

Future recommendations

The trade-off between sampling thoroughly and quickly that exists everywhere is acute in city parks, where the danger of vandalism exists for equipment left overnight. Although a Malaise (flight-interception) trap would return a larger sample and reduce the biases of hand-sweeping and irregular weather, such a trap would risk being lost. Even pitfall traps baited with human feces are subject to interference if left overnight in city parks (Liz Nichols, *pers. comm*.). The sampling regime should continue to use methods that can be deployed in a day.

A hand-held beating sheet, fixed on a frame, and an aspirator are highly recommended for the beating procedure: the frame, to facilitate the sheet's maneuverability, and the aspirator, to increase the capture rate of flying and fast-moving insects. The number of specimens collected by beating could be at least doubled by this method. A hand-held beating sheet, or something other than a net, should also be used in thorny undergrowth. Thorns impeded the net at the European Poplar site and the Big Red Oak site, possibly contributing to the lower diversity recorded from those sites. As small as the beating samples are, I believe they hardly affect the overall total species counts and contribute only to the counts of spiders (Araneae) and inchworms (Geometridae: Lepidoptera). Hence, the absence of beating samples from 20 July and the mix-up of samples of 27 July are insignificant losses.

Because herbivorous insects are often host-specific, a very direct way to increase the species sampling would be to investigate plants (both *in situ* and vouchered) for their herbivores. This method may be time-intensive and would have to follow the processing of botanical specimens, which would make it less amenable to statistical analyses (due to the biases of small samples). It may also be less efficient at increasing the gross species richness than other methods (e.g., Malaise traps), but it would recover species that other methods fail to, demonstrate ecological links directly (rather than relying on data from elsewhere to predict, for example, what the insect feeds on), and would not involve leaving equipment unattended.

Time limits precluded the investigation of how much overlap in diversity exists among the sites. This would require that the specimens be individually pinned/pointed and labelled, which would be a full-time job for at least one person, even for a modest amount of material. Subjectively speaking, I did got the impression that the sites shared many species in common (especially of flies and spiders), but a considerable amount of non-overlap may exist in species that were taken as singletons (especially with higher trophic levels, like the wasps). As with any insect sampling project, the singletons must be expected to constitute a large percentage of diversity unless the sampling effort is intensive. Given the small amount of effort that this project involved, I do not think that relative abundance data would have been worth recording (as it would have been statistically insufficient). A sampling regime that employs more traps and kinds of traps would better address the issue of species evenness (the skew of the species-abundance curve, or lack thereof). This in turn would provide a clue to the health of the habitats, since species evenness is often associated with habitat stability. However, species richness (number of species) should receive priority, since it is less effort-intensive and can yield basic information about specialists (e.g., those that feed on one host plant).

Summary explanation of taxa found in study and other identifications.

Orders, non-insects:

Acari	Mites: various habits
Araneae	Spiders: predators of small fauna
Collembola	Springtails. Detritivores and relatives of insects.
Isopoda	Includes sowbugs and pillbugs, terrestrial detritivorous crustaceans.

Orders, insects:

Auchenorrhyncha	Leafhoppers, planthoppers and cicadas

Blattodea	Cockroaches
Coleoptera	Beetles
Diptera	Flies. An ecological Renaissance Taxon: will do anything
Ephemeroptera	Mayflies
Heteroptera	"True" bugs. Suck plant juices or prey on other insects
Hymenoptera	Wasps and sawflies, including bees, ants and a world of parasitoid wasps.
Lepidoptera	Moths (and butterflies). Larvae are major herbivores
Neuroptera	Lacewings, for our purposes. Predatory
Orthoptera	Crickets, grasshoppers, katydids
Psocoptera	Bark lice. Suck plant juices
Sternorrhyncha	Aphids, whiteflies and other sedentary bugs
Thysanoptera	Thrips. Minute; feed on pollen and plant juices
Families:	
Acanaloniidae	Large-winged planthoppers: feed on plant juices.
Acrididae	Grasshoppers.
Agromyzidae	Leafminer flies. Larvae mine leaves; acalyptrates.
Alleculidae	Beetles associated with decaying wood. Found in crevice in Big Oak, South Zone.
Anisopodidae	Wood gnats. Larvae and some adults feed on sapflows.
Anthomyiidae	Calyptrate flies. Larvae feed mostly on roots.
Anthomyzidae	Acalyptrate flies. Larvae feed on marsh graminoids.
Anthribidae	Fungus weevils. Live on dead wood and under bark, where fungi grow.
Aphididae	Aphids.
Apidae	Bees: only *Bombus* spp. (bumblebees) caught.
Araneidae	Orb-weaving spiders.
Arctiidae	Tiger moths. Often specialize on noxious plants.
Asilidae	Robber flies (predaceous).
Astatidae	Sphecoid wasps (predaceous).
Aulacigastridae?	Acalyptrate flies.
Braconidae	Common parasitoid wasps.
Calliphoridae	Blow flies
Camillidae	One species, *Camilla glabra*, introduced. Like drosophilids
Cecidomyiidae	Gall midges.
Ceratopogonidae	Biting midges.
Cercopidae	Leafhoppers.
Berytidae	Stilt bugs: not uncommon plant-feeders. One possible nymphal record.
Chalcididae	Parasitoids in Coleoptera, Diptera, Lepidoptera; some hyperparasites.
Chironomidae	Midges *par excellence*. Non-biting.
Chloropidae	Grass flies. Very common.
Chrysididae	Cuckoo wasps: (hyper)parasitoids of wasp and bee larvae.
Chrysomelidae	Leaf beetles. Very common and diverse. Includes some case-bearing larvae found on goldenrod.
Chrysopidae	Green lacewings. Larvae prey on aphids.
Cicadellidae	Leafhoppers. Very peciose and common; feed on a variety of plants.
Coccinellidae	Ladybird beetles. Feed on aphids.
Colletidae	Yellow-faced bees (*Hylaeus*). Solitary; provision with pollen.
Corylophidae	Minute fungus beetles. Feed on fungus spores.
Crabronidae	Sphecoid wasps: provision with flies, beetles, bugs, or small wasps.
Culicidae	Mosquitoes.
Curculionidae	Weevils.
Cynipidae	Gall wasps: larvae form galls in various plants. (A few parasitoids in this family).
Delphacidae	Planthoppers.
Diapriidae	Parasitoid wasps of adult flies.
Dictyopharidae	Grass-feeding planthoppers.

Dolichopodidae	"Long-legged" flies. Very common and speciose; mostly small, metallic green; predaceous.
Drosophilidae	"Fruit flies." Larvae often live in decaying plants or fungi; some larvae parasitoids on caterpillars or predaceous on sternorrhynch nymphs.
Dryinidae	Wasps, parasitoids on leafhopper nymphs and adults. Seen here only as larvae extruding from hosts.
Elateridae	Click beetles.
Empididae	Dance flies. Medium-sized, predaceous.
Entomobryidae	Springtails. Feed on decaying matter, pollen, fungi, and so forth.
Ephemeridae?	Mayflies: order certain, family uncertain.
Ephydridae	Acalyptrate flies. Occupy many habitats, including salt marshes.
Erythraeidae	Red-velvet mites. Predaceous.
Eucoilidae	Parasitoid wasps of fly pupae.
Eupelmidae	Parasitic wasps with several hosts. Adults jump as well as fly.
Flatidae	Large-winged planthoppers: feed on plant juices; like acanaloniids.
Forficulidae	Earwigs. Largely detritivorous. Probably the European *Forficula auricularia.* One specimen.
Formicidae	The ants.
Geometridae	Inchworm moths. Larvae feed on many hosts.
Gryllidae	Crickets, including the gracile oecanthinae tree-crickets. Herbivorous.
Halictidae	"Sweat bees." Common, diverse, metallic; solitary to eusocial.
Heleomyzidae	Acalyptrate flies. Larvae saprophagous.
Hemerobiidae	Brown lacewings. Small; larvae predaceous.
Histeridae	Hister beetles. Prey on instects that consume carrion and other rot.
Ichneumonidae	Parasitoid wasps, common & diverse. Variety of hosts.
Issidae	Planthoppers: feed on plant juices.
Lampyridae	Fireflies. Larvae prey on small insects and so forth.
Lauxaniidae	Acalyptrate flies. Larvae saprophagous.
Lonchaeidae?	Acalyptrate flies. Uncommon.
Lonchopteridae	Primitive, uncommon acalyptrate flies. Larvae saprophagous.
Lycaenidae	Blues and other butterflies. Larvae are mutualists with ants.
Lycosidae	Wolf spiders.
Lygaeidae	Seed bugs: feed on plant juices; members of the Geocorinae are predaceous.
macrolep.	Unidentified macrolepidoptera.
Megaspilidae	Obscure parasitoid wasps; variety of hosts, including lacewings, flies, sternorrhynchous bugs and other wasps.
Meloidae	Blister beetles. Feed on plants, insect eggs and other things.
Membracidae	Treehoppers: feed on juices of trees & shrubs. Ours mimic thorns.
microlep.	Unidentified microlepidoptera.
Micropezidae	Uncommon acalyptrate flies, gangly. Larvae saprophagous?
Milichiidae	Acalyptrate flies. Larvae saprophagous.
Miridae	Leaf bugs. Common & diverse.
Mordellidae	Tumbling flower beetles. Larvae live in pith and rotting wood.
Muscidae	The fly of flies. Actually, a large, diverse family with many habits.
Mycetophilidae	Fungus gnats.
Nabidae	Predaceous bugs.
Nepticulidae	Among the smallest of moths. Larvae mine leaves.
Nitidulidae	Sap beetles. Tiny; consume sap, plant juices; some around flowers.
Noctuidae	Largest known moth family. Feed on a variety of plants.
Nymphalidae	Nymphalid butterflies.
Nyssonidae	Sphecoid wasps with variety of hosts. Here, including *Sphecius* sp., the large "cicada-killer."
Oniscoidea	Sowbugs (terrestrial isopod crustaceans). Detritivores, probably introduced spp.
Otitidae	Medium-sized acalyptrate flies. Larvae saprophagous.
Pemphredonidae	Sphecoid wasps.
Pentatomidae	Stinkbugs: feed on plant juices.

Phalacridae	Shining flower beetles (*Olibrus*) and a variety of mold- and smut-consumers.
Phoridae	Scuttle flies. Larvae saprophagous, endoparasitoids & inquilines with ants and termites.
Pipunculidae	Big-headed flies: head is almost all eyeball. Diverse but uncommon. Parasitoids of leafhoppers & planthoppers.
Psyllidae	Jumping plantlice: feed on plant juices.
Pteromalidae	Huge family of tiny parasitoid wasps; variety of hosts.
Pterophoridae	Plume moths. Larvae are leaf rollers and stem borers.
Pyralidae	Pyralid moths. Most of our specimens are crambine grass-feeders.
Reduviidae	Assassin bugs (predatory heteropterans).
Rhagionidae	Primitive predatory brachyceran flies: probably *Chrysopilus* sp., or *Ptiolina*.
Salticidae	Jumping spiders.
Sarcophagidae	Flesh-flies: larvae scavengers of animal material, or parasites. Includes miltogrammatines, whose larvae feed on grunge and larvae in nests of Hymenoptera.
sawfly	Caterpillar-like larvae that consume foliage, often of conifers.
Scarabaeidae	Dung beetles and leaf chafers.
Scatopsidae?	Scavenging midges. Larvae saprophagous.
Scelionidae	Wasps, parasitoids in insect eggs.
Sciaridae	Fungus gnats.
Sciomyzidae	Marsh flies. Larvae prey on snails & slugs.
Sepsidae	Acalyptrate flies, ant-like habitus. Breed in excrement and rot.
Simuliidae	Black flies and similar biting midges. Larvae aquatic.
Sphaeroceridae	Acalyptrate flies, apparently one species in PBP. Breed in excrement.
Sphecoidea	Superfamily of solitary wasps, paraphyletic to the bees (Apoidea). Provision nests with a variety of paralyzed host insects.
Stratiomyidae	Soldier flies. Rather large, gracile; adults of one sp. taken around polypore fungus in cleft of Old Oak, Southern Zone.
Syrphidae	Flower flies. Common pollinators; larvae saprophagous, herbivores, aphidivores, or inquilines in nests of eusocial insects.
Tabanidae	Horseflies & deerflies. Females bloodsucking, males anthophilous; larvae predaceous.
Tachinidae	Very large group of calyptrate flies. Larvae parasitoids on wide variety of insects.
Tephritidae	Fruit flies. Larvae live in fruits & plant tissue.
Tethinidae	Small, uncommon; associated with beaches. A questionable but possible identification.
Tettigoniidae	Katydids.
Thomisidae	Crab spiders. Cryptic ambush-predators, often in flowers.
Thyreocoridae	"Negro bugs." Suck juices of herbs, grasses.
Tingidae	Lace bugs. Suck plant juices, especially of trees; parental care of nymphs.
Tiphiidae	Wasps; larvae mostly in scarab beetles. Possibly misidentified sphecoids.
Tipulidae	Crane flies. Adults nectarivorous, if anything; larvae detritivorous.
Torymidae	Small wasps; larvae in various hosts, depending on subfamily.

Other finds:

Throughout the Park, observed occasionally: *Papilio* spp. (swallowtail butterflies), *Danaus plexippus* (monarch), *Vanessa cardui* (painted lady), *Vanessa atalanta* (red admiral), *Pieris rapae* (cabbage white).

Gama-grass field, Orchard Beach, 13 July: adult Lepidoptera: Red admiral, *Urola nivalis* grass moth, *Cycnia tenera* (larva feeds on Asclepiadaceae).

Field near Oak, Southern Zone, 20 July: adult Lepidoptera: *Crambus* grass moths, *Cycnia tenera*, 3 skippers (one silver-spotted, *Epargyreus clarus*, vouchered), 1 satyrine (cf. *Megisto*; satyrines feed on grasses and sedges), 1 lycaenid (cf. *Everes*: feed on Fabaceae), *Caenurgina* cf. *crassiuscula* moth (feeds on clover, lupine: Fabaceae), plusiine noctuid (looper moth; feeds on many things).

South Zone, 28 Sept. 2003: Horntail sawfly (Siricidae), probably *Tremex columba*, on tree trunk (tree species not recorded). In collection of J. Hayden. Larvae bore in wood of weakened hardwoods, especially maples and beeches.

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